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AIRCRAFT FUEL SERVICING 1974

NATIONAL FIRE PROTECTION ASSOCIATION

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Standard for
Aircraft Fuel Servicing
Including
Aircraft Fueling Hose, Aircraft Fuel Servicing Vehicles and Airport Fixed Fueling Systems

NFPA No. 407 — 1974
ANSI Z119.1

1974 Edition of No. 407

This Standard, prepared by the NFPA Sectional Committee on Aircraft Fuel Servicing and submitted to the Association through the NFPA Committee on Aviation, was adopted in this edition on May 21, 1974 by the NFPA at its 78th Annual Meeting held in Miami Beach, Florida. The present text supersedes the 1973 Edition.

Sixteen revisions were made to the 1973 edition in this 1974 text. They include an editorial change in the subtitle to the Standard and revisions to Paragraphs 231, 283, 287.a.(2), 287.a.(3), 418.f. (redesignated 418.c.), 442, 443 (new), 455, 473.b., 533.f., 620 (and subparagraphs), A-418.c. (new), A-473.b., A-533.f. (new), and A-623 (new).

The 1971 Edition of this Standard was approved by the American National Standards Institute and designated as ANSI Z119.1–1972. The 1972 edition was not processed through ANSI. The 1973 edition was submitted to ANSI and approved by them on May 14, 1974. This 1974 Edition is being submitted for similar approval by ANSI. The ANSI designation and date of approval will appear on the front cover of the pamphlet copies of this edition if and when such approval has been received.

Origin and Development of No. 407

Active work by the National Fire Protection Association leading towards the development of this Standard started in 1951. Since that date, the responsible Sectional Committee has made every effort to keep the text up-to-date and progressive editions have been published almost every year since 1955. This is the 19th Edition of the Standard. It is being used widely as the basis of good practice in the interest of fire prevention by aircraft operators and airport managements nationally and internationally. In the U.S.A., the Federal Aviation Administration has issued an Advisory Circular (AC 150–5230–3) entitled Fire Prevention During Aircraft Fueling Operations (4-8-69) which references this text.

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NOTE
Reference herein to the 1974 National Electrical Code, NFPA No. 70, is to that code adopted by the National Fire Protection Association on May 22, 1974 at its Annual Meeting. This code is also known as the 1975 National Electrical Code.

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NOTICE
An asterisk (*) preceding the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Part I. General and Definitions

100. Scope: This Standard applies to fuel servicing of all types of aircraft on the ground. It does not apply to: (a) airborne fueling; (b) fueling of flying boats or amphibious aircraft on the water; or (c) draining and filling aircraft tanks during fuel system maintenance operations.

110. Need for Standard: Fueling aircraft involves the transfer of flammable or combustible liquids under conditions which are often less than optimum. Operational requirements make it necessary for fuel servicing crews to perform their duties efficiently and quickly in all types of weather conditions, at all hours, and concurrent with a number of other aircraft servicing operations. The increasing fuel capacities of modern air transports and military aircraft aggravate the problem and make it imperative to establish basic fire safety procedures.

120. Contents of Standard.

121. Part I covers the scope of this Standard, the general nature of the fire hazards involved in aircraft fuel servicing, definitions common to all parts of this Standard, and a listing of related NFPA publications:

122. Part II covers the mandatory provisions for aircraft fuel servicing, including spill prevention and control; elimination and control of electrostatic sparks; control of other ignition sources, such as aircraft engines, auxiliary power plants, heaters, automotive equipment, electrical circuits, open flames and radar equipment; and additional precautions regarding fueling locations, fueling during boarding and deplaning of passengers, safeguards when the aircraft is occupied, positioning of fuel servicing vehicles, operation of fueling equipment, precautions during lightning storms, and the provision for fire extinguishers on ramps where fueling is conducted.

123. Part III covers aircraft fueling hose, discussing the need for specially built hose for this service, fuel hose design, hydrostatic test requirements, and hose inspection requirements and procedures.

124. Part IV covers aircraft fuel servicing vehicles, giving requirements on cargo tank piping and connections; vehicle chassis, assembly, protection systems and equipment; cabinets housing vehicle auxiliary equipment; fire extinguishers for aircraft fuel servicing vehicles; operation of fuel servicing vehicles; marking; and tank vehicle loading.

125. Part V covers airport fixed fueling systems, covering basic considerations; fuel storage and general transfer; valving; filter separators; installation and location of fueling hydrants and fueling pits; cathodic protection; and tests and maintenance.

126. Part VI covers fueling at elevated heliports, giving guidance on fueling facilities, emergency control stations, and fire protection.

127. Appendix A gives added recommendations which are not mandatory but which may assist those using this Standard to achieve its fire safety objectives.

128. Appendix B gives information on the fire hazard properties of aviation fuels (ground handling).

129. Appendix C gives information on the generation of static electricity on aircraft on the ground.

130. The General Nature of the Fire Hazard:

131. From a fire hazard standpoint, aviation gasoline does not differ radically from ordinary gasoline. Jet fuels require safety precautions similar to those recommended for aviation gasoline.*

132. The vapor densities of aviation fuels are such that released vapors, particularly under calm wind conditions, may travel considerable distances along the ground and collect in depressions where they may not readily dissipate. The concentration of fuel vapors in the area surrounding the aircraft under normal atmospheric conditions depends upon wind velocity and rate of fueling. Every effort shall therefore be made to prevent fuel spillage which represents the greatest hazard.

133. Principal ignition sources likely to be present during aircraft fuel servicing are:

a. Electrostatic sparks (see Section 220)

*See Appendix B for further information on the fire hazard properties of aviation fuels.

b. Operating aircraft engines, auxiliary power units, and heaters (see Section 230)

c. Operating automotive or other internal combustion engine servicing equipment in the vicinity (see Section 240)

d. Arcing of electrical circuits (see Section 250)

e. Open flames (see Section 260)

f. Energy from energized high frequency radar equipment (see Section 270)

g. The autoignition temperatures of turbine fuels are such that the residual heat of aircraft turbine engines after shutdown or the residual heat of turbine aircraft brakes following hard use can ignite such fuels if they are spilled or sprayed on these surfaces before they have cooled to a temperature below the autoignition temperatures of the fuels.

134. Effective fire prevention measures are directed toward the elimination or control, as far as practicable, of (1) spillages, (2) release of excessive flammable vapors, and (3) ignition sources.

140. Definitions.

141. Whenever the following terms are used in this publication, they shall have the meaning defined herein.

a. Aircraft Fuel Servicing Hydrant Vehicle (Hydrant Vehicle). A vehicle equipped with facilities to transfer fuel between an aircraft fuel hydrant and an aircraft.

b. Aircraft Fuel Servicing Tank Vehicle (Fueler). Any vehicle (tank truck, tank full trailer, tank semitrailer, tank vehicle) designed for or employed in the transportation and transfer of fuel into or from an aircraft.

c. Aircraft Servicing Ramp or Apron. An area or position at an airport used for the fuel servicing of aircraft.

d. Baffle. A nonliquid-tight transverse partition in a cargo tank.

e. Bulkhead. A liquid-tight transverse closure between compartments of a cargo tank.

f. Carcass Saturation. This refers to the condition where fuel has permeated the reinforcement materials of a hose carcass.

g. Cargo Tank. Any container having a liquid capacity in excess of 100 gallons, used for the carrying of flammable liquids, and mounted permanently or otherwise secured upon a tank vehicle. The term "cargo tank" does not apply to any container used solely for the purpose of supplying fuel for the propulsion of the tank vehicle upon which it is mounted.

h. Compartment. A liquid-tight division in a cargo tank.

i. Deadman Control. A device which will prevent the flow of fuel from the system to any hose, including the hose between a hydrant and a hydrant cart, unless the control is held open by an operator.

j. Fixed Fueling System. An arrangement of aviation fuel storage, pumps, piping, and associated equipment, plus dispensing hydrants, cabinets and/or pits at an airport designed to service aircraft from locations established by the installation of the equipment.

k. Fueler. (See Aircraft Fuel Servicing Tank Vehicle.)

l. Fuel Servicing. Fuel servicing includes fueling and defueling of aircraft fuel tanks but does not include aircraft fuel transfer operations and testing aircraft fuel systems during aircraft maintenance and overhaul operations.

m. Fuel Servicing Cabinet. A boxlike structure above the surface of the ground with hose, meters and auxiliary equipment from which it is possible to dispense fuel into aircraft without any additional equipment.

n. Fuel Servicing Pit. A pit (usually covered by a substantial grating or plate flush with the surface of the ramp) containing hose, meters and auxiliary equipment which make it possible to dispense fuel into aircraft without additional equipment.

o. Fuel Storage Facilities. Fuel storage for airport fixed fueling systems may be provided in one and/or both of the following ways:

(1) **Main (Primary) Storage Facilities** Tanks for the storage of aviation fuel and associated facilities. Main storage facilities are generally located remotely from aircraft servicing and movement areas.

(2) **Operating (Satellite) Storage Facilities.** Operating

storage facilities, when provided, are of smaller capacity than the main storage facilities and are generally located as close as practical to aircraft servicing ramps.

p. Head and Bulkhead. A liquid-tight transverse closure at the end of a cargo tank.

q. Hydrant. An outlet in a fixed fueling system designed to permit the transfer of fuel only after the matching fuel connection on dispensing equipment is properly attached.

r. Pressure:

(1) **Burst Pressure.** This is the pressure at which any randomly selected component will rupture.

(2) **Design Pressure.** Design pressure is that pressure for which a system or component is designed. Design pressure shall always be equal to or exceed the service pressure, which includes surge pressure. The design pressure shall never be exceeded except during pressure test.

(3) **Operating Pressure.** The pressure existing in a system under flowing conditions or static conditions against pump's maximum no-flow head but excluding surge pressures.

(4) **Service Pressure.** The maximum pressure, excluding test pressure, to which a system or component may be subjected. It includes any surge pressures which may be developed in the system.

(5) **Test Pressure.** This is the pressure to which the system or a component of such system is tested to verify the integrity of the system or component. It is usually expressed as a percentage of the service pressure or design pressure.

s. Standard Grades of Aviation Fuel. A fuel of whatever octane rating used in aircraft, including aviation gasoline (AVGAS) and blends of hydrocarbons commonly referred to as jet fuels (such as JET A, JET A-1, JET B, JP-4, JP-5 or their equivalents). For further information on this subject see Appendix B on Fire Hazard Properties of Aviation Fuels (Ground Handling).

t. Tank Full Trailer. A vehicle that is not self-propelled which has a cargo tank mounted thereon or built as an integral part thereof and used for the transportation of flammable liquids, and so constructed that practically all of its weight and load rests on its own wheels.

u. Tank Semitrailer. A vehicle that is not self-propelled which has a cargo tank mounted thereon or built as an integral

part thereof, and used for the transportation of flammable liquids, and so constructed that when drawn by a tractor by means of a fifth wheel connection, some part of its load and weight rests upon the towing vehicle.

v. Tank Truck. Any single self-propelled motor vehicle equipped with a cargo tank mounted thereon, and used for the transportation of flammable liquids.

w. Tank Vehicle. Any tank truck, tank full trailer, or tractor and tank semitrailer combination.

x. Transfer Pipeline. Piping used to transfer fuel between the main storage facilities, the operating storage tanks (if any), and the hydrant.

150. Related NFPA Publications.

151. Attention is also directed to the following NFPA publications which include information related to fire safety in aircraft fuel servicing and are further referred to in this Standard:

a. NFPA No. 10 (ANSI Z112.1). Standard for the Installation of Portable Fire Extinguishers.

b. NFPA No. 10A. Recommended Good Practices for the Maintenance and Use of Portable Fire Extinguishers.

c. NFPA No. 11. Standard for Foam Extinguishing Systems.

d. NFPA No. 12. (ANSI A54.1). Standard on Carbon Dioxide Extinguishing Systems.

e. NFPA No. 15. Standard on Water Spray Fixed Systems for Fire Protection.

f. NFPA No. 16. Standard on Foam-Water Sprinkler and Foam-Water Spray Systems.

g. NFPA No. 17. Standard for Dry Chemical Extinguishing Systems.

h. NFPA No. 30. Flammable and Combustible Liquids Code.

i. NFPA No. 70 (ANSI C1). National Electrical Code.

j. NFPA No. 77. Recommended Practice on Static Electricity.

k. NFPA No. 385. Recommended Regulatory Standard for Tank Vehicles for Flammable and Combustible Liquids.

l. NFPA No. 409. (ANSI Z214.1). Standard on Aircraft Hangars.

m. NFPA No. 410C. (ANSI Z119.2). Recommendations on Safeguarding Aircraft Fuel System Maintenance.

n. NFPA No. 415. Standard on Aircraft Fueling Ramp Drainage.

o. NFPA No. 416. (ANSI Z246.1). Standard on Construction and Protection of Airport Terminal Buildings.

p. NFPA No. 505. (ANSI B56.2). Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks.

q. NFPA No. 512. Truck Fire Protection Recommended Good Practices.

Part II. Aircraft Fueling/Defueling

200. Intent:

*201. This Standard sets forth requirements for fire safety in fueling and defueling aircraft while on the ground. (See Part I, General and Definitions).

210. Spill Prevention and Control:

*211. Careful operation of fuel servicing equipment in compliance with this Standard will minimize the number of accidental spills. Proper training of fuel servicing personnel is essential. Proper maintenance of the equipment is another essential. Every spill, no matter how small, shall be investigated as to its cause so that remedial action may be taken. Employees shall promptly report each spill to supervisory personnel. Every spill shall be treated as a potential fire source and the fire department notified if it constitutes a hazard to life or exposed equipment, or if the spill is over 10 feet in any dimension and over 50 square feet in area, or is of a continuing nature. Recommendations for removing spilled fuel are given in Appendix A.

*220. Elimination and Control of Electrostatic Sparks:

221. Procedures with Aircraft Fuel Servicing Vehicles: When tank trucks or hydrant vehicles are used for servicing an aircraft (*Exception: see Paragraph 227*), the following bonding and grounding procedures shall be followed:

a. Connect a grounding cable from the vehicle to a satisfactory ground.

***b.** Connect a grounding cable from the ground to the aircraft grounding fitting, if one is provided, or to another convenient unpainted metal point on the aircraft. Do not make this connection to a propeller, a radio antenna or to the highly stressed components of the landing gear where scratches could initiate metal failure.

c. Bond the vehicle to the aircraft. Where a "Y" or "V" cable permanently attached to the fueling vehicle is used to accomplish steps **a.** and **b.**, a separate bonding cable is not necessary. Do not depend solely on conductive hose to accomplish this bonding.

***d.** Bond the fuel nozzle to the aircraft. For overwing servicing, connect a bonding cable from the fuel nozzle to the aircraft. For underwing servicing, this bond is achieved by the metal to

*Asterisks indicate that Appendix A gives added recommendations to assist in achieving this objective.

metal contact between the aircraft fitting and the nozzle and a bonding cable is not required.

(1) Where aircraft and fuel nozzles are equipped with "plug and jack" bonding facilities, the nozzle bonding "plug" shall be in positive wiping contact with the aircraft "jack" before the aircraft fuel tank filler cap is opened.

*(2) When fueling aircraft not having bonding "jacks" and in fueling all aircraft having fabric covered wings, the bonding clip at the end of the nozzle bond wire shall first be touched to the tank filler before it is opened to assure that no difference in electrostatic potential exists between the two elements. The nozzle shall be equipped with a strong bond wire having a spring clamp which shall then be firmly attached to a bonding post or other uninsulated metallic part of the aircraft and this contact shall be maintained throughout the fueling operation (until the flow of fuel has been discontinued and all measuring completed).

e. Disconnect in reverse order on completion of fuel servicing.

222. Procedures with Fueling Pits or Cabinets: When a pit or cabinet is used for fuel servicing, grounding shall be provided in the construction. The following procedure shall be used:

a. Connect a bonding cable from a satisfactory bonding connection at the dispenser to the aircraft. (See Paragraph 221.c.)

b. For overwing servicing connect a bonding cable to the aircraft. (See Paragraph 221.d.)

c. Disconnect in reverse order on completion of fuel servicing.

223. Procedures Using Drums: Where aircraft are serviced with flammable liquids from drums by means of hand-operated or power-driven pumps, the procedures outlined in Paragraph 221 shall be followed. Gasoline and other low flash point flammable liquids shall not be handled in open buckets.

***224. Procedures on Ice, Sandy, or Desert Terrain, etc.:** Where fuel servicing operations are conducted on ice, sandy or desert terrain, or wherever it may not be practicable to secure a satisfactory ground, the authority having jurisdiction may waive the requirements for grounding the aircraft and the fuel dispenser. The requirements for bonding the aircraft and the fuel dispenser and of bonding overwing nozzles to the aircraft shall *not* be waived.

***225. Procedures Using Funnels.** When a funnel is used in filling an aircraft fuel tank it shall be bonded to the aircraft and to the nozzle as specified in Paragraph 221.d.(2). and the aircraft shall be grounded. Metal funnels only shall be used.

226. Equipment for Electrostatic Bonding, Grounding:

***a.** Bonding cables shall be of flexible, durable design and material.

b. The plug and jack assembly and the spring clamp shall be of unpainted metal.

***c.** The bonding system (cables and connections) shall be tested for electrical resistance when initially secured and inspected for continuity and integrity periodically as required by frequency of use and type of cable.

***d.** An adequate number of suitable grounding connections shall be provided on aprons and ramps where fuel servicing operations may be conducted.

***e.** As low a resistance as possible shall be secured. 10,000 ohms is a practical recommended maximum when determined by standard procedures.

f. All bonding and grounding connections shall be firm and to clean, unpainted metal parts.

227. Light Aircraft Servicing. When the fuel flow is not over 25 gallons per minute, the requirements herein for bonding and grounding during fueling may be waived by the authority having jurisdiction.

230. Aircraft Engines, Auxiliary Power Units, and Heaters.

231. An operating engine on an aircraft may be a potential source of ignition during fuel servicing under certain conditions. For this reason, aircraft engines shall be shut down during fuel servicing.

Exception: In an emergency resulting from the failure of an onboard auxiliary power unit on a jet aircraft, a jet engine mounted at the rear of the aircraft or on the wing on the side opposite from the fueling point may be operated to provide aircraft electrical power during fueling provided that the operation follows procedures published by the operator to assure safety in the operation.

232. Turbine-powered auxiliary power units installed aboard aircraft may be operated during fueling provided their location and combustion air source has been proven not to constitute a fuel-vapor ignition source.

233. Combustion heaters on aircraft (i.e., wing and tail surface heaters, integral cabin heaters, etc.) shall not be operated during fueling operations.

240. Safeguards Against Hazards Incident to Automotive Equipment Operation:

241. Vehicles, other than those performing aircraft servicing functions, shall not be permitted within 50 feet of aircraft during fuel servicing operations.

*242. All vehicles performing aircraft servicing functions other than fuel servicing (e.g. baggage trucks, air conditioning vehicles, etc.), shall not be driven or be parked under aircraft wings while fueling is in progress. Drivers shall be thoroughly instructed as to the hazards inherent in operating or parking such vehicles in close proximity to fueling operations.

250. Prevention of Arcing of Electrical Circuits:

251. During fuel servicing, aircraft batteries shall not be raised or lowered nor shall battery chargers be connected, operated or disconnected.

*252. Ground power generators shall not be placed under wings or within five feet aft of the trailing edge of wings. The act of connecting or disconnecting ground power generators shall not be accomplished while aircraft fueling is in progress.

*253. Electric tools, drills, buffers or similar tools likely to produce sparks or arcs shall not be used during fueling operations.

254. Photographic flash bulbs or electronic flash equipment shall not be used within 10 feet of fueling equipment or of the fill or vent points of aircraft.

260. Elimination of Open Flames:

261. Open flames and lighted open flame devices shall be prohibited on the passenger ramps and in other locations within 50 feet of any aircraft fuel servicing operation. Local airport management shall establish other locations where open flames and open flame devices shall be prohibited. Included in the category of open flames and lighted open flame devices are the following:

a. Lighted cigarettes, cigars, pipes, etc. (All entrances to fueling areas from adjacent buildings shall be posted with "NO SMOKING" signs.)

b. Exposed flame heaters (liquid, solid or gaseous devices, including portable and wheeled gasoline or kerosine heaters).

c. Welding or cutting torches, blowtorches, etc.

d. Flare pots or other open flame lights.

262. Cigarette lighters or "strike anywhere" matches shall not be carried or used by anyone while engaged in fuel servicing operations.

***270. Control of High Frequency Radar Equipment:**

***271.** Weather-mapping airborne radar shall not be operated when the aircraft in which it is mounted is being fueled.

***272.** Antennas for airport surface detection radar equipment shall be located so that the beam will not be directed toward any fuel storage or loading racks located within 100 feet. No aircraft fueling operations or any operations involving flammable liquids or vapors shall be conducted within 100 feet of such antennas.

***273.** Airborne surveillance radar shall not be operated within 300 feet of any operations in which flammable liquids and vapors may be present or created.

***274.** Antennas of aircraft warning radar shall be located so that the beam will not be directed toward any fuel storage or loading racks within 300 feet. No aircraft fueling operations or any operations involving flammable liquids or vapors shall be conducted within this 300-foot distance.

280. Additional Precautions:

281. Fueling Locations

***a.** Aircraft fuel servicing shall be done outdoors.

***b.** Aircraft being fueled shall be positioned so that aircraft fuel system vents or fuel tank openings are not closer than 25 feet from any terminal building, hangar, service building, or enclosed finger (other than loading bridges), or within 50 feet of any combustion and ventilation air intake to any boiler, heater, or incinerator room facing the ramp side of the terminal or finger.

***c.** Accessibility to aircraft by emergency fire equipment shall be considered in establishing fuel servicing positions.

***282. Fueling During Boarding and Deplaning of Passengers:** Operators shall determine for each aircraft type the areas through which it might be hazardous for boarding or deplaning passengers to pass while the aircraft is being fueled. Controls shall be established so that passengers avoid such areas.

283. Aircraft Occupancy. If passengers remain on board an aircraft during fuel servicing, at least one trained cabin attendant shall

be in the aircraft at or near a door at which there is a passenger loading bridge, integral stairs which are down, or a passenger loading stair or stand. Aircraft operators shall establish specific procedures covering emergency evacuation under such conditions for each type aircraft they operate. A "NO SMOKING" sign shall be displayed in the cabin(s) and the rule enforced.

284. Positioning of Aircraft Fuel Servicing Vehicles: A clear path shall be maintained to permit rapid removal of aircraft fuel servicing vehicles from an aircraft in an emergency. Vehicles and equipment shall not be located where they would obstruct egress from occupied portions of the aircraft in the event of fire. Hand brakes shall be set on vehicles before operators leave the cab or vehicle. Aircraft fuel servicing vehicles shall be positioned so they can be moved promptly (assuming all aircraft fuel hoses have been disconnected and racked) and so located that vehicle engines are not under the wing.

285. Operation of Fueling Equipment:

a. Compatible with design, during fueling operations there shall be adequately trained personnel available to quickly shut off the flow of fuel from the servicing equipment in an emergency.

***b.** Only competent and qualified operators shall be permitted to operate the equipment.

c. Locking of self-closing nozzles or deadman controls in an open position, even momentarily, shall be prohibited.

d. Kinks and short loops in fueling hose shall be avoided. The hose shall not be stretched with the complete weight of the hose off the ground as this places extra strain on the nozzle coupling (see Part III for further details of hose handling).

e. The fuel nozzle shall never be allowed to drag along the ground.

286. Lightning Storms: Use extreme caution when fueling during lightning and electrical storms. Suspend fueling operations during severe lightning disturbances in the immediate vicinity of the airport.

***287. Fire Extinguishers on Ramps Where Fueling is Conducted:** Portable extinguishers shall comply with the Standard for the Installation of Portable Fire Extinguishers (NFPA No. 10; ANSI Z112.1).

***a. Extinguisher Recommendations:** (See NFPA No. 10 for explanation of ratings of extinguishers.) For the protection of fuel servicing operations, extinguishers shall be provided at con-

venient locations and shall have the ratings indicated herein based on the open hose discharge capacity of the aircraft fueling system in service:

(1) Where said capacity does not exceed 200 gallons per minute, at least one approved extinguisher having a minimum rating of 20-B shall be provided.

(2) Where said capacity is in excess of 200 gallons per minute but not over 350 gallons per minute, one approved, wheeled dry chemical extinguisher having a minimum rating of 80B and a minimum capacity of 125 pounds of agent shall be provided.

(3) Where said capacity is in excess of 350 gallons per minute, two approved, wheeled dry chemical extinguishers, each having a minimum rating of 80B and a minimum capacity of 125 pounds of agent, shall be provided.

(4) Extinguishers of over 50 pounds gross weight shall be of wheeled type or be mounted on carts to provide mobility and ease of handling.

(5) Stationary-type fire extinguishing systems having adequate hose line coverage of the fuel servicing area and a fire extinguishing capability on Class B fires equal to or greater than that specified for the portable extinguishers in Paragraph 287.a.(1) or (2) may be used in lieu of the portable equipment, provided that one portable device having at least ½ the rating specified in the referenced paragraphs is also available or, in the case of the condition described in Paragraph 287.a.(3), that one approved extinguisher having an 80-B minimum rating is also available. Any stationary system provided shall conform to the applicable sections of one of the following NFPA Standards:

(a) Foam Extinguishing Systems (NFPA No. 11)

(b) Carbon Dioxide Extinguishing Systems (NFPA No. 12; ANSI A54.1)

(c) Water Spray Fixed Systems (NFPA No. 15)

(d) Foam-Water Sprinkler and Foam-Water Spray Systems (NFPA No. 16)

(e) Dry Chemical Extinguishing Systems (NFPA No. 17)

Hose line stations of stationary extinguishing systems shall be located so that they are easily accessible and so that the hose supply available shall adequately cover the probable spill hazard area.

(6) Extinguishers shall be protected from ice, snow, etc., by canvas covers, enclosed compartments or other suitable means

wherever necessary. Extinguishers located in enclosed compartments shall be readily accessible and their location shall be clearly marked in letters at least 2 inches high.

b. Extinguisher Maintenance: Extinguishers shall be maintained in accordance with the Recommended Good Practice for the Maintenance and Use of Portable Fire Extinguishers (NFPA No. 10A).

Part III. Aircraft Fueling Hose

300. General:

*301. Only fueling hose specifically built for aircraft fuel servicing and labeled in accordance with Paragraph 312 shall be used. Fueling hoses shall be in continuous length except in those cases where existing manufacturing processes do not permit a piece of hose to be made as long as required. Where two or more sections of hose are required to obtain necessary length, the number of all hose sections shall be held to an absolute minimum. When affixing couplings to new or used hose, the coupling size shall match the hose's outside dimension, inside dimension, and thickness. Coupled hose and recoupled hose assemblies shall withstand test pressures according to Paragraph 320.

302. Aircraft fueling hose above 2 inches nominal inside diameter shall have swivel couplings between the hose and the nozzle which shall permit free rotation of the nozzle, regardless of pressures, to avoid kinks in the hose.

310. Fuel Hose Design:

311. Fueling hose shall be fabricated of materials that are resistant to the action of aviation fuels. The hose cover shall be suitable for the requirements of the service for which it is designed, and resistant to damage by the hazards indicated in Paragraph A-301.b.

312. Each coupled length of hose shall have at least one inlaid label or an embossed brand which shall furnish the manufacturer's name or trademark, date of manufacture (quarter and year), hose specification identification (e.g., Aircraft Fueling Hose), and the design pressure of the hose. Where hose length exceeds 25 feet, labels as described herein shall be provided at intervals of 25 feet or less.

313. All fueling hose shall have a design pressure of not less than the service pressure to which it will be subject but in no case shall hose 2 inches nominal inside diameter and larger have a design pressure less than 125 psig. The minimum burst pressure shall be five (5) times the design pressure. The burst pressure test shall be run in accordance with the Standard Methods of Testing Rubber Hose (D380–72a), published by American Society for Testing and Materials (1916 Race Street, Philadelphia, Pa. 19103).

*320. Hydrostatic Test Requirements:

321. Before placing in initial service, new hose assemblies shall

be hydrostatically tested at a minimum of one and one-half (1½) times the design pressure.

322. Recoupled hose shall be hydrostatically tested at a minimum of one and one-half (1½) times the design pressure before being returned to service.

***323.** Suitable records shall be kept of hydrostatic tests.

330. Hose Inspection Requirements:

331. Hose in daily use shall be inspected daily. Hose used less frequently shall be inspected once each day it is used.

340. Fuel Hose Inspection Procedure:

341. The following minimum preventive maintenance and inspection program shall be performed.

***a.** Hose showing damaged covering shall be scrapped. Undamaged portions may be salvaged by recoupling.

***b.** If coupling slippage or leaks at couplings is found, the hose shall be immediately removed from service. The coupling shall be removed and the cause of the slippage, misalignment and/or coupling leakage shall be determined. If the hose is found satisfactory, it may be recoupled after removing the end portion.

***c.** Hose showing soft spots behind couplings or which abnormally twist or balloon when tested at operating pressures shall be withdrawn from service. Good sections of the hose may be salvaged.

***d.** Salvage hoses shall be hydrostatically tested in accordance with Paragraph 322.

***e.** If hose screens show rubber particles more than twice during the first week or any one time after the first week, the hose shall be scrapped immediately.

Part IV. Aircraft Fuel Servicing Vehicles

400. General

401. Scope:

*a. This Part gives minimum requirements for the design and construction of vehicles for the servicing of aircraft with standard grades of aviation fuel (see Paragraph 121.s.) operated by the vehicle motor and for facilities for loading the cargo tanks of these vehicles.

b. Aircraft fuel servicing tank vehicles which are used on public highways shall also comply with the requirements of the NFPA Recommended Regulatory Standard for Tank Vehicles for Flammable and Combustible Liquids (NFPA No. 385).

402. Magnesium: Magnesium shall not be used in the construction of any portion of an aircraft fuel servicing tank vehicle.

410. Cargo Tanks, Piping and Connections.

411. Cargo Tanks:

a. Cargo Tanks Constructed of Mild Steel: Tanks constructed of mild steel shall comply with the material specifications in Article 22 of the NFPA Recommended Regulatory Standard for Tank Vehicles for Flammable and Combustible Liquids (NFPA No. 385).

b. Cargo Tanks Constructed of Low Alloy, Low Carbon (High Tensile) Steel: Tanks constructed of low alloy, low carbon steel, commonly known as high tensile, shall comply with the material specifications in Article 22 of the NFPA Recommended Regulatory Standard for Tank Vehicles for Flammable and Combustible Liquids (NFPA No. 385).

c. Cargo Tanks Constructed of Aluminum: Tanks constructed of aluminum shall comply with the material specifications in Article 22 of the NFPA Recommended Regulatory Standard for Tank Vehicles for Flammable and Combustible Liquids (NFPA No. 385).

412. Piping, Joints and Flanged Connections:

a. Product discharge piping shall be of metal and rated for at least 125 psi design pressure.

b. Except as provided in Paragraph 412.c., all joints shall be welded. Elbows and fittings shall be kept to a minimum and, where used, shall be of the performed welding type.

c. Flanged connections or approved couplings shall be provided to avoid the need for cutting and welding when servicing or replacing components. Gaskets in flanged connections shall be of a material and design that will resist fire exposure for a time comparable to the flange and bolts.

d. Brackets or supports shall be used to provide rigidity to the piping and to support it if any section or component is removed for servicing.

e. In cargo tanks constructed of aluminum alloys, all joints in and to tank shells, heads and bulkheads shall be welded. All welded aluminum joints shall be made in accordance with recognized good practice, and the efficiency of a joint shall not be less than 85 percent of the annealed properties of the material in question. Aluminum alloys for high strength welded construction shall be joined by an inert gas arc welding process using filler metals R-GR40A, E-GR40A (5154 alloy) and R-GM50A, E-GM50A (5356 alloy) as conforming to American Welding Society Specification No. A5.10–69.

413. Test:

a. At the time of manufacture every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 pounds per square inch applied to the whole tank (or each compartment thereof if the tanks are compartmented). Such pressure shall be maintained for a period of at least 5 minutes, during which, if the test is by air pressure, the entire exterior surface of all the joints shall be coated with a solution of soap and water, heavy oil, or other material suitable for the purpose, foaming or bubbling of which will indicate the presence of leaks. Hydrostatic pressure, if used, shall be gaged at the top of the tank. The tank shall be inspected at the joints for the issuance of liquid to indicate leaks. Any leakage discovered by either of the methods above described, or by any other method, shall be deemed as evidence of failure to meet the requirements of this specification.

414. Tank Outlets:

a. Outlets shall be substantially made and securely attached to the tank.

b. Sight glasses (to determine water condensation quantities) at sump drains shall not be permitted.

415. Bulkheads and Baffles:

a. Bulkheads:

*(1) Aircraft fuel servicing tank vehicles used solely on an airport shall not be required to have bulkheads or compartments.

(2) Cargo tanks with compartments carrying different types of aviation fuel or different grades of the same type of fuel shall have an air space between compartments. Such air spaces shall be equipped with drainage facilities which are maintained in operative condition at all times. Each compartment carrying a different grade of fuel shall have independent delivery systems to dispense the fuels.

b. Baffles:

(1) Every cargo tank, and every compartment over 90 inches in length shall be provided with baffles, the number of which shall be such that the linear distance between any two adjacent baffles, or between any tank head or bulkhead and the baffles nearest it, shall in no case exceed 60 inches.

(2) The cross-sectional area of each baffle shall be not less than 80 percent of the cross-sectional area of the tank and the thickness of such baffle shall be not less than that required for heads and bulkheads of the cargo tank in which installed.

416. Vents

a. Normal Venting

(1) Each cargo tank or tank compartment shall be provided with a normal vent or vents having a minimum through area of .44 square inches. The pressure vent shall be set to open at no more than 1 psig. Pressure and vacuum vents shall be designed to prevent loss of liquid through the vent in case of vehicle upset.

*(2) If the tank is designed to be loaded or unloaded with the dome cover closed, the vent or vents shall be designed to limit the vacuum to one pound per square inch and the tank pressure to 3 psig on the basis of the maximum product transfer rate. Unless effective protection against overflowing is made, the pressure vent shall have sufficient liquid capacity to prevent the pressure from exceeding 3 psig in case of accidental overflowing.

b. Emergency Venting for Fire Exposure.

(1) **Total Capacity.** Each cargo tank or tank compartment shall be provided with one or more devices with sufficient capacity to limit the tank internal pressure to 5 psig. This total emergency venting capacity shall be not less than that determined from Table 1, using the external surface of the cargo tank or tank compartment as the exposed area.

(2) **Pressure-Actuated Venting.** Each cargo tank or tank compartment shall be equipped with pressure-actuated vent or vents set to open at not less than 3 psig. The minimum venting capacity for pressure-actuated vents shall be 6,000 cubic feet of free

Table 1

Minimum Emergency Vent Capacity in Cubic Feet Free Air/Hour (14.7 psia and 60°F.)

Exposed Area Square Feet	Cubic Feet Free Air per Hour	Exposed Area Square Feet	Cubic Feet Free Air per Hour
20	15,800	275	214,300
30	23,700	300	225,100
40	31,600	350	245,700
50	39,500	400	265,000
60	47,400	450	283,200
70	55,300	500	300,600
80	63,300	550	317,300
90	71,200	600	333,300
100	79,100	650	348,800
120	94,900	700	363,700
140	110,700	750	378,200
160	126,500	800	392,200
180	142,300	850	405,900
200	158,100	900	419,300
225	191,300	950	432,300
250	203,100	1,000	445,000

NOTES: Interpolate for intermediate sizes.

The venting capacities have been calculated on the basis of 75% of the square feet of the total exposed area of the cargo tank, using the formulas for heat input contained in the NFPA Flammable and Combustible Liquids Code (No. 30). The derivation of these formulas is also explained in NFPA No. 30.

air per hour (14.7 psia and 60°F.) at 5 psig. Pressure-actuated devices shall be designed so as to prevent leakage of liquid past the device in case of surge or vehicle upset but shall function in case of pressure rise when in upset position.

(3) **Fusible Venting.** If the pressure-actuated venting required by (2) does not provide the total venting capacity required by (1), additional capacity shall be provided by adding fusible venting devices each having a minimum area of 1.25 square inches. The fusible vent or vents shall be actuated by elements which operate at a temperature not exceeding 250°F. when the tank pressure is between 3 and 5 psig. When fusible venting devices are used no less than two such devices shall be used on any cargo tank or tank

compartment over 2,500 gallons in capacity, and at least one such device shall be located close to each end of the cargo tank or tank compartment.

*c. **Flow Testing and Marking of Vents.** Each venting device shall be flow tested in the ranges specified in the applicable preceding paragraphs. The actual rated flow capacity of the vent in cubic feet of free air per hour at the pressure in psig at which the flow capacity is determined shall be stamped on the device. The fusible vent or vents shall have their flow rating determined at 5 psig differential.

d. Location of Vents. Vents shall be located near the center of the tank or compartment to minimize surge spillage when the vehicle is stopping or accelerating.

417. Fill Openings and Top Flashing:

a. Filler opening dome covers shall be provided with a forward mounted operating hinge, self-latching catches to hold the cover closed, and fitted with water-tight seals or gaskets designed to prevent spillage or leakage from overturn or the weather.

b. Flashing shall be provided around filler opening dome covers to prevent spilled fuel from draining near possible sources of ignition including the engine, the engine exhaust system, electrical equipment or into any portion of the vehicle housing auxiliary equipment.

c. The tank filler openings shall be protected against overturn damage by a rigid member or members firmly fixed to the tank and extending a minimum of 1 inch above any dome cover, handle, vent opening or projection of the unit. Overturn protection shall be adequately braced to prevent collapse. Where overturn protection creates a trough or pocket apt to collect rain water or snow, it shall have a drain that is either exterior to the cargo tank or one that complies with 418.e.

418. Outlet Valves and Emergency Shutoff Controls:

a. The outlets of each cargo tank or compartment, including water drawoff valves, shall be equipped with a reliable and efficient shutoff valve located inside the shell, or in the sump when it is an integral part of the shell, and designed so that the valve must be kept closed except during loading and unloading operations. Water drawoff valves shall be of a type that cannot be locked open.

b. The operating mechanism for each tank outlet valve shall be adjacent to the fuel delivery system operating controls and shall be arranged so that the outlet valve(s) can be simultaneously and

instantly closed in the event of fire or other emergency. There shall be at least two quick-acting emergency tank outlet valve shut-off controls, remote from each other (preferably on opposite sides of the vehicle) and from the fill openings and discharge outlets, which can be conveniently operated from a ground level standing position. In addition, all vehicles equipped with a top deck platform shall have an emergency tank outlet valve shut-off control conveniently accessible from the deck.

*c. Emergency tank outlet valve shutoff controls shall be placarded "EMERGENCY SHUTOFF" in letters at least two inches high and of a color that contrasts with the background for ready visibility. Method of operation shall be indicated by an arrow or by the word "PUSH" or "PULL", as appropriate. The word "EMERGENCY" shall not be used to identify any control or device on the vehicle other than these tank outlet emergency shutoff controls.

d. Each discharge valve shall be provided with a standard fusible device which will cause the valve to close automatically in case of fire.

e. In every case there shall be provided, between shut-off valve seats and discharge outlets, a shear section which will break under strain unless the discharge piping is so arranged as to afford the same protection and leave the shut-off valve seat intact.

f. All openings into cargo tank compartments connected to pipe or tubing (which extends through the cargo tank and where such tubing is subject to undetected breakage or failure) shall be plugged unless the pipe or tubing is fitted with a spring loaded check valve, a self-closing valve or similar device to prevent the accidental discharge of fuel in case of equipment malfunction or line breakage. Unless such valves are located inside the tank, they shall be equipped with a shear section as described in 418.d.

*g. Where a deadman valve is used to monitor aircraft fueling, the time of closure shall assure a minimum "overshoot" while minimizing surge pressure upstream of the deadman valve. Where the valve closure may be affected by low downstream pressure, "overshoot" shall be determined with a reduction of downstream pressure such as would result from a major line break.

419. Fuel Dispensing System. The components and arrangement of the system for dispensing fuel from an aircraft fuel servicing vehicle to the aircraft shall conform to the following requirements:

a. The valve which monitors the flow of fuel from an aircraft fuel servicing vehicle shall have a deadman control which must be

held by the fuel serviceman to permit fuel to flow. The use of any means which would allow fuel to flow without the operator holding this control shall be prohibited. The fuel flow control valve may be:

(1) In an overwing nozzle (see 419.c.);

(2) At the tank outlet [see 419.g.(2)];

(3) A separate valve on a tank vehicle; or

(4) In a hydrant (see 532.b.).

The flow control system shall be designed to minimize surge pressure ahead of the flow control valve and to reduce "overshoot" (the quantity of fuel passing through the valve after the deadman control is released). The system shall be designed to shut off fuel flow quickly and effectively when the deadman control is released, even though there may be a reduction of pressure downstream of the flow control valve such as could result from a major line or hose break. A screen shall be provided ahead of the valve to trap foreign material that could interfere with complete closure of the valve.

b. Hydrant system fuel servicing vehicles for use with a hydrant system that has more than 3 outlets or a rate of flow of more than 60 gallons per minute per outlet shall not have a fuel control valve installed on them. On such vehicles this function shall be provided by deadman control of the hydrant valve. (See also 532.b.)

c. Nozzles for overwing servicing on aircraft fuel servicing tank vehicles may have the deadman flow control in the nozzle. Notches or latches in the nozzle handle which could allow the valve to be locked open shall be prohibited.

d. Nozzles for underwing servicing shall be designed so that they must be securely and completely seated in the mating connection on the aircraft before the poppet valve can be opened. It shall not be possible to disengage the nozzle from the aircraft fitting until the poppet valve is fully closed.

e. On aircraft fuel servicing tank vehicles used for underwing fuel servicing, the fuel flow control valve shall be located ahead of the fuel line to the aircraft fuel servicing nozzle. The deadman control shall be arranged so that the fuel serviceman can observe the operation while he is holding the control.

f. Fuel servicing pump mechanisms shall be designed and arranged so that failure or seizure will not cause rupture of the pump housing, a tank or of any fuel containing component. Fuel pressure shall be controlled within the stress limits of the hose and

plumbing by means of either an engine speed controller, a system pressure-relief valve, or other suitable means. The rated working pressure of any system component shall equal or exceed any pressure, including surge pressure, to which it may be subjected.

g. On tank full trailer or tank semitrailer units, the use of a pump on the tractor unit with flexible connections to the trailer shall be prohibited unless:

(1) Flexible connections are arranged above the liquid level of the tank in order to prevent gravity or siphon discharge in case of a break in the connection or piping, or

(2) The cargo tank discharge valves required by 418 are arranged to be normally closed and to open only when the brakes are set and a control is held manually by an operator. The manual control must be of the "deadman" type so that the valves will close at once if the control is released.

h. Where provided, hose reels shall be of sufficient size for the length and diameter of the hose to be used.

i. Hose shall be connected to rigid piping or coupled to the hose reel in a manner which will prevent undue bending action or mechanical stress on the hose or hose couplings.

j. Aircraft fuel servicing vehicles having provision for underwing fuel servicing shall have a system or device which will prevent the vehicle from being moved unless all fuel lines are disconnected from the aircraft and stowed properly on the vehicle.

420. Fuel Servicing Vehicle Chassis, Assembly, Protection Systems and Equipment:

421. Tires: All aircraft fuel servicing vehicles shall be equipped with rubber tires on all wheels.

422. Assembly: Every cargo tank shall be adequately supported upon and securely attached to or be a part of the tank vehicle upon which it is carried.

423. Static Protection:

a. Cargo tanks and vehicle chassis shall be electrically bonded.

b. Provision shall be made in the tank structure of the vehicle for the bonding of vehicle to the fill pipe during truck loading operations.

***c.** A static discharge cable shall be provided to enable

grounding and bonding during aircraft servicing as recommended in Part II, Section 220.

***d.** There shall be attached to each over-the-wing hose nozzle a cable with clamp or plug to provide for the bonding connection as recommended in Part II, Section 220.

424. Protection Against Collision: Drawoff valves or faucets projecting beyond the frame at the rear of a tank vehicle shall be adequately protected against collision by bumpers or similar means.

425. Vehicle Lighting and Electrical Equipment:

***a.** All wiring shall be fully insulated, adequately supported, and protected against chafing. Terminal connections shall be firmly attached with snap or screw-type connections. Wiring shall be sized to provide sufficient current-carrying capability and mechanical strength. All circuits shall have overcurrent protection.

b. Spark plugs and other terminal connections shall be suitably insulated to prevent sparking in the event of contact with conductive materials.

c. All motors, alternators, or generators and associated control equipment located outside of the engine compartment or vehicle cab, shall be of a type approved for use in Class I, Group D, Division 1 hazardous locations.†

d. Electrical equipment and wiring located within a closed compartment shall meet the requirements for Class I, Group D, Division 1 hazardous locations.† Adequate air circulation shall be provided in closed compartments to prevent overheating.

e. Electrical service wiring between the tractor and cargo tank on a semi-trailer vehicle shall be designed for heavy-duty service. The cable shall mate with a multi-connector plug terminal mounted on the cargo tank. The connector shall have a positive engaging device (e.g., twistlock or screwed coupling collar).

f. Lamps and switching devices, other than those covered in Paragraphs 425.b. and d., shall be of the enclosed and gasketed type which are of weather-tight construction. Electrical wiring shall be in metallic raceways, aluminum sheathed cable (Type ALS), or mineral insulated cable (Type MI). Other electrical components shall be designed to meet the requirements for Class I, Group D, Division 2 locations.†

†For further information, see National Electrical Code (NFPA No. 70-1974; ANSI C1-1974).

426. Vehicle Fuel System:

a. Vehicle fuel tanks shall be so designed, constructed and installed as to present no unusual hazard and no part of any fuel tank or container or intake pipe shall project beyond the over-all width of any tank vehicle upon which it is mounted. Fuel tanks mounted outside the frame of the vehicle, or in exposed locations shall be of the approved type. All fuel tanks shall be so arranged as to vent during filling operations and to permit drainage without removal from their mountings.

b. The use of a gravity feed fuel system shall be prohibited.

c. All portions of the fuel-feed system, including carburetor, pumps, and all auxiliary mechanisms and connections shall be constructed and installed in a workmanlike manner, and so constructed and located as to minimize the fire hazard, with no readily combustible materials used therein, and shall, except for Diesel fuel connections, be well separated from the engine exhaust system. A pressure-release device shall be provided where necessary. The fuel-feed lines shall be made of materials not adversely affected by the fuel to be used or by other materials likely to be encountered, of adequate strength for their purpose and well secured to avoid chafing or undue vibration. Joints depending upon solder for mechanical strength and liquid tightness shall not be used in the fuel system at or near the engine, or its accessories, unless the solder has a melting point of not less than 340°F., or unless a self-closing, thermally controlled valve set to operate at not exceeding 300°F., or other equivalent automatic device, shall be installed in the fuel line on the fuel-tank side of such joint.

d. The engine air intake shall be equipped with an effective flame arrester (or an air cleaner having effective flame arrester characteristics), substantially installed and capable of preventing emission of flame from the intake side of the engine, in event of backfiring.

e. When provided, the sediment bowl in the fuel supply line shall be of steel or of materials of equivalent fire resistance.

427. Exhaust System:

a. The exhaust system, including muffler (or silencer) and exhaust line shall have ample clearance from the fuel system and combustible materials, and shall not be exposed to leakage or spillage of product or accumulations of grease, oil or gasoline.

b. The exhaust system, including all units, shall be constructed and installed in a workmanlike manner. A muffler (or silencer) cutout shall not be used.

c. No portion of the exhaust system shall be located beneath or near the servicing platform, or any part of the cargo delivery system. Where required, adequate shielding shall be installed so that fuel spillage from the cargo tank vent, or overflow systems, cannot come in contact with the exhaust systems.

428. Vehicle Brakes:

a. Vehicle brakes shall be of acceptable commercial quality for this type of vehicle service.

b. Each full trailer, and semi-trailer, shall be equipped with reliable brakes on all wheels, and adequate provision shall be made for their efficient operation from the driver's seat of the vehicle drawing the trailer, or semi-trailer.

429. Full Trailers and Semi-Trailers:

a. Trailers shall be firmly and securely attached to the vehicle drawing them, in a manner conforming with recognized good practice.

b. Trailer connections shall be such as to prevent the towed vehicle from whipping or swerving from side to side dangerously or unreasonably and shall cause the trailer to follow substantially in the path of the towing vehicle.

430. Cabinets Housing Vehicle Auxiliary Equipment: All cabinets housing vehicle auxiliary equipment shall have expanded metal, perforated metal or grating type flooring to facilitate air circulation within the enclosed space and to prevent accumulation of spilled liquid.

***440. Fire Extinguishers for Aircraft Fuel Servicing Vehicles:**

441. Extinguishers shall comply with the Standard for the Installation of Portable Fire Extinguishers (NFPA No. 10, ANSI Z112.1).

442. There shall be at least two extinguishers mounted on each aircraft fuel servicing tank vehicle. Each extinguisher shall have a rating of not less than 20–B. At least one extinguisher shall be readily accessible from either side of the vehicle.

443. There shall be at least one extinguisher mounted on each aircraft fuel servicing hydrant vehicle. Each extinguisher shall have a rating of not less than 20–B.

444. Extinguishers shall be protected from ice, snow, etc., by canvas covers, enclosed compartments or other suitable means where necessary. Extinguishers located in enclosed compartments shall be readily accessible and their location shall be clearly marked in letters at least 2 inches high.

450. Operation of Fuel Servicing Vehicles

451. Fueling and Defueling of Aircraft. Refer to Parts I and II of this Standard for procedures for aircraft fueling and defueling.

452. Maintenance.

a. Aircraft fuel servicing vehicles shall not be operated unless they are in proper repair and free of accumulations of grease, oil, or other combustibles in other than normal storing and transfer tanks and lines.

b. Leaking vehicles shall be removed from service, defueled, and parked in a safe area until repaired.

453. Filling and Discharging:

a. An attendant shall be present and shall observe filling operations at all times and shall not block open or render inoperative any safety control equipment supplied (see Section 470).

b. The motor of tank vehicles shall be shut down during cargo tank and vehicle fuel tank filling operations.

c. The cargo tank shall be bonded to fill pipe when cargo tank loading operations are in progress. The bond wire connection shall be made prior to opening the dome covers. It shall be maintained in place during the entire filling operation and the dome covers shall be securely closed before the bond wire is disconnected from the cargo tank.

***d.** No cargo tank or compartment shall be loaded liquid full. Sufficient space (outage) shall be left vacant in every case to prevent leakage by expansion of the contents due to rise in temperature of the cargo. The outage shall be not less than 1 percent of the volume of the tank or compartment.

454. Smoking and Open Flames:

a. No open flames shall be allowed within 50 feet of fuel servicing equipment including:

(1) Lighted cigarettes, cigars, pipes, etc.

(2) Exposed flame heaters, snow-melters (liquid, solid, or gaseous devices, including portable and wheeled gasoline or kerosine heaters).

(3) Welding or cutting torches, blowtorches, etc.

(4) Flare pots or other open flame lights.

b. A "NO SMOKING" sign shall be displayed prominently in the cab of every aircraft fuel servicing vehicle.

c. Smoking equipment such as cigarette lighters and ash trays shall not be installed. If vehicle has such equipment when initially procured, it shall be removed or rendered inoperable.

455. Fuel Servicing Vehicle Maintenance. Maintenance and servicing of aircraft fuel servicing vehicles shall be done outdoors or in a building approved for this purpose.

Exception: If emergency repairs are required on an aircraft fuel servicing vehicle during inclement weather and no such approved building is available, minor repairs necessary to get the vehicle back into service may be done in a hangar, provided that the following requirements are observed:

(a) Approval to perform the work in the hangar shall be secured from the supervisor responsible for the hangar operation. The approval shall be in writing. It shall specify the work to be done, the location assigned for the work, the requirements listed below, and any special requirements deemed necessary.

(b) Not more than one such vehicle shall be permitted in a hangar at one time. Repairs shall be limited to those needed to get the vehicle back in service.

(c) Approval shall be limited to vehicles used for Jet A fuels only.

(d) Welding, cutting or open flames shall be prohibited.

(e) Portable electrical equipment used during the repair of the vehicle shall conform to the requirements of Article 513 of the National Electrical Code (NFPA No. 70 — 1974; ANSI C1 — 1974).

(f) The hangar shall be constructed and protected in accordance with the provisions of the Standard for Aircraft Hangars (NFPA No. 409–1973; ANSI Z214.1).

(g) At least two wheeled dry chemical extinguishers, each having a minimum rating of 80B and a minimum capacity of 125 lbs., shall be located within 50 feet of the vehicle being serviced.

(h) A separation of at least 50 feet shall be maintained between the vehicle being serviced and the nearest part of any aircraft in the hangar.

456. Parking Fuel Servicing Vehicles. Parking areas for aircraft fuel servicing vehicles shall be arranged to:

a. Facilitate dispersal of the vehicles in event of emergency;

b. Provide reasonable accessibility for fire control purposes;

c. Prevent any leakage from draining to an adjacent building;

d. Minimize exposure to damage from out-of-control aircraft; and

e. Provide at least 50 feet from any airport terminal building, aircraft cargo building, aircraft hangar, or other airport structure housing the public which have windows or doors in the exposed walls.

460. Marking:

461. Each aircraft fuel servicing vehicle shall be conspicuously and legibly marked to indicate the nature of the cargo. The marking shall be on each side and the rear thereof in letters at least 3 inches high on a background of sharply contrasting color, optionally, as follows:

a. With a sign or lettering on the vehicle with the word FLAMMABLE, or

b. With the name GASOLINE, JET A, JET B, or the name of the fuel being handled.

470. Tank Vehicle Loading:

471. The following procedures shall be used when top loading or overhead loading of tank trucks:

a. Filling the vehicle cargo tank shall be under the control of an operator at all times. A "deadman" type manual control shall be provided, located so that the operator can observe the liquid level in the tank.

b. Drop tubes attached to loading assemblies extending into the vehicle tank shall extend to the bottom of the tank and be maintained in that position until the tank is loaded to provide submerged loading and avoid splashing or free fall through atmosphere of the fuel, or

c. Fixed drop tubes permanently mounted in the vehicle tank shall extend to the bottom of the tank or to inside the sump to maintain submerged loading and avoid overshoot or splash loading of the fuel.

d. Drop tubes used in top loading or overhead loading of tank vehicles shall have a diverter designed to minimize turbulence.

*472. The following procedures shall be used when bottom loading of the tank vehicle:

a. Loading hose suitable for the service shall be used in accordance with Part III herein, equipped with swivel connections at each end as necessary to avoid kinks or sharp bends in the hose, or

b. Loading swing arms of metal shall be supported by counterbalancing and having adequate flexibility by swivel joints to allow free movement for the changing level of the fuel vehicle connection during loading.

c. The hose or swing arm shall terminate at the tank vehicle connection with a self-sealing, leak-proof, dry-break coupler which cannot be opened until it is securely engaged to the vehicle tank companion adapter. It shall not be possible to disconnect the hose coupler from the tank vehicle connection unless the internal valving of both components is fully closed.

d. The supply piping terminating at the loading hose or swing arm shall be supported in a manner to carry the load imposed by the hose or arm.

e. A shutoff valve, self-closing by manual or heat actuated release, shall be provided in the piping immediately upstream of the loading hose or swing arm connection.

*f. The bottom loading adapter of the tank vehicle shall be of self-sealing spring-loaded check valve type which will remain in closed position until opened by use of the companion coupler.

g. To prevent overfilling, control of the maximum fill condition in the vehicle cargo tank shall be provided by a preset metered liquid control, a float actuated shutoff, a sensing or other automatic device, or by a deadman type manual control located at a position where the operator can observe the liquid level in the tank. Any liquid bled from a sensing device during loading shall be returned to the bottom of the cargo tank through a closed system.

h. Where maximum fill condition control is provided by liquid level device, a means of prechecking the level control system shall be incorporated using a manual valve. Prechecking shall check both the level sensing and shutoff device as an integral system operation. A visible means, such as a pressure gage, shall be provided so that the operator will have a positive signal that the precheck works.

*i. On fuel servicing tank vehicles equipped for bottom loading, the fill pipe and valving shall be such as to prevent the fuel spraying in the cargo tank and to minimize liquid turbulence.

473. Emergency Remote Control Stations:

a. Each tank vehicle loading station shall be provided with an emergency shutoff system. This requirement is in addition to the deadman control required in Paragraph 471.a. for top loading and permitted in Paragraph 472.g. for bottom loading. It shall be the purpose of this system to shut down the flow of fuel in the entire system or in sections of the system if an emergency occurs.

***b.** One or more emergency shutoff stations shall be provided. Each station location shall be placarded EMERGENCY FUEL SHUTOFF in letters at least two inches high. Method of operation shall be indicated by an arrow or by the word "PUSH" or "PULL", as appropriate. Any action required to gain access to the shutoff device (e.g., "BREAK GLASS") shall be clearly shown. Lettering shall be on a background of a contrasting color for ready visibility. Placards shall be weather resistant, shall be at least seven feet above the ground, and located so that they can be readily seen from a distance of at least twenty-five feet.

c. The emergency shutoff system shall be designed and constructed so that delivery of fuel will be shut off if an emergency shutoff station control is operated or if the control operating energy source fails.

Part V. Airport Fixed Fueling Systems

500. General:

501. Scope:

a. This Part covers airport fixed fueling systems designed or employed in the transfer of standard grades of aviation fuel into or from an aircraft. It is intended to provide minimum fire safety recommendations for these systems.

b. The applicable portions of Parts I through IV shall be followed.

c. Each installation shall be studied individually to determine whether additional fire safety measures are necessary. Plans and specifications shall be approved by the airport authority prior to commencing any work on the construction or alteration of a fixed fueling system.

510. Basic Considerations:

511. From a fire safety viewpoint, the basic considerations of an airport fixed fueling system are:

a. The service pressure to which the system and its components may be subjected shall not exceed the design pressure rating. Surge pressures shall be controlled by the use of pressure regulating equipment, slow closing valves, surge suppressors and/or other devices properly placed in the system.

b. System components shall be designed and installed in accordance with accepted industry safe practices.

c. System components shall be designed and installed so as to permit safe operation without placing an abnormal demand on the abilities of operating personnel.

d. Emergency shutoff mechanisms shall be installed as an integral part of the system. They shall be so located as to be readily accessible in the event of an accident or spill.

e. Fuel dispensing equipment shall include a deadman type control.

f. Emergency control devices shall be so constructed and designed that they shall shut off the delivery of fuel upon operation or the failure of the operating energy.

g. Sources of ignition in the vicinity of the fueling operation

shall be controlled in accordance with Part II and other portions of this Standard.

h. Consideration shall be given to the need for accessibility by emergency fire equipment as detailed in Paragraph 281 of Part II when establishing aircraft fuel servicing locations and laying out airport fixed fueling systems.

520. Fuel Storage and General Transfer:

521. Construction, Spacing and Location of Fuel Storage Tankage:

***a.** The construction and spacing of fuel storage tankage shall meet the requirements of NFPA No. 30† for Class I flammable liquids.

b. Airport management shall determine the clearances required from the center line of airport runways to any aboveground fuel storage structures or fuel transfer equipment with due recognition given to national and international standards establishing clearances from obstructions. Tanks located in aircraft movement areas or aircraft servicing areas shall be of the underground type or mounded over with earth with depth and type of cover determined by consideration of aircraft wheel and impact loads. Vents from such tanks shall be constructed in a manner to minimize collision hazards with operating aircraft and aircraft operators shall be consulted as to the height and location of such vents with care to avoid venting flammable vapors in the vicinity of any existing ignition sources, including operating aircraft and automotive equipment permitted in the area.

***522. Types of Fuel Transfer Systems:** Fuel transfer may normally be accomplished by any one of three methods: (1) pumping, (2) gravity, or (3) hydraulic or inert gas pressure on the storage tank. Regardless of the method employed for fuel transfer means for controlling flow in event of emergency shall be provided.

523. Transfer Piping:

a. Locate transfer piping outdoors. Underground piping shall be used in the vicinity of aircraft traffic zones unless the piping is protected by a substantial barrier guard.

***b.** Fuel piping shall not run under buildings or passenger loading fingers (excluding movable loading bridges) except when

†Flammable and Combustible Liquids Code published in National Fire Codes and in pamphlet form.

run in buried steel casings enclosing only the fuel piping. Piping shall be protected by suitable sleeves or casings where necessary to protect the pipe from shock hazards or where it crosses sewer manholes, service tunnels, catch basins or other underground services. Piping shall be laid on firm supports using clean, noncorrosive, backfill. Corrosion protection shall be provided where necessary.

*c. Piping, valves and fittings shall be of metal, suitable for aviation fuel service, and designed for the working pressures and mechanically and thermally produced structural stresses to which they may be subjected. The minimum requirements of the American National Standards Institute Code for Pressure Piping, Petroleum Refinery Piping (B31.3-1973) shall be used as a basic guide.

(1) Cast-iron piping and fittings shall not be used where subject to fire exposure.

(2) Aluminum piping and fittings may be used subject to the approval of the authority having jurisdiction.

(3) In the selection of pipe, valves and fittings, the following shall be given consideration:

*(a) Service pressure (including surge pressures).

(b) Bending and external mechanical strength (including settlement).

(c) Allowance for internal and external corrosion with the external corrosion protection evaluated based on the type of corrosion protection system used, if any, and internal corrosion considered in connection with purity of the fuel handled.

(d) Impact stresses.

(e) Method of fabrication and assembly.

(f) Location of piping and accessibility for repair or replacement.

(g) Possibility of mechanical atmospheric or heat (fire) damage to exposed pipe, valves and fittings.

(h) Expected period of service and effect of future changes in fuel specifications on materials used.

*(4) Gaskets in flanged connections shall resist fire temperatures for a time period comparable to the flange and bolts.

(5) Allowances shall be made for thermal expansion and contraction by the use of pipe bends, welding elbows or other flexible

design. Hydrostatic relief valves shall be provided in long lines which may be valved off.

*(6) Welded joints shall be made up by qualified welders, under close supervision, and with all necessary safeguards observed.

530. Valving:

***531. System Component Isolation:** Isolation valves or devices shall be provided to minimize the quantities of fuel which will be released when it is necessary to dismantle portions of the fueling system for maintenance purposes. When a valve is closed for maintenance purposes, it shall be placarded until the maintenance work has been completed.

532. Hydrant Valves:

a. In addition to the isolation valve specified in Paragraph 531., each hydrant shall be so designed that the flow of fuel shall be shut off when the hydrant coupler is disconnected or when the hydrant valve fails due to impact or tension loads beyond its design strength.

b. Except in hydrant systems having not more than 3 outlets and a rate of flow of 60 gallons per minute or less per outlet, the valve which monitors the flow of fuel to the aircraft shall be located at the hydrant. It shall have a deadman control which must be held by the fuel serviceman to permit fuel to flow. The use of any means which would allow fuel to flow without the operator holding this control shall be prohibited. The deadman control shall be arranged so that the fuel serviceman can observe the operation while he is holding the control. The flow control valve may be an integral part of the hydrant valve or shall be located as close as possible to the supply side of the hydrant valve. The fuel control valve shall be arranged so that it shall not be rendered inoperative by a surface accident, spill or malfunction and shall fail safe by closing completely if the control power fails. The fuel control system shall be designed to minimize "overshoot," which is the quantity of fuel passing through the valve after the deadman control is released. The system shall be designed to shut off fuel flow quickly and effectively even though there may be a reduction of pressure downstream of the flow control valve such as could result from a major line or hose break. A screen shall be provided ahead of the valve to trap foreign material that could interfere with complete closure of the valve.

533. Emergency Shutoff System:

a. Every hydrant fueling system shall have a means for quickly

and completely shutting off fuel flow in an emergency. This requirement is in addition to the deadman control required in Paragraph 532.b.

b. The emergency shutoff system shall include shutoff stations located outside of probable spill areas and near the route that would be normally used to leave the spill area or to reach the fire extinguishers provided for the protection of the area.

c. At least one emergency shutoff control station shall be conveniently accessible to each fueling position.

***d.** The emergency shutoff system shall be designed so that operation of a station will shut off fuel flow to all hydrants that have a common exposure (e.g., all hydrants on one side of a finger).

e. Emergency shutoff systems shall be designed so that they will shut off flow of fuel if the operating energy fails.

*f. Each emergency shutoff station shall be placarded "EMERGENCY FUEL SHUTOFF" in letters at least two inches high. Method of operation shall be indicated by an arrow or by the word "PUSH" or "PULL", as appropriate. Any action required to gain access to the shutoff device (e.g., "BREAK GLASS") shall be clearly shown. Lettering shall be on a background of a contrasting color for ready visibility. Placards shall be weather resistant, shall be at least seven feet above the ground, and located so that they can be readily seen from a distance of at least twenty-five feet. Valves used to shut off a hydrant for maintenance purposes shall *not* have placards that could cause confusion in an emergency.

g. Access to emergency shutoff control stations shall be kept clear at all times.

h. If the fuel flow is stopped for any reason, it shall first be presumed that the emergency shutoff system has been operated. The cause of the shutoff shall be corrected before fuel flow is reinstated.

***534. Pressure Control Valves:** Valves shall be provided as necessary to automatically control the pressure of the fuel being delivered to the aircraft.

***540. Filter Separators:** All sections of the filtering system shall have electrical continuity with adjoining piping and equipment.

550. Electrical Equipment in Fuel Storage Areas and on Associated Fuel Transfer Equipment: All electrical equipment

and wiring shall comply with the applicable provisions of Article 515 of the National Electrical Code (NFPA No. 70; ANSI C1).

560. Installation and Location of Fueling Hydrants and Fueling Pits:

561. Fueling hydrants and fueling pits shall be recessed below the ramp surface and fitted with a cover designed to sustain the load of vehicles or aircraft apt to taxi over or park on the device.

562. Fueling hydrants, cabinets and pits having a flow rate in excess of 60 gallons per minute shall be located at least 50 feet from any terminal building, hangar, service building or enclosed finger (other than movable aircraft loading walkways).

563. The ramp surfacing material shall be graded to form a gradual slope away from the rim or edge of fueling hydrants or fueling pits to prevent flooding.

564. Fueling hydrant boxes or fueling pits which are connected to a ramp drainage system shall be fitted with vapor sealing traps.

570. Aircraft Fuel Servicing Pits and Cabinets

571. The hose on aircraft fueling cabinets or pits shall meet the requirements of Part III herein and shall be maintained in accordance with its provisions.

572. Nozzles:

a. Overwing servicing nozzles shall conform to Paragraph 419.c. in Part IV.

b. Underwing servicing nozzles shall conform to Paragraph 419.d. in Part IV.

573. Piping, valves, meters, filters, air eliminators, connections, outlets, fittings and other components shall be designed to meet the service pressure requirements of the system.

580. Cathodic Protection:

581. Systems provided with cathodic protection shall have appropriate signs located at points of entry warning against separation of units without prior de-energization or without proper jumpers across the sections to be disconnected.

590. Tests and Maintenance:

591. Acceptance Test — Piping and Components of Fixed Fueling Systems: After completion of the installation (including fill and paving) that section of a fixed fueling system between the pump discharge and the connection for the dispensing facility shall be subjected to a hydraulic test pressure equal to 150 percent of the system design pressure for at least 30 minutes and proven tight before it is placed in service.

592. Acceptance Test — Hydrant Vehicles, Pits, and Cabinets: The fuel handling system of hydrant vehicles, fueling pits and cabinets including piping, valves, meters, filters, air eliminators, connections, outlets, fittings, and other components shall be subjected to a hydrostatic test pressure equal to 150 percent of the system design pressure for at least 30 minutes and proven tight before being placed into service.

593. Leakage Tests: A leakage test shall be conducted annually in the same manner as the acceptance tests described in Paragraphs 591 and 592 except that the test pressure shall be 100 percent of the service pressure.

594. Hose Tests: For requirements for testing hoses refer to Part III.

595. Emergency Devices: Emergency shutoff devices, hydrant valves, pressure control regulators and operational controls shall be operationally checked on a regular schedule to make sure that they function properly.

596. Records: Suitable records shall be kept of tests required by this Section.

Part VI. Fueling on Elevated Heliports

600. General

*601. If it is necessary to provide fuel servicing of helicopters at elevated heliports, the following procedures shall be followed:

a. Fueling on elevated heliports shall only be done when permitted by the authority having jurisdiction.

b. Facilities for dispensing fuel with a flash point below 100°F shall not be provided at any elevated heliport.

c. The heliport must comply with requirements for construction, drainage and fixed fire protection in addition to the special requirements of this Part.†

d. When it is necessary to provide fuel to safely ferry a helicopter from an elevated heliport which does not have facilities conforming to the requirements of this Part, the authority having jurisdiction may authorize this to be done, prescribing such protective measures as may be deemed necessary. Each such emergency operation shall be separately authorized.

610. Fueling Facilities. Facilities for fueling at elevated heliports shall comply with the following:

611. The fuel storage, piping and dispensing system shall comply with the requirements of Flammable and Combustible Liquids Code (NFPA No. 30-1972) and with applicable portions of Parts I-V herein in addition to any special requirements of this Part.

612. The entire system shall be designed so that no part of the system will be subjected to pressures above its allowable working pressure.

613. The fuel storage system shall be located at or below ground level.

614. Pumps.

a. Pumps shall be located at or below ground level. Relay pumping is prohibited.

b. Pumps installed outside of buildings shall be located not less than 5 feet from any building opening. They shall be substantially anchored and shall be protected against physical damage from collision.

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†See Standard on Roof-top Heliport Construction and Protection, NFPA No. 418-1973.

c. Pumps installed within a building shall be in a separate room with no opening into other portions of the building. The pump room shall be adequately ventilated. Electrical equipment shall conform to the requirements of the National Electrical Code (NFPA No. 70; ANSI C1).

615. Piping above grade shall be steel and, unless otherwise approved by the authority having jurisdiction, shall be suitably cased or shall be installed in a duct or chase. Such piping duct or chase shall be so constructed that a piping failure will not result in the entry of fuel liquid or vapor into the building. All piping casings, ducts and/or chases shall be suitably drained. Piping shall be substantially anchored and shall be protected against physical damage for a height of at least 8 feet above the ground. An isolation valve shall be installed on the suction and discharge piping of each pump. In addition, a check valve or other anti-reverse flow device shall be installed at the base of each fuel piping riser to automatically prevent the reverse flow of the fuel into the pump room in the event of pump seal failure, pipe failure, etc.

616. Overwing nozzles shall conform to Paragraph 419.c. in Part IV herein. A nozzle bonding cable shall be provided in accordance with Paragraph 221.c. of Part II herein.

617. Underwing nozzles shall conform to Paragraph 419.d. in Part IV herein.

618. Facilities shall be provided for grounding the helicopter in compliance with Section 220 of Part II herein. The piping of the fuel dispensing system shall not be used for this purpose.

619. Each fuel dispensing hose shall have a fail-safe deadman controlled fuel shutoff in conformance with Paragraph 532.b. of Part V herein.

620. Emergency Control Stations.

621. A system to completely shut off the flow of fuel in an emergency shall be provided. The system shall shut off the fuel at the grade level.

622. At least two emergency shutoff stations, adequately separated, shall be provided on the operating area. An additional emergency shutoff station shall be at grade level, near but at least ten feet from the pumps.

***623.** Each emergency shutoff station shall be placarded "EMERGENCY FUEL SHUTOFF" in letters at least two inches

high. Method of operation shall be indicated by an arrow or by the word "PUSH" or "PULL", as appropriate. Any action required to gain access to the shutoff device (e.g., "BREAK GLASS") shall be clearly shown. Lettering shall be on a background of a contrasting color for ready visibility. Placards shall be weather resistant. Placards on the operating deck shall be at least seven feet above the deck and located so that they can be readily seen from the fueling area.

624. All heliport personnel shall be trained in the operation of the emergency shutoff controls.

625. The emergency shutoff controls shall be in addition to the normal operating controls for the pumps.

630. Fire Protection. In addition to the fixed fire protection required by the referenced document in Paragraph 601.c., the following portable fire equipment shall be provided:

a. At elevated heliports having facilities for fuel servicing at least two 20-B:C dry chemical extinguishers and at least one 160-B:C dry chemical extinguisher shall be provided on the landing area.

b. At the remote emergency station near the pumps an additional 20-B:C dry chemical extinguisher shall be provided.

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Appendix A

Additional Recommendations and Explanatory Material — Standard for Aircraft Fuel Servicing

Numbered Paragraphs refer to the text in Parts II–VI of the Standard

A-201. Defueling and Draining of Aircraft Fuel Tanks/Systems. Defueling operations are similar to fueling operations and present approximately the same fire hazards. Draining operations present greater fire hazards because the procedures are more difficult to accomplish and because drainage provisions are seldom convenient. Normally, initial drainage will be accomplished by suction with a hose inserted at the fuel tank filler neck utilizing pumping equipment. Following this, remaining liquid must normally be drained from the fuel piping system, most often from the sumps or central valves in the system. Final draining is normally done with temporary pipe or hose connected into vented drums or covered containers. The necessity for providing static bonds at points of possible spark gap where flammable vapors may be present is obligatory despite the relatively small amounts of fuel and slow rates of delivery experienced in this draining operation. Variations between different types of aircraft preclude the establishment of standard procedures but the same principles apply in all cases.

NOTE: See Section 460 of NFPA Recommendations on Safeguarding Aircraft Fuel System Maintenance (No. 410C) for further information on fuel transfer equipment and operations.

A-211. Handling Fuel Spills. In the event of a fuel spill the following actions may be appropriate although each spill will have to be treated as an individual case because of such variables as the size of the spill, type of flammable or combustible liquid involved, wind and weather conditions, equipment arrangement, aircraft occupancy, emergency equipment and personnel available, etc.

a. Stop the Flow of Fuel if Possible. If the fuel is discovered leaking or spilling from fuel servicing equipment or hoses, operate the emergency fuel shutoff at once. If the fuel is discovered leaking or spilling from the aircraft at the filler opening, vent line or tank seams during fueling operations, stop fueling immediately. Evacuation of the aircraft should be ordered when necessary. The aircraft must then be thoroughly checked for damage or entrance of flammable liquid or vapors into any concealed wing or fuselage area before being placed in normal operational service.

b. Notify the Fire Department if the spill presents a fire hazard. The only normal exceptions are for small spills. As required in Paragraph 211, supervisory personnel should be notified to

assure that operations in progress may either be continued safely or halted until the emergency is past and that corrective measures can be taken to prevent recurrence of a similar accident.

c. Small Priming Spills involving an area less than 18 inches in any dimension are normally of minor consequence although ramp personnel manning ramp fire extinguishers during start-up procedures should stand by until the aircraft is dispatched. Occasionally such small spills will ignite from engine exhaust sparks or heat but the amount of fuel is so small as not to require application of an extinguishing medium unless the spill is in close proximity to ramp personnel or equipment which might be endangered.

d. Other Small Spills of not over 10 feet in any dimension or not over 50 square feet in area and not of a continuing nature should have a fire guard posted. The fire guard should be provided with at least one ramp fire extinguisher having a rating as described in Paragraph 287.a. If the spill is not ignited, either absorbent cleaning agents (such as diatomaceous earth) or emulsion compounds or rags may be used to absorb the spilled fuel. The use of absorbent cleaning agents or emulsifiers is preferred to rags as they can be applied with less personnel hazard. This is particularly true in the case of spills of aviation gasoline and similar low flash point fuels. Contaminated absorbents and fuel soaked rags should be placed in metal containers with self-closing lids until they can be disposed of by burning at a safe location. An exception to this method may be authorized if the spill occurs in an area where no operations are in progress or will be conducted until ample opportunity is provided for volatile fuels to evaporate harmlessly. In such an event, the area should be roped off to prevent unauthorized entry. Fuels that will not evaporate in air readily (such as kerosine) must be removed by one of the methods indicated above and note should be taken of the fact that some types of ramp surfacing are adversely affected by liquid fuel contact.

e. Larger spills of over 10 feet in any dimension and over 50 square feet in area or of a continuing nature normally require handling by the airport fire brigades or local fire department. They should be summoned immediately. Anyone in the spill hazard area should leave it at once. Only general guidance can be given, but the following procedures should be considered in the event of this type of spill following the alerting of the responsible fire brigade or department.

(1) It may be necessary to evacuate the aircraft if the spill is such as to pose a serious fire exposure to the aircraft or its occupants. Do not permit anyone to walk through the liquid area of the fuel spill. If any person has been sprayed with fuel or had his

clothing soaked with fuel, he should go to a place of refuge, remove his clothing and wash his body. Individuals whose clothing may be ignited should be told or forced to roll on the ground or be wrapped in flame smothering blankets to aid in the extinguishment of any such clothing fires.

(2) Mobile fueling equipment and all other mobile equipment should be withdrawn from the area or left "as is" until the spilled fuel is removed or made safe. No fixed rule can be made as fire safety will vary with circumstances. "Shutting down" equipment or moving vehicles may provide a source of ignition if no fire immediately results from the spillage.

(3) Neither any idle aircraft nor any idle automotive or spark producing equipment in the area should be started before the spilled fuel is removed or made safe. If a vehicle engine is running at the time of the spill, it is normally good practice to drive it from the hazard area unless the hazard to personnel is judged too severe. Fuel servicing vehicles in operation at the time of the fire should not be moved until a check is made that any fuel hose which may have been in use or connected between the vehicle and the aircraft is safely stowed.

(4) If any aircraft engine is operating at the time of the spill, it is normally good practice to move the aircraft from the hazard area unless air currents set up by operating power plants would aggravate the extent or the nature of the vapor hazard existing.

(5) If circumstances dictate that operating internal combustion engined equipment within a spill area which has not ignited should be "shut down," engine speeds should be reduced to "idle" prior to cutting ignition in order to prevent backfire.

(6) The volatility of the fuel may be a major factor in the initial severity of the hazard created by a spill. Aviation gasoline and other low flash-point fuels at normal temperatures and pressures will give off vapors which are capable of forming ignitible mixtures with the air near the surface of the liquid, whereas this condition does not normally exist with kerosine fuels (JET A or JET A-1) except where ambient temperatures are in the 100°F range and/or the liquid has been heated to a similar temperature.

(7) Spills of aviation gasoline (Avgas) and low flash point turbine fuels (JET B) greater than 10 feet in any dimension and covering an area of over 50 square feet or which are of a continuing nature should be blanketed or covered with foam. The spills should then be washed from critical areas with water and allowed to evaporate before the site is again used for normal operations. The nature

of the ground surface and the exposure conditions existing will dictate the exact method to be followed. Such fuels should not normally be washed down sewers or drains unless no alternative is available or unless exposure conditions are such that this would obviously be the safest procedure. If such action is taken, the decision to do so should be restricted to the chief of the airport fire brigade or the fire department. If fuels do enter sewers, either intentionally or unintentionally, large volumes of water should be introduced to flush such undergrounds as quickly as possible to dilute, to the maximum possible extent, the flammable liquid content of the underground. Normal operations involving ignition sources (including aircraft and vehicle operations) should be prohibited on surface areas adjacent to open drains or manholes from which flammable vapors may issue due to the introduction of liquids into the sewer system until it can be established that no flammable vapor air mixture is present in the proximity.

NOTE: See NFPA Standard on Aircraft Fueling Ramp Drainage (No. 415) for further information on aircraft fueling ramp drainage designs to control the flow of fuel which may be spilled on a ramp and to minimize the resultant possible danger therefrom.

(8) Spills of kerosine grades of aviation fuels (JET A or JET A-1) greater than 10 feet in any dimension and covering an area of over 50 square feet or which are of a continuing nature and which have not ignited, may be blanketed or covered with foam if there is danger of ignition. If there is no danger of ignition, an absorbent compound or an emulsion type cleaner may be used to clean the area. The emulsified residue can be safely flushed away with water. Kerosine does not evaporate readily at normal temperatures and must be cleaned up. Smaller spills may be cleaned up using an approved, mineral-type, oil absorbent.

(9) With either type of fuel it may be possible to wash the fuel with water spray nozzles to a safe location, but caution should be used since ground surface contamination is normally of considerable concern in the proximity of aircraft operations.

(10) Aircraft on which fuel has been spilled must be thoroughly inspected to assure that no fuel or fuel vapors have accumulated in flap well areas or internal wing sections not designed for fuel tankage. Any cargo, baggage, express, mail sacks or similar items that have been wetted by fuel should be decontaminated before being placed aboard any aircraft.

A-220. Static Reference. For detailed information on static electricity see NFPA Recommended Practice on Static Electricity (No. 77) published in Volume 9 of the National Fire Codes and in separate pamphlet form.

A-221.b. Aircraft Structural Bonding: The bonding connection recommended herein assumes that all adjoining aircraft structural (plate) surfaces of metal covered aircraft are bonded so that a single point bond will satisfactorily equalize all static charges on adjoining surfaces.

A-221.d. Static Bonding. The bond between the nozzle and the aircraft is most essential and is to be maintained throughout the fueling operation — until after the fuel tank filler cap has been closed.

A-221.d.(2) Purposes of Static Bonding and Grounding. During overwing fuel servicing operations, the almost unavoidable presence of flammable vapors in the air in the immediate proximity of open fuel intakes may create a fire hazardous condition. Any leakage or spillage increases the area of the hazard. Protection against electrostatic spark ignition of such flammable vapor-air mixtures as may be created at fuel intakes during this fuel servicing necessitates control over the accumulation of such charges and good practice dictates the draining of any electrostatic charges that have accumulated on the aircraft or the fuel dispenser. A bonding cable between the fueling nozzle and the airframe (as shown in Figure A-221.d.) will minimize the possibility of a static spark at the fill opening. With *underwing* servicing, the fill opening is closed until the filler nozzle is properly connected. The mechanical metal-to-metal contact between the aircraft fitting and the nozzle eliminates the need for a separate bonding connection at this point.

A-224. Exception on Certain Terrains. On ice, sandy, or desert terrain, reliance is placed on equalizing rather than draining static charges that may accumulate on the aircraft, fuel dispenser, fuel hose and nozzle. It is important that objects possessing different electrostatic potentials not be brought into contact with this equipment in a manner which may produce a spark gap in the proximity of a flammable vapor-air atmosphere.

A-225. Funnels and Filters. Ordinary plastic funnels or other non-conducting materials can increase static generation. The use of chamois as a filter is extremely hazardous.

NOTE: See also Section 540 on the importance of electrostatic bonding of filter separators.

A-226.a. Bonding Cables. If a protective covering is provided on bonding cables to minimize the danger of hand injury, it may be loose fitting or bonded to the cable during manufacture. Preformed cable reduces the risk of hand injury without requiring a covering.

A-226.c. Bonding Cable Maintenance. Bonding cables should be checked for electrical continuity at least monthly.

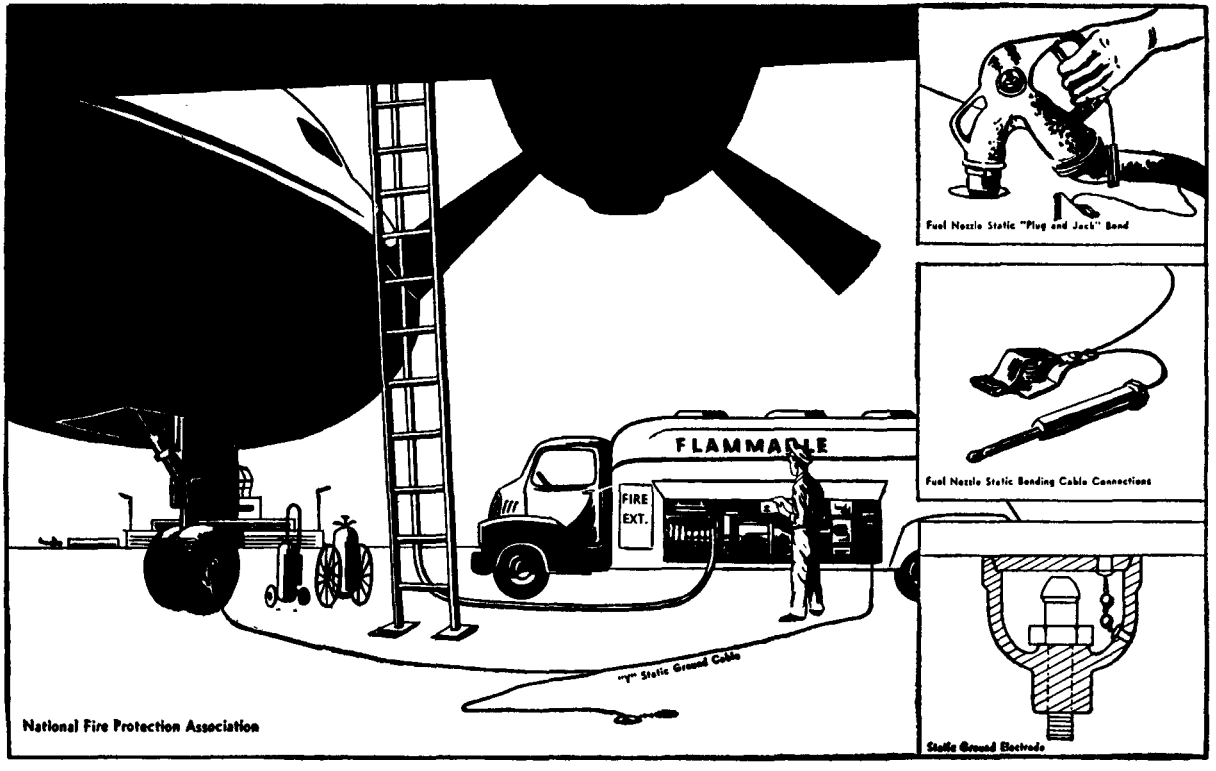

Figure A-221.d. A typical over-the-wing fuel servicing operation from an aircraft fuel servicing tank vehicle showing static grounding and bonding recommendations and certain other details.

A-226.d. Grounding Electrodes. Grounding electrodes, consisting of pipes or rods ½-inch to ¾-inch in diameter, of galvanized iron, steel or copperweld steel, driven into the ground to reach below the permanent ground moisture level (normally 6 feet long) are customarily used. The top of the rod should be level with the surface of the apron or ramp, with a dished out area around the rod for attachment to the leads. Flush type terminal fittings which minimize tripping hazards are available. Since the conductivity of the soil varies in different locations, due principally to the moisture content of the soil, it may, in certain locations, be necessary to employ ground rods longer than 6 feet in length. Tie down bolts imbedded in concrete ramps have sometimes been found to be satisfactory as grounding electrodes, but when using this type of ground the connection shall be made to the *eye bolt*, not the tie down ring, and all such eye bolts shall be tested initially (and yearly thereafter, preferably during dry seasons) to assure that they actually do constitute a satisfactory grounding medium. Driven electrodes do not need to be tested periodically after having been installed and after having met the resistance criteria stipulated in Paragraph 226.e.

A-226.e. Methods of Measuring Resistance to Ground. There are several methods of measuring the resistance to ground of buried metallic structures. Two satisfactory methods are:

(1) The first method is to connect a 24 volt aircraft battery in series with the ground electrode to be measured, a multi-range ammeter and a buried metallic structure such as a water pipe. The resistance of the water line will be so small in comparison with the resistance of the ground electrode, that for all practical purposes the total circuit resistance can be considered to be the resistance of the latter. All connections should be cleaned thoroughly (filed) to assure a good metal-to-metal contact. The circuit resistance can readily be determined by reading the battery voltage and the milliamperes flowing in the circuit.

Thus $R = \frac{1000E}{I}$

where R is in ohms
E in in volts
I is in milliamperes

Since there will be, in general, a potential difference between the ground electrode and the water pipe (usually from 0.15 to 0.60 volt), a reading should be obtained and then a second reading with the polarity of the battery reversed should be recorded. An average of these two readings will give approximately the correct reading.

(2) The second method requires three sets of readings to be taken between three ground electrodes. Let R_1 = resistance of first electrode in ohms; R_2 = resistance of second electrode in ohms; and

R_3 = resistance of third electrode in ohms. Then measuring the resistance between all 3 pairs of the three electrodes as outlined in the first method there results: $R_1 + R_2 = A$; $R_1 + R_3 = B$; $R_2 + R_3 = C$, where A, B and C are the calculated values of $\frac{I}{1000E}$ for the three pairs respectively.

Solving the above simultaneous equations there results —

$$R_1 = \frac{A + B - C}{2} \qquad R_2 = \frac{A + C - B}{2} \qquad R_3 = \frac{B + C - A}{2}$$

Inaccuracies arise in the above mentioned methods due to stray currents, polarization, and back emfs. However, for the purpose intended, they are sufficiently accurate to recommend their use by maintenance personnel. A higher degree of accuracy could be obtained using A.C. as a source of power; however, this is not normally as readily available on airport aprons as an aircraft battery. Instruments specifically designed to measure ground resistances directly are commercially available.

A-242. Aircraft servicing operations normally require mechanized equipment and it is most often impractical to suspend such operations during fueling. Minimum precautions dictate superior ramp vehicle maintenance (to avoid arcing across vehicle electrical terminals, emission of sparks or backfire flames from exhausts, prevention of vehicle ignition system short circuits, etc.) and schooling of vehicle operators in recognizing potentially hazardous conditions such as fuel spills.

A-252. Aircraft ground power generators should be located as far as practical from aircraft fueling points and tank vents to reduce the danger of igniting flammable vapors (that may be discharged during fueling operations) at sparking contacts or on hot surfaces of the generators.

A-253. Electric hand lamps or flashlights used in the immediate proximity of the fueling operation should be of the type approved for use in Class I, Group D, Division 1 hazardous locations (as defined by the National Electrical Code, NFPA No. 70; ANSI C1).

A-270. The beam from high frequency radar equipment can cause ignition of flammable vapor-air mixtures from inductive electric heating of solid materials or from electrical arcs or sparks from chance resonant conditions. The ability of an arc to ignite flammable vapor-air mixtures depends on the total energy of the arc and the time lapse involved in the arc's duration which is related to the dissipation characteristics of the energy involved. The in-