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SUGGESTED AIRCRAFT RESCUE AND FIRE FIGHTING EQUIPMENT AND OPERATING PROCEDURES FOR AIRPORTS

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FOREWORD

The material in this Circular is reproduced with the kind permission of the National Fire Protection Association (International)* of the United States of America and is a reprint of their pamphlets, NFPA Nos. 402 and 403 - 1954.

The Circular contains comprehensive information on extinguishing media and on rescue and fire fighting equipment, organization and procedures. Of special note is the stress placed on the value of having light mobile rescue vehicles and equipment for forcible entry into aircraft at all airports regardless of the availability of heavier major fire fighting units and the importance of training of ground crews and co-operation with aircraft operators to ensure that the former are thoroughly familiar with the physical features of aircraft operating on the airport.

To facilitate acquisition and study of this material by States, it is published in the form of an ICAO Circular but should not be construed as representing an official view held by ICAO.

* Note: The National Fire Protection Association (International) is a non-profit technical and educational organization with headquarters at 60 Batterymarch Street, Boston 10, Mass., U.S.A.. Members receive a monthly "Fire News" and four issues of the "Quarterly" of the NFPA, which provide guidance in fire prevention and protection. A special aviation fire safety program is sponsored by the Association through its Committee on Aviation and Airport Fire Protection. Periodic bulletins of special interest are distributed to members requesting this service. NFPA Nos. 402 and 403 are sponsored by an international Committee of the Association which meets periodically to keep the recommendations current and effective.

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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.

Meanwhile, in June, 1948, the International Civil Aviation Organization distributed in ICAO Circular 4-AN/3 for study by the member states the recommendations of their working party mentioned previously. No final action has been taken on these recommendations up to the present time (1954).

The current text was adopted at the 1954 Annual Meeting of the Association with one negative vote which was stated to apply to the limitations imposed on the use of dry chemical for aircraft rescue and fire fighting, Paragraphs 209.e. and 309 herein. This subject was discussed and the Committee went on record that while no change could be accepted at this time, the Committee will seek to secure further data on dry chemical usage and will keep the matter open for further discussion and evaluation during the coming years.

This publication, like its 1951 predecessor, is drafted as a "Suggested Good Practice" rather than a "Standard" since these recommendations cannot be strictly applied internationally because of varied conditions existing at airports. The recommendations, however, are applicable to all airports and may be used as a guide for local practices.

SUGGESTED AIRCRAFT RESCUE AND FIRE FIGHTING EQUIPMENT FOR AIRPORTS

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Section 100 - Introduction

101. These recommendations pertain solely to aircraft rescue and fire fighting equipment for airports. They do not include fire protection facilities for airport structures (i.e. hangars*, shops, terminals, buildings, etc.) although the equipment recommended herein might constitute valuable fire protection for such structures and their contents in many instances.

102. The threat of fire is ever present and may occur at any time when aircraft is involved in either operational or servicing accidents. Experience has shown that the most 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 very short time after outbreak and 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.

103. 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 in their immediate vicinity due to the concentration of air traffic, let down, 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.

104. These recommendations are designed to supplement the National Fire Protection Association publications entitled "Suggested Standard Operating Procedures, Aircraft Rescue and Fire Fighting" (NFPA No. 402), and "Aircraft Rescue and Fire Fighting Techniques for Municipal and Rural Fire Departments Using Conventional Fire Apparatus and Equipment" (NFPA No. 406).**

105. 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

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* See NFPA Pamphlet No. 409, "Standard on Aircraft Hangars," available from the Association, 50 cents each.

** NFPA Pamphlets 402 and 406 are available from NFPA Publications Service Department, 35 cents each.

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" should be established and airport management should provide instruction to cooperating public agencies on the special problems and techniques associated with aircraft rescue and fire fighting.

106. These recommendations are suggested for international application. The aeronautical terminology used is defined in Appendix C.

Section 200 - Basis for Recommendations

201. To provide a workable index useful in determining the minimum amounts of fire extinguishing agents for aircraft rescue and fire fighting, aircraft are grouped into the following weight categories:

Aircraft Maximum Gross Weight Ranges	Approximate Fuel Capacity Ranges*	Normal Number of Occupants**
Under 3,000 lbs.	Under 70 gals.	1 to 4
3,000 to 8,500 lbs.	70 to 150 gals.	4 to 6
8,500 to 15,000 lbs.	150 to 500 gals.	5 to 10
15,000 to 26,000 lbs.	500 to 1,000 gals.	10 to 25
26,000 to 50,000 lbs.	1,000 to 2,000 gals.	25 to 40
50,000 to 90,000 lbs.	2,000 to 4,000 gals.	30 to 45
Over 90,000 lbs.	Over 4,000 gals.	Over 45

All aircraft do not conform precisely to the above characteristics in the weight groupings indicated, but they do apply generally (see Appendix D). 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 opportunities 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.

202. It should be clearly understood that 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 201 merely indicates the relative fire

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

** See footnote to Paragraph 203 and Appendix D.

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.

203. The chief purpose of providing rescue and fire fighting equipment is to save the lives of passengers and crew. It is often necessary, particularly in transport category aircraft, to effect complete control or extinguishment of the fire to ensure such rescue. The equipment recommended herein is based upon this concept. Passenger and crew capacities* are generally related to the gross weight of the aircraft (see Paragraph 201) and thus are related to the other features useful in determining the adequacy of extinguishing agents.

204. The quantities of fire extinguishing agents recommended should be related to the heaviest weight category of aircraft normally using the facility. (For example, an airport having DC-3 operations with only one or two DC-4 landings a day should normally be equipped to handle aircraft in the 15,000-26,000 lbs. category. Prudent operators should, however, provide auxiliary facilities for a possible DC-4 emergency.)

205. The number of recurrent operations per day influences the assignment of personnel needed to man the equipment, but, basically, the type of protection provided should be in accordance with Paragraph 204. This is based on the concept that the life safety of those aboard one aircraft are no less important than those on other similar aircraft, regardless of the frequency of operations or exposures to accidents.

206. It is realized that the cost of providing the suggested aircraft rescue and fire fighting facilities might be considerable and that, in the case of remote airports, the cost may be materially more than at those located within zones where public fire protection is afforded. The scale of the facilities provided, therefore, may have to be related to the revenue produced by the air traffic and the overall requirements for such specialized fire protection in each situation. The economics of the protection must not ignore however, the life protection factors, the airline carrier investments at risk, the service rendered by the equipment for structural and other airport fire protection requirements, and the loss of revenue which could result from loss of passenger patronage due to unfavorable accident experience.

207. Heavy air traffic conditions may require an increase in the scale of facilities, especially where parallel runways are provided or where

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* An exception to this relationship results from so-called "high density" seating, most often used 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 D for further data on "high density" seating).

runways are widely spaced and exceed 8,000 ft. in length.

208. 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 recommending protection for aircraft rescue and fire fighting is in terms of the minimum amounts and discharge rates of the desired extinguishing agents for initial operations. In addition, certain objective and functional specifications may be given for equipment design and operation which may apply to existing or future designs of vehicles. (See Section 300.)

209. In order to establish the types of extinguishing agents recommended for aircraft rescue and fire fighting, it is desirable to consider certain basic principles concerning the various agents available for the purpose. These may be summarized as follows:

a) Water, used as water spray (water "fog") or otherwise, is the best universally available cooling agent for the control of fire and for personnel protection from heat. The extinguishing ability of water and water spray, however, is poor on large gasoline 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) because of its limitations in finalizing extinguishment. It is thus not recommended as the sole agent available for this type of fire fighting. Water spray is, nonetheless, so very useful 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, that its availability is recommended. This is usually entirely practical through the use of adjustable valves and nozzles on equipment designed essentially to dispense foam. The use of straight water streams discharged at high velocity is not recommended for aircraft rescue and fire fighting except where it is desired to "sweep" fuel spills from hazardous areas. 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.

b) Foam used for aircraft rescue and fire fighting is an aggregation of small bubbles of lower specific gravity than oil or water and shows tenacious qualities for covering and clinging to vertical or horizontal surfaces. It cools hot surfaces by its high water retention abilit and flows freely over a burning liquid surface to form a tough, air-excluding blanket that seals off volatile flammable vapors from access to air or oxygen. Good quality foam is dense and long lasting, resistin disruption due to wind and draft or heat and flame attack and is capable of resealing in event of mechanical rupture of an established blanket. 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 solutio (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 special foam stabilizer (a liquid) to water to make it capable of foaming in the presence of air which is incorporated by the mechanical action of jets in fixed foam maker or playpipe.

Mechanical foam (air foam) is more suitable for aircraft rescue and fire fighting because of advantages in speed of operation, reduced manpower requirements and ease of carrying the needed basic ingredient. The most serious limitation of foam for aircraft rescue and fire fighting is the time element involved in its application (usually best accomplished by the deflection of foam off the fuselage and working outwards to form a blanket over flammable liquid spills). To be effective for the primary mission of rescue, rapid discharge facilities must be available to permit application of large quantities in the shortest possible time. 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) "Fog-foam" used for aircraft rescue and fire fighting is the commonly used name applied to foam discharged at relatively high pressures in water solution through specially designed spray nozzles. It has excellent cooling effects and measurably increases the extinguishing efficiency of plain water spray (water "fog"). With its high water content (which is reflected in its cooling ability), there is, however, a sacrifice in its smothering quality as compared with "ordinary" foam (see Paragraph 209 (b)), and, hence, in the permanency of the foam blanket formed by its application on flammable liquid spills. Quantity application of "fog-foam" on an aircraft fire at a high rate of discharge provides for effective extinguishment and unexcelled cooling within the limitations imposed on any single agent method now available.

d) Carbon dioxide used for aircraft rescue and fire fighting provides a most rapid means of fire extinguishment on flammable liquids when dispensed adequately over the fire area in sufficient quantity at a sufficiently high rate of discharge. As an inert gas, its thorough penetration to otherwise inaccessible areas is particularly significant and its speed of action is tremendously important to the primary mission of rescue. The cooling effect of carbon dioxide is not always sufficient to reduce heated metal parts below the ignition temperatures of flammable liquid vapors liable to persist in the area. This introduces the hazard of reignition of such exposed flammable vapors upon diffusion of the inerting carbon dioxide gas. The permanency of extinguishment may also be affected by atmospheric conditions (particularly wind direction and velocity) but firemen's training has a great influence on this contingency.

e) Dry chemical (gas expelled) has been used extensively for aircraft fire fighting at airports in quantities up to approximately

* See "NFPA Standards for Foam Extinguishing Systems" (NFPA No. 11) for tests of mechanical (air) foam quality.

400 pounds and experimentally in larger quantities. A number of airports have "Jeeps" or similar vehicles with dry chemical tank supplies and hand lines (see Paragraph 309). Its use in larger aircraft rescue and fire fighting vehicles has been proposed and tests have been conducted but final recommendations on its absolute use are not possible at this time (January 1954) but deserves further consideration.

f) 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 recommendations at this time (January 1954). Experimentation is underway with such agents as chlorobromomethane and certain other halogenated hydrocarbons. Until complete evaluation is made, however, the use of these agents cannot be specifically recommended.

210. It should be noted from the information in Paragraph 209 that no single agent meets all the necessary qualifications for speedy and permanent aircraft fire extinguishment in event of a major aircraft fire. A combination of agents for such a major fire is thus desirable, especially for aircraft weighing over 15,000 lbs. gross weight (over 500 gals. of gasoline). The selection of carbon dioxide and foam is recommended as the most effective means currently available for handling normal, major aircraft rescue and fire fighting assignments. This combination provides for rapid blanketing, effective cooling and permanent extinguishment, assuming adequacy of agent supply and discharge facilities. The use of either of these two agents or dry chemical is recommended for "incipient" aircraft fires (see Paragraphs 209(e) and 309). The use of dry chemical in lieu of carbon dioxide may prove feasible on major aircraft fires, but until fire experience is accumulated, no recommendation can be given on its large scale use. For aircraft weighing under 15,000 pounds gross weight, the combined use of carbon dioxide and foam is likewise recommended but recognition is given to the potential successful utilization of carbon dioxide, dry chemical or foam singly by virtue of the limited fuel exposures liable to be involved. Under certain conditions, it might also be possible to extinguish incipient fires on larger aircraft with a single agent attack but the availability of carbon dioxide and foam as specified in Table No. 1 is a recommended minimum safeguard for aircraft in all weight categories.

211. The types and quantities of extinguishing media recommended in Table 1 are based on the finding indicated in Paragraph 210 and on research, large scale tests and actual experience studies in the United Kingdom and the United States as related to the particular requirements of civil aircraft operations. The quantities recommended are the minimums to be immediately available for direct application.

212. 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 Paragraph 209) 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; or (3) by cooling with water or "fog foam" (this process liable to temporarily intensify flame spread until the application is sufficient to produce the degree of cooling required). *

Section 300 - Recommendations

301. Table No. 1 indicates the quantities of carbon dioxide and water (for conversion to foam) recommended as the minimum amounts for immediate application, graded according to aircraft weight categories (see Paragraph 201) and in accordance with the findings indicated in Paragraphs 210 and 211.

302. It is recommended that equipment dispensing these agents be so designed that the total amounts of water (dispensed as foam, "fog-foam" or water spray) and the total amount of carbon dioxide indicated in Table No. 1 be discharged within 2-1/2 minutes maximum time so as to afford the desired rates of discharge considered essential to fire extinguishment or control.

303. Table No. 1 applies to all airports other than those where extremely low temperature conditions exist over extended periods of time necessitating special safeguards for the effective utilization of mobile aircraft rescue and fire fighting equipment.

304. The minimum amounts of water (for conversion to foam) and carbon dioxide suggested in Table No. 1 are based on their being immediately available for application from properly designed and equipped mobile aircraft rescue and fire fighting equipment available at the airport (see Paragraphs 307 and 309), manned by thoroughly trained and equipped aircraft rescue and fire fighting crews (see Paragraph 316). The minimum agent quantities suggested in Table No. 1 presume the existence of additional water supply facilities (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 agents carried as the initial minimums.

305. The amount of water shown in Table No. 1 for each weight grouping is the minimum considered desirable for fire extinguishment based on conversion to foam and when the foam is applied in conjunction with carbon dioxide (see Paragraph 210). The gallonage is expressed in gallons of water (not in gallons of foam) and the mechanical foam production contemplated is based upon an average expansion ratio of 10 to 1. When the water supply is used for other than foam production, the extinguishing efficiency or effectiveness should equal that of the foam method.

306. The amount of carbon dioxide shown in Table No. 1 for each weight category is the minimum considered necessary for fire extinguishment when applied in conjunction with foam (see Paragraph 210). Other inert gases (or agents which produce inert gases when applied to fire) may be utilized following

* See also NFPA Pamphlet No. 48 (25 cents), "Standards for Magnesium."

TABLE No. 1

Suggested Minimum Amounts of Extinguishing Agents and Minimum Personnel for Aircraft Rescue and Fire Fighting Operations Graded According to Aircraft Weight Categories

Aircraft by Gross Weight Categories (See Par. 201)	Minimum Quantities Extinguishing Agents (See Pars. 301-306)		Minimum Personnel on Duty (See Pars. 314-316)		Typical Civil Aircraft in Weight Category (See also Appendix "D")
	Water in U.S. Gals (For Foam Production)	Carbon Dioxide in Pounds	Full Time	Trained Auxiliaries	
Under 3,000 lbs.	300 gals.	and 300 lbs.	1	2	Piper Super Cub, Cessna 140, Beech Bonanza, Navion, etc.
3,000- 8,500 lbs.	400 gals.	and 500 lbs.	1	2	Grumman Widgeon Cessna 190, de Havilland Beaver, etc.
8,500-15,000 lbs.	500 gals.	and 750 lbs.	1	4	Beech D-18S, Grumman Mallard, Short Sealand, etc.
15,000-26,000 lbs.	750 gals.	and 1,200 lbs.	3	4	Douglas DC-3, Beech Model 34, Lockheed Lodestar, etc.
26,000-50,000 lbs.	1,500 gals.	and 2,000 lbs.	4	4	Convair Liner, Martin 202, Douglas Super DC-3, etc.
50,000-90,000 lbs.	Either 2,500 gals.	and 4,000 lbs.	4-5	6	Douglas DC-4, "North Star" Handley-Page Hermes IV, etc.
	or 3,500 gals.	and 2,000 lbs.			
Over 90,000 lbs.	Either 3,500 gals.	and 4,000 lbs.	5-6	6	Douglas DC-6, Lockheed Constellation, Boeing Stratocruiser, etc.
	or 4,500 gals.	and 2,000 lbs.			

Note 1: Maximum discharge period for dispensing the total amounts of both agents should not exceed 2 1/2 minutes for each. See paragraph 302 for further details.

Note 2: As new mediums are developed consideration will be given to modification of this Table (see Paragraphs 209 (c) and (f)).

Note 3: See also Paragraphs 309 and 310 for recommendations on auxiliary equipment.

a determination of their extinguishing efficiency and effectiveness and assuring reasonable compatibility with foam. When other such agents are used, however, their extinguishing efficiency or effectiveness should equal that of comparable amounts of carbon dioxide.

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

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 (b) of this section. This 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 multiple units available to attack a fire from more than one point or quarter.

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, the vehicle should 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 achieve 50 miles per hour within 45 seconds or in a distance of 1,400 feet, without engine preheating and with ambient temperatures above 45°F. (7°C.).

3. Braking should permit the vehicle to be brought to a stop in 20 feet when traveling 20 miles per hour, fully loaded and manned, on 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 importance of using proper tire sizes, treads and inflations cannot be overemphasized. Standard commercial vehicles may be used satisfactorily at some airports, but, at others, terrain conditions may require that special attention be given to vehicle flotation and traction. Flotation and traction on soft soil is best obtained by the use of low tire inflations. The tire load and inflation tables in Appendix A were supplied through the courtesy of the Tire and Rim Association (U.S.A.) as a guide in choosing adequate tire sizes, where

* See Paragraph 309 for vehicles under 3 tons gross weight.

terrain conditions indicate the need for low pressure (25 psi) inflations. It should be noted that the use of low pressures decreases tire loads requiring larger-sized tires and greater body clearances than is customarily provided on standard commercial vehicles. Inflations lower than 25 psi are not recommended since their use requires some provisions for preventing the tires from creeping on the rims. 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.* Great care must be used to avoid the danger of sidewall injury and pinching of tubes which may occur with under-inflated tires.

5. Angles of approach and departure should be not less than 30 degrees and center clearance not less than 15 inches, except where only flat terrain exists within the normally accessible environs of the airport.

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 specifications engineered for the terrain conditions at the airport being served. Normally, front and rear axle drive is desirable with positive four-wheel drive recommended for all difficult terrain where the need may be illustrated by actual test runs.

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.

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. Vehicle length and height should take into consideration garaging facilities.

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 not enough for large aircraft fires; elevated turrets or horns 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.

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* Full details available and published by the Tire and Rim Association, Akron, Ohio.

f) Accessory equipment desirable includes:

1) Manual Cutting, Opening and Access Tools*:

Large and small axes specially designed for piercing metallic fuselage skin surfaces (non-wedging)
Bolt, bar and metal cutters
Metal and wood cross cut and hack saws
Rounded tip knives for cutting safety belts, parachute straps (See Figure 1)
Vise and electrical wire cutting pliers
Access ladders (length depending on types of aircraft using the airport)
Screwdrivers and fastener tools
Keys to aircraft compartments

2) Manual Shifting Tools:

Crow bar and claw tool
Grappling hook and cable (with tow hooks mounted on front and rear of mobile truck)
Long handled shovels
Pike pole
Sledge hammer
Plugs and crimping tools for flammable liquid lines and tanks

3) Electrical or Mechanical Tools (may be mounted on separate Auxiliary Unit**):

Electrical, circular metal cutting saw
Electrical, push-pull metal cutting saw
Electrical lighting plant with generator
Portable public address system with batteries
Power winch or crane

4) First Aid Equipment (may be mounted on separate Auxiliary Unit)

First aid fire extinguishers
First aid medical kit
Asbestos and wool blankets
Stretchers
Resuscitator

* See Figure 2 for typical crash tool kit.
** See Appendix B.

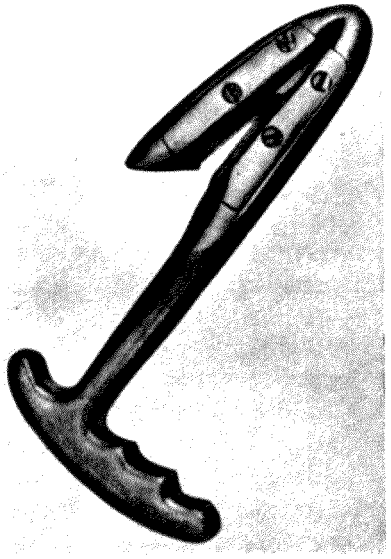

Fig. 1.

Harness Cutting Tool.

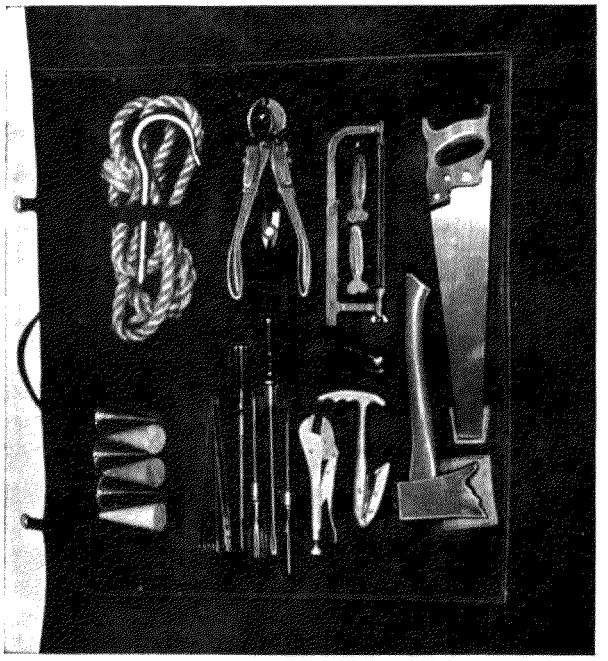

Fig. 2.

Typical Crash Rescue Tool Kit.

Fig. 3.

Typical Protective Suit.

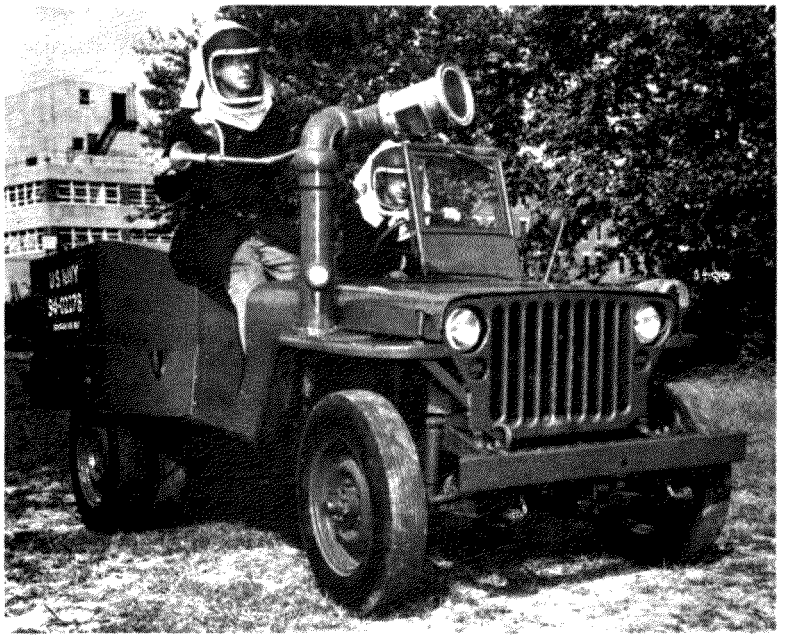

Fig. 4.

Experimental Navy "Jeep" foam rescue vehicle carries 230 gals. of water and 20 gals of foam. Designed for carrier operations.

308. The following fire fighters' personal equipment is the minimum recommended:

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 gountlet wrist protection.

c) Standard fireman boots with wool lining.

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

309. Light, mobile vehicles weighing under 3 tons gross, equipped with 100-300 gallons of water plus 10-30 gallons of foam or 100-400 pounds of carbon dioxide or dry chemical are desirable for airports regardless of the availability of heavier, major units of aircraft rescue and fire fighting equipment. These vehicles may be equipped with a turret or hand line capable of discharging the extinguishing agent content rapidly and effectively. It is very important that this vehicle have four-wheel drive and be able to achieve, when fully loaded, a speed of 50 miles per hour within 25 seconds or within a distance of 1,300 feet, without engine preheating and with ambiant temperatures above 45 °F. (7.3 °C.). The main function of such vehicles is to reach accident sites quickly, to initiate 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. Another unit of auxiliary equipment which might be desirable at larger airports is one equipped with power tools for forcible entry purposes (see Appendix B).

310. Water tank trucks are desirable auxiliary units, particularly where water supplies on and around the airport are limited. Such 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. Foam supplies and combination foam, "fog-foam," and water spray nozzles might also be carried on the tank truck.

311. No attempt is made in these recommendations 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 production rates as specified in Table No. 1 and the manpower needed to place the vehicle in full operation. Wherever possible, optimum benefits are normally achieved with mobile equipment by approaching an aircraft fire from the windward position but this is not always possible.** This dictates that turrets and hand lines should be so located

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* See NFPA "Specifications for Motor Fire Apparatus." (NFPA No. 19) for reference data.

** See Paragraph 104.

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.

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

313. All aircraft rescue and fire fighting vehicles should be painted red in accordance with "Army-Navy-Civil Uniform Requirements for the Marking of Vehicles Used on Landing Areas."* This requirement applies in the United States only, but international adoption is recommended.

314. During all operational flight periods of transport category aircraft, the principal** aircraft rescue and fire fighting unit should be driver manned, equipped with two-way radio on airport control radio station frequency, and should normally be located where maximum practicable access and observation can be obtained of the operational runways. At airports operating personal aircraft exclusively, the provision for an alert unit and driver should be optional with aircraft operators utilizing the airport. It must be emphasized that the entire purpose and function of the fire defense organization established by these recommendations will be defeated if the equipment specified is not available for immediate action the moment an accident occurs. Since all accidents cannot be anticipated, the need for an alert unit is obvious. Supplementary mobile equipment garaged at a central station should be provided with an assigned driver for each such unit. This central 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.

315. It is recommended that full crews (including auxiliaries) man the equipment and that this equipment be placed at predetermined emergency

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* See Technical Standard Order N4 (July 2, 1947) available from the Civil Aeronautics Administration, Washington 25, D.C., U.S.A.

** The "principal" unit is defined as the unit designated as the first major unit to be employed.

stations on the movement area prior to any landing or take-off under any abnormal flight or weather conditions which might increase the accident potential during such operations. 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 NFPA pamphlet "Suggested Standard Operating Procedures, Aircraft Rescue and Fire Fighting." (NFPA No. 402.)*

316. Personnel recommendations are as follows:

a) Sufficient trained aircraft rescue and fire fighting personnel (Emergency Crew) should be available during all periods of flight operations to bring into immediate employment at least one-third of the total extinguishing media specified or a minimum of one unit of equipment, whichever is the greater. This contemplates that the principal** aircraft rescue and fire fighting unit can be fully manned with full-time and auxiliary personnel within 30 seconds of an alarm and that each additional unit of equipment has a fully qualified driver-operator immediately available. Other trained auxiliary personnel should be available to complete these additional vehicle manning requirements. Table No. 1 may be used as a guide in the interpretation of these recommendations.

b) It is recommended that structural fire fighters (where available), personnel of tenants and users of the airport, as well as airport employees be trained as auxiliaries.

c) All full-time or auxiliary trained personnel (Emergency Crew) 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. This involves particularly expert knowledge of:

1. The capabilities and limitations of their mobile and auxiliary aircraft rescue and fire fighting equipment and thorough familiarity with procedures recommended for their operation and for the accomplishment of their mission.

2. The physical features of the aircraft operating on the airport particularly as to the location of:

Crew and passenger seats
Entry and exit facilities and emergency exit equipment
Forcible entry areas
Fuel tanks, fuel shut-off controls, fuel line drainage points, fuel filler caps
Battery locations and battery master switches
Lubricating oil tanks and shut-off valves
Hydraulic fluid tanks and shut-off valves

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* Available from the Association.

** The "principal" unit is defined as that unit designated as the first major unit to be employed.

De-icer tanks
Baggage compartment areas
Fire extinguishing systems and controls
Fire extinguisher locations
Heater locations and controls

3. The behavior of fuel vapors and flammable liquids and their control and extinguishment under conditions encountered in aircraft accidents. Knowledge of aircraft fuel system construction is important in this connection.

4. The methods of preventing fire following aircraft accidents where fire does not initially occur.

5. Medical first aid and the proper manner of handling injured personnel to avoid additional suffering or injury in extricating trapped occupants from crashed aircraft.

6. Flight patterns and operational practices on the airport and airspace, including knowledge of ground flight obstructions and airport topography.

317. Full-time emergency crewmen should be assigned airport fire prevention duties (inspections and fire-guard functions) and be responsible for the maintenance of all airport fire equipment but should not be given janitorial or labor duties outside their quarters or field of service.

318. The utility of and requirements for aircraft rescue and fire fighting equipment should also take into consideration such local factors as:

a) Aircraft storage practices, quantity of aircraft stored, and the inherent hazards associated therewith.

b) Aircraft maintenance activities, facilities and inherent hazards associated therewith.

c) Installed fire protective equipment provided for aircraft hangars and aircraft repair and storage buildings.

d) Gasoline handling and storage practices and the inherent hazards associated therewith.

e) Frequency of adverse weather conditions which might effect the number of emergency landings and the radio and radar landing aids provided.

f) The availability of suitably organized and equipped public protective agencies available for assistance and aid to the airport fire defense organization.

g) Flight obstructions and hazards surrounding the airport.

h) The value of the real property investments on the airport.

319. 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 E is the Official Report of the Association and full size copies are available from the NFPA.

APPENDIX A

Tires for Aircraft Rescue and Fire Fighting Equipment Maximum Recommended Loads at 25 Pounds Inflation

A Tire and Rim Association Standard

Tire Size	Ply Rating	Load at 25 PSI	Tire Size	Ply Rating	Load at 25 PSI
6.50-17	6	1000	11.00-24	12	2740
6.50-18	6	1050			
6.50-20	6	1130	12.00-20	14	2780
			12.00-22	14	2940
7.00-17	8	1115	12.00-24	14	3120
7.00-18	8	1165			
7.00-20	8	1260	13.00-20	16	3300
			13.00-24	16	3700
7.50-17	8	1260			
7.50-18	8	1320	14.00-20	18	3880
7.50-20	8	1420	14.00-24	18	4320
			16.00-20	10	5125
8.25-18	10	1530	16.00-24, 25	12	5675
8.25-20	10	1660	16.00-28, 29	12	6300
			16.00-32, 33	12	6800
9.00-18	10	1850			
9.00-20	10	1970			
			18.00-24, 25	16	7325
10.00-18	12	2060	18.00-29	16	8025
10.00-20	12	2190	18.00-32, 33	16	8700
10.00-22	12	2340			
10.00-24	12	2490			
			21.00-24, 25	16	9400
11.00-20	12	2460	21.00-29	16	10200
11.00-22	12	2600	21.00-33	16	11000

APPENDIX B

Suggested Specifications for Aircraft Forcible Entry Vehicle

This auxiliary vehicle may be useful to any airport aircraft rescue and fire fighting organization. The basic requirement for this vehicle is that it be capable of reaching any potential crash site on the movement area of the airport within 90 seconds under all normal operating conditions.

This vehicle is designed solely to make available at accident sites forcible entry equipment useful for emergency rescue work. Light fire fighting vehicles on chassis of similar design are covered under Paragraph 309 of this Pamphlet. The following specifications cover the design of this typical forcible entry vehicle:

1. Truck, 1/4 ton, 4 x 4, Kaiser-Willys "Jeep" or equivalent.

2. Generator, 110 volt, D.C. with power take-off (3KW or larger, depending upon electrical accessories used).

3. Floodlights, two 500 Watt.

4. Radio, 2-way with Airport Control Radio.

5. Siren, electric.

6. Electrical extension cord reel, 100 ft., number 10 gauge, rubber covered, two-wire conductor cord, connected to explosion-proof outlet plug.

7. Saw, electric, circular, metal cutting.

8. Saw, electric, push-pull, metal cutting.

9. Tools, manual.

a. Axes, non-wedging, metal cutting
b. Bar, wrecking, goose-neck, 3/4" x 30"
c. Bolt and cable cutter
d. Hammers, ballpeen and sledge
*e. Hatchet, 5-1/2" edge
f. Keys, aircraft compartment
*g. Knives, rescue, rounded tip (See Fig. 1, Par. 307.f.)
*h. Pliers, wire cutting, lineman
i. Pole, pike
j. Saws, hand, metal cutting
*k. Screwdrivers, 6", 8" and fastener tools
l. Shears, metal
m. Shovel, long handled
n. Snips, tinners
o. Wrenches, various sizes

* To be in belt for rescue personnel.

10. Ladder, folding, minimum 10 ft. when extended (longer if required by aircraft operating at the airport).

11. Grappling hook with 50 ft. of flexible wire cable on reel, truck mounted.

12. Flashlights, three, explosion-proof.

13. Plugs, synthetic rubber, fuel line (various sizes).

14. Fire extinguishers, two 15 lb. carbon dioxide or two 20 lb. dry chemical and one 2-1/2 gallon foam as minimum (exclusive of trailer unit).

15. Trailer hitch.

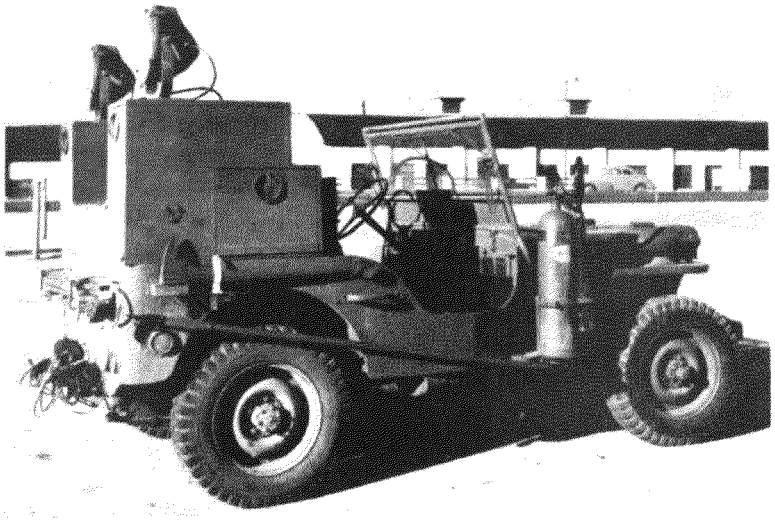


Fig. B-1.

Typical Quarter-Ton Auxiliary Aircraft Forcible Entry Vehicle.

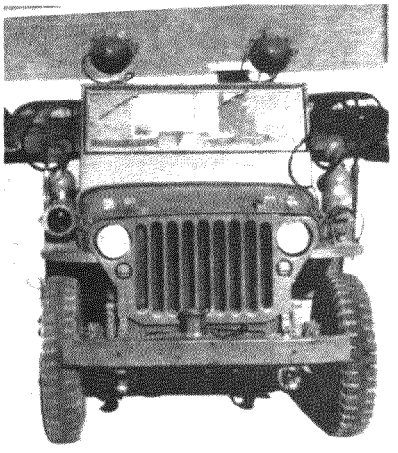


Fig. B-2.

Front View Showing Winch.

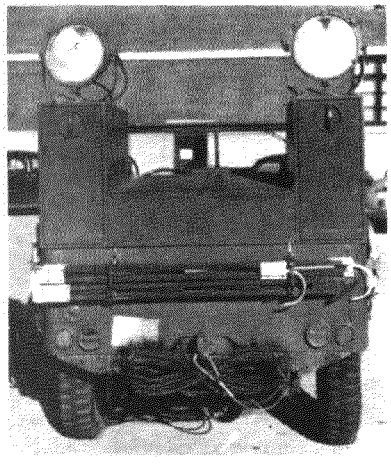


Fig. B-3.

Rear View Showing Grappling Cable.

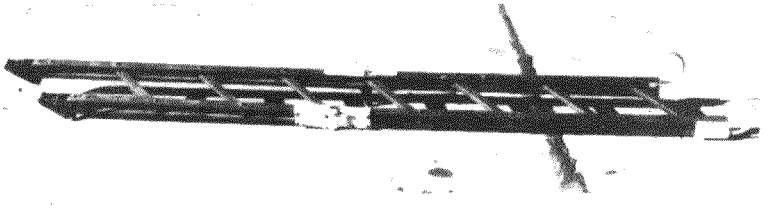


Fig. B-4.

Collapsible Ladder Opening Sideways.

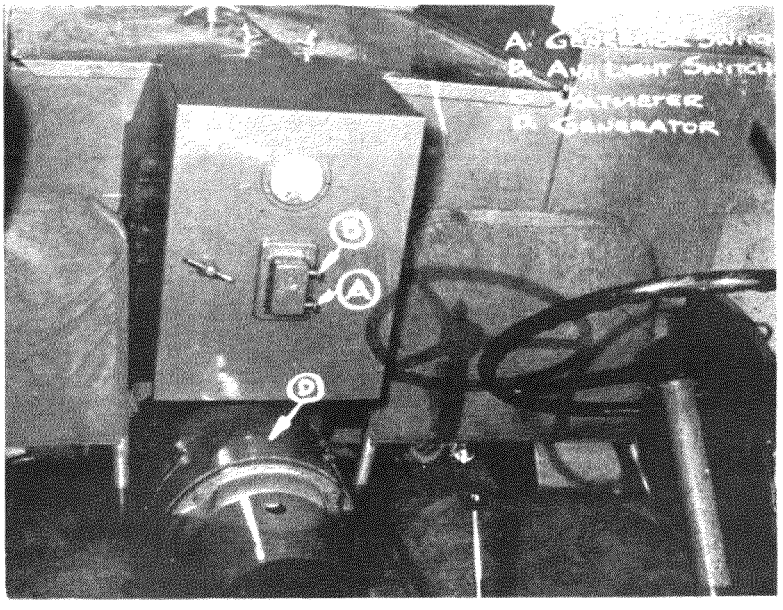


Fig. B-5.

Front Seat Showing Generator and Auxiliary Equipment as Labeled.

APPENDIX C

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

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.

Aircraft: Any machine that can derive support in the atmosphere from the reactions of the air.

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

Air Traffic: All aircraft in flight or operating on the maneuvering area of an aerodrome.

Landing Area: The part of the movement area intended for landing and take-off run of aircraft.

Movement Area: That part of an aerodrome intended for the surface movement of aircraft.

The following definitions are added to clarify the foregoing text. These definitions are promulgated by the NFPA Committee:

Aircraft Fire Fighting: The control of extinguishment of aircraft fires following ground accidents incident to aircraft rescue and thereafter. Aircraft fire fighting, as used in these recommendations, does not include the control or extinguishment of airborne fires in aircraft.

Aircraft Rescue: The removal of personnel from an aircraft which has sustained a ground accident. Rescue, as used in these recommendations, does not include search operations or medical services other than first aid treatments.

Airport Control: A service established to provide air traffic control for airports.

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 of Emergency Crew.

Chief of Emergency Crew: As used in these recommendations, 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.

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

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.

Standard Operating Procedure: A recommended good practice.

APPENDIX D

A Listing of Representative Civil Aircraft by Weight Classifications

Representative Civil Aircraft Under 3,000 lbs. Gross Weight Normal Fuel Capacities: Under 70 Gals.

Manufacturer	Name and Symbol 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
All American	Ensign 10 A
Anderson Greenwood	Model AG-14
Auster	J. 1, J. 1B, J. 5B
Beechcraft	Bonanza, Model 35
Bell	Helicopter, Model 47 D
Bellanca	Cruisemaster
Call	Callair A-2, A-3
Cessna	Models 140, 170 and 180
Engineering and Research Corp.	Club-Air, Model G
Funk	B85C
Gyrodyne Co.	Gyrodyne, Model 5
Helio	Courier 391
Jamieson	Jupiter
Kaman	Model K-225, Helicopter
Monocoupe Aircraft and Engineering	Monocoupe, Models 90, 110
Mooney	Model M-18, Mite
Piper	Super Club, 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 Club 212
Taylorcraft	Model BC-12D, Model 15 and Sportsman 19
Texas Engineering and Manufacturing	GC-1B Swift; 8F De Luxe Silvaire
United Helicopters	Hiller 360, Model UH-12

Representative Civil Aircraft 3,000-8,500 lbs. Gross Weight Normal Fuel Capacities: 70 to 150 Gals.

Aero	Commander 520
Baumann	B-290 "Brigadier"
Beech	Twin Bonanza 50
Canadian Car and Foundry	Norseman 5N-29

Manufacturer	Name and Symbol of Aircraft
Cessna	Model 190, 195
de Havilland	Beaver DHC-2 and Dove, D.H. 104
Doman	Pelican
Grumman	Widgeon, G-44A
North America	AT-6 (SNJ-2)
Piper	PA-23
Sikorsky	Helicopter S-51 and S-55

Representative Civil Aircraft 8,500-15,000 lbs. Gross Weight
Normal Fuel Capacities: 150 to 500 Gals.

A.V. Roe	Avro XIX
Beech	D 188
de Havilland	Heron DH114
Grumman	Mallard, G-73
Percival	P-50, Prince
Short	Sealand

Representative Civil Aircraft 15,000-26,000 lbs. Gross Weight
Normal Fuel Capacities: 500 to 1,000 Gals.

Beach	T-36A
Douglas	DC-3, DC-3A
Lockheed	Lodestar
Handley Page	Marathon 1 and 2

Representative Civil Aircraft 26,000-50,000 lbs. Gross Weight
Normal Fuel Capacities: 1,000 to 2,000 Gals.

Armstrong-Whitworth	AW55, Apollo
Boeing	307 B Stratoliner
Bristol	170 Wayfarer 21E
Consolidated-Vultee	Convair Liner, Model 240 and 340
Douglas	Super DC-3
Glenn L. Martin	202, 202A and 404
Northrop	N-23, Pioneer
Svenska Aeroplan A.B.	Scandia
Vickers-Armstrong	Valetta

Representative Civil Aircraft 50,000-90,000 lbs. Gross Weight
Normal Fuel Capacities: 2,000 to 4,000 Gals.

Airspeed	Ambassador (AS-57)*
A. V. Roe	York; Avro Jetliner; Avro Tudor I, II and IV
Canadair	DC-4M ("North Star")
Douglas	DC-4
Handley Page	Hastings; Hermes HP-81 and HP-82
Short	Solent 4

* Weight 52,000 lbs.; gasoline capacity 1,000 gals (Imperial)

Representative Civil Aircraft Over 90,000 lbs. Gross Weight
Normal Fuel Capacities: Over 4,000 Gals.

Manufacturer	Name and Symbol of Aircraft
Boeing	Stratocruiser 377
*Bristol	Brabazon 2, (Jet) and 175
de Havilland	Comet (Jet)
Douglas	DC-6, DC-6A, DC-6B and DC-7
*Douglas	Globemaster
Lockheed	Constellation (749A and 1049)
*Lockheed	Constitution
*Saunders Roe	Princess (Turbo prop)
*Short	S-35 Shetland

Reference is made in the footnote to Paragraph 203 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:

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

APPENDIX E

On the following four pages are reproductions of the official NFPA "Aircraft Fire Report" form. This form should be used to report aircraft fire experience to the Association. Full size (8-1/2 x 11 inches) copies are available from the NFPA Executive Office upon request.

* Indicates aircraft not in current civilian service.

NATIONAL FIRE PROTECTION ASSOCIATION

Report No. _____ **Aircraft Fire Report** Class: 840.00

Mail Promptly to Committee on Aviation and Airport Fire Protection, National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

Location of Emergency: (Give name of city, airport, nearest city, nearest airport, stating distance factors, compass directions where applicable.)

Time Factors:

Date of Accident: _____

Approximate Hour: _____ A. M. / P. M.; Time Zone: _____ (Hour)

Time of Alarm: _____ Time of F. D. Arrival: _____

Time Required to Accomplish Rescue or Removal of Occupants: _____

Time Required to Extinguish Fire: _____

Weather Factors:

General Weather Conditions:

CFR or IFR	
Approximate Ceiling	Feet
Approximate Visibility	Miles
Approximate Wind Velocity	M. P. H.

Adverse Weather was Cause of Accident ☐

Adverse Weather a Contributing Factor ☐

Effect of Weather Conditions on Fire Suppression Activity:

Terrain Conditions: (Give nature of terrain, influence on extent of aircraft damage, effect on accessibility for fire equipment, etc.)

Aircraft Data:

Type (Common name or symbol): _____ ; No. of Engines: _____ ; Manufacturer: _____

Register Number (Painted on Aircraft): _____

Aircraft Being Used for What Purpose at Time: _____

Classification (Check)

- Commercial ☐ Name of Operator _____
- Military ☐ Service Branch _____
- Manufacturer's Test ☐ Name of Company _____
- Personal ☐ Name of Owner _____
- Other ☐ (Specify) Name of Operator _____

Pilot's Name: _____

Route of Flight. From: _____ To. _____

Other Information:

Type of Accident: (Check or Specify)

- Aircraft Crash, No Fire ☐
- Aircraft Crash, Immediately Followed by Fire: ☐
- Aircraft Crash Followed by Fire but Delay in Ignition (Time Interval:) ☐
- Aircraft Fire in the Air, Fire Extinguished in Flight ☐
- Aircraft Fire in the Air Followed by Crash and Fire ☐
- Aircraft Fire (No Crash) on the Ground ☐
- Aircraft Fire (No Crash) Inside Hangar ☐
- Aircraft Fire — Other (Specify) ☐

Flight Factors: (Check or Specify)

- Crash at Take Off ☐
- Crash Immediately After Take Off ☐ (Maximum Altitude: Ft.)
- Aircraft in Flight, Power Stall ☐
- Aircraft in Flight, Explosion in the Air ☐
- Aircraft in Flight, Fire in the Air ☐ (Designate Origin:)
- Aircraft in Flight, Structural Failure ☐ (Designate Type:)
- Collision with Other Aircraft While Air Borne ☐
- Power-On Collision with Structure ☐ (Designate Type:) (Designate Height:)
- Power-On Collision with the Ground ☐ (Designate Nature:) (Designate Height:)
- Crash While Making Normal Landing ☐
- Crash While Making Emergency Landing ☐ (Designate Terrain:)
- Other (Specify) ☐

Landing Aids Available: (To be completed where such aids are a factor)

Was GCA (Ground Controlled Approach) Available? _____

Was ILS (Instrument Landing System) Available? _____

Was Aircraft Equipped with Direction Finders? _____

Was Aircraft Equipped with Radio Altimeters? _____

Was Aircraft Equipped with VHF Radio Equipment? _____

Other Landing or Navigational Aids Available or Needed (Specify which) _____

Combustibility Factors: (What Burned and How Much?)
Estimated Quantity of Aviation Gasoline Aboard at Time of Accident _____
Estimated Quantity of Aviation Gasoline Involved in Fire _____

Was Situation Such that Pilot Could Reduce Amount of Fuel before Emergency? _____
Was Such Action Taken? _____ How? _____
Result

If Other Fuel Used, Specify Type of Power Plant, Amount of Fuel, and Significant Factors: _____

Other Combustible Materials Adding to Fire that were Part of Aircraft: _____

Other Combustible Materials Adding to Fire that were Not Part of Aircraft: _____

If No Fire Resulted, Explain: _____

Ignition Factors: (What was the Source of Ignition? Examples: Fuel Tank Severed, Vapors Ignited by Hot Engine Parts, Friction Sparks, Electrical Short Circuit, etc.; Hydraulic Line Punctured, Atomized Spray Ignited by Hot Engine Parts, Electrical Short Circuit, etc.; Piston Failure Causing Cylinder Head to Crack and Escaping Oil Ignited on Hot Engine Parts, etc.; etc.): _____

Trace Progress of Fire Stating Origin and Extent of Spread: _____

Other Factors of Interest: _____

If No Fire Resulted, Explain: _____

Aircraft Protection: (To be Completed Where Applicable) _____
Did Aircraft Have Remote Control Fire Extinguishing System? _____
What Type of System (Specify Agent Employed)? _____
Was It Used? _____ What Effect Did it Have on Fire? _____
Were Aircraft Hand Fire Extinguishers Available? _____ Were They Used? _____
State Effectiveness: _____
Other Information: _____

Personnel: (Fill in Appropriate Blanks — Both Sides of Double Vertical Line)

Conditions	No. Not Injured	No. Injured	Total No. Aboard	No Burns	Minor Burns	Major Burns
No. Escaped Unaided						
No. Rescued Alive						
No. Removed Dead						
Totals						

Number Who Died Later as Result of Crash Injuries? _____
How Many Died Because of Impact Injuries? _____
How Many Died Because of Burns Received from Fire? _____
How Many Died Because of Suffocation? _____
What Special Factors are Important Regarding Personnel (Examples: Number Thrown Clear of Wreckage, Number that Parachuted, etc.; Rescue Difficulties Imposed Because of Location of Occupants, Type of Injuries, etc.) _____

Rescue, Fire Fighting and Medical Services: (If None, So State in Appropriate Spaces, If Rescue Work Performed by Fire Fighting Forces Indicate by Stating "Same" in Rescue Column.)

Factors	Rescue Forces	Fire Fighting Forces	Medical Services
Name of Organization and Sponsor of Service			
Manpower Available			
Type and Nature of Major Pieces of Equipment			
Type and Nature of Hand Equipment Utilized			

Detection and Alarm:

How Long After Accident Was It Discovered? _____

Who Discovered It? _____

Who Gave the Fire Alarm? _____

How Was the Fire Alarm Transmitted? Box: [ ] ; Telephone: [ ] ; Radio: [ ] Observed: [ ]

Other (Specified): _____

Was Site of Accident Correctly Given in the Alarm? _____

If Not, State Why and Effect of Any Consequent Delay in Rescue, Fire, or Medical Services: _____

How Long Did It Take Rescue, Fire and Medical Services to Reach the Scene and State Any Factors Involved with Comment on Effect of Time Interval: _____

What Were Fire and Rescue Conditions at Time of Arrival: _____

Fire Extinguishing Agents Used and Techniques Employed:

Agents Used	Approximate Quantity	Order in Which Employed	Technique Used in Application and Results
Carbon Dioxide (Low Pressure)	Pressure: PSI		
Carbon Dioxide (High Pressure)	Pressure: PSI		
Dry Chemical			
Foam (Premixed)			
Foam (Pick-Up)			
Water Fog	Pressure: PSI		
Fog - Foam			
Water - Straight Stream	Pressure: PSI		

What Were Water Supply Sources? _____

How Distant Was Closest Static Source or Hydrant? _____

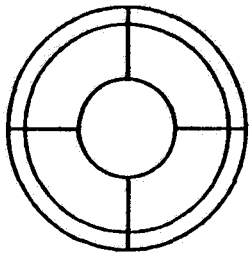
Was Enough Water Available? _____ Was Enough Special Extinguishing Agent Available? _____

Evaluation of Technique Employed. _____

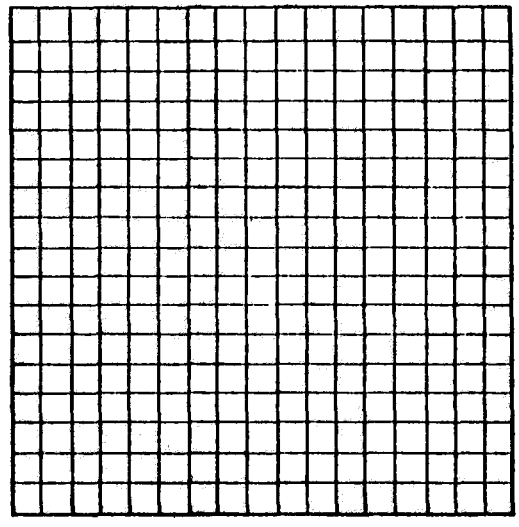
Values and Losses:

Values		Losses	
Sound Value of Aircraft:	$	Loss to Aircraft:	$
Sound Value, Other Property:	$	Loss Other Property:	$
Total	$	Total	$
Specify Types of Other Property Involved and Sub-divide Values and Losses, if Applicable:			

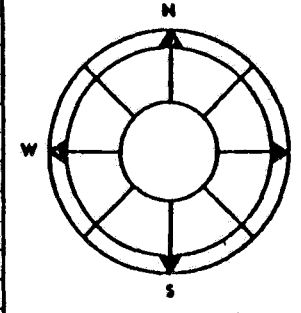
Diagram Scene of Accident: (Show as Many of the Following as Possible: Relation of Crash to City or Airport, Water Supply Sources, Placement of Aircraft and Fire Equipment, Direction of Wind, Unusual Terrain Conditions, Location of Fuel Spillages, Any Other Pertinent Factors.)



Indicate Grid Compass Directions (Letter Compass Points)



Grid Map



Indicate Wind Direction (Insert Arrow in Center Circle)

Narrative Report: (Use Separate Sheet if Desired)

Date Form Completed

Month Day Year

Name of Person Completing Form

Title Organization

STANDARD OPERATING PROCEDURES, AIRCRAFT RESCUE AND FIRE FIGHTING

NFPA No. 402 - 1954

These standard operating procedures are designed to secure maximum utilization of aircraft rescue and fire fighting equipment available at airports. The 1954 text is a revision of the 1951 version and was acted upon at the 1954 Annual Meeting of the Association held in Washington, D.C., May 17-21. The first edition of the text was adopted tentatively in 1947. The official recommendations of the National Fire Protection Association covering "Suggested Aircraft Rescue and Fire Fighting Equipment for Airports" are contained in NFPA No. 403.

This publication, like its 1951 predecessor, is drafted as a "Suggested Good Practice" rather than a "Standard" since these recommendations cannot be strictly applied internationally because of varied conditions existing at airports. The recommendations, however, are applicable to all airports and may be used as a guide for local practices.

Introduction

1. The basic premise upon which these Standard Operating Procedures are predicated is rescue of personnel involved in aircraft accidents. Control of fire incident to expeditious rescue is a necessary corollary but final extinction of fire is considered secondary to the rescue operations. Speed in response and rescue is the primary requisite.

2. The following breakdown of conditions liable to be encountered is adopted to aid in practical application of the Standards:

Condition A - On the Airport - On Land.

Situation 1: Anticipated accident at landing.
Situation 2: Potential accident during take-off.
Situation 3: Unexpected accidents and features common to all airport accidents.

Condition B - Off the Airport - On Land.

Situation 4: Normally within radius of one to five miles or within reasonably accessible distances.
Situation 5: Beyond radius described above (Situation 4).

Condition C - On or off the Airport - In the Water.

Additional Standard Operating Procedures are given to cover the following:

Local Public Fire Department Cooperation.
Aircraft Crew Training and Discipline.
Ambulance and Medical Services.

3. The following Standard Operating Procedures are predicated upon the provision of an aircraft rescue and fire fighting organization with adequate equipment (including radio facilities) and personnel. 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" should be established and airport management should provide educational instruction on the special problems and techniques associated with aircraft rescue and fire fighting to cooperating public agencies. During an aircraft fire emergency the Chief of Emergency Crew should normally be in complete charge of operational phases of aircraft rescue and fire fighting.

4. It will be noted that no differentiation is made in these Standard Operating Procedures between the various types of aircraft liable to be involved in accidents although this obviously will have a marked effect upon the type and quantity of aircraft rescue and fire fighting equipment required to handle any fire which might result. (See NFPA No. 403 for "Suggested Aircraft Rescue and Fire Fighting Equipment for Airports".*)

5. Terminology used in this standard has been adapted for international use by employing, as far as possible, definitions from the "Lexicon" issued by the International Civil Aviation Organization. (See Appendix A.)

* Available from the Association (50 cents per copy).

Condition A - Situation 1

On the Airport, on Land
Anticipated Accident at Landing

101. If, prior to landing, any abnormal condition existing on the aircraft is reported to Airport Control, a report of this condition should be made to the Chief of Emergency Crew who may order a stand-by alert, either on the landing area (at predetermined locations judged most suitable for the type of emergency) or in the fire station, as conditions warrant.

102. The Airport Control Tower will give the Chief of Emergency Crew as much of the following information as possible. * If this information is not volunteered by the Control Tower operators, the Chief will request the information from this or other reliable source.

a) Type of aircraft.

b) Number of occupants.

c) Nature of trouble.

d) Runway to be used.

The following additional information (as applicable) should be provided by Control Tower operators if time and conditions permit:

e) Position and injuries to occupants, or type of cargo.

f) Amount of fuel aboard at time of emergency and location of tanks.

g) Presence or absence of fire in flight, time burning, action taken to combat fire, its apparent origin and smoke conditions.

h) Condition of landing gear, brakes, wing flaps, etc. which might affect landing runs.

i) Power available and engines affected.

j) Pilot's visibility for landing.

k) Anticipated ground contact point and estimated run.

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* Tower operators should be expected to supply only the information indicated in subparagraphs 102 a., b., c., and d., unless it is clear that the pilot of the disabled aircraft is not engaged in more critical duties.

l) Position of control switches at time of landing:

1) Ignition and battery switches.
2) Fuel and oil cut-off switches.
3) Throttle and propeller feathering controls.
4) Fire extinguisher control switches.

m) Anticipated use of hatches and emergency escapes:

1) Whether escapes are manned for immediate use.
2) Whether escapes are jammed or blocked.
3) Whether passengers are panicky .
4) Distribution of occupants at exits.

103. Airport Control will maintain facilities for continuous verbal or radio contact with the Chief of Emergency Crew for last-minute changes in the distressed aircraft's flight plan or emergency conditions existing. Mutual aid as may be needed to help fight any fire or accomplish rescue will be called by Airport Control according to prearrangements completed by the Chief of Emergency Crew. Where advisable, Airport Control will also notify the pilot of the distressed aircraft of the emergency action being taken to receive the aircraft.

104. The Chief of Emergency Crew will supervise placing aircraft rescue and fire fighting equipment in position to facilitate response.

a) Rescue and fire fighting equipment will be spaced so that the runs will be the minimum necessary but back of the anticipated ground contact point of the aircraft in distress. A safe distance will be maintained to avoid collision with the aircraft.

b) Rescue and fire fighting equipment will be distributed parallel to the runway or landing area to be used and grouped to afford maximum utilization.

105. The Chief of Emergency Crew will place equipment "on the roll" immediately as landing is accomplished and clearance given by Airport Control to enter the movement area even if no fire is visible and apparently a successful landing has been accomplished. The aircraft will be followed until it stops and fire prevention or fire-fighting operations will be conducted until the emergency is over. It is the Chief's duty to notify Airport Control when the fire emergency ends. Airport Control has no authority to recall rescue and fire fighting equipment until the Chief of Emergency Crew pronounces the emergency terminated.

106. The possibility will not be overlooked that the aircraft might swerve suddenly because of faulty landing gear, improper brake action, tire failure, obscured vision of pilot, etc., or that the aircraft might overrun the landing area. Rescue and fire fighting equipment should not have to retract appreciably in any such contingency. This calls for long-range planning including analysis of topography, terrain conditions, fencing of the airport, mobility of equipment and mutual aid facilities.

107. Airport Control will be in charge of other field activities during the emergency and will be particularly alert for the possibility of simultaneous rescue or fire emergencies. Airport Control will keep the Chief of Emergency Crew fully advised by radio.

(See also Situation 3)

Condition A - Situation 2

On the Airport, on Land
Potential Accident During Take-off

201. Immediately upon notification or observance of potential take-off accident, the Chief of Emergency Crew will order aircraft rescue and fire fighting equipment placed "on the roll" toward the scene keeping in radio contact with Airport Control for clearance to enter movement area.

202. Great care will be exercised in this response to avoid going out of position until the accident location is defined to a given area. Remember that while the aircraft is airborne, unexpected attitudes might suddenly change the course of flight and consequently the final accident site.

(See also Situation 3)

Condition A - Situation 3

On the Airport, on Land
Unexpected Accidents and Features Common to all Airport Accidents

301. Constant observation will be maintained of flight activity from the Fire Station (advantageously located for this purpose) to supplement Airport Control personnel. This observation should be conducted by personnel familiar with aircraft, the airport operating regulations, normal air traffic patterns, and accepted principles of safe ground operation of aircraft. They should be provided with every possible visual aid including binoculars and should also have radio and telephone or loud speaker interphone communication facilities for prompt transmission of alarm and contact with Airport Control. Proper location of the Fire Station to afford maximum visibility of movement area is essential.

302. Emergency Crew personnel will take turns on alert duty during all hours of flight activity. Observation duties should include the following visual checks:

a) Clearance of movement area for arriving and departing aircraft.

b) Continuity of power in aircraft engines in the air and at time of take-off.

c) Clearance of structures, trees, and other obstructions.

d) Taxiing operations, ground operations of engines, security of landing gears, and aircraft maintenance operations on the flight line (including fuel servicing).

303. When approaching an aircraft fire, rescue and fire fighting equipment will be placed so as to facilitate rescue. The following conditions will be particularly noted:

a) Wind direction.

b) Location of fire and its extent at time of arrival.

c) Location of fire relative to personnel involved.

d) Relation between wind, fire, personnel and fuel tanks.

e) Terrain conditions and exposures.

f) Flammable liquid spillages.

Proper training of drivers of the equipment is vital in this connection.

304. Emergency Crew personnel used for rescue work will be protected with appropriate agents when entering any fire zone to accomplish rescue and will wear protective clothing. Protective clothing recommended includes:

a) Bunken 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 firemen boots with wool lining.

d) Firemen helmet with plastic full vision face shield, and front and neck protective aprons. *

305. All available lines will be charged for use on the fire after equipment is properly positioned irrespective of the extent of the fire at time of arrival. This will assure an immediate discharge available in case of a gasoline flash which would endanger emergency crews and equipment at the scene as well as occupants of the aircraft. If no fire is visible, all equipment will be placed in immediate readiness for service with lines laid but not charged.

* See NFPA No. 403, for information on protective clothing and rescue tools.

306. All spills of flammable liquids will be neutralized or blanketed with foam as quickly as possible taking into consideration the water requirements for the primary rescue mission and the total supply available.

307. Since a continuous water supply is essential and usually not available at all points on an airport, pumpers will be immediately positioned at the time of alarm to relay water to the aircraft rescue and fire fighting equipment and the lines charged upon direction of the Chief of Emergency Crew. In addition, general purpose vehicles will be available on prearranged schedules to bring additional supplies of extinguishing agents and equipment to the scene. (If the airport maintenance equipment includes a ladder truck or portable emergency lighting equipment, it is important that prearrangements include the automatic response of such mobile facilities.)

308. Rescue operations will be accomplished through regular doors and hatches wherever possible but emergency crews must be trained in forcible entry procedures and be provided with the necessary tools. *

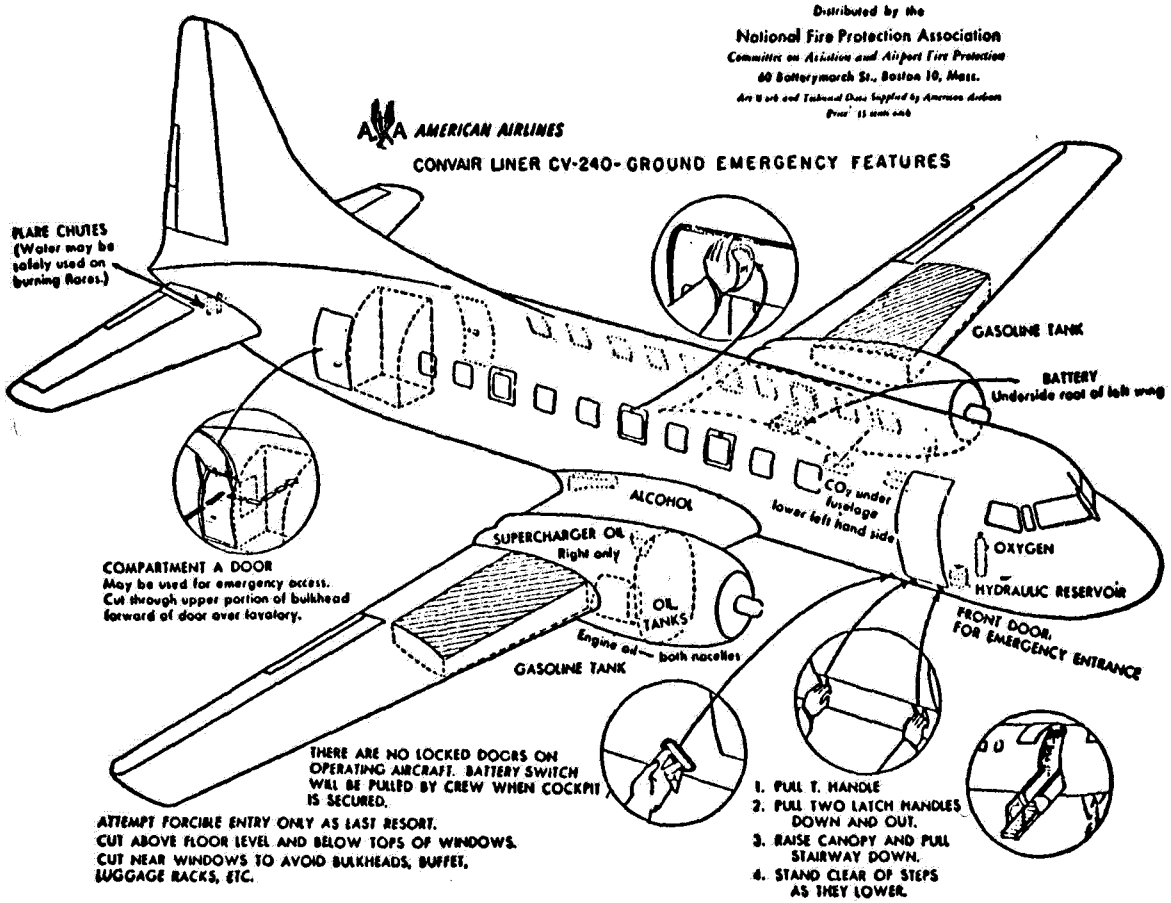

Fig. 402-1

Aircraft charts such as this one of the Convair CV-240 as operated by American Airlines are useful tools for training aircraft rescue and fire fighting personnel. Copies of this and similar charts of some other aircraft are available from the NFPA for 15 cents each (8-1/2 x 11 inches, two colors).

* See NFPA No. 403, for information on protective clothing and rescue tools.

309. Rescue of personnel involved in aircraft accidents will proceed with the greatest possible speed. While care will be necessary in the evacuation of injured occupants so as not to aggravate such injuries, removal from the fire threatened area is the primary requirement. (See Paragraphs 901-903.)

310. One member of the Emergency Crew will be detailed to disconnect the battery and to check the ignition, fuel, and fire extinguisher cockpit control switches and firewall shut-off valves to limit the extent of fire whenever such action is made possible by the fire condition existing. Only fully competent fire fighters should be assigned this duty to avoid the hazard of untrained men causing further damage or upsetting critical settings on instruments that might be subject to technical investigation to determine the cause of the accident. (See Paragraphs 319 and 320.)

311. Broken fuel, hydraulic fluid (flammable type), alcohol and oil lines will be plugged or pinched to reduce the amount of spill and extent of fire.

312. If the source of heat cannot be removed and flames threaten, fuel tanks will be cooled by appropriate agents and vented to prevent explosion.

313. Where immediate rescue entrance cannot be achieved, bayonet type nozzles might be employed to distribute water spray ("water fog") in the interior of the aircraft to reduce the hazard to life of those occupants trapped inside.

314. Windows of aircraft may often be used for rescue or for ventilation. Some windows are designed as emergency exit hatches. On newer transport aircraft, these hatches are marked and have latch release facilities on the outside. Many emergency hatches open outward but some push inward. A knowledge of the design features of the exits on different aircraft is essential for the rescue crew. Plastic window panels are often heated above the "forming" temperature of the material (about 250°-300° F.) by a fire. They then become elastic and rubbery and are very difficult to shatter with an axe or sledge. *

315. Interior portions of the aircraft will be ventilated before removing the aircraft after rescues have been accomplished and the fire extinguished. Runway and ground surfaces will be thoroughly flushed of all flammable liquid spills before moving aircraft or permitting normal traffic to resume. Gasoline tanks will be drained (approved methods followed for fire safety) prior to removing aircraft if conditions necessitate and permit. One rescue and fire fighting unit will be retained at the site while this work is performed. If the aircraft or parts must be removed prior to completion of full investigation and safetying, a record should be made of the accident locations of all parts and care exercised to preserve any evidence available that might help determine the cause of the accident. (See also Paragraphs 319 and 320.)

* Experiments have shown that cooling the panels to below the forming temperature with carbon dioxide to facilitate shattering is not practical.

316. Assure that the "No Smoking" rule is enforced at the scene of the accident and in the immediate vicinity.

317. Where the use of grappling hooks or tow chains must be used to expedite rescue or to assist in controlling fires, exercise discretion lest such a procedure result in strains which might release quantities of fuel from partially damaged tanks or cause greater injuries to entrapped personnel.

318. Burning magnesium parts should be covered with dirt, sand, or special powder extinguishing agents to prevent reflashes.

319. Emergency crews should avoid operation of any controls on a damaged aircraft (post fire) other than absolutely necessary.

320. Emergency crews should be prepared to present a record of exactly what controls were handled in which manner and what damage to the aircraft was caused in gaining access or in otherwise carrying out their rescue, fire fighting or fire prevention responsibilities.

Condition B - Situation 4

Off the Airport, on Land Normally Within Radius of One to Five Miles or Within Reasonably Accessible Distances

(See also Situation 3 and Appendix B)

401. Despite any delay in transmission of alarm, pre-designated aircraft rescue and fire fighting equipment will be dispatched by the Chief of Emergency Crew to all accidents within the radius described or a similar radius where response is adjudged necessary because of factors surrounding the particular accident or life hazards presented.

402. Aircraft rescue and fire fighting equipment held in reserve will be only auxiliaries capable of handling incipient fires. Airport control will be immediately advised of the substandard fire defense facilities available and will be in constant radio contact with the emergency units off the airport attending the accident.

403. All off-airport areas within the radius described will be plotted on a grid or azimuth map and the exact location of any accident will be spotted by coordinates as soon as established. Copies of this map will be mounted in every piece of aircraft rescue and fire fighting equipment, in the Fire Station, and in the Airport Control Tower. It is recommended that this map also be circulated widely within the geographical vicinity of the airport with copies made available to such agencies as: local public fire departments and equipment, police stations and cruiser cars, hospitals and ambulance services, telephone exchanges, gasoline stations, and selected citizens. One or more local aircraft should also possess copies for possible use in spotting accident sites from the air. Prearrangements with all available fire protection agencies in the area are essential.

404. Response by aircraft rescue and fire fighting equipment will be organized to avoid delays en route. Local police cooperation will be prearranged. Radio equipment will keep the major equipment, the Fire Station, and Airport Control within constant communication. Wherever possible, local fire departments will also be tied into this radio network.

405. The fastest and most mobile aircraft rescue and fire fighting equipment will proceed independently of slower heavier units, but the former will direct the latter by radio, supplying route information wherever necessary.

406. Auxiliary water tank trucks and pumpers with auxiliary water tanks will be dispatched wherever there is an indication of their possible utilization and especially when the accident site is known to be beyond normal fire-protected zones (underground water mains and hydrants) or where water relays may be required.

407. Special aircraft rescue tools will be arranged in a kit for manual transportation to accident sites when circumstances prevent close approach by motorized units (i.e. marshy land, heavily wooded areas, high structures, etc.).

408. Judicious utilization of agents supplied is particularly important in unprotected off-airport locations and techniques of employment must be carefully selected to permit most advantageous use.

409. Prior surveys of off-airport terrain and traffic conditions will be made to prevent delays at time of emergency. Significant factors will be charted on the grid maps supplied to aircraft rescue and fire fighting equipment.

410. Prearrangements with police agencies will be made to handle crowds, to enforce "No Smoking" regulations, and to preserve property and evidence useful in determining the cause of the accident.

411. Damaged aircraft will be tethered for protection against wind damage wherever possible and necessary to preserve evidence as investigations may be prolonged. Souvenir collection will be prohibited and firemen will be instructed in restricting unnecessary damage to the aircraft. (See also Paragraphs 310, 319 and 320.)

Condition B - Situation 5

Off the Airport, on Land Beyond Radius Described in Situation 4

(See also Situations 3 and 4)

501. Only one unit of aircraft rescue and fire fighting equipment will normally respond to crashes over five miles from the airport. This unit will be the most mobile and self-contained available, possessing a combination of

agents and equipment for employment as the individual situation warrants. The airport protection will not be unjustly jeopardized by prolonged absence of emergency equipment unless the airport can be closed to air traffic during the period of the emergency.

502. Response to these distant accidents will be in cognizance of the danger that, in some, ignition is a delayed result of impact, that only trained aircraft rescue and fire fighting crews are capable of safetying damaged aircraft to eliminate potential fire hazards, and that removel of any trapped occupants from the danger zone may require special equipment.

503. Aimless wandering to fix exact location of the accident will be forestalled as much as possible by coordination of effort between local police, fire department, and spotter aircraft. Radio communication is essential in this regard.

Condition C

On or Off the Airport, In the Water

601. All available aircraft rescue and fire fighting boats will be immediately dispatched, equipped with standard facilities and adequate crews.

602. Coast Guard, Naval, and municipal or similar fire and rescue units (as might be available) will be immediately notified and requested to assist in the emergency. This request will normally be made irrespective of the apparent seriousness of the accident and according to prearrangements.

603. Normally sweeping fire away from the aircraft with hose streams is the best practice in aircraft fires on water, but ample foam and water fog should be available for suppression purposes and rescue entry in case of extensive flammable liquid spills which might cover wide areas. It should be appreciated that calm waters produce worse surface fires than rough seas. Rescue boats should approach from the windward side and the fire attacked off the quarter and from broadside as the rescue boat maneuvers. (It is very difficult to maintain a stationary position in this type of fire fighting and excellent maneuverability is the primary operating requirement of boats used for this service. Turrets should be capable of 360° rotation.) Land rescue and fire fighting equipment will be mobilized to bring additional supplies of required agents to the nearest docking facilities.

604. Immediate attention must be given to occupants injured or trapped inside the aircraft particularly when fire is involved or the buoyancy of the damaged aircraft is in question. Those who have escaped unassisted and can swim in fire-free areas should be encouraged to help themselves until trapped persons and non-swimmers can be removed to safety by rescue forces. Life preservers should be standard equipment on rescue launches. Any apparent flammable liquid spills which have not been ignited should be swept away from the danger zone with hose streams as quickly as possible. The aircraft battery should be disconnected promptly. Ignition switches, fuel switches and firewall fluid shut-off valves should be closed. Motor launch backfires should be prevented.

Local Public Fire Department Cooperation

701. Local public fire departments will be periodically included in aircraft rescue and fire fighting training activities conducted at the airport by participating in drills, tests, and aircraft familiarization programs. Such activities will be specifically pointed toward increasing the utility of local fire defense personnel in handling off-airport accidents and assisting in a mutual aid capacity for serious airport accidents. Municipal and rural fire departments may refer to NFPA Pamphlet No. 406 for information on "Aircraft Rescue and Fire Fighting Techniques Using Conventional Fire Apparatus and Equipment". (See also Appendix B, Paragraph 6 thereof.)

702. Confidence in handling aircraft fires can only result from actual aircraft fire experience or training in realistic simulated accidents. Local fire department crews which arrive at the scene of an aircraft fire first will be instructed to proceed with the rescue and fire suppression work. Upon arrival of specialized airport equipment, the Chief of the Airport Emergency Crew will consult with the public Fire Department Chief on what rescue efforts have not been successfully completed and will direct the combined crews to assist in the furtherance of this aspect of the accident. After rescues are completed, both agencies will concentrate on final extinguishment, the division of responsibilities being a matter for individual determination by those in charge in accordance with previous arrangements.

703. Local public fire departments will be tied in closely with the airport emergency alarm service, preferably by radio or direct line telephone. They will be supplied with grid maps used for spotting accident locations. They will be encouraged to carry special equipment for aircraft rescue and fire suppression purposes (not uncommon to equipment which might be carried for gasoline tank truck or other flammable liquid fire fighting work).

704. Local public fire departments will be offered schooling in aircraft fire hazards and physical structures of the types commonly operating out of the airport involved.

Aircraft Crew Training and Discipline

801. Since many emergency landings are caused by fires sustained in flight, it is vitally important that aircraft crews be well trained and disciplined in fire prevention and what to do in such an emergency. Knowledge of proper operation of installed fire protection systems in aircraft is the first essential. Important points for engine fires in multi-engine aircraft are:

a) Warn other aircraft crew members.

b) Place mixture control at idle cut-off.

c) Feather propeller, affected power plant.

d) Turn-off fuel to affected power plant.

e) Close firewall fluid shut-off valves (fuel, oil, hydraulic fluid) of affected power plant.

f) Switch-off ignition to affected power plant.

g) Check position of cowl flaps, affected power plant.

h) Select extinguisher position and operate system.

This procedure presupposes sufficient altitude to avoid ground collision from loss of power. Aircraft crews will also be familiar with hand fire extinguishers on board the aircraft and how they are properly operated. Cabin and cargo section fires must be promptly and effectively blanketed to avoid danger of asphyxiation of crew and passengers.

802. Aircraft crews will be instructed in the air flow configurations and methods which can be taken to prevent spread of fire and smoke throughout the aircraft. The dangers of opening doors and windows will be thoroughly understood.

803. Radio notification of emergency landings from the pilot will include information on:

a) Type of aircraft.

b) Number of occupants.

c) Nature of trouble.

d) Runway to be used.

(See Paragraph 102 for possible supplementary information which might be volunteered if time and conditions permit.)

804. The aircraft crew can also be of great assistance to the ground aircraft rescue and fire fighting crews by taking as many of the following steps as possible to prevent or limit the amount of fire after landing:

a) Switch-off ignition and battery.

b) Stop flow of fuel and oil by operating cut-off switches.

c) Activate the installed fire protection systems at time of ground impact (if not done for control of fire in flight) even if no fire exists.

d) Open emergency hatches just before landing to prevent entrapment caused by jamming of escapes by impact stresses. (This is not recommended where an airborne fire is in progress affecting cabin or crew compartments or where flames might enter cabins from powerplant fires through such openings.)

e) In some cases, especially with wing fires, it is possible to shift the position of the aircraft after landing by braking in such a

manner that the wind will carry flames away from the fuselage and main fuel cells.

f) When circumstances permit, bring aircraft to rest on paved surfaces to permit easy approach by aircraft rescue and fire fighting equipment.

g) Maintain as much discipline as possible among passengers to prevent panic. Organize escape routes to prevent "bottlenecks" at certain exits. Enforce the use of safety belts during the landing.

h) Provide technical information to the Chief of Emergency Crew but do not attempt to direct the Emergency Crews in the performance of their duties.

Ambulance and Medical Services

901. Ambulance and medical services, like rescue and fire fighting services, will be provided to administer aid to those involved and in need of medical assistance. Response of ambulances to the emergency will be automatic regardless of whether or not it is apparent that medical services are required.

902. Ambulance and medical services may be an integral part of the rescue and fire fighting organization and this is recommended. A specialized attendant will be available during all operating periods to perform the dual function of ambulance driver and first-aid practitioner. Where operations are of such nature that a permanent ambulance service is not feasible, prearrangements with local, private or public services will result in prompt dispatch of a satisfactory assignment of ambulance and medical services. Where the latter arrangement is relied upon, it is of special importance that aircraft rescue and fire fighting crews be well trained in first-aid practices.

903. Doctors will be on immediate call for all emergencies and will be notified of such emergencies by Airport Control according to prearranged schedules and procedures.

APPENDIX A

A-1. The following definitions of terms are extracted from the "Lexicon" issued by the International Civil Aviation Organization:

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.

Aircraft: Any machine that can derive support in the atmosphere from the reactions of the air.

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

Air Traffic: All aircraft in flight or operating on the maneuvering area of an aerodrome.

Landing Area: The part of the movement area intended for landing and take-off run of aircraft.

Movement Area: That part of an aerodrome intended for the surface movement of aircraft.

A-2. The following definitions are added to clarify the foregoing text. These definitions are promulgated by the NFPA Committee:

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 these recommendations, does not include the control or extinguishment of airborne fires in aircraft.

Aircraft Rescue: The removal of personnel from an aircraft which has sustained a ground accident. Rescue, as used in these recommendations, does not include search operations or medical services other than first aid treatments.

Airport Control: A service established to provide air traffic control for airports.

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 of Emergency Crew.

Chief of Emergency Crew: As used in these recommendations, 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.

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

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.

Standard Operating Procedure: A recommended good practice.

APPENDIX B

B-1. The following information is published by the United States Government, Departments of the Army, the Navy and the Air Force, under Special Regulation No. 95-50-1 (Navaer 00-80C-501, Air Force Regulation No. 92-4), dated 28 August 1951, under the title "Procedure for Aircraft Crash Fire Fighting and Rescue," and is reproduced here for the information and guidance of civil authorities.

5. Applicability to Non-Military Airfields: These regulations are not directly applicable to airfields and airports not under the management jurisdiction of departments or agencies of the Department of Defense. However, these procedures are applicable in principle to such locations and adoption of these or equivalent procedures should be encouraged, particularly where such airfields are located in proximity to a military airfield, or are utilized recurrently by military activities.

6. Coordination: Coordination and cooperation between Defense departments and agencies, and between field commands and installations thereof is essential. Similar coordination and cooperation between military and civil airport and municipal fire fighting organizations is most desirable and should be encouraged to the utmost. Execution of mutual agreements between responsible activities referred to above is encouraged in order to have available within their respective agencies well coordinated plans for fire fighting and rescue in off-installation crashes.

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52. Special Action Involving Hospital Aircraft Movements: Crash rescue crew will be notified of impending hospital evacuation take-offs and landings sufficiently in advance to permit mobilization of emergency precautionary procedures. Upon receipt of such notification the following action will be taken:

a) At least one major crash truck, ..., with crew, will assume a strategic position to afford rapid response in the event of accident.

b) As soon as aircraft has landed, crash truck will proceed to the immediate vicinity of the unloading position.

c) Crash truck and crew will stand-by hospital aircraft for the entire period that incapacitated or litter patients are aboard, in readiness for instantaneous action.

d) Fueling of hospital aircraft will be accomplished when patients are aboard only when absolutely necessary.

e) For departure of hospital aircraft the procedure prescribed above will be reversed.

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53. Grid Map:

(NOTE: The 15-mile radius referred to herein is considered an optimum approximate distance and may be modified to conform to local conditions and terrain.)

a) A system for locating and reaching an off-the-base crash in a minimum time, with as much crash fire, rescue and medical equipment as circumstances warrant, must be employed at each airfield.

b) A map of the base and surrounding area of approximately 15 miles radius must be maintained at the operations office, air traffic control tower, crash fire and fire stations, hospital and security office. These maps should be ruled off in numbered grids and marked for easy location of any point within the map area. Compass headings from the fields will be ruled on the map to facilitate location of crashes by aircraft. Copies of this map must be kept in all vehicles and liaison aircraft that may be sent off the field in the event of a crash. Such maps should be coordinated between all airfield activities in the general area.

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55. Notification:

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b) Any person receiving information of an off-the-base crash should immediately notify the base operations office. Individual receiving information should ascertain as near as possible the location of crash, type of airplane involved and name of person transmitting this information.

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64. Action by Provost, Police or Security Officer:

a) The provost, police or security officer or his representative, and guards, proceed to the scene of an off-the-base crash with other elements of the convoy.

b) Upon arrival at the scene of the crash, guards are posted for the purpose of preventing unauthorized personnel from reaching the immediate vicinity of the accident.

c) He takes whatever steps are necessary to assure that rescuemen and equipment are not hampered.

d) Where necessary, he requests civilians to assist in the interest of public safety.

e) He covers or conceals, if possible, any personnel or equipment which should not be exposed to general view.

f) He turns control of civilians over to the civilian police officers if present.

g) He informs property owners that the government cannot be responsible for damage caused by civilian trespassers.

h) He allows local officials such as the coroner or police officers to accomplish whatever work is necessary.

i) He sees that no information is given to the press or civilians regarding personnel involved in the accident, except in accordance with military regulations.

j) He posts proper relief of military guards.

65. Action by Liaison Aircraft:

a) Where necessary, a liaison or other aircraft is used to locate and guide crash trucks and convoy in reaching the scene of the crash.

b) Aircraft guidance is accomplished by:

1) Radio contact with control tower, or with convoy, as appropriate.

2) The following visual and audible signals:

Airplane Signal	Meaning
Jazzing engine (3 blips)	Follow me
Jazzing engine (3 blips) immediately followed by chandelle ending in direction of home airport	Go back to home airport
Short dives and zooms	Standard signal for yes
Fishtailing	Standard signal for no
Steep turn to the right	Turn right next road
Steep turn to the left	Turn left next road
Circling (left) or Dive (Pointing to crash scene)	Here is your stop
Engine cut full back	Stop; go by foot
Rocking wings from side to side, or green flashes on signalling lamp	Message received and understood
Making a complete right-hand circuit, or red flashes on signalling lamp	Message not understood

c) Pilot of liaison aircraft circles crashed aircraft when not directing crash trucks or convoy to the scene of the accident until relieved, fuel supply permitting.

- END -

ICAO TECHNICAL PUBLICATIONS

The following summary gives the status, and also describes in general terms the contents of the various series of technical publications issued by the International Civil Aviation Organization. It does not include specialized publications that do not fall specifically within one of the series, such as the ICAO Aeronautical Chart Catalogue *or the* Combined Meteorological Tables for International Air Navigation.

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES are adopted by the Council in accordance with Articles 54, 37 and 90 of the Convention on International Civil Aviation and are designated, for convenience, as Annexes to the Convention. The uniform application by Contracting States of the specifications comprised in the International Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of international air navigation. Knowledge of any differences between the national regulations or practices of a State and those established by an International Standard is essential to the safety or regularity of international air navigation. In the event of non-compliance with an International Standard, a State has, in fact, an obligation, under Article 38 of the Convention, to notify the Council of any differences. Knowledge of differences from Recommended Practices may also be important for the safety of air navigation and, although the Convention does not impose any obligation with regard thereto, the Council has invited Contracting States to notify such differences in addition to those relating to International Standards.

PROCEDURES FOR AIR NAVIGATION SERVICES (PANS) are approved by the Council for worldwide application. They comprise, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome. As in the case of Recommended Practices, the Council has invited Contracting States to notify any differences between their national practices and the PANS when the knowledge of such differences is important for the safety of air navigation.

REGIONAL SUPPLEMENTARY PROCEDURES (SUPPS) have a status similar to that of PANS in that they are approved by the Council, but only for application in the respective regions. They are prepared in consolidated form, since certain of the procedures apply to overlapping regions or are common to two or more regions.

The following publications are prepared by authority of the Secretary General in accordance with the principles and policies approved by the Council.

ICAO FIELD MANUALS have no status in themselves but derive their status from the International Standards, Recommended Practices and PANS from which they are compiled. They are prepared primarily for the use of personnel engaged in operations in the field, as a service to those Contracting States who do not find it practicable, for various reasons, to prepare them for their own use.

TECHNICAL MANUALS provide guidance and information in amplification of the International Standards, Recommended Practices and PANS, the implementation of which they are designed to facilitate.

ICAO CIRCULARS make available specialized information of interest to Contracting States.

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