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Suggestions for

Aircraft Rescue and Fire Fighting Services for Airports

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NATIONAL FIRE PROTECTION ASSOCIATION
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National Fire Protection Association

International

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

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

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

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

Definitions

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

SHALL is intended to indicate requirements.

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

APPROVED refers to approval by the authority having jurisdiction.

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

Approved Equipment

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

Suggestions for
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Foreword

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 the subject of "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 at its Annual Meeting in Detroit, Michigan, and unanimously accepted. Subsequently, the text was revised in 1954, 1955, 1956, and this edition incorporates the latest (1957) changes.

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. This publication is printed in English, French and Spanish editions and is available from ICAO Offices in Montreal, Canada; Paris, France; Lima, Peru; London, England; Cairo, Egypt; Bangkok, Thailand; and New Delhi, India. 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. It is anticipated that during 1957, the report of this Panel will be processed through ICAO procedures.

The current NFPA text as reproduced herein follows generally the guidance material submitted by the United States of America to the ICAO Panel with changes adopted by the NFPA Committee on Aviation and Airport Fire Protection following the useful exchange of information resulting from the December 1956 international meeting mentioned in the previous paragraph and as a result of NFPA sponsored meetings held September 27–28, 1956, November 29–30, 1956 and January 25, 1957. Formal adoption of this 1957 Edition of NFPA No. 403 in the name of the Association was taken at the 1957 NFPA Annual Meeting held in Los Angeles, California, May 20–24, 1957.

This publication is drafted in the form of "Suggestions" rather than as a "Standard" since these suggestions cannot be strictly applied internationally because of varied conditions existing at airports. A great many of the suggestions are applicable to all airports but they should be used only as a guide, giving due consideration to local conditions.

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Table of Contents

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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, buildings, etc.) although the services suggested herein might constitute valuable fire protection for such structures and their contents in many instances.

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.

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 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 equipment, 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

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

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.* They are suggested for international application. 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, whether a governmental agency, a private corporation, or an individual, and irrespective of how such activities are financed and/or organized. Airport management should also have administrative duties in connection with aircraft rescue and fire fighting within the reasonably accessible environs of the airport movement area where there is no conflict with the administrative jurisdiction of suitably organized and equipped public protective agencies. A prearranged high degree of mutual aid (joint defense measures) is desirable between airport rescue and fire fighting organizations and any public protective agencies serving the immediate vicinity. An "area emergency plan" is helpful and airport management should encourage and offer instruction to cooperating public agencies on the special problems and techniques associated with aircraft rescue and fire fighting.

*See Appendix C References for a bibliography of helpful information on the subject.

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	Over 120,000 lbs.	Over 5,000 gals.	Over 70

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-800). 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-900 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 two 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 — made 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 tough, fire-resistant foam.

(**2**). Mechanical Foam (Air Foam) — made by the addition of a liquid foam compound to water to make it capable of foaming in the presence of air by the mechanical action of jets in fixed foam maker or playpipe.

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.

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 good "flooding" characteristics and penetrates to otherwise inaccessible areas. However, particularly during rescue operations, it is necessary to guard against the reignition of flammable vapors by magnesium or other burning materials normally found in an aircraft fire. The permanency of extinguishment with carbon dioxide 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.

b. 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 utilized, carbon dioxide 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.

(2). As a combined agent, in large quantities (usually over 1,000 lbs. minimum), with a rapid rate of application, to be used with foam as a principal agent. In this application the minimum discharge rate would be 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 by magnesium or other burning materials normally found in an aircraft fire. 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 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 (1957) 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 (1957) 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 (1957). 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 com-

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*During 1956 announcements have been made in the United States and the United Kingdom of the development of a foam compatible type of dry chemical. Lack of field use and experience to date (1957) prevents making definite suggestions on the use of this type dry chemical at this time.

†Experimentation is under way in Canada, Germany, Sweden, the United Kingdom and the United States on such large scale usage.

bination 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.

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.

249. 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.

**See Appendix C References for additional information on this subject.

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 the referenced Tables for Airport Categories 5, 6, 7 and 8 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 approved types of high pressure cylinders (nominal pressure of 850 psi at 70° F.) 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 each category.

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 and 7) 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 and 330) and manned by thoroughly trained and equipped aircraft rescue and fire fighting crews (see Section 390). It is suggested that at least one of these vehicles meet the design and performance criteria suggested in Section 330. The agent quantities suggested presume the existence of additional water supplies (mobile or otherwise) and any special chemicals upon which dependence is placed for fire extinguishment 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 No. 1-A and 1-B.

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	Typical Civil Aircraft in Weight Categories	Extinguishing Agents Available on Fire Fighting Units				Additional Water for Foam to Assure Continuous Application for Minimum of Five Minutes
			Principal		Supplementary		
	(See Section 210)	(See also App. B)	Water for Foam Production		Carbon Dioxide or	Dry Chem.	
No.	Lbs.	Examples	Gals.*	G.P.M.*	Lbs.	Lbs.	Gals.*
1	Under 3,000	Piper Super Cub, Cessna 140, Beech Bonanza	350	140	50	30	None
2	3,000–6,500	Grumman Widgeon, Cessna 190	500	200	75	30	None
3	6,500–15,000	Beech D-18S, Grumman Mallard	700	280	100	50	None
4	15,000–30,000	Douglas DC-3, Lockheed Lodestar	1,000	400	200	100	None
5	30,000–60,000	Convair 240, Martin 404, Vickers Viking, Bristol 170	1,000	400	400	200	1,000
6	60,000–90,000	Douglas DC-4, Vickers Viscount, Hermes 4A, Canadair C-4	1,750	700	750	375	2,000
7	90,000–120,000	Douglas DC-6, DC-6A, DC-6B, Lockheed Constellation 049, 649, 749, 1049, Lockheed Electra	2,000	800	850	425	2,250
8	Over 120,000	Douglas DC-7, DC-8, Lockheed Constellation 1049G, 1649, Bristol Britannia, Boeing 377, 707, Comet 4	2,500	1,000	1,000	500	2,500

*Figures in U.S. Gallons

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	Carbon Dioxide	or Foam Compatible Dry Chem.	Additional Water for Foam to Assure Continuous Application for Minimum of Five Minutes
No.	Lbs.	Examples	Gals.*	G.P.M.*	Lbs.	Lbs.	Gals.*
1 2 3 4	Under 3,000 3,000–6,500 6,500–15,000 15,000–30,000	Use Table No. 1-A					
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, Canadair C-4	1,500	600	2,000	**	1,850
7	90,000–120,000	Douglas DC-6, DC-6A, DC-6B, Lockheed Constellation 049, 649, 749, 1049, Lockheed Electra	1,750	700	3,000†	**	1,900
8	Over 120,000	Douglas DC-7, DC-8, Lockheed Constellation 1049G, 1649, Bristol Britannia, Boeing 377, 707, Comet 4	2,000	800	4,000†	**	2,200

*Figures in U.S. Gallons
**Alternate Possibility for Future Use: Foam Compatible Dry Chemical.
†Maximum Discharge Time: 2½ Minutes

Table No. 2

Suggested Amounts of Extinguishing Agents for
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	Carbon Dioxide or	Dry Chem.	Additional Water for Foam to Assure Continuous Application for Minimum of Five Minutes
			U.S. Gals.	U.S. GPM	Lbs.	Lbs.	U.S. Gals.
H-1	Under 3,000 lbs.	Bell 47 G Sikorsky S-52	Either 300	120	300	150	300
			or 100	40	750	300	100
H-2	3,000–15,000 lbs.	Sikorsky S-51, S-55, S-58 Vertol H-21	Either 750	300	750	300	750
			or 250	100	1,500	750	250

*The selection of the alternates suggested should be evaluated upon the physical and practical circumstances at the heliport being protected and any design factors particular to the rotary aircraft being safeguarded. 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 and to protect large elevated landing areas, mobile vehicles are suggested.

314. The quantity of water specified in 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 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.b. (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.b. (2). Other quick "knock-down" agents (see Paragraph 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. Table No. 2 indicates the quantities of water (for foam production) and the quantity of carbon dioxide or dry chemical that are suggested for heliports, categorized according to helicopter weight groupings. The use of other agents may be satisfactory but definite amounts cannot be suggested because of lack of field experience.

320. Major Vehicle Suggestions*

321. Aircraft rescue and fire fighting equipment should be mobile and the major* vehicles (gross weight over 4 tons) provided for conveying the extinguishing media quickly to the scene of the accident should be constructed to comply generally with the following objective suggestions:

*See also Article 330 covering light rescue vehicles weighing under 4 tons gross for suggestions for special performance.

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 sub-paragraph 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 attacking a fire from more than one point or quarter as an aid to expedite rescue.

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. In most cases 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 plys 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 tire loads requiring larger-sized tires and greater body clearances than is customarily provided on standard commercial vehicles. If the vehicle service requirements are over such terrain that inflations need not be as low as 25 psi, tire sizes can be reduced by the use of higher inflations and tire durability should be satisfactory providing there is adherence to standard truck load-inflation tables.

(**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.

†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.

(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. 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).

d. 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.

e. 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.

f. See also Section 350.

330. Light Rescue Vehicle Suggestions

331. Light, mobile vehicles weighing under 4 tons gross, equipped with 100–400 gallons of water plus 10–40 gallons of foam or 300 pounds or more of carbon dioxide or dry chemical are suggested for consideration regardless of the availability of heavier, major units of aircraft rescue and fire fighting equipment (see Section 320).

332. These vehicles may be equipped with a turret and hand line capable of discharging the extinguishing agent content rapidly and effectively.

333. It is very important that this vehicle have maximum flotation and traction capabilities when evaluated against the terrain and weather conditions liable to be encountered, and be able to achieve, when fully loaded, on paved surfaces, a speed of 50 miles per hour within 25 seconds, without engine preheating and with ambient temperatures above 45° F. (7° C.).

334. The main function of such vehicles is to reach accident sites quickly, to initiate rescue and extinguishing action pending arrival of major units of equipment and to traverse adverse terrain which might make access for larger units of equipment difficult or impossible. Two-way radio equipment should be provided on such vehicles (see Paragraph 321 (c) and Section 370).

335. On the same vehicle, or alternately on a separate vehicle, it is suggested that power tools be provided for forcible entry purposes (see Section 360). Separate vehicles should also meet the performance recommendations given in Paragraph 333.

336. See also Section 350.

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 and 1-B. It is desirable that these vehicles meet the performance recommendations given in Paragraph 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.

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. Other 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 Tables No. 1-A and 1-B, and the manpower available and needed to place the vehicle in full operation.

352. It is suggested that vehicles provided for this service be designed to permit uninterrupted pump discharge even if it may be necessary to maneuver the vehicle during the rescue operation.

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

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 (3/4 inch recommended) with a safety lock-eye hook on each end.

c. Long handled shovels.

*See Appendix C References, especially C-104.
**See Appendix C References, especially C-105.

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.

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 Paragraphs 321 (c) and 334). 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 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. 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).*

392. Sufficient fully trained personnel should be available to operate the equipment at maximum capacity and to provide the necessary rescue force. During all periods of flight operations sufficient personnel should be immediately available to bring into immediate employment at least one-third of the total extinguishing media suggested in Tables No. 1-A or 1-B or a minimum of one unit of the equipment described in Section 320, whichever is the greater. It is also desirable that if a unit of the type described in Section 330 is available, this unit also should be fully manned immediately. The personnel manning this light rescue vehicle may also serve as the rescue or hand-line operators for one of the major units to arrive subsequently. Each additional unit of equipment should have a fully qualified driver-operator immediately available. Other trained personnel should be available to complete the vehicle manning requirements.

393. 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.

394. 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.

395. 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.

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*See Item C-103 in Appendix C.

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

396. 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 have regard to 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 ambulance should have regard to the ambulance facilities available in the area of the airport and their ability to meet within a reasonable period of time a sudden demand for assistance on the scale envisaged. Regard should also be had to the suitability of such ambulances for movement in the terrain in the vicinity of the airport. Where it is decided that the provision of an ambulance or ambulances by the airport authority is necessary then regard may be had to the following considerations:

a. The vehicle to be provided should be of a type suitable for movement in the terrain in 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 uses will not interfere with its availability in the event of an accident. It must be suitably modified to permit the carriage of stretchers and any other necessary 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 and auxiliary equipment 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.

Appendix A

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 properly should have administrative control over aircraft rescue and fire fighting services operating on the movement area of the airport. 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
Beech	Bonanza, Model H35
Call	Callair A-2, A-3, A-4 (Ag), Super Cadet, A-6
Cessna	Models 140, 172, 180, and 182
Champion Aircraft	Champion
Colonial Aircraft	Skimmer
Fletcher Aviation	Defender, Utility
Helio	Courier 391, 391B
Monocoupe Aircraft and Engineering	Monocoupe, Models 90, 110
Mooney	Model M-18, Mite, Mark 20
Northern Aircraft (formerly Bellanca)	Cruisemaster
Piper	Super Cub, Model PA-18; Pacer, Model PA-20 and Tri Pacer, Model PA-22
Piper-Stinson	Station Wagon, Model 108-3
Ryan	Navion A, Model 205 and Navion B, Model 260
Sanders	Ercoupe Cub 212
Taylorcraft	Zephyr, Topper, Seabird
Texas Engineering and Manufacturing	GC-1B Swift; 8F De Luxe Silvaire

Article B-200. Reference Index 2

Representative Civil Aircraft 3,000-6,500 Lbs. Take-off Weight
Normal Fuel Capacities: 70 to 150 Gals.
Normal Personnel Capacities: 4 to 6

Manufacturers	Names and Symbols of Aircraft
Aero Design and Eng'g. Co.	Commander 560A
Baumann	B-290 "Brigadier"
Beech	Twin Bonanza D50, Travel Air 95
Cessna	Model 190, 195, 310
de Havilland	Drover
de Havilland Canada	Beaver DHC-2
Grumman	Widgeon G-44A
Monocoupe	Meteor Mk 2
North America	AT-6 (SNJ-2)
Piper	PA-23, Apache
Scottish Aviation	Pioneer CC, Mk 1
Transland Company	Ag-2

Article B-300. Reference Index 3

Representative Civil Aircraft 6,500-15,000 Lbs. Take-off Weight
Normal Fuel Capacities: 150 to 500 Gals.
Normal Personnel Capacities: 5 to 10

Manufacturers	Names and Symbols of Aircraft
Aero Design and Eng'g. Co.	680 Super
A. V. Roe	Avro XIX
Beech	Super 18 (E 18S), Twin Bonanza E-50
de Havilland	Heron DH114, Dove DH104
de Havilland Canada	Otter DHC3
Grumman	Mallard G-73
Hunting Percival	President, Pembroke
Scottish Aviation	Twin Pioneer

Article B-400. Reference Index 4

Representative Civil Aircraft 15,000-30,000 Lbs. Take-off Weight
Normal Fuel Capacities: 500 to 1,000 Gals.
Normal Personnel Capacities: 10 to 25

Manufacturers	Names and Symbols of Aircraft
Cessna	Model 620
Douglas	DC-3, DC-3A
Handley-Page	Marathon M-60
Lear	Executive
Lockheed	Lodestar

Article B-500. Reference Index 5

Representative Civil Aircraft 30,000-60,000 Lbs. Take-off Weight
Normal Fuel Capacities: 1,000 to 2,000 Gals.
Normal Personnel Capacities: 25 to 40

Manufacturers	Names and Symbols of Aircraft
Boeing	Stratoliner, 307B
Bristol	Model 170, Mk 21, 31, 32
Convair	Models 240, 340, 440
Curtiss	C-46F
de Havilland	Airspeed Ambassador
Douglas	Super DC-3
Fairchild Aircraft Div.	F-27 Friendship
Handley-Page	Herald HPR3
Hurel	Dubois HD32
Martin	Models 202, 202-A, 404
Northrop	Pioneer, N-23
Royal Dutch Aircraft (Fokker)	Friendship F27
SNCA du Nord	Noratlas, Nord. 2501
Svenska Aeroplan AB	Scandia
Vickers	Viking

Article B-600. Reference Index 6

Representative Civil Aircraft 60,000-90,000 Lbs. Take-off Weight
Normal Fuel Capacities: 2,000 to 4,000 Gals.
Normal Personnel Capacities: 40 to 70

Manufacturers	Names and Symbols of Aircraft
Avro (A. V. Roe)	York
Canadair	DC-4M (North Star)
Douglas	DC-4
Handley-Page	Hermes 4A (HP-81)
Short	Sandringham, Solent
Vickers Armstrongs	Viscount

Article B-700. Reference Index 7

Representative Civil Aircraft 90,000-120,000 Lbs. Take-off Weight
Normal Fuel Capacities: 4,000 to 6,000 Gals.
Normal Personnel Capacities: 60 to 100

Manufacturers	Names and Symbols of Aircraft
Douglas	DC-6, DC-6A, DC-6B
Lockheed	Constellation, Models 049, 649, 749 and 1049
Lockheed	Electra L-188*
Sud-Est Aviation	Caravelle SE210*

*Aircraft not in current commercial service.

Article B-800. Reference Index 8

Representative Civil Aircraft Over 120,000 Lbs. Take-off Weight
Normal Fuel Capacities: Over 5,000 Gals.
Normal Personnel Capacities: Over 70

Manufacturers	Names and Symbols of Aircraft
Boeing	Stratocruiser 377, Boeing 707*
Breguet	Provence 763
Bristol	Britannia 175
Convair	Model 880*
de Havilland	Comet 4*
Douglas	DC-7, DC-7B, DC-7C, DC-8*
Lockheed	Constellation, Models 1049C/E, 1049G, 1049H and 1649A
Vickers	Vanguard 950

Article B-900. High Density Seating

B-910. Reference is made in the footnote to Paragraphs 211 and 214 of aircraft employing so-called "high-density" seating requiring special consideration due to problems associated with the evacuation and rescue of occupants who may be involved in an aircraft accident. Following is a list of typical aircraft currently used in this service with their average "first class" occupancy and the minimum occupancy which classifies them in the "high-density" seating category:

Typical "High Density" Aircraft Occupancies

Type Aircraft	Average First Class Occupancy	Minimum High Density Seating
Douglas DC-4	44	68
Douglas DC-6	52	70
Douglas DC-6B	58	80
Douglas DC-7	60	95
Lockheed 649, 749, 1049	66	88
Boeing 377	75	86

*Aircraft not in current commercial service.