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FUELING AIRCRAFT ON THE GROUND

Fire Safety Recommendations

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Fifty cents*

NATIONAL FIRE PROTECTION ASSOCIATION
International
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National Fire Protection Association

International

Executive Office: 60 Batterymarch St., Boston 10, Mass.

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes over a hundred and ninety national and regional societies and associations (list on outside back cover) and more than fifteen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

This pamphlet is one of a large number of publications on fire safety issued by the Association including periodicals, books, posters and other publications; a complete list is available without charge on request. All NFPA standards adopted by the Association are published in six volumes of the **National Fire Codes** which are re-issued annually and which are available on an annual subscription basis. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing losses of life and property by fire. All interests concerned have opportunity through the Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

NFPA standards are purely advisory as far as the Association is concerned, but are widely used by law enforcing authorities in addition to their general use as guides to fire safety.

Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

SHOULD is intended to indicate recommendations, or that which is advised but not required.

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters.

Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada and the Factory Mutual Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

Fueling Aircraft on the Ground

Fire Safety Recommendations
NFPA No. 407

Foreword

Active work by the National Fire Protection Association leading towards the development of these recommendations started in 1951. The work followed coordination between the Executive Office of the NFPA and a project undertaken on the same subject by the Air Transport Section of the National Safety Council.

The present text, adopted at the 1955 NFPA Annual Meeting, is the result of extensive meetings of the Sub-Committee and liaison with other interested groups including the Flight Safety Foundation, the American Petroleum Institute, airline operators, airport management groups, tank truck manufacturers and others. It supersedes previous drafts of the proposed and tentative NFPA texts on this subject, including NFPA No. 407-T issued in pamphlet form in June 1954 after action by the 1954 NFPA Annual Meeting.

Much of the interest and controversy which delayed the issuance of these recommendations for four years centered on the technical justification, if any, for static *grounding* (as opposed to static *bonding*) recommendations specified in Article 220 herein. No truly adequate test program has been conducted to establish with certainty the need for this protection up to May 1955 although efforts are continuing to secure facilities and a qualified laboratory to undertake the desired research. The sponsoring Committee recommends, in the interim, that prudent operators follow these standards.

Two continuing projects of the Committee are the development of a Standard on Aircraft Fuel Servicing Vehicles (adopted tentatively at the 1955 NFPA Annual Meeting and published in pamphlet form by the NFPA (identified as NFPA No. 407A-T) and the development of performance specifications on aircraft refueling hose. This latter work will probably result in some changes in Appendix A of this text as printed on pages 407-22 to 407-24 herein during the current year. The hose project is under the sponsorship of a Conference Committee of the NFPA Sub-Committee on Fueling Aircraft.

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*Serving in a personal capacity in accordance with Par. 11-b-2 of the Regulations on Technical Committee Procedure.

Committee Scope Statement

This Committee, along with its affiliated Committees on Aircraft Hangars and Aircraft Maintenance and Storage, is organized to develop and encourage aeronautical fire safety for the purpose of reducing to a minimum the life hazard and the loss of physical property as a result of fires which may occur in aircraft in flight, on the ground, or at time of crash impact.

Sub-Committee on Fueling Aircraft

The following Sub-Committee has been appointed to handle the NFPA recommendations on fueling aircraft on the ground, preventive maintenance on hose and aircraft fuel servicing vehicles (listing corrected to June 1955).

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Part I. General

100. Scope:

101. These recommendations are intended to apply to the fuel servicing of all types of aircraft on the ground. They do not apply to airborne refueling or to fueling of flying boats on the water.

102. Fueling aircraft involves the transfer of flammable liquids under conditions which are often fire hazardous. Operational requirements make it necessary for fueling crews to perform their duties efficiently and quickly under 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. These recommendations are intended to help prevent accidental fuel spills and to eliminate and control fuel vapor ignition sources as far as is presently practicable. It is recognized that there are certain hazards (especially the operation and use of internal combustion engine operated aircraft servicing equipment and ground power generators in close proximity to fueling operations) over which positive control cannot be presently established for practical reasons. Specific cautions are given herein with regard to these hazards.

110. The General Nature of the Fire Hazard:

111. From a fire hazard standpoint, aviation gasoline does not differ radically from ordinary gasoline. Jet fuels require the same safety precautions recommended for aviation gasoline.

112. 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 should therefore be made to prevent fuel spillage which represents the greatest hazard.

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

a. Electrostatic sparks

b. Operating aircraft engines

c. Operating automotive or other internal combustion engine servicing equipment in the vicinity

d. Arcing of electrical circuits

e. Open flames

f. Energy from energized high frequency radar equipment.

114. 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.

Part II. Fueling Recommendations

200. Intent:

201. These recommendations are intended to represent good practice requirements for fire safety in fueling aircraft while on the ground. (See Part I, General)

210. Spill Prevention:

211. Careful operation of fuel servicing equipment in compliance with these recommendations 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, should be investigated as to its cause so that remedial action may be taken. Employees shall report each spill to supervisory personnel. Every spill should be treated as a potential fire source and the spilled fuel removed by one of the methods detailed in Paragraph 212.

212. In event of extensive fuel spills on the ground, a fire guard shall be immediately posted to establish and maintain a restricted area around the spill and to keep unauthorized personnel from entering the area. To insure safe debarking of all passengers following a bad spill, mobile fueling equipment, and all other mobile equipment, in the vicinity which would constitute a fire hazard should be withdrawn or left "as is" until the spill is removed or made safe. No fixed rule can be made on this subject since fire safety will vary with individual circumstances. However, it should be remembered that "shutting down" equipment or moving vehicles may provide the ignition source if no fire immediately results from the spillage. Neither any idle aircraft nor any idle automotive or spark producing equipment in the area of the spill shall be started before the spill is cleaned up. If the vehicle engine is running at the time of the spill it is normally good practice to remove it from the hazard area after being sure that any fuel hose which may be in use or connected between the vehicle and any aircraft is safely stowed.

213. Small spills may be absorbed by rags or oil absorbents. Rags used to absorb spillage should be discarded immediately or placed in closed metal containers. Large spills should be blanketed or covered with foam. They should then be washed from critical areas with water or allowed to com-

pletely evaporate before the site of the spill is again used for normal operations. (The nature of the ground surface and exposure conditions will dictate the method to be followed. Natural drainage of areas where refueling operations take place should be away from properties subject to exposure from any inadvertent fuel spillage.) Fuel should not be washed into sewers or drains. If spillage should enter sewers, adequate flushing should be accomplished at once. The use of carbon tetrachloride on fuel spills in an effort to render the fuel nonflammable is not recommended because it is only partially and temporarily effective and may produce a toxicity hazard.

220. Elimination and Control of Electrostatic Sparks*:

221. Over-the-Wing Fuel Servicing: During over-the-wing 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. (Note: 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. *Bonding* of the fuel nozzle at the tank filler opening should prevent the development of a static charge sufficient to create a spark hazard in the vapor-hazard area around the fill opening. *Grounding* of the aircraft and fuel dispenser, as indicated below, should drain any latent static charges that may not have "bled" to ground through rubber tires.

a. Procedures with Aircraft Fuel Servicing Vehicles: When aircraft fuel servicing vehicles are used for over-the-wing fuel servicing the following specific procedures apply (see Figure 1):

(1). Connect a grounding cable from the vehicle to a satisfactory ground.

(2). Connect a grounding cable from the ground to the aircraft (on landing gear axle or other

*For detailed information on static, see NFPA Static Electricity in Aircraft Operations and Maintenance published in National Fire Codes Vol. VI and in separate pamphlet form.

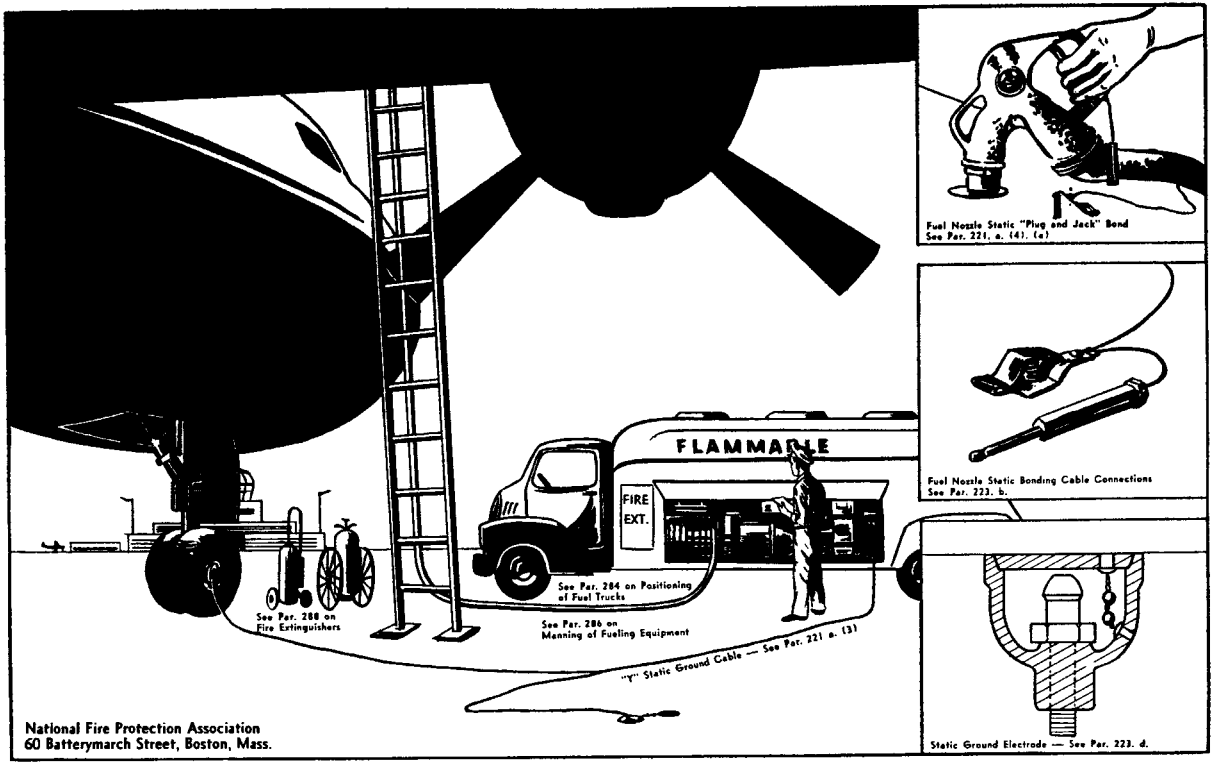

Figure 1. A typical over-the-wing fuel servicing operation from an aircraft fuel servicing vehicle showing static grounding and bonding recommendations and certain other details.

convenient unpainted metal part, excluding propeller or radio antenna).

(3). Connect a bonding cable from the vehicle to the aircraft.†

NOTE: The most practical way of accomplishing Items (1) to (3) is to use a "Y" or "V" cable permanently connected to the vehicle.

(4). Connect a bonding cable from the fuel nozzle to the aircraft.

(a) 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. This bond between the nozzle and the aircraft is most essential and shall be maintained throughout the fueling operation (until after the fuel tank filler cap has been closed).

(b) 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 cap 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).

NOTE: Disconnect in reverse order on completion of fuel servicing.

b. Procedures with Fueling Hydrants, Pits or Cabinets: When a hydrant, pit or cabinet is used for over-the-wing fuel servicing, grounding of the fuel piping is normally provided for in the construction. The procedure to be followed in this case is as follows:

(1). Connect a grounding cable from a satisfactory grounding connection (at the dispenser or elsewhere) to the aircraft.†

†Conductive type fuel hose is not a satisfactory method of accomplishing the procedures outlined and is, therefore, not recommended.

(2). Connect a bonding cable from the fuel nozzle to the aircraft. [Follow same instructions as given in Paragraph 221.a.(4)(a) and (b)].

NOTE: Disconnect in reverse order on completion of fuel servicing.

(3). Where mobile dispensing carts are used in connection with fixed fueling equipment, they shall be grounded as required for conventional aircraft fuel servicing vehicles.

c. 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.a. shall be followed. Gasoline and other low flash point flammable liquids shall not be handled in open buckets.

d. 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 aircraft and the fuel dispenser shall be connected by a bonding cable and the procedures described in Paragraph 221.a. (4). followed. Under these conditions, 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.

e. Procedures Using Chamois Filters: The practice of using chamois should be discouraged as its use is hazardous under any conditions. Where a chamois is used to filter the fuel, an increase in the static hazard results from the passage of fuel through the material. The nozzle, chamois filter and funnel shall be bonded to the aircraft as specified in paragraph 221. a. (4). (b) and the aircraft shall be properly grounded.

f. 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.

222. Under-the-Wing Fuel Servicing: For under-the-wing fuel servicing, the chance of an electrostatic spark ignition of flammable vapors is greatly reduced since the "in-the-wing" fitting is completely closed as is the mating nozzle and "splash filling" is avoided. The fuel does not flow until the complete attachment is made and electrostatic bonding is normally provided in the design of the nozzle and tank fitting. However, grounding and bonding of the aircraft and fuel servicing vehicle as required in Paragraph 221 (except for nozzle-to-aircraft bond) is still necessary.

223. Equipment for Electrostatic Bonding, Grounding:

a. Bonding and grounding cables shall be bare or covered with a loose flexible plastic or rubber covered protective sleeve (transparent or otherwise). Cable shall be of a gauge which will be satisfactory from the durability standpoint (as influenced by mechanical strains and usage). (Speedometer, preformed steel or equivalent cable will minimize danger of employee hand injury where a protective sleeve is not employed.)

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 monthly thereafter. As low a resistance as possible should be secured and maintained. Continuity of bonding cables may be easily checked with a simple buzzer and dry cell battery (locate spark producing equipment away from hazardous vapor areas).

d. 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 ft. 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 ft. 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. (See also Paragraph 223.f. and Figure 1.)

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

f. As low a resistance as possible should be secured and maintained. 10,000 ohms is a practical recommended maximum when determined by standard procedures.*

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*There are several methods of measuring the resistance to ground of buried metallic structures. Two satisfactory methods that are practical and may be accomplished by relatively inexperienced personnel are given below.

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 is 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 $\frac{1000E}{I}$ for the three pairs respectively.

Solving the above simultaneous equations there results —

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

(Footnote continues next page.)

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

230. Aircraft Engines and Heaters:

231. Fuel servicing shall not be done on an aircraft until the aircraft's engines (or engine) have been stopped (ignition OFF).

232. Aircraft combustion heaters shall not be operated during fueling operations.

240. Safeguards Against Hazards Incident to Automotive Equipment Operation:

241. No vehicles, other than those performing aircraft servicing functions, shall 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. [Aircraft servicing normally requires 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

(Footnote continued from previous page.)

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.

†For industrial tractors see NFPA Standards for the Use, Maintenance and Operation of Industrial Trucks (NFPA No. 505); for other vehicles, see NFPA Truck Fire Protection (NFPA No. 512); both published in National Fire Codes Vol. VI and in separate pamphlet form.

backfire flames from exhausts, prevention of vehicle ignition system short circuits, etc.) and schooling of vehicle operators in recognizing potentially hazardous conditions such as spills.]

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. 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 hot surfaces of the generators. Ground power generators shall not be placed under wings or just 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 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*).

254. No electric tools, drills, buffers or similar tools likely to produce sparks or arcs shall be used during fueling operations.

255. Aircraft electrical switches which control units in wing or tank areas should not be operated during fueling operations except in an emergency.

256. Photo flash bulbs shall not be used in the immediate vicinity of the aircraft during fuel servicing.

257. Electrical equipment in fuel pits shall be of the type approved for Class I, Group D, Division 1 hazardous locations (as defined by the National Electrical Code, NFPA No. 70*).

NOTE: See also Section 240 for internal combustion engine equipment which may have electrical sparking hazards.

*Published in National Fire Codes, Vol. V and in separate pamphlet form.

260. Elimination of Open Flames:

261. No open flames or lighted open flame devices shall be permitted within 50 feet of aircraft undergoing fueling, including:

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

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

c. Welding or cutting torches, blowtorches, etc.

d. Flare pots or other open flame lights.

262. "Strike-anywhere" matches and cigarette lighters shall not be permitted on persons engaged in fueling operations.

270. Control of High Frequency Radar Equipment:

271. High frequency radar equipment mounted in the aircraft being fueled shall not be operated during fueling.

280. Additional Precautions:

281. Fueling Location: All aircraft fuel servicing shall be done outdoors at least 50 feet from any building to minimize the danger of ignition of flammable vapors discharged during fueling operations by sources of ignition likely to exist in such buildings.

282. Outage Space: Fuel expansion space should be left in each aircraft fuel tank to prevent overflow in event of temperature increase. A three per cent outage space is recommended. (Fuel expansion is at the rate of about one per cent for each 14°F. of temperature rise.)

283. Concurrent Operations: During fueling operations, no aircraft maintenance shall be conducted which will provide a source of ignition for fuel vapors.

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 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 aircraft fuel serv-

icing vehicles before operators leave the cab to service an aircraft. Aircraft fuel servicing vehicles and other gasoline or electric powered vehicles or equipment shall not be positioned under the trailing edge of the wings or located so that in event of spillage the fuel will flow on the equipment. Aircraft fuel servicing vehicles may be positioned under wings only outboard of the outboard engine, in positions where they can be moved promptly without backing and located so that vehicle engines are not under the wing.

285. **Aircraft Occupancy:** If passengers remain aboard an aircraft during fueling, an attendant shall be present at the cabin door and passenger loading steps shall remain in place. A "NO SMOKING" sign shall be displayed in the cabin and the rule enforced. Food and cabin servicing may be done during fueling but care should be taken to prevent dangerous blocking of cabin egress facilities if the aircraft is occupied. The attendant should promptly notify fueling personnel if fuel vapors are detected in the passenger compartment or of any condition which might be a potential hazard. Upon such notification, fueling should be stopped until the condition is corrected.

286. **Manning of Fueling Equipment:** Adequate manpower shall be constantly available to quickly shut off the flow from the servicing equipment (vehicles, hydrants, pits or cabinets) in an emergency. Fuel nozzles used in over-the-wing fueling hose assemblies shall be designed so that the nozzle will close and the flow of the fuel will stop when the hand of the operator is removed; blocking nozzles in an open position even momentarily shall be prohibited. Only competent and qualified operators shall be permitted to operate the equipment (see Paragraph 401). It is recommended that other aircraft servicing personnel be trained in the operation of emergency fuel shutoff controls in the event of a spill or other hazardous condition. Kinks and short loops in the fueling hose should be avoided. The fuel nozzle should never be allowed to drag along the ground. The hose should not be stretched with the complete weight of the hose off the ground as this places extra strain on the nozzle coupling.

287. **Lightning Storms:** Extreme caution should be used in fueling during lightning and electrical storms. Operations shall be suspended during severe disturbances.

288. **Fire Extinguishers:*** Class "B" fire extinguishers of both the quick smothering and final blanketing types are

*See footnote next page.

desirable. The amount of hand extinguishing equipment available should be related to the quantity of fuel likely to be spilled due to accidental overflow, hose or coupling failure, etc. and the availability of major fire apparatus (aircraft rescue and fire fighting equipment**) and fixed fire fighting equipment.† Extinguishers providing at least forty-five pounds of carbon dioxide or at least thirty pounds of dry chemical are recommended. All ramp extinguishers should be mounted on mobile carts or be of the wheeled type and at least one such extinguisher shall be located within 100 feet of each fueling location (closer if weather conditions or ramp traffic would handicap movement of extinguishers in an emergency). Where hose reel fire protection equipment is installed for ramp fueling protection, this type protection is preferred to portable extinguishers if adequately supplied from bulk cylinder or tank sources and is particularly recommended where fuel dispensing is at a rate in excess of 100 gallons per minute. Such fixed equipment, however, only replaces the type of hand extinguisher supplying the same extinguishing agent.

*For detailed information on fire extinguishers, see NFPA Standards for the Installation, Maintenance and Use of First Aid Fire Appliances (NFPA No. 10) published in National Fire Codes Vol. IV and in separate pamphlet form.

**For detailed information on aircraft rescue and fire fighting equipment, see NFPA Suggested Aircraft Rescue and Fire Fighting Equipment for Airports (NFPA No. 403) published in National Fire Codes, Vol. VI and in separate pamphlet form.

†For detailed information on airport fixed fire fighting equipment, see NFPA Standards on Aircraft Hangars (NFPA No. 409) published in National Fire Codes Vol. VI and in separate pamphlet form.

Part III. Defueling Recommendations

301. 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 shall be done with temporary pipe or hose connected into vented drums or covered containers.

302. The safeguards listed herein for electrostatic bonding and grounding during fueling apply equally during defueling. The necessity for providing static bonds at such points of possible spark gap where flammable vapors may be present remains obligatory despite the relatively small amounts of fuel and slow rates of delivery experienced in this draining operation.

303. Variations between different types of aircraft preclude the establishment of standard procedures but the same principles apply in all cases.