NFPA No.

403

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Suggestions for

AIRCRAFT RESCUE and FIRE FIGHTING SERVICES for AIRPORTS and HELIPORTS

May

1961

One Dollar*

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NATIONAL FIRE PROTECTION ASSOCIATION

International

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National Fire Protection Association

International

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection. Its membership includes national and regional societies and associations (list on outside back cover) and over eighteen thousand individuals, corporations, and organizations. Anyone interested may become a member; the annual dues are $15.00. Full membership information is available on request.

This is one of a large number of publications on fire safety issued by the Association. All NFPA standards and recommended practices, including this text, are prepared by the technical committees of the NFPA and adopted at an Annual Meeting of the Association. They are intended to prescribe reasonable measures for minimizing losses of life and property by fire.

This text and most other NFPA standards and recommended practices are published in the **National Fire Codes,** a compilation of NFPA's official technical material, issued in seven clothbound volumes. Full information on the availability of these Codes and other NFPA publications can be secured from the Association.

Official NFPA Definitions

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. One foot = 0.3048 meters. One inch = 25.40 millimeters. One pound per square inch = 0.06805 atmospheres = 2.307 feet of water.

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Suggestions for
Aircraft Rescue and Fire Fighting Services for Airports and Heliports

NFPA No. 403 — May 1961

These "Suggestions," prepared by the NFPA Sectional Committee on Aircraft Rescue and Fire Fighting and submitted to the Association through the NFPA Committee on Aviation, were adopted by the Association at its Annual Meeting in May 1961. This edition supersedes all previous editions of NFPA No. 403.

History

Committee work leading to the development of these recommendations by the Association commenced in 1947 following a request from the Civil Aeronautics Board (U.S.A.) for information on what constituted "adequate" ground fire fighting equipment and personnel for airports served by scheduled air carrier aircraft. During the same year a working party, organized under the auspices of the International Civil Aviation Organization, met in Montreal and drafted a paper on "Crash Fire and Rescue Equipment at Aerodromes."

NFPA Committee work continued during 1948 and in 1949 the Association adopted a tentative text at its Annual Meeting held in San Francisco, California. At the time of its tentative adoption, representatives of the Airport Operators Council and the American Association of Airport Executives presented formal resolutions objecting to certain portions of the text. During 1949 and 1950 further meetings were held during which time the airport management groups were invited to participate. In 1951 a revised text was submitted for final adoption by the Association, and unanimously accepted.

Meanwhile, in June, 1948, the International Civil Aviation Organization distributed ICAO Circular 4 — AN/3 which contained the recommendations of their working party mentioned previously. In February 1955, the ICAO reproduced the 1954 editions of this text and NFPA No. 402 in ICAO Circular 41 — AN/36. During December 1956, the International Civil Aviation Organization (ICAO) sponsored a meeting of a specially constituted international "Panel on Aircraft Rescue and Fire Fighting Services at Aerodromes" to develop "specifications or further guidance material" on the subject (see Appendix C, Paragraphs C-139, 144 and 204). The Third Edition (September 1958) of Annex 14, Aerodromes, as amended, contains the official text of the ICAO recommendations (see Appendix C, Paragraph C-202).

Since its original adoption in 1951, this text has been revised eight times (in 1954, 1955, 1956, 1957, 1958, 1959, 1960 and in this 1961 edition).

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Changes in 1961 Edition

This 1961 edition of NFPA No. 403 differs from that published in 1960 only by the addition of the "Notes" following Paragraph 321.a. (pages 403–26) and editorial changes to bring the current edition up to date.

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Aircraft Rescue and Fire Fighting Services for Airports and Heliports

Table of Contents

Suggestions for

Aircraft Rescue and Fire Fighting Services for Airports and Heliports

NFPA No. 403

Article 100. Introduction

110. Application

111. This material pertains solely to aircraft rescue and fire fighting services for airports and heliports. This material does not include fire protection facilities for airport structures (*i.e.*, hangars,* shops, terminals, other airport buildings, etc.) although the services suggested herein might constitute valuable fire protection for such structures and their contents in many instances. Vehicles designed for aircraft rescue and fire fighting services at airports are specialized pieces of equipment. Attempts to incorporate additional features useful *only* for structural fire fighting may result in compromises which would be undesirable.

112. Heliports designed *exclusively* for the handling of rotary aircraft operations are generally limited in area and need to be separately evaluated as regards rotary aircraft rescue and fire fighting services. Heliports may be located at ground level, on platforms constructed specifically for the purpose or on the roofs of buildings. The degree of fire protection suggested depends on the type of rotary aircraft using the heliport, the potential life hazards involved and the nature of the operations conducted at the heliport. Heliport aircraft rescue and fire fighting services and information on rotary aircraft rescue and fire fighting problems are contained in Paragraphs 216, 252, 316, and Table No. 2.

120. Type of Aircraft Operations Safeguarded

121. The threat of fire is ever present and may occur at any time when an aircraft is involved in either operational or servicing accidents. Experience has shown that severe problems of

*See Appendix C References for a bibliography of helpful information on the subject, particularly C-101.

rescue are encountered when fire occurs incident to operational accidents. Fire is especially apt to occur immediately following ground impact in operational accidents (but may occur at any time during rescue operations) because of the nature of the aircraft fuel and lubricants used, the latent heat of operating aircraft engines, exhaust flames and hot gases, the possibility of sparks being created through disturbance of electrical circuits or from friction, or the discharge of accumulated electrostatic charges at time of ground contact.* The outstanding characteristic of aircraft fires is their tendency to reach lethal intensity within a very short time after outbreak. This not only handicaps rescue efforts but also presents a severe hazard to the lives of those involved in the accident and anyone attempting their rescue.

130. Location of Accidents

131. The possibility of aircraft accidents is constantly present throughout the extent of air routes. The accident potential is greatest, however, on the movement areas of airports or heliports or in their immediate vicinity due to the concentration of air traffic, letdown, landing, taxiing, take-off, fueling, and maintenance operations†. For this reason, the provision of special means to deal with incidents on and in the immediate vicinity of such movement areas is of primary importance. It is within such limits that there are the greatest opportunities of saving life and property.

140. Nature of Suggestions

141. These suggestions are designed to give guidance on the amount and type of services considered helpful to provide aircraft rescue and fire fighting protection at civil airports and heliports. The aeronautical terminology used is defined in Appendix A.

150. Administrative Control

151. Aircraft rescue and fire fighting on the movement area of an airport should be under the administrative control of airport management *except* where the aircraft rescue and fire fighting services at airports are organized as a part of a municipal (or

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*See Appendix C References for a bibliography of helpful information on the subject, particularly C-106 and C-158.

†See Appendix C, Reference C-152.

similar regional) fire service and are thus under the *direct* administrative jurisdiction of the Chief of the municipal (or similar regional) Fire Department. Under the latter conditions close liaison with airport management is essential to integrate fire department and aircraft operations to assure effective and safe response of emergency equipment on the movement area of the airport.

152. Where aircraft rescue and fire fighting services are not under the direct administrative jurisdiction of the Chief of a municipal (or similar regional) fire service, airport management should exercise administrative control whether such management is a governmental agency, a private corporation or an individual, and irrespective of how the aircraft rescue and fire fighting services are financed and/or organized. Airport management should also have administrative duties in connection with aircraft rescue and fire fighting services within the reasonably accessible environs of the airport movement area *where* there is no conflict with the administrative jurisdiction of suitably organized and equipped municipal (or similar regional) fire services.

153. Regardless of the administrative control of aircraft rescue and fire fighting services on the airport, a prearranged high degree of mutual aid (joint defense measures) is desirable between such services on airports and any municipal (or similar regional) fire or rescue agencies serving the environs of the airport. An "area emergency plan" is desirable and airport management should encourage and offer instruction to cooperating agencies on the special problems and techniques associated with aircraft rescue and fire fighting.

Article 200. Basis for Suggestions

210. Airport Reference Index

211. To provide a generally applicable index useful in determining the suggested amounts of fire extinguishing agents for aircraft rescue and fire fighting to be available at airports, aircraft (other than rotary types) are grouped as indicated below:

Reference Index	Aircraft Maximum Take-off Weight Ranges	Approximate Aircraft Fuel Capacity Ranges†	Normal No. of Aircraft Occupants*
1	Under 3,000 lbs.	Under 70 gals.	1 to 4
2	3,000 to 6,500 lbs.	70 to 150 gals.	4 to 6
3	6,500 to 15,000 lbs.	150 to 500 gals.	5 to 10
4	15,000 to 30,000 lbs.	500 to 1,000 gals.	10 to 25
5	30,000 to 60,000 lbs.	1,000 to 2,000 gals.	25 to 40
6	60,000 to 90,000 lbs.	2,000 to 4,000 gals.	40 to 70
7	90,000 to 120,000 lbs.	4,000 to 6,000 gals.	60 to 100
8	120,000 to 200,000 lbs.	5,000 to 7,500 gals.	70 to 110
9	Over 200,000 lbs.	Over 7,500 gals.	Over 90

212. This Reference Index is used in Tables No. 1-A and 1-B (see Article 300) to establish the suggested quantities of extinguishing agents for aircraft in the various weight ranges indicated. Rotary aircraft are separately treated (see Paragraph 216).

213. All aircraft do not conform precisely to the above characteristics in the weight groupings indicated, but they do apply generally (see Appendix B Articles B-100 through B-900). Similarly, all aircraft which conform to the characteristics in the weight groupings do not have identical crash impact fire dangers. (For example, aircraft with fuel cells well segregated from ignition sources and with properly designed plumbing generally have less impact fire dangers than other aircraft in the same category which lack this design feature. Similarly, rescue oppor-

†U. S. gallons are used in this table.

*Special attention needs to be given to aircraft which have so-called "high density" seating. This is most frequently found in "air coach" type aircraft. Airports served frequently by aircraft employing this "high density" seating should give special consideration to the problems presented in the evacuation and rescue of occupants who may be involved in an aircraft accident (see Appendix B Article B-1000 for further data on "high density" seating).

tunities in aircraft in a given weight category may vary with the nature of the exit facilities provided.) The utility of this index is thus subject to discriminating use until experience makes possible more accurate definition of rescue and fire fighting requirements based on actual impact fire hazard characteristics of individual aircraft, and, as applicable, of individual models of the same aircraft.

214. The chief purpose of providing aircraft rescue and fire fighting services is to save the lives of the passengers and crew. It is often necessary, particularly in transport category aircraft, to effect complete control or extinguishment of the fire in the fuselage area to ensure such rescue. The services suggested herein are based upon this concept.

215. The validity of the index in Paragraph 211 should be checked by an analysis of information obtainable locally from aircraft operators as to actual aircraft in use. Such an assessment should consider basically the rescue problem — the number of persons liable to be involved, the aircraft entry and exit facilities, the emergency exit equipment available and an analysis of the inherent aircraft fire hazards as they may affect safe evacuation or rescue.

216. Rotary aircraft do not fit the criteria given in Paragraph 211 because of their particular configuration. Severe life hazards from fire may exist in accidents because the fuel supply is normally located in particularly close proximity to the occupied portions of the aircraft and their compact design may result in direct impact shocks causing damage to fuel tankage in event of unintended ground collision or severe malfunctioning of operating rotors. The mitigating circumstances from the life safety viewpoint in rotary aircraft fire incidents are that the carrying capacities of current commercial helicopters are not large and fuel loads are similarly moderate. Current rotary aircraft in civilian service may be divided into three categories for the purposes of these suggestions as indicated in Table No. 2 (see Paragraph 316).

220. Applicability of Index

221. It is not anticipated that the total fuel capacity of each aircraft will be involved in fire following each and every accident. The index in Paragraph 211 merely indicates the relative fire danger from fuel exposure and the total potential fuel capacities which might be involved. While the fuel capacity of an aircraft generally governs the potential magnitude of the fire risk, it should also be clearly understood that lubricating oils, flammable hydraulic fluids, alcohol, combustible fabrics or cargoes, magnesium parts, etc., may provide the initial fuel or contribute significantly to fire spread. Conversely, installed fire protection devices designed to operate on impact may eliminate or lessen the magnitude of the potential fire hazard.

222. The type of aircraft "normally" using an airport should be used as a guide in establishing the protection provided (see Tables No. 1-A, 1-B, and 2).

NOTE: As a practical guide, "normally" is defined, for these purposes by some authorities, as at least 150 aircraft movements a month. Under such a definition, where the number of movements by the heaviest type of aircraft is less than 150 a month, the scale of protection to be provided would be derived by adding to that number, the number of movements of aircraft of lesser weights until the number thereof reaches 150 a month. Under these conditions, the scale of protection to be provided might be that shown by the lowest category reached except that the following guidance is offered: when the total monthly movements do not reach 150 per month or where the result calculated by the method indicated above produces a scale of protection below the following, it is suggested that the protection be calculated as follows:

(a). When the monthly movement rate of the heaviest aircraft is less than 150 but more than 50, the protection should be not less than to the next lowest Index scale.

(b). When the monthly movement rate of the heaviest aircraft is less than 50, the protection should be not less than to the second lower Index scale.

223. Personnel provided to man the aircraft rescue and fire fighting equipment will vary not only with the design of the equipment, the number of units and similar factors, but also with the distribution of the traffic over each 24-hour period and the duty hours of the personnel assigned.

224. The availability of suitably organized and equipped public protective agencies available for assistance and aid to the airport rescue and fire fighting organization should be considered in applying the suggestions herein to a particular airport.

225. Heavy air traffic conditions may indicate the desirability of an increase in the scale of facilities, especially where parallel runways are provided or where runways are widely spaced and exceed 8,000 feet in length.

230. Basis for Equipment

231. In view of the lack of uniformity in the size and type of rescue and fire fighting equipment in use throughout the world, the most convenient means of suggesting a scale of protection is in terms of the amounts and discharge rates of the desired extinguishing agents. In addition, certain objective and functional suggestions are offered for equipment design and operation which may apply to existing or future designs of vehicles. (See Article 300.)

240. Types of Extinguishing Agents

241. In order to establish the types of extinguishing agents suggested for aircraft rescue and fire fighting, it is desirable to consider certain basic principles concerning the various agents available for the purpose. These are summarized in Paragraphs 242 through 246.

242. Water

a. Water is recognized as the best cooling agent universally available for the control of fire and for personnel protection from heat but the ability of water to effect extinguishment is limited on large flammable liquid based fires of the type usually encountered in accidents involving aircraft weighing over 15,000 lbs. gross weight (over 500 gallons (U.S.) of fuel capacity). Therefore, it is not suggested as the sole agent available for this type of fire fighting on airports where accident frequency justifies specialized aircraft fire fighting equipment.*

b. Water spray may be used effectively for the protection of trapped personnel in aircraft accidents involving fire and for the protection of rescue and fire fighting personnel from severe radiant heat conditions and its availability is therefore considered desirable. This is usually entirely practical through the use of adjustable valves and nozzles on equipment designed essentially to dispense foam.

c. The use of straight water streams discharged at high velocity is not considered desirable for aircraft rescue and fire fighting except where it is desired to "sweep" fuel spills from hazardous areas.

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*See Appendix C References, C-102, for suggestions on utilizing conventional fire apparatus and equipment for aircraft rescue and fire fighting.

d. Wetting agents added to water improve its extinguishing efficiency on flammable liquid based fires but care must be exercised to assure compatibility if foam is a supplementary agent.

243. Foam

a. Foam used for aircraft rescue and fire fighting consists of an aggregation of bubbles of lower specific gravity than oil or water possessing tenacious qualities for covering and clinging to vertical or horizontal surfaces. It should be able to cool hot surfaces, flow over a burning liquid surface and form a long lasting, air-excluding blanket that seals off volatile flammable vapors from access to air or oxygen. Good quality foam should be homogeneous, resisting disruption due to wind and draft or heat and flame attack. It should be capable of resealing in event of mechanical rupture of an established blanket. Foam, when applied to the fuselage of an aircraft, insulates, cools and reflects radiant heat, providing protection to occupants. There are two kinds of foam:

(1). Chemical Foam — A foam which is produced by the reaction of an alkaline salt solution (usually bicarbonate of soda) and an acid salt solution (usually aluminum sulphate) to form a gas (carbon dioxide) in the presence of a foaming agent which causes the gas to be trapped in bubbles to form a foam.

(2). Mechanical Foam (Air Foam) — A foam which is produced by the physical agitation of a mixture of water, air and a liquid foam compound.

b. Mechanical foam (air foam) is particularly suited for aircraft rescue and fire fighting because the basic ingredients, water and foam compound, can be carried in bulk to the scene of the accident and brought into operation with the minimum of delay. The most serious limitation of foam for aircraft rescue and fire fighting is the problem of quickly supplying large quantities of foam to the fire in a gentle manner so as to form an impervious fire-resistant blanket on large flammable liquid spills. The hazards of disrupting established foam blankets by turbulence, water precipitation and heat baking can be overcome by firemen's training and the purchase of a good quality of the basic foam ingredient.

c. Mechanical foam (air foam) may be produced in a number of ways. The methods of foam production selected should be carefully weighed considering the techniques of employment best suited to the airport concerned, the rates and patterns of discharge desired and the manpower needed to properly dispense the foam capabilities of the vehicles. The principal methods of foam production in use are:

(1). Nozzle Aspirating Systems. Foam is produced by pumping a proportioned solution of water and foam compound under high pressure into a specialized discharge appliance or nozzle which draws in atmospheric air and mixes it mechanically with the solution. Various devices are used to shape the discharge pattern between a straight stream and a spray.

(2). In-Line Foam Pump Systems. A proportioned solution of water and foam compound is injected at atmospheric or higher pressure into a positive displacement type pump which sucks in atmospheric air and mixes it with the solution to generate foam. The foam is formed in the discharge piping or hose as in the in-line aspirating and in-line compressed air systems. Nozzles serve only to distribute the foam in various patterns.

(3). In-Line Aspirating Systems. An inductor in the pump discharge line receives a proportional solution of water and foam compound under pressure, or water only if the inductor is designed also to draft the correct amount of foam compound. The liquid in passing through the inductor draws in atmospheric air which is mixed with the solution to form foam in the discharge lines. Nozzles serve only to distribute the foam in various patterns.

(4). In-Line Compressed Air Systems. These are similar to in-line aspirating systems except that air under pressure is injected into the solution. The air is supplied by a compressor on the vehicle.

d. Foam is currently applied in two principal pattern configurations, solid stream and dispersed patterns. Normally both methods of application are available using variable nozzles. Training and experience will determine the best method of application under a given set of circumstances. Foam when dispersed in wide, uniformly dispersed patterns (sometimes called "fog-foam" or "snow-foam") is used principally for direct application to a large area of burning fuel or while securing the rescue area. It falls very gently on the surface, giving radiation protection to the fire fighter and cooling and smothering the fire in a short time. Solid streams of foam are used principally for fire situations requiring long distance reach or where the foam may be deflected from a solid barrier to facilitate gentle application. Solid stream foam is not recommended for close-in rescue operations.

e. The quality of water to be used in making foam may affect foam performance. No corrosion inhibitors, freezing point depressants or any other additives should be used in the water supply without prior consultation and approval of the foam compound manufacturer.

244. Carbon Dioxide

a. Carbon dioxide provides a means of quickly "knocking down" flammable liquid fires when applied at a proper rate and in sufficient quantity. It has excellent flooding characteristics and penetrates to otherwise inaccessible areas. It leaves no residue. As atmospheric conditions (particularly wind direction and velocity) may interfere with the smothering effect of carbon dioxide and as the cooling effect may not always be sufficient to prevent reignition of flammable vapors by hot or burning materials, a supplementary cooling and blanketing agent (foam or water) is normally necessary. Fireman's training has a great influence on the effective use of carbon dioxide. When liquid carbon dioxide is discharged to the atmosphere a portion is converted to "dry ice" at minus 110° F.

b. The following subparagraphs define high pressure and low pressure carbon dioxide:

(1). High pressure carbon dioxide is used to indicate that the carbon dioxide is stored in pressure containers at atmospheric temperatures. At 70° F. the pressure in this type of storage is 850 pounds per square inch. High pressure carbon dioxide on airports is preferably limited to portable extinguishers and small cylinder systems used for standby protection on ramps and flight lines but cylinders may be manifolded and used on aircraft rescue and fire fighting vehicles.

(2). Low pressure carbon dioxide is used to indicate that the carbon dioxide is stored in an insulated pressure container at controlled low temperatures, usually at 0° F. At this temperature the pressure in this type of storage is 300 pounds per square inch. Low pressure is used where large storage capacity and high discharge rates are required, as in aircraft rescue and fire fighting operations. The lower liquid temperature and higher discharge rate combine to produce greater cooling effect and longer reach.

c. Carbon dioxide is normally used in aircraft rescue and fire fighting service in one of the following ways:

(1). When foam is the principal agent, carbon dioxide, either high or low pressure, is employed as a supplementary media (usually in relatively small quantities), either initially (before or as foam is being applied) when the fires are in their incipient stages or subsequently to control or extinguish fires in concealed or inaccessible locations, or to check "running" fires. (See Table 1-A in Article 300.)

(2). As a combined agent with foam, low pressure carbon dioxide is applied in large quantities (1,000 lbs. or more) at a minimum discharge rate of 1,000 lbs. per minute. (See also Table 1-B in Article 300.)

245. Dry Chemical

a. Dry chemical provides a means of quickly "knocking-down" flammable liquid fires when applied at a proper rate and in sufficient quantity. It has good "flooding" characteristics and penetrates to otherwise inaccessible areas. It has good shielding effects against radiant heat and good range under normal outdoor conditions. However, particularly during rescue operations, it is necessary to guard against the reignition of flammable vapors. The permanency of extinguishment with dry chemical may also be affected by atmospheric conditions, particularly where air currents or wind conditions are adverse, but firemen's training has a great influence on this contingency. A blanketing agent such as foam should be used to effect adequate cooling and to secure the desired blanket over any flammable liquid spillage. Dry chemical used in conjunction with foam poses some problems of compatibility which vary with the quantities involved and the techniques used.*

b. Dry chemical is normally used in aircraft rescue and fire fighting service in one of the following ways:

(1). When foam is the principal agent utilized, regular dry chemical is employed as a supplementary medium (usually in relatively small quantities) before the foam is applied when the fires are in their incipient stages. Regular dry chemical may also be used subsequently to control or extinguish fires in concealed or

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*Announcements have been made in the United States and other countries of the development of a foam compatible type of dry chemical. Lack of definitive field experience to date prevents making definite suggestions on the use of this type dry chemical at this time.

inaccessible locations, or to check "running" fires where foam is not being used simultaneously. Care must be taken when using regular dry chemical in conjunction with foam to avoid deleterious effects on the foam. Foam compatible dry chemicals are in current development but not in widespread use up to the present time.*

(**2**). Some limited use has been made of large quantities of dry chemical compound (quantities of over 1,000 lbs.) with a rapid rate of application, as a principal agent, especially at extremely cold weather locations. In this application the minimum discharge rate would be 1,000 lbs. per minute. (See also Table 1-B in Article 300.) Experience in this use of the material up to the present time is too limited to establish firm suggestions on the quantities desired and the most satisfactory techniques.

246. Several vaporizing liquid extinguishing agents effective on flammable liquid fires under proper conditions have been proposed for aircraft rescue and fire fighting but their use for this purpose has not been evaluated sufficiently to permit any conclusive suggestion at this time. Experimentation is under way with such agents as chlorobromomethane and certain other halogenated hydrocarbons. Until complete evaluation is made, however, the quantities to be employed in the use of these agents cannot be specifically suggested. When these agents are used, their extinguishing efficiency or effectiveness when used in combination with foam should be at least equal to that of comparable amounts of carbon dioxide within the same time period.

247. The information given in paragraphs 242–246 indicates that no single agent has all the qualities needed to accomplish speedy and permanent extinguishment of all aircraft fires. Foam, applied as discussed in 243.d. is, however, the most effective medium found to date and is therefore the principal extinguishing agent upon which reliance is placed for this service. For further suggestions see Article 300.

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*Announcements have been made in the United States and other countries of the development of a foam compatible type of dry chemical. Lack of definitive field experience to date prevents making definite suggestions of the use of this type dry chemical at this time.

248. The types and quantities of extinguishing media suggested in Tables No. 1-A, 1-B and 2 are based on the conclusions indicated in Paragraph 247.

250. Magnesium Fire Control

251. The presence of magnesium alloys in aircraft structures introduces an additional problem to fire extinguishment in cases where this metal becomes involved in an aircraft fire. None of the agents available for bulk application (see Paragraphs 242–246) is capable of securing positive extinguishment of burning magnesium under all conditions and experience proves that a definite reignition hazard to flammable liquid vapors exists from burning magnesium following almost complete control over other ignited materials. The only practical methods of overcoming this difficulty are: (1) by the removal of the magnesium from the fire area where accessible and identifiable; (2) by the localized application of special magnesium extinguishing agents* or covering with sand or dirt; (3) by cooling with water or foam (this process liable to temporarily intensify flame spread until the application is sufficient to produce the degree of cooling required); or (4) by blanketing the exposed flammable liquids with foam and allowing the magnesium to burn itself out.

252. The form and mass of magnesium in normal airframe components of conventional aircraft is such that ignition does not normally occur until it has been subjected to considerable flame exposure (as from a fire involving aviation fuels or ordinary combustibles). This fact indicates that the problems with magnesium fire control on such aircraft normally occur following, rather than preceding, rescue opportunities. Exceptions include thin forms of magnesium frequently employed in rotary aircraft airframes, powerplant magnesium components which may be ignited by powerplant fires and magnesium wheels or landing gear components which may be ignited following friction heating or brake fires.

253. Magnesium fires attacked in their incipient stages may be controlled under some conditions by the application of special magnesium fire extinguishing agents as indicated in Paragraph 251 but generally where a mass of magnesium becomes involved

*See Appendix C References for additional information on this subject, particularly C-145.

the application of large volumes of coarse water streams provides the best ultimate control method. Attacking magnesium fires this way, however, is undesirable where the primary fire control technique is with foam as the coarse water streams would have the effect of breaking down foam blankets in the area. Thus volume application of foam is indicated during the critical period when flammable liquid spills present the primary hazard with the aim to so cover exposed flammable liquid spills to prevent or eliminate their vapor hazard. Following completion of rescue and all possible salvage, it is, however, frequently advisable to apply coarse water streams to still-burning magnesium components even if the immediate result might be a localized intensification of flame and considerable sparking. In this connection it is sometimes feasible to segregate burning magnesium components from the main fuel spill area with shovels or cranes to permit separate fire control treatment of this material.

Article 300. Suggestions

310. Extinguishing Agent Suggestions

311. Tables No. 1-A and 1-B indicate the quantities of water (for foam production) and the quantity of carbon dioxide or dry chemical that are suggested for aircraft rescue and fire fighting at airports categorized according to aircraft weight groupings (see Paragraph 211). The use of other quick "knock-down" agents as discussed in Paragraph 246 may be satisfactory but definite amounts cannot be suggested because of lack of field experience.

312. The rates of discharge suggested in Column 5 of Tables No. 1-A and 1-B indicate the desired minimum rates in U. S. gallons per minute of water (not foam) for foam production. The additional water supplies suggested in Column 8 of Tables No. 1-A and 1-B for Reference Indexes 5, 6, 7, 8 and 9 are based on similar rates of discharge. The rates of discharge for the carbon dioxide equipment suggested in Table No. 1-A are based on the use of high pressure carbon dioxide except as otherwise noted therein and for dry chemical equipment on approved units in the nominal sizes specified. The rate of discharge for the carbon dioxide equipment suggested in Table No. 1-B should be at least 1,000 lbs. per minute with a 2½ minute maximum discharge time for the quantities indicated in Reference Indexes 7, 8 and 9. It is recommended that at least 75 per cent of the rates of discharge indicated in Column 5 of Tables 1-A and 1-B for Reference Indexes 4–9 should be capable of being discharged through the elevated turret nozzle(s).

313. The amounts of water (for foam production) and of supplementary agents (carbon dioxide or dry chemical) suggested in Tables No. 1-A and 1-B (Columns 4, 6, 7 and 8) are based on their being immediately available for application from properly designed and equipped mobile aircraft rescue and fire fighting vehicles stationed on the airport (see Sections 320–350) and manned by thoroughly trained and equipped aircraft rescue and fire fighting crews (see Section 390 and Article 600). It is suggested that at least one of the vehicles provided be of the type suggested in Section 330. The agent quantities suggested in the Tables are designed to provide for a mobile rescue and fire fighting striking force which offers the maximum practical capability for achieving the rescue and fire control functions. Where water tank trucks (Section 340) are relied upon to supply the water suggested in Column 8 of Tables 1-A and 1-B, it is essential that these tank trucks be so designed and operated that they can reach accident sites in time to supply operational fire fighting units with the additional water specified and thus permit uninterrupted rescue and fire fighting operations. It is presumed that additional water supplies (mobile or otherwise) and any special chemicals upon which dependence is placed for fire extinguishment will also be available to make possible continuing rescue and fire fighting operations for a reasonable period of time after the discharge of the amounts suggested in the referenced Tables.

314. The quantity of water specified in Columns 4 and 8 of Table No. 1-A is the amount considered desirable where foam alone is used as the principal agent upon which reliance is placed to achieve the desired extinguishment or control to permit rescue operations. The quantity of water suggested in Columns 4 and 8 of Table No. 1-B is the amount considered desirable where large quantities of carbon dioxide are available for complimentary and simultaneous use with foam as a principal agent. When other quick "knock-down" agents (other than carbon dioxide) are used as principal agents in conjunction with foam, the amount of water (for conversion to foam) should be adequate to assure equal extinguishing efficiency within the same time period as may be achieved with the combined use of carbon dioxide and foam.

315. The amounts of carbon dioxide or dry chemical shown in Table No. 1-A are suggested for such utilization as is described in Paragraph 244.c. (1) and Paragraph 245.b. (1). The amounts of carbon dioxide shown in Table No. 1-B are suggested for such utilization as is described in Paragraph 244.c. (2). Other quick "knock-down" agents (see Paragraphs 245.b. (2) and 246) may be utilized following a determination of their extinguishing efficiency and effectiveness and an assurance of reasonable compatibility with foam. When other such agents are used, however, their extinguishing efficiency or effectiveness when used in combination with foam should equal that of comparable amounts of carbon dioxide within the same time period.

316. Heliport Protection

a. Table No. 2 indicates the quantities of water (for foam production) and the quantity of dry chemical or carbon dioxide that are suggested for heliports (see Paragraph 112), categorized according to rotary aircraft weight groupings (see Paragraph 216).

Table No. 1-A

Suggested Amounts of Extinguishing Agents for

Aircraft Rescue and Fire Fighting

Using Foam as the Principal Agent and Carbon Dioxide or Dry Chemical as Supplementary Agents

1	2	3	4	5	6	7	8
Reference Index	Aircraft Index by Maximum Take-off Weight (See Section 210)	Typical Civil Aircraft in Weight Categories (See also App. B)	Extinguishing Agents Available on Fire Fighting Units: Principal — Water for Foam Production		Supplementary — Carbon Dioxide or	Dry Chem.	Additional Water for Foam to Assure Continuous Application
No.	Lbs.	Examples	Gals.*	G.P.M.*	Lbs.	Lbs.	Gals.*
1	Under 3,000	Piper Super Cub, Cessna 140, Beech Bonanza	350	140	75	20	None
2	3,000–6,500	Grumman Widgeon, Cessna 190	500	200	75	20	None
3	6,500–15,000	Beech D-18S, Grumman Mallard	700	280	200	30	None
4	15,000–30,000	Douglas DC-3, Lockheed Lodestar	1,000	400	200	30	None
5	30,000–60,000	Convair 240, Martin 404, Vickers Viking, Bristol 170	1,000	400	600**	150	1,000
6	60,000–90,000	Douglas DC-4, Vickers Viscount, Hermes 4A	1,750	700	750**	150	2,000
7	90,000–120,000	Douglas DC-6, 6A, 6B; Constellation 049, 649, 749, 1049; Electra	2,000	800	1,000**	300	2,250
8	120,000–200,000	Douglas DC-7; Constellation 1049G, 1649; Boeing 377, Comet 4	2,500	1,000	1,000**	300	2,500
9	Over 200,000	Douglas DC-8, Boeing 707, Convair 600	3,000	1,500	1,000**	300	6,000

*U. S. Gallons. **Low pressure preferred; where high pressure, discharge rate should be 300 pounds-per-minute or more.

Table No. 1-B

Suggested Amounts of Extinguishing Agents for
Aircraft Rescue and Fire Fighting
Using Foam and Carbon Dioxide as Principal Agents (Combined Agent Technique)

1	2	3	4	5	6	7	8
			Principal Agents				
			Water for Foam Production				
Reference Index	Aircraft Index by Maximum Take-off Weight (SEE SECTION 210)	Typical Civil Aircraft in Weight Categories (SEE ALSO APP. B)	Amount of Water	Rate of Discharge	Low Pressure or Carbon Dioxide	Foam Compatible Dry Chem.	Additional Water for Foam to Assure Continuous Application
No.	Lbs.	Examples	Gals.*	G.P.M.*	Lbs.	Lbs.	Gals.*
1	Under 3,000	Use Table No. 1-A					
2	3,000–6,500						
3	6,500–15,000						
4	15,000–30,000						
5	30,000–60,000	Convair 240, Martin 404, Vickers Viking, Bristol 170	1,000	400	1,000	**	800
6	60,000–90,000	Douglas DC-4, Vickers Viscount, Hermes 4A	1,500	600	2,000	**	1,850
7	90,000–120,000	Douglas DC-6, 6A, 6B; Constellation 049, 649, 749, 1049; Electra	1,750	700	3,000†	**	1,900
8	120,000–200,000	Douglas DC-7; Constellation 1049G, 1649; Boeing 377, Comet 4	2,000	800	4,000†	**	2,200
9	Over 200,000	Douglas DC-8, Boeing 707, Convair 600	2,500	1,200	6,000†	**	4,000

*U. S. Gallons. **Alternate Possibility for Future Use. †Maximum Discharge Time: 2½ Minutes.

Table No. 2

Suggested Amounts for Companion Extinguishing Agents

Rotary Aircraft Rescue and Fire Fighting at Heliports

1	2	3	4	5	6	7	8
			Selection of Extinguishing Agents*				
			Water for Foam Production				
Ref. Category Index	Rotary Aircraft Take-off Weight Ranges	Typical Rotary Aircraft in Weight Categories	Amount of Water	Rate of Discharge	Dry Chem. or (see footnote)	Carbon Dioxide	Additional Water for Foam to Assure Continuous Application
			U.S. Gals.	U.S. GPM	Lbs.	Lbs.	U.S. Gals.
H-1	Under 3,000 lbs.	Bell 47G Sikorsky S-52	150**	60**	75**	†	150**
H-2	3,000–15,000 lbs.	Sikorsky S-51, S-55, S-58 Vertol H-21	300**	120**	150**	†	300**
H-3	15,000–30,000 lbs.	Sikorsky S-56	600	240	300	†	600

*The method of providing the protection suggested will depend, in part, upon the physical features of the heliport. Fixed extinguishing systems may be employed with sufficient hose line coverage on roof-top or platform facilities if the areas of coverage make this practical. At ground level heliports, motor vehicles may be considered more desirable than fixed equipment especially if an "off the heliport" incident is to be adequately covered. At elevated platforms, fixed or wheeled equipment should be provided due to the limited operating area and lack of access by motor vehicles. Fixed or wheeled equipment located at individual rotary aircraft landing pads may be credited with meeting these recommendations.

**As an alternate for Reference Index H-1 and H-2, the amounts suggested may be altered to agree with the criteria set forth in Reference Indexes 1 and 2 of Table No. 1-A where the higher water discharge rates are available.

†For this protection, dry chemical is preferred to the use of carbon dioxide. Where carbon dioxide is used the amount suggested should be approximately three times that suggested for dry chemical and where quantities exceed 600 lbs., low pressure carbon dioxide is preferred.

b. As indicated in Paragraph 216, the severe life hazards from fire that are inherent in the design of rotary aircraft, make it imperative that extinguishing equipment for heliports be capable of discharging their agents in an absolute minimum of time. The amounts of agents and the discharge rates suggested in Table No. 2 are designed primarily to effect instant knock-down to permit rescues which may be needed.

c. Where unlimited water supplies are available for foam production, it is recommended that sufficient foam liquid be adequate for 5 minutes of continuous operation at the recommended rates of discharge indicated in Table No. 2.

d. Attention is called to the first footnote to Table No. 2 for alternate methods of providing the scale of protection recommended. Even though the area of heliports is normally relatively small (as compared with airports), mobility of fire protection equipment is desirable to permit personnel to rapidly employ the equipment. Fire extinguishers designed to meet these requirements should thus be of the wheeled type and fixed standpipe and hose facilities should be so designed, and hose should be of sufficient length (consistent with performance requirements) to permit rapid employment over the entire area.

320. Fire Fighting Vehicle Suggestions*

321. Aircraft rescue and fire fighting equipment should be mobile and the fire fighting vehicles provided for conveying the extinguishing media quickly to the scene of the accident should be constructed to comply generally with the following objective suggestions:†

a. The optimum carrying capacity of a vehicle and its gross weight will depend upon various chassis and body design features. In this respect, vehicle capacity and gross weight should be compatible with, and without prejudice to, the performance characteristics specified in subparagraph 321.b. These criteria will determine the suitability of the vehicle for the duties described. In this connection, it should be noted that with the larger type aircraft (particularly aircraft over 15,000 lbs. gross weight) it is desirable to have more than one vehicle available to facilitate

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*See also Article 330 covering light rescue vehicles.

†See Reference C-174 in Appendix C for further information on vehicle design and Reference C-172 for testing procedures.

attacking a fire from more than one point or quarter as an aid to expedite rescue. To handle adequately rescue and fire fighting at accidents involving these larger aircraft, major units of equipment are necessary but it is suggested that at least one of the fire fighting vehicles have a gross weight of under 4 tons so that advantage might be taken of the increased speed and greater maneuverability of such comparatively lightweight vehicles (see Paragraph 321.c.).

NOTES: The number of vehicles required to effectively meet these suggestions will vary, based on individual airport preferences and policies.

As a guide, the following thoughts are advanced to assist those seeking to implement these suggestions. As indicated in Paragraph 313, the preceding Subparagraph and Subparagraph 321.c., one light rescue vehicle having the characteristics and meeting the performance recommendations outlined in Section 330 is suggested at all airports, regardless of the availability of other rescue and fire fighting vehicles. As also indicated in the preceding Paragraph, it is desirable to have more than one vehicle available to facilitate attacking a fire from more than one point or quarter as an aid to expedite rescue. This is particularly important for aircraft having a gross weight of 15,000 pounds or more because: (1) of the need to insulate the fuselage with foam to maintain its integrity as a shield for the occupants against flame impingement and radiated heat attack from fuel spill fires, and, (2) the need to make and maintain a rescue path or paths from aircraft exit point(s) to permit the safe evacuation of the occupants.

The length of the aircraft fuselage and the number of emergency exits provided on the aircraft operating at each airport should be evaluated prior to making a decision on the number of aircraft rescue and fire fighting vehicles needed to meet the suggestions given in Column 4 of Tables 1-A, 1-B and 2 as well as how the number of vehicles influence manpower requirements and vehicle maintenance problems.

The number of tank vehicles needed to provide the mobile water supply suggested in Column 8 of Tables 1-A, 1-B and 2 will be governed by the recommendations given in Section 340.

Caution should be exercised not to overload vehicles in a manner which might compromise their recommended performance as outlined in Subparagraph 321.b.(1–6).

b. Design and construction of the vehicle should be suitable for carrying its full load at relatively high rates of speed over all types of roads, trails, open and rolling country under all reasonable conditions of weather and terrain on the movement area of the airport and in the immediate vicinity thereof. More specifically, it is suggested the vehicle have the following characteristics:

(1). A cruising speed of at least 50 miles per hour on paved roads.

(2). Acceleration such that the vehicle, fully loaded, is able to accelerate from a standing start to 50 miles per hour in the maximum times specified below for vehicles in the weight ranges indicated:

Gross Vehicle Weights	*Maximum Acceleration Time*
Under 10,000 lbs. (see Sec. 330)	25 seconds
Over 10,000 lbs. including 30,000 lbs.	45 seconds
Over 30,000 lbs. including 35,000 lbs.	50 seconds
Over 35,000 lbs. including 40,000 lbs.	55 seconds
Over 40,000 lbs. including 45,000 lbs.	60 seconds
Over 45,000 lbs.	65 seconds

Tests to determine this acceleration should be run on paved, level and dry surfaces without preheating of the engine and with ambient temperatures above 45°F. (7°C.).

(3). Braking should permit the vehicle to be brought to a stop in 30 feet when traveling 20 miles per hour, fully loaded and manned, on level, dry pavement.

(4). Detailed vehicle traction and flotation specifications cannot be issued on a blanket basis as they will vary with the terrain conditions existing or liable to exist at the individual airports at which the vehicle is in service. The off-road capability of vehicles designed for this service should weigh heavily in the selection of the vehicle purchased. For the larger trucks (vehicles weighing over 4 tons gross) this need makes it desirable to provide for individual wheel drive* with tires capable of carrying the vehicle over the unimproved ground surfaces liable to be encountered. The importance of using tires of the proper design, construction and size, so inflated and mounted to assure maximum traction and flotation, cannot be overemphasized. Specially designed off-road tires capable of carrying the load imposed at low inflation pressures (preferably about 25 psi with not less than a 20 per cent tire deflection) are most frequently needed. Tires should have the smallest number of actual plies compatible with the tire section and inflation pressure. Generally, large, low pressure single tires give superior off-highway mobility than do dual tires of smaller size and higher pressure. It should be noted that the use of low tire pressures decreases

*Individual wheel drive may be achieved by the use of torque proportioning or no-spin differentials or by means of other devices which will ensure that each wheel of the vehicle is driven independently of the other wheels. This should be accomplished without sacrificing the necessary differential action required for the vehicle to make turns or travel over uneven ground.

tire loads requiring larger-sized tires and greater body clearances than is customarily provided on standard commercial vehicles. Where soft terrain conditions do not or are not likely to exist at any time of year in the vicinity of the airport, higher tire pressures and reduced sizes may be used. In any event, ratings of the Tire and Rim Association should not be exceeded.

(5). Angles of approach and departure and center clearance should be sufficient to permit the vehicle to cross depressions, such as ditches and gullies and to mount slopes, banks and high curbs which constitute obstructions to movement. The expected area of operation should be inspected to determine minimum angles and clearance. Flat terrain obviously will permit small angles and low clearance. Particularly severe conditions might necessitate special bridging or access roads to avoid complications in truck design. As a guide, angles of approach and departure should be not less than 30 degrees and center clearance should be not less than 12 per cent of the vehicle wheel base. In figuring angles of departures, overhanging platforms mounted on trucks should be considered.

(6). Vehicle motor horsepower requirements, transmission power ratios and chassis design should be governed by vehicle weight, the acceleration and speed requirements and by the flotation and traction requirements. The latter two factors will be determined by the terrain and weather conditions at the airport being served. Where vehicles must travel over unimproved surfaces or where snow or ice are encountered, individual wheel drive* is suggested.

(7). Power steering is suggested on all vehicles having a load in excess of 10,000 lbs. on the ground at the front axle.

c. It has been suggested in Paragraph 321.a. that one of the fire fighting vehicles should be a fast, light vehicle to be used in conjunction with the major fire fighting appliances. This light vehicle should be the first equipment to reach an accident site. It is considered extremely important that this vehicle be so designed that it can be operated and handled by one man and that this one man can actuate the extinguishing media while en route when the occasion requires so that there is no delay in placing the vehicle in service upon arrival. Such a vehicle has proven

*See footnote on page 403–27.

extremely valuable in attacking fires in their incipient stages and in many cases the availability of such a light, fast vehicle has permitted extinguishment of the fire before the arrival of the major units of rescue and fire fighting equipment. In other cases this light, fast vehicle has performed a successful holding action until the larger units have reached the scene. It is suggested that this light, fast vehicle should be so designed and equipped that its gross weight does not exceed 4 tons. Trucks of the "Jeep" type or similar four-wheel-drive vehicles are preferable where available. The amount of water (for foam production), foam compound, dry chemical or carbon dioxide which may be carried on this light fire fighting vehicle will depend on its load capacity but extreme care should be exercised to prevent overloading the vehicle and, thus, detracting from its acceleration, speed, flotation and traction capabilities. The extinguishing agent available must be capable of being discharged with minimum delay and manpower requirements. (See also Section 330.)

d. All essential vehicles (those designed to reach the scene first and the major units) should be provided with two-way radio facilities to assure communication opportunities with Airport Control. (See Section 370.)

e. Overall vehicle dimensions should be within practical limits having regard to local standard highway practices, width of gates and height and weight limitations of bridges, and other local considerations.

f. Simplicity of vehicle operation (particularly operation of extinguishing agent discharge facilities) is highly important because of the time restrictions imposed upon successful aircraft rescue and fire fighting operations and the need to keep to the minimum the crew required. It must be remembered that fast blanketing of the fire area is essential. Hand hose lines are thus usually not enough for fires involving larger types of aircraft (over 30,000 lbs.); elevated turrets or similar devices having large discharge capacities are needed to quickly blanket the fire and knock down the bulk of the flames. Hand lines are used primarily for covering rescue parties, for controlling the fire in the rescue area, and for spot cooling of the fuselage to avoid heat suffocation to trapped occupants.

g. See also Section 350.

330. Light Rescue Vehicle Suggestions

331. Wherever possible it is desirable that a light, fast vehicle be provided to reach accident sites quickly and to initiate rescue operations pending the arrival of the major units of fire fighting equipment. (See Paragraph 321.d. and Section 370 with regard to communications equipment.)

332. Rescue tools (see Section 360) should be carried by this light, fast vehicle and, wherever possible, it is recommended that these rescue tools be provided on the light fire fighting unit discussed in Paragraph 321.c. above. Caution should be exercised in connection with this recommendation, however, that the addition of the rescue tools does not overload the vehicle or interfere with the vehicle's performance. In cases where it is not possible to combine the rescue and fire fighting functions on one vehicle, it is suggested that a separate light rescue vehicle be provided, equipped with the rescue tools and hand portable fire fighting equipment designed to aid in the evacuation of crews and passengers from aircraft in distress. This is such an important provision that such light rescue vehicles should be available regardless of the availability of other units of aircraft rescue and fire fighting equipment.

340. Water Tank Vehicle Suggestions

341. Water tank trucks may be desirable auxiliary units at some airports, particularly where water supplies on and around the airport are limited. They may be the most convenient means for meeting the suggestions given in Column 8 of Tables No. 1-A, 1-B and 2. It is suggested that these vehicles meet the performance recommendations given in Paragraphs 313 and 321.b. except that the speed may be reduced to 40 miles per hour and the acceleration to 40 miles per hour in 60 seconds.

342. Water tank trucks should be equipped with a pump and hose for relaying water to major rescue and fire fighting equipment or for direct application on the fire. It is desirable that pumps have sufficient capacity to replenish the fire fighting vehicle having the largest rate of discharge when that vehicle is operating at maximum capacity. Proper type and sufficient quantity of hose should be provided to transfer the water content of the tank vehicle to the major rescue and fire fighting vehicle. It is essential that if the operational suggestions given herein (see Paragraph 313) are to be followed that the water tank trucks be capable of supplying the operational fire fighting units with their total water supply at a sufficient rate to permit uninterrupted rescue and fire control efforts.

343. Auxiliary supplies of foam compounds, combination straight and dispersed pattern foam nozzles, and water spray nozzles might also be carried on the tank truck.

344. See also Section 350.

350. General Vehicle Suggestions

351. No attempt is made in these suggestions to detail water pump capacities, pump inlet and outlet plumbing, power take-offs, foam proportioners and controls, the location of elevated nozzles and their operations, hose reel location, hose sizes and length, cab and manpower carrying facilities and similar equipment details,* although they are all items requiring careful engineering and design. Basically such equipment is related to the extinguishing media used, the discharge rates as suggested in the Tables, and the manpower available and needed to place the vehicle in full operation.

352. Vehicles provided for this service should be designed to permit uninterrupted pump discharge even when maneuvering the vehicle during the rescue operation. This may be accomplished by providing an independent pumping engine(s), or, if the vehicle engine(s) is (are) also used for pumping, by providing a specially designed transmission or engine-powered take-off. Use of such a transmission or power take-off should not result in more than a slight decrease in pump pressure, as well as not interrupting extinguishing agent discharge while vehicle movement is being accomplished.

353. Wherever possible, optimum benefits are normally achieved with mobile equipment by approaching civil aircraft fires from the windward position but this is not always possible.† This dictates that turrets and hand lines should be so located and operable to be efficient in any position (or any angle of vehicle approach) to avoid any waste of time (turrets operable

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*See Appendix C References, especially C-104.

†See Paragraph 645 and Appendix C References, especially C-103 and C-105.

360° and hand lines on reels or hose bed). Ground sweep nozzles (discharging foam under the front bumper of the vehicle) are desirable.

354. At airports adjacent to water or swampy areas or where snow, ice or unusual terrain may affect fire and rescue activities, special consideration should be given to these factors.

360. Accessory Equipment Suggested

361. MANUAL CUTTING, OPENING AND ACCESS TOOLS:

a. Large and small axes specially designed for piercing metallic fuselages (non-wedging).

b. Bolt, bar, metal cutters.

c. Metal and wood crosscut and hack saws.

d. Rounded tip knives for cutting safety belts, parachute straps.

e. Vise and electrical wire cutting pliers.

f. Access ladders (length depending on types of aircraft).

g. Screwdrivers and fastener tool.

h. Keys to aircraft compartments.

362. MANUAL SHIFTING TOOLS:

a. Crowbar and claw tool.

b. Steel center cable (¾ inch recommended) with a safety lock-eye hook on each end.

c. Long handled shovels.

d. Pike pole.

e. Sledge hammer.

f. Plugs and crimping tools for fuel lines and tanks.

g. Lifting jacks.

363. ELECTRICAL OR MECHANICAL TOOLS:

a. Electrical or pneumatic, circular metal cutting saw.

b. Electrical lighting plant.

c. Portable public address system with batteries.

d. Power winch or crane.

364. FIRST AID EQUIPMENT:

a. First aid medical kit.

b. Asbestos and wool blankets.

c. Stretchers.

d. Resuscitator.

365. Aircraft Emergency Evacuation Stairs. It is suggested that at least one set of aircraft emergency escape stairs be provided and carried on either the light rescue vehicle or one of the major units of aircraft rescue and fire fighting equipment as covered in Sections 330 and 320 respectively. A typical set of these emergency escape stairs is illustrated in Figures 365–1 through Figures 365–3.

370. Communications and Alarms Suggested

371. The provision of two-way radio communication, special telephone and general alarm systems is desirable between Airport Control and the Airport Fire Station. Dependable transmission of essential emergency signals is a vital necessity. Mobile vehicles considered essential for the effective rescue and fire fighting service should be provided with two-way radio equipment (see Paragraph 321.d.). Consistent with the individual situations at each airport, communication and alarm equipment should serve the following purposes:

a. Provide for direct communication between Airport Control and the Airport Fire Station to ensure the prompt alerting and despatch of rescue and fire fighting vehicles and personnel in event of an alert or incident.

b. Provide for emergency signals to ensure the immediate summoning of auxiliary personnel not on stand-by duty at the Airport Fire Station.

c. As necessary, provide for the summoning of cooperating public protective agencies (public fire departments, ambulance and medical services, police or security personnel) and others located on or off the airport.

d. Provide for communication by means of two-way radio with all radio-equipped aircraft rescue and fire fighting vehicles.

380. Related Airport Features

381. The installation of underground water service mains with flush type hydrants along aprons and in front of administration and service areas is suggested. Underground water service

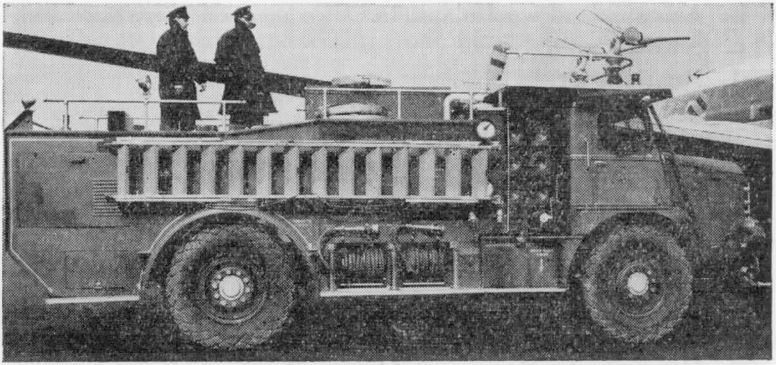

Figure 365–1

Figure 365–2

Figure 365–3

NOTE: Most transport category aircraft now carry canvas escape slides at normal and emergency escape doors. Current regulations in the United States call for these slides to be lowered by the crew after a ground impact emergency. The use of such slides will normally speed evacuation and erection of emergency escape stairs should not interrupt use of the slides unless it is evident that difficulty exists in the use of the latter and that evacuation would be speeded by erection of the stairs.

mains for the movement area are also desirable wherever economically feasible. The construction of ramps, cisterns, docks, etc., to permit utilization and access to natural water sources available should not be overlooked.

382. Consideration should be given at all airports, depending on local conditions, to provide for ready access to such natural water supplies (lakes, ponds, streams, etc.) as may be available in the immediate vicinity and provision should be made on at least one unit of the fire fighting equipment available for drafting and pumping from such water supplies to augment the capabilities of the aircraft rescue and fire fighting vehicles.

383. Depending on the location of the airport and local topography, consideration should be given to the provision of suitable quick exits around the perimeter of the airport for aircraft rescue and fire fighting vehicles and to provide good approaches to access roads beyond the airport boundary for as far a distance as is necessary or practical. Particular attention should be given to the provision of ready access to the undershoot and overrun areas.

384. Aircraft rescue and fire fighting vehicles normally should be garaged at a central station. This station should be heated (where necessary) to assure immediate starting of garaged vehicles and should be located so:

a. That access to the movement area is unobstructed.

b. That vehicle running distance to active runways is the shortest possible consistent with local regulations regarding clearances of structures from landing areas.

c. That visibility of flight activity is normally obtainable.

d. That auxiliary personnel, trained for aircraft rescue and fire fighting, will be able to reach their stations without unnecessary delay.

e. That direct communication with Airport Control be available.

390. Personnel Suggestions

391. All personnel provided for aircraft rescue and fire fighting duties should be fully schooled in the performance of their duties under the direction of a designated Chief of Emergency Crew.

392. Personnel: Men recruited for aircraft rescue and fire fighting services should be of a high physical standard, resolute, possess initiative, competent to form an intelligent assessment of a fire situation and, above all, must be well trained and fully qualified. Ideally, every man should be capable of sizing up changing circumstances at an aircraft accident and to take the necessary action without detailed supervision. Where, of necessity, the available manpower displays limited capacity to use initiative, the deficiency must be made good by the provision of additional supervisory staff of a superior grade who will be responsible for exercising control of their crews. The officer responsible for the organization and training of the fire service should be an experienced, qualified and competent leader.

393. Fully trained personnel, whether full-time or auxiliary, should be available to operate the rescue and fire fighting equipment supplied at maximum capacity. During flight operations, sufficient personnel should be available to bring into *immediate use* any light rescue vehicle available as recommended in Section 330 and at least one-third of the total extinguishing media indicated for the airport or heliport in Tables No. 1-A, 1-B or 2 or a minimum of one unit of the "major vehicles" described in Section 320, whichever is the greater. Each additional unit of equipment available should be in the charge of a qualified driver-operator to ensure its operational readiness. Other trained personnel should be readily available to complete the manning requirements for all vehicles.

394. Movement and utilization of aircraft rescue and fire fighting equipment and of other emergency equipment at the time of emergency should be governed by the principles set forth in "Standard Operating Procedures, Aircraft Rescue and Fire Fighting" (NFPA No. 402).*

395. It is suggested that equipment be manned and placed at predetermined emergency stations on the movement area prior to any landing or take-off attempted under any abnormal flight or weather conditions which might increase the accident potential during such operations.

396. All authorized personnel should be given suitable identifying insignia to prevent any misunderstanding as to their right

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*See Item C-103 in Appendix C.

to be in the fire area or on the movement area of an airport during an emergency.

397. The following fire fighters' personal equipment is suggested:

a. Bunker suit with heat insulative interliners for coat and trousers to afford full arm, body and leg protection, outer garment to be water repellent and flame resistant.

b. Protective gloves of chrome leather with heat insulative interliner and gauntlet wrist protection.

c. Standard fireman boots with wool lining.

d. Fireman helmet with plastic full vision face shield and front and neck protective aprons.

398. Full-time aircraft rescue and fire fighting personnel, where available, may profitably be assigned airport fire prevention duties (inspections and fire-guard functions) and be responsible for the routine maintenance of all airport fire equipment if suitable arrangements are provided to alert them for instant duties when away from the central fire station and if suitable transportation is available, when needed, to assure timely response to alarms.

Article 400. — Ambulance and Medical Facilities

410. Suggested Provision for Ambulances

411. The availability of ambulance and medical facilities for the removal and after-care of casualties arising from an aircraft accident should receive the careful consideration of airport managements and should form part of the overall emergency plan established to deal with such emergencies.

412. The extent of the facilities to be provided should be determined by the type of traffic and the maximum number of passengers likely to be involved in the largest aircraft normally using the airport.

413. Any decision regarding the provision of ambulances on the airport proper should consider the ambulance facilities available in the proximity of the airport and the possibility of assembling this equipment to meet within a reasonable period of time a sudden demand for assistance of the scale envisaged. It is also important to consider the suitability of such ambulances for movement on the terrain in the vicinity of the airport. Where it is decided that the provision of an ambulance or ambulances on the airport is necessary, then consideration should be given to the following:

a. The vehicle to be provided should be of a type suitable for movement on the terrain over which it may reasonably be expected to operate and should provide adequate protection for the casualties.

b. As a measure of economy, the vehicle may be one which is used for other purposes, provided such other uses will not interfere with its availability in the event of an accident. Any dual purpose vehicle should be easily modified to permit the carriage of stretchers and other medical equipment. In a case where auxiliary personnel are relied on for fire fighting and rescue purposes the ambulance vehicle could be used for the transport of such personnel to the scene of the accident and then assume its role as an ambulance.

420. Suggestions for Organization of Medical Assistance Program

421. The provision of a first aid room on the airport for the reception and treatment of casualties may be desirable. Such a room should be equipped to the standard considered necessary to meet the local requirement which will of course take into account the availability and proximity of hospital services with whom predetermined arrangements should exist for the reception and handling of casualties arising from an aircraft accident.

422. The emergency plan should provide for the summoning of doctors in the event of an accident and for the recruitment and training in first aid of as many people as possible from airport staffs who may be prepared to undertake such duties either on a voluntary basis or on such other basis as may be determined locally. It is especially desirable that personnel manning ambulances should be trained in medical first aid.

423. The usefulness and efficiency of any ambulance and first aid organization to be provided on an airport may be greatly assisted if it is used to deal with incidents whether of a minor or major character arising during the normal routine working of the airport. By so doing a situation is avoided whereby trained personnel and a useful organization may be left untried and unused over very long periods.

Article 500. — Reports

510. NFPA Reports

511. Each operation of aircraft rescue and fire fighting equipment should be carefully reported and analyzed and one copy of each such report should be sent to the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. The form reproduced in Appendix D is the Official Report of the Association and full size copies are available from the NFPA.

Article 600. Training Procedures
Aircraft Rescue and Fire Fighting Personnel at Airports

610. Introduction

611. Instances when personnel whose protection duties consist solely of the rescue and fire fighting services for aircraft movements are actually called upon to face a serious situation involving major rescue and fire fighting operations are relatively infrequent. Normally, they will experience numerous standbys to cover ramp and other aircraft movements and servicing operations (under circumstances where the possibility of a serious accident may reasonably be anticipated) plus a few actual minor incidents. Under such conditions they are seldom called upon to put their full knowledge and experience to a supreme test. It follows, therefore, that only by means of a most carefully planned, and rigorously followed program of training can there be any assurance that both men and equipment will be able to deal with a major aircraft fire should the necessity arise.

612. Training of aircraft rescue and fire fighting personnel falls into two broad categories: (1) basic training in the use and maintenance of equipment (see Section 630); and (2) tactical training which covers the deployment of men and equipment to accomplish control of a fire to permit rescue operations to proceed (see Section 640).

620. The Training Program

621. The officer responsible for the training program must endeavor to maintain the interest and enthusiasm of his crews at all times. In certain respects this will not be too difficult. There are so many factors affecting aircraft rescue and fire fighting procedures which, as far as possible, must be anticipated, staged and practiced, that the officer has an opportunity of sustaining the interest of his students indefinitely. Each new type of aircraft using the airport brings with it new problems which must be assessed and incorporated into the training program. Other more routine aspects of training become less interesting over a long period and here it is essential that the officer should ensure that each man realizes to the full the need of such training. For example, it is a fundamental practice in the rescue and fire fighting service that each man satisfies himself, when on duty, that the equipment he may be called upon to use is serviceable. This particular aspect of a man's duty could deteriorate after a long period of comparative inaction unless the man is really convinced of the importance of this task. The entire training program must be designed to ensure that both men and equipment are at all times fully efficient. This represents a very high standard to achieve but anything less than full efficiency is not only not good enough but may be dangerous both to those in need of aid and those who are seeking to give such aid.

630. Basic Training

631. Fire and Fire Extinguishment: All rescue and fire fighting personnel should have a general knowledge of the causes of fire, the factors contributing to spread of fire and the principles of fire extinguishment. Only when armed with such simple knowledge can they be expected to take intelligent action when confronted with a serious fire situation. It must be known, for instance, that certain types of fire require a cooling agent while others need blanketing or smothering action, and equally, that certain of the media used extinguish by cooling, while others blanket or smother a fire (see Section 240). The scope of instruction will vary with the intelligence of the trainees. In most cases, the simpler this instruction is kept, the more successful it is likely to be. In no case should enthusiasm, engendered by the interest value of the subject, be allowed to carry the instruction beyond its practical application.

632. Types of Extinguishing Agent Employed: It is essential that the agents employed shall be thoroughly understood. In particular, every opportunity should be given to use the agents on actual fires to understand by experience not only the virtues but also the limitations of each agent. Each routine equipment test should be used as a training exercise in the proper handling of the equipment and the correct application of the particular agents involved.

633. Handling of Equipment: All rescue and fire fighting personnel must be capable of handling their equipment, not only under drill ground condition, but also in rapidly changing circumstances. The aim must always be to ensure that every man is so well versed in the handling of all types of equipment that, under stress conditions, he is able to operate it in an automatic manner. This can be accomplished in the initial state of training by employing the "change-round" technique during standard drills, and later by training involving the use of two or more pieces of equipment simultaneously. Particular attention should be paid to actual operation. This form of training is, of course, a continuing commitment.

634. Care of Equipment: A thorough knowledge of all equipment is essential in order to insure its intelligent handling and to insure thorough maintenance which is essential to guarantee operational efficiency under all circumstances. It is important that every fire fighter shall satisfy himself that any pieces of equipment which he may be called upon to use will work satisfactorily and, in the case of auxiliary equipment, that it is in its correct storage position. The importance of correct storage of small equipment to insure that it can be instantly located cannot be overstressed. Officers responsible for training are advised to hold periodic compartment drills when individual crew members are required to produce immediately a particular item. All rescue and fire service equipment must be regularly tested or inspected and careful records must be maintained of the circumstances and results of each test. Some items of equipment can be repaired locally and training in such subjects should be provided.

635. Local Terrain: A thorough knowledge of the airport and its immediate vicinity is essential. Training should include instruction in the use of alternative routes where obstacles, natural or artificial, may be encountered. The existence in any part of the area of ground which may from time to time become impassable should be known to all crew members and, where these features are not permanent, arrangements should be made for the current circumstances to be made widely known. Each man must have a complete knowledge of the availability of local water supplies.

636. Aircraft Familiarization Training: The importance of this aspect of training cannot be overemphasized. Rescue and fire fighting personnel may be called upon to effect a rescue from an aircraft interior under adverse conditions, working in an atmosphere heavily laden with smoke and fumes. (If self-contained breathing apparatus is supplied careful training in its use is essential.) It is also essential that every man should have an intimate knowledge of all types of aircraft normally using the airport. This knowledge cannot be acquired solely from a study of diagrams which are issued by many operators. There is no substitute for a periodic inspection of the aircraft, paying particular attention to position and locking mechanism of all exits, both normal and emergency, and to the internal layout and seating arrangements. So far as is practicable, fire fighters should be allowed to operate the emergency exits and certainly should be fully conversant with the method of opening all the main doors. An elementary knowledge of aircraft construction is highly desirable since such knowledge is invaluable if, as a last resort, forcible entry is necessary. The cooperation of the engineering staff of the aircraft operators should be sought on this aspect of training.

637. First Aid: Every member of the rescue team should, if at all possible, be trained and periodically requalified in first aid. The prime reason for this qualification is to ensure that casualties are intelligently handled so that injuries are not needlessly aggravated.

638. Search and Rescue

a. The training program should provide instruction in search procedures, not only in enclosed spaces of an aircraft, but also for procedures for systematic searching of the area in the immediate vicinity of an aircraft accident and also in the path of the aircraft.

b. As a broad principle, it should be taught that the persons involved in a fire are most frequently found near an exit, *i.e.*, doors and windows, or in lavatories and compartments, etc.

c. Rescue is always best effected by way of a normal channel, if available. For example, it is easier to carry a person through a doorway than to manipulate him through a window. The main cabin door of an aircraft should always be attempted first. Should the door be jammed it will usually be found quicker to force it by applying leverage at the right spot than to achieve entry and rescue through another form of opening. Success in this form of operation requires a full knowledge of the locking mechanism and direction of travel of the door concerned. Forcible entry through other than normal channels should only be attempted when it is obvious that regular means cannot be employed. Many operators are now indicating with external markings, suitable points at which entry can best be effected. Pressurized cabins offer tough resistance to penetration by an axe, although entry can be made by a man well trained in the use of the proper type axe and possessing a working knowledge of aircraft construction. The practice of providing power-operated saws on airports has increased. Properly designed power saws are of value in making forcible entry, but expert knowledge in handling this tool is a prime requisite to successful use in an actual emergency.

d. All fire fighters should be trained in rescue procedures. The working space inside a cabin is necessarily somewhat restricted and it will generally be found advisable to restrict the number of rescuers working inside the aircraft and work on a chain or "buddy" principle.

e. Where possible, the airport emergency organization should provide for the availability of personnel other than rescue and fire fighting personnel, for the handling of casualties from the moment they are removed from the aircraft.

f. All rescue personnel should be trained in fireman's lift and other forms of rescue.

640. Tactical Training

641. When personnel are well versed in the handling of fire fighting equipment they should receive training in tactics to be adopted at aircraft fires. Teamwork is a primary essential.

642. This training is a continuing commitment and must be absorbed to the point where compliance with the initial action called for is automatic, in the same sense that hose-laying to a well-trained fire fighter is automatic and will, therefore, follow even when working under stress. Only when this is achieved, will the officer-in-charge be in a position to assume complete control of the situation.

643. Tactical training is designed to deploy men and equipment to advantage in order to establish conditions in which people may be rescued from an aircraft which is involved in, or liable to become involved in, fire. The object is to isolate the fuselage from the fire, cool the fuselage, establish and maintain an escape route and achieve the degree of fire control necessary to permit rescue operations to proceed. This is fundamental and must be stressed in the training program. The service to be provided is primarily life saving but the personnel must be trained in fire fighting because aircraft involved in a serious accident frequently are involved in fire simultaneously. Until all the occupants of the aircraft are accounted for, fire fighting operations must be directed to those measures which are necessary to permit rescue to be carried out. This includes fire precautionary measures at those incidents where no fire has broken out. When the life saving commitment has been met it is necessary, of course, to utilize all available resources to secure protection of property.

644. The main attack on the fire will normally be by means of mass application of foam or, alternately, by the combined use of carbon dioxide at rates of 1,000 pounds per minute or more backed-up by the mass application of foam. Where foam alone is used as the principle agent a suitable back-up agent must be available to deal with pockets of fire which may be inaccessible to direct foam application. This will generally be provided in the form of carbon dioxide, dry chemical or vaporizing liquid extinguishing agents to be used on running liquid fuel fires or in enclosed spaces, such as wing voids, in an engine nacelle, or wheel well. (See Section 240 and Article 300.)

645. The following points should be covered in the tactical training program:

a. The Approach: Equipment should approach the incident by way of the fastest route in order to reach the incident in the shortest possible time. This is quite frequently not the shortest route as, speaking generally, it is preferable where possible to travel on a paved surface than to approach over rough ground or grassland. The essence is to insure that apparatus get there and are not subjected to unnecessary hazards en route. When nearing the scene of the incident a careful watch must be maintained for occupants who may be dashing away from the aircraft or who may have been flung clear and are lying injured in the approaches. This applies particularly at night, of course, and calls for intelligent use of spot or floodlights.

b. Positioning of Equipment: The positioning of equipment, both airport and assisting equipment, is important in many respects and regard should be had to the following factors: The equipment operator must be in a position to view the fire ground; the equipment must not be placed in a position of hazard due to spillage of fuel or due to slope of ground or wind direction; no one unit should deny access to the scene for other emergency vehicles, such as ambulances; equipment must be positioned to operate effectively on the fire but not be so positioned that it might be trapped by fire.

c. Positioning of Light Fire Fighting and Rescue Vehicle(s):

(1). Normally, the light fire fighting and/or rescue vehicle (see Paragraph 321.c. and Section 330) reaches the accident site first and is used to initiate rescue and fire fighting at the earliest possible moment. Hopefully, the mission of its crew is to prevent fire outbreak and initiate rescue operations, to control or extinguish the fire in its incipient stage to permit rescue, or, alternately, to try to secure a rescue path, to size up the rescue and fire fighting problem and to be in a position to direct the positioning of the major appliances upon arrival.

(2). The light fire fighting and rescue vehicle(s) should be positioned to permit the most rapid access to the principal egress route from the aircraft in distress except when it is obvious that occupants are evacuating safely without assistance and the fire or threat of fire is otherwise located.

(3). Since the light fire fighting vehicle has limited extinguishing capability, caution must be taken to avoid placing the vehicle in untenable locations in event of sudden extension of the flame front or an explosion. After the vehicle's extinguishing capacity has been exhausted and assuming incomplete control, the vehicle should be withdrawn from a position which might be subsequently occupied to advantage by later-arriving fire fighting equipment.

d. Position of Major Fire Fighting Vehicles:

(1). Major units equipped with turrets for the mass application of the extinguishing media should be positioned as to make effective use of the turret streams. It is vitally important to avoid wastage of the limited amounts of agent available so that turrets should be used only when they are being effective. Normally, hand lines control the rescue paths so it is equally important to locate equipment to permit the effective employment of these lines. Proper positioning of apparatus is, in fact, often the key to successful operations.

(2). The main initial object is to insulate and cool the fuselage and to safeguard the escape routes. The type and number of nozzles available will vary with the type and the scope of the equipment provided. NFPA Charts 403–2A and 403–2B on the Principles of Fire Fighting for Civil Aircraft (copies available at 15 cents each) illustrate some useful techniques.

(3). The initial discharge of foam should cover and be along the line of the fuselage and then directed to drive the fire outwards. When selecting the best position to accomplish this purpose, always remember that the wind has considerable influence upon the rate of fire and heat travel. The position should be chosen with this in mind, thus utilizing the wind, whenever possible, to assist in the main objective. Except in unusual circumstances hose streams should not be directed towards the fuselage at right angles as this may tend to drive burning fuel toward the occupied areas handicapping survival of trapped occupants. Similarly, care must be exercised to avoid the possibility of disturbing a foam blanket by the careless application of additional foam or any other agent. Foam should always be laid on a liquid fuel fire so that it gently forms a blanket with the least possible turbulence to the fuel surface.

(4). There are two basic methods of applying foam. One involves the use of a straight stream which can be applied directly or indirectly on a surface at some distance. The second is to use a spray or diffused stream at close range. Often, foam can be applied to a fire area by deflecting from another surface, such as against the contour of the fuselage. This has the advantage of simultaneously insulating the fuselage by building up a foam cover. Whenever foam equipment is being subjected to a periodic routine check the opportunity should be taken to train crew members in these methods of application. It is important that such training be carried out on actual fires so that personnel will obtain an assessment of the value, as well as the limitations, of the agent so applied and familiarize himself with the heat conditions he will experience. These drills should be carried out at intervals of not more than one month.

(5). Officers responsible for training should decide on the optimum positioning of equipment best suited to their available resources under each simulated condition and then take steps to train their crews accordingly. At a fire there is little time for individual briefing of crew members and while the initial layout may have to be adjusted to cope with the existing circumstances, it is very important for the crews to know exactly what their first action should be well in advance. It should always be remembered that this layout of equipment should be standard practice at an aircraft incident even when fire has not broken out and under these conditions, at least one nozzle should be manned and in readiness to go into instant action should the occasion arise.

650. Additional Comments

651. Conservation of Extinguishing Media: The quantities of extinguishing agents available at an aircraft accident are normally very limited. Accordingly it is essential that the minimum of wastage is permitted. This calls for complete coordination between pump and nozzle operators. The personnel engaged in fire fighting should cease using extinguishing media as soon as it is certain beyond doubt that equipment is not serving a useful purpose. Simple hand signals can be employed to achieve the necessary liaison. Such signals would not be required, however, where the design of the equipment permits remote control.

Appendix A — Definitions

Article A-100. ICAO Definitions

A-110. The following definitions of terms are extracted from the "Lexicon" issued by the International Civil Aviation Organization:

A-111. AERODROME: A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and movement of aircraft.

A-112. AIRCRAFT: Any machine that can derive support in the atmosphere from the reactions of the air.

A-113. AIRPORT: An aerodrome at which facilities have, in the opinion of the State authorities, been sufficiently developed to be of importance to civil aviation.

A-114. AIR TRAFFIC: All aircraft in flight or operating on the maneuvering area of an aerodrome.

A-115. LANDING AREA: The part of the movement area intended for landing and take-off run of aircraft.

A-116. MOVEMENT AREA: That part of an aerodrome intended for the surface movement of aircraft.

Article A-200. NFPA Definitions

A-210. The following definitions are added to clarify the foregoing text:

A-211. AIRCRAFT FIRE FIGHTING: The control or extinguishment of aircraft fires following ground accidents incident to aircraft rescue and thereafter. Aircraft fire fighting, as used in this paper, does not include the control or extinguishment of airborne fires in aircraft.

A-212. AIRCRAFT RESCUE: The removal of personnel from an aircraft which has sustained a ground accident. Rescue, as used in this paper, does not include search operations or medical services other than first aid treatments.

A-213. AIRPORT CONTROL: A service established to provide air traffic control for airports.

A-214. AIRPORT MANAGER: The individual having managerial responsibility for the operation and safety of the airport whether he represents a governmental agency, a private corporation, or an individual. The airport manager may have administrative control over aircraft rescue and fire fighting services operating on the movement area of the airport (see Section 150 for details). He should not normally be required to exercise authority over operational matters at the time of emergency, said responsibility normally being that of a duly appointed Chief.

A-215. CHIEF OF EMERGENCY CREW: As used in this text, the individual normally having operational control over aircraft rescue and fire fighting equipment and manpower (Emergency Crew) specifically made available for aircraft rescue and fire fighting activity on the airport, or his designated assistant. He has both the authority and responsibility for decisions affecting rescue and fire fighting activity and is normally in sole command of such operations at time of emergency.

A-216. EMERGENCY CREW: Personnel under the operational jurisdiction of the Chief of Emergency Crew assigned on a full-time or part-time basis to aircraft rescue and fire fighting activities.

A-217. MOVEMENT: As used herein, a movement means a landing *or* a take-off of an aircraft at an airport.

A-218. MUTUAL AID: Prearranged exchanges of aid and assistance between various fire defense organizations within a given area, as, for instance, the mutual aid which might be provided between aircraft rescue and fire fighting organizations and local public fire departments for an "area" defense of the community, the airport, and surrounding territories.

Appendix B

A Listing of Representative Civil Aircraft by Weight Classifications Excluding Rotary Aircraft

Article B-100. Reference Index 1

Representative Civil Aircraft Under 3,000 Lbs. Take-off Weight
Normal Fuel Capacities: Under 70 Gals.
Normal Personnel Capacities: 1 to 4

Manufacturers	Names and Symbols of Aircraft
Aero Flight	Streak 85, Model NC-1; Streak 125, Model NC-2; and Streak 165, Model NC-3
Aeronca	Sedan, Model 15AC and Champion, Models 7EC and 7CCM
Auster	J.1, J.1B, J.5B
Bee Aviation Assoc. Inc.	Queen Bee, Honey Bee
Beech Aircraft	Bonanza, Model M35, Debonair (33)
Call Air	A-5, A-6
Cessna Aircraft	Models 150, 172, 175, 180, 182, 210 Skylane, Skylark
Champion Aircraft	7EC Traveler, 7FC Tri-Traveler, 7GC Sky-Trac, 7HC DX'er
Downer Aircraft Ind., Inc.	Bellanca 260
Forney Aircraft	Fornaire F-1
Helio Aircraft	Courier H395A; Super Courier H395
Lake Aircraft Corp.	C-2 Skimmer
Mooney Aircraft	Mark 20-A
Myers Aircraft Co.	Myers 200A
Piper	PA-18 "95," PA-18 "150," PA-18A Super Cub, PA-22 Caribbean, PA-22 "160," Tri-Pacer, PA-24 "180" Comanche, PA-24 "250" Comanche, PA-25 Pawnee
Ryan	Navion A, Model 205 and Navion B, Model 260
Stits Aircraft	SA9A Skycoupe
Taylorcraft	Zephyr, Topper