NFPA No.
403
File: 400 Series
Aviation

NFPA HISTORICAL

Suggested

Aircraft Rescue and Fire Fighting Equipment for Airports

June

1956

Fifty Cents*

NATIONAL FIRE PROTECTION ASSOCIATION
International
60 Batterymarch Street, Boston 10, Mass.

2M-6-56-FP

*Discount for Quantities

Printed in U.S.A.

National Fire Protection Association

International

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

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

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

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

Definitions

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

SHALL is intended to indicate requirements.

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

APPROVED refers to approval by the authority having jurisdiction.

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

Approved Equipment

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

Suggested
Aircraft Rescue and Fire Fighting Equipment for Airports

NFPA No. 403 — 1956

Foreword

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

NFPA Committee work continued during 1948 and in 1949 the Association adopted a tentative text at its Annual Meeting held in San Francisco, California. At the time of its tentative adoption, representatives of the Airport Operators Council and the American Association of Airport Executives presented formal resolutions objecting to certain portions of the text. During 1949 and 1950 further meetings were held during which time the airport management groups were invited to participate. In 1951 a revised text was submitted for final adoption by the Association at its Annual Meeting in Detroit, Michigan, and unanimously accepted. Subsequently, the text was revised in 1954, 1955, and in 1956. This edition contains the most recent changes (1956).

Meanwhile, in June, 1948, the International Civil Aviation Organization distributed ICAO Circular 4 — AN/3 which contained the recommendations of their working party mentioned previously. In February 1955, the ICAO reproduced the 1954 editions of this text and NFPA No. 402 in ICAO Circular 41 — AN/36. This publication is printed in English, French and Spanish editions and is available from ICAO Offices in Montreal, Canada; Paris, France; Lima, Peru; London, England; Cairo, Egypt; Bangkok, Thailand; and New Delhi, India.

The current text was adopted at the June 1956 Annual Meeting of the Association. Changes of more than editorial significance were made in Paragraphs 307.(b)2, 307.(b)5 and 307.(b)6 and in Appendix A. Some reshuffling affecting Paragraphs 308–316 was done as an editorial improvement.

This publication 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. A great many of the recommendations are applicable to some airports but they cannot be applicable to all airports and should be used only as a guide, giving due consideration to local conditions.

Committee on Aviation and Airport Fire Protection

Jerome Lederer,† *Chairman*
Managing Director, Flight Safety Foundation, 468 Fourth Avenue, New York 16, N. Y.

George H. Tryon, III,† *Secretary*
National Fire Protection Association, 60 Batterymarch St., Boston 10.

EXECUTIVE DIVISION

Harvey L. Hansberry, *Chairman*
Fireye Division, Electronics Corp. of America, Holliston, Mass.

J. C. Abbott,* British Overseas Airways Corp.

Col. Edwin E. Aldrin,† Institute of the Aeronautical Sciences.

Ben W. Ashmead, Civil Aeronautics Board, Bureau of Safety Investigation.

J. A. Bono, Underwriters' Laboratories, Inc.

J. A. Brooker, Ministry of Transport and Civil Aviation (United Kingdom).

Carl M. Christenson,* United Air Lines.

Gifford T. Cook, Hq. Department of the Air Force.

Allen W. Dallas,* Air Transport Association.

Charles Froesch, Society of Automotive Engineers, Eastern Air Lines.

Francis E. Kimble, Jr., National Association of State Aviation Officials, N. J. Bureau of Aeronautics.

Jerome Lederer,† (Ex-officio), Flight Safety Foundation.

Carl Ljungberg,**† International Civil Aviation Organization.

W. A. McCallum, Squadron Leader, Royal Canadian Air Force Fire Marshal.

C. M. Middlesworth,† Civil Aeronautics Administration, Technical Development and Evaluation Center.

J. A. O'Donnell,* American Airlines.

William H. Rodda, Transportation Insurance Rating Bureau.

Clarence N. Sayen, Air Line Pilots Association.

W. B. Spelman,† Civil Aeronautics Administration, Office of Aviation Safety.

Douglas C. Wolfe, American Association of Airport Executives, Broome County Airport (Binghamton, N. Y.).

TECHNICAL DIVISION

J. R. W. Barrette,* Parker & Co.

Neill G. Bennett,* Graviner Works.

W. E. Bertram,* Northwest Airlines, Inc.

Richard J. Brady,*† Port of New York Authority Fire Dept. (LaGuardia).

G. A. Brelie,* Ansul Chemical Company.

John W. Bridges, Military Air Transport Service, Dept. of the Air Force.

V. H. Brown, Air Line Pilots Association.

Harold J. Burke, Fire Equipment Manufacturers Association.

C. L. Byram,*† District of Columbia Fire Dept.

Robert C. Byrus,* Fire Service Extension, University of Maryland.

John Cardoulis, Northeast Air Command.

Joseph M. Chase, Flight Safety Foundation.

N. L. Christoffel,* United Air Lines.

George W. Clough,* Fire Marshal, Nassau County.

John W. Crowley, Jr.,**† National Advisory Committee for Aeronautics.

John A. Dickinson, National Bureau of Standards.

R. J. Douglas,* Oklahoma A. & M. College.

John F. Dowd,* Chief, Westover Air Force Base Fire Dept.

A. G. Downing,* Arabian American Oil Co.

Carl Dreesen, Bureau of Aeronautics, Dept. of the Navy.

H. A. Earsy,* United Aircraft Corp.

Albert Edson, American Assn. of Airport Executives, Logan International Airport.

Milton M. Fischer,* Chief, Mitchel Air Force Base Fire Dept.

J. A. Giammatteo,*† Chief, Glen Echo Volunteer Fire Department.

D. D. Gordon-Carmichael,* Trans-Canada Air Lines.

R. B. Gottschalk,* North American Aviation.

A. M. Grunwell, NFPA Committee on Firemen's Training, District of Columbia Fire Dept.

I. J. Hammill, Fire Equipment Manufacturers Association, Inc., Walter Kidde & Co.

J. B. Hartranft, Jr.,† Aircraft Owners and Pilots Association.

K. E. Hisey,* Dade County Port Authority.

H. A. Klein,† Wright Air Development Center, Dept. of the Air Force.

W. E. Koneczny,† Civil Aeronautics Board, Bureau of Safety Regulation.

A. W. Krulee,* Cardox Corporation.

Hervey F. Law,* The Port of New York Authority.

Dr. L. G. Lederer, Airlines Medical Directors Association, Capitol Airlines.

E. T. Lee,* Eastern Air Lines.

Henry F. Loeffler,* Republic Aviation Corp.

E. E. Lothrop, American Petroleum Institute.

William J. Lotzer, National Aviation Maintenance Council.

R. Dan Mahaney,† Civil Aeronautics Administration, Washington National Airport.

C. I. Manetta, Jr.,* Eastern Air Lines.

Daniel Mapes, Compressed Gas Association.

C. J. McGlamery,* Chance Vought Aircraft, Inc.

George McSherry, American Assn. of Airport Executives, Port of New York Authority.

Harold C. Messersmith, American Assn. of Airport Executives, San Francisco International Airport.

Chief William L. Miller, NFPA Fire Marshal Section, Los Angeles Fire Dept.

E. J. R. Moulton,* J. S. Frelinghuysen Corp.

Edward D. Nass,* Chief, Andrews Air Force Base Fire Department.

Howard W. Naulty,* Cornell Aeronautical Laboratory, Inc.

A. B. Nehman, Bureau of Aeronautics, Dept. of the Navy.

Wing Commander F. H. Nichols, Dept. of National Defence (Canada).

Willard Northrop, Association of Casualty and Surety Companies.

Jesse O. Parks,* San Francisco International Airport Fire Marshal.

John Peloubet, Magnesium Association, Dow Chemical Co.

J. M. Perri*

R. C. Petersen,* Port of New York Authority.

R. L. Potter,* American Airlines.

D. B. Rees, Civil Aviation Division, Department of Transport (Canada).

L. E. Rivkind,* Mearl Corporation.

James C. Rogers,* Nassau County Vocational Education Board.

E. B. Rumble, National Automatic Sprinkler and Fire Control Association.

W. E. Seal,* Boeing Airplane Co.

Roussel G. Smith,* Pan-American World Airways System, Pacific Alaska Division.

William R. Smith,† Wright Air Development Center, Dept. of the Air Force.

John T. Stephen, American Assn. of Airport Executives, Mercer County Airport (Trenton, N. J.).

E. F. Tabisz, Underwriters' Laboratories of Canada.

H. R. Voight,* Air Material Command, Dept. of the Air Force.

Robert W. Vreeland,* Strategic Air Command, Dept. of the Air Force.

Ted R. Wagner,* Ellsworth Air Force Base Fire Dept.

J. H. Waterman,* Trans World Airlines.

E. J. C. Williams, Air Ministry (United Kingdom).

Roger H. Wingate,* Liberty Mutual Fire Insurance Co.

Alternates.

T. S. Duke. (Alternate to E. B. Rumble.)

Edward B. Heyl. (Alternate to Ben W. Ashmead.)

---

†Non-voting member.

**Representation is *organizational*, not personal, and is for coordination purposes only.

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

Sub-Committee on Aircraft Rescue and Fire Fighting

George H. Tryon, III,† *Chairman*
National Fire Protection Association
60 Batterymarch St., Boston 10, Mass.

J. C. Abbott*
British Overseas Airways Corp.

R. J. Brady*†
Port of New York Authority

George A. Brelie*
Ansul Chemical Company

J. W. Bridges*
U.S.A.F. Military Air Transport Service

J. A. Brooker
Ministry of Transport and Civil Aviation (United Kingdom)

R. C. Byrus*
University of Maryland

J. M. Chase
Flight Safety Foundation

N. L. Christoffel*
United Air Lines

G. T. Cook
Headquarters, Department of the Air Force

J. F. Dowd*
Chief, Westover Air Force Base Fire Department

C. Dreesen
Bureau of Aeronautics, Dept. of the Navy

H. A. Earsy
Fire Marshal, United Aircraft Corp.

A. L. Edson
American Association of Airport Executives, Logan International Airport

M. M. Fischer*
Chief, Mitchel Air Force Base Fire Department

J. A. Giammatteo*
Chief, Glen Echo Volunteer Fire Department

R. B. Gottschalk
North American Aviation

A. W. Grunwell
NFPA Committee on Firemen's Training, District of Columbia Fire Department

H. L. Hansberry*
Electronics Corp. of America

A. W. Krulee*
Cardox Corporation

H. F. Law*
Port of New York Authority

J. Lederer†
Flight Safety Foundation

R. D. Mahaney†
Washington National Airport

S/L W. A. McCallum
Fire Marshal, Royal Canadian Air Force

C. J. McGlamery
Chance Vought Aircraft, Inc.

E. D. Nass*
Chief, Andrews Air Force Base

J. A. O'Donnell*
American Airlines

J. E. Parks*
San Francisco International Airport Fire Department

J. A. Peloubet
Magnesium Association (Dow Chemical Co.)

J. M. Perri*
Delegate at Large

R. C. Petersen*
Port of New York Authority

D. B. Rees
Civil Aviation Division, Department of Transport (Canada)

L. E. Rivkind*
Mearl Corporation

James Rodgers*
Nassau County Vocational Education Board

W. R. Smith†
Wright Air Development Center, U.S. Air Force

J. T. Stephen
American Association of Airport Executives

R. W. Vreeland*
Hq. U.S.A.F. Strategic Air Command

T. R. Wagner*
Ellsworth Air Force Base Fire Department

E. J. C. Williams
Air Ministry (United Kingdom)

Douglas C. Wolfe
American Association of Airport Executives

---

*Serving in a personal capacity.

† Non-voting member.

Suggested

Aircraft Rescue and Fire Fighting Equipment for Airports

NFPA No. 403

Table of Contents

Suggested
Aircraft Rescue and Fire Fighting Equipment for Airports

NFPA No. 403 — 1956

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.

---

*See NFPA Standard on Aircraft Hangars (NFPA No. 409) published in National Fire Codes, Vol. VI and in separate pamphlet form.

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 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 B.

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

Section 200 — Basis for Recommendations

201. To provide a workable index useful in determining the suggested 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 "C"). 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 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.

†U. S. gallons are used in this table.
*See footnote to Paragraph 203 and Appendix C.

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 lb. 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 is 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 equip-

*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 C for further data on "high density" seating).

ment 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 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 suggested 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 are summarized in Paragraphs 210 through 214.

210. 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.

211. Foam

(a) 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 ability 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, resisting 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. Foam, when applied to the fuselage of an aircraft, insulates, cools and reflects radiant heat providing protection to occupants. There are two kinds of foam:

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

(2) Mechanical Foam (Air Foam) — made by the addition of a 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.

(b) 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 problem of quickly supplying large quantities of foam to the fire in a gentle manner so as to form an impervious fire-resistant blanket on large flammable liquid spills. The hazards of disrupting established foam blankets by turbulence, water precipitation and heat baking can be overcome by firemen's training and the purchase of a good quality of the basic foam ingredient.*

(c) Foam is currently applied in two principal pattern configurations, solid stream and dispersed patterns. Solid streams of foam are used principally for fire situations requiring long distance reach or where the foam may be deflected from a solid

*See NFPA Standards for Foam Extinguishing Systems (NFPA No. 11) published in National Fire Codes Vol. IV and in separate pamphlet form.

barrier to facilitate gentle application. Foam when dispersed in wide, uniformly dispersed patterns (sometimes called "fog-foam" or "snow-foam") is used principally for direct application to a large area of burning fuel. It falls very gently on the surface, giving radiation protection to the fire fighter and cooling and smothering the fire in a short time.

212. Carbon dioxide provides a means of quickly "knocking-down" flammable liquid fires when applied at a proper rate and in sufficient quantity. It has good "flooding" characteristics and penetrates to otherwise inaccessible areas. It is particularly effective on flowing or three dimensional fires. When liquid carbon dioxide is discharged a portion is converted to fine particles of "dry-ice" at minus 110° F. The per cent converted to "dry-ice" increases as the storage temperature of the liquid is reduced. Heat absorption results but the cooling effect may not always be sufficient to reduce heated metal below the ignition temperature of flammable liquid vapors liable to persist in the area. Re-ignition may therefore occur. Supplementary extinguishing agent, either more carbon dioxide or cooling and blanketing agents (water or foam), may be necessary. 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.

213. Dry chemical provides a means of quickly "knocking-down" flammable liquid fires when applied at a proper rate and in sufficient quantity. It has good "flooding" characteristics and penetrates to otherwise inaccessible areas. It is particularly effective on flowing or three dimensional fires. It has good shielding effects against radiant heat and good range under normal outdoor conditions. Dry chemical does not have sufficient cooling effect to assure cooling of heated metal below the ignition temperature of fuel vapors as rapidly as it extinguishes the fire. Re-ignition may therefore occur. Supplementary extinguishing agent, either more dry chemical or cooling and blanketing agents (water or foam), may be necessary. Dry chemical used in conjunction with foam poses some problems of compatability which vary with the quantities involved and the techniques used. 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.

214. 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 1956). 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.

215. The information in Paragraphs 210–214 indicates that no single agent has all the qualities needed for speedy, permanent extinguishment of a major aircraft fire. A combination of agents is desirable for rapid blanketing, effective cooling and permanent extinguishment. The supply of agents must be sufficient and discharge facilities adequate for the size and extent of the fire. For incipient fires a single agent may be satisfactory (see Paragraph 308) but the use of a quick "knock-down" extinguishing agent, such as described in Paragraphs 212 and 213, in conjunction with a cooling and blanketing agent, such as foam (Paragraph 211), is recommended as the most effective means currently available for handling a major aircraft fire. For aircraft weighing under 15,000 pounds gross weight, the combined agent technique 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 a combination of agents is a recommended minimum safeguard for aircraft in all weight categories.

216. The types and quantities of extinguishing media recommended in Table 1 are based on the conclusions indicated in Paragraph 215 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 suggested amounts to be immediately available for direct application.

217. The presence of magnesium alloys in aircraft structures introduces an additional problem to fire extinguishment in cases where this metal becomes involved in an aircraft fire. None of the agents available for bulk application (see Paragraphs 210–214) 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 foam (this process liable to temporarily intensify flame spread until the application is sufficient to produce the degree of cooling required).*

*See also NFPA Standards for Magnesium (NFPA No. 48) published in National Fire Codes Vol. II and in separate pamphlet form.

Section 300 — Recommendations

301. Table No. 1 indicates the quantities of carbon dioxide and water (for conversion to foam) recommended for immediate application, graded according to aircraft weight categories (see Paragraph 201) and in accordance with the findings indicated in Paragraphs 215 and 216. The use of other quick "knock-down" agents as discussed in Paragraphs 213 and 214 may be satisfactory but definite amounts cannot be specified because of lack of field experience.

302. It is recommended that equipment dispensing these agents be so designed that the total amount of water (for conversion to foam) and the total amount of carbon dioxide indicated in Table No. 1 may be discharged within 2½ minutes maximum time so as to afford the desired rates of discharge considered essential to fire extinguishment or control. Rates of discharge of other agents used (see Paragraphs 213 and 214) should be carefully established to assure maximum effectiveness in application.

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 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 308), manned by thoroughly trained and equipped aircraft rescue and fire fighting crews (see Paragraph 315). The 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 amounts.

Table No. 1

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

Aircraft by Gross Weight Categories (See Par. 201)	Suggested Quantities Extinguishing Agents (See Pars. 301–306)		Suggested Personnel on Duty (See Pars. 313–315)		Typical Civil Aircraft in Weight Category (See also Appendix "C")
	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, deHavilland 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, 404, 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,-7 Lockheed Constellation, Boeing Strato-cruiser, etc.
	or 4,500 gals. and	2,000 lbs.			

*The use of other quick "knock-down" agents, as discussed in Paragraphs 213 and 214, may be satisfactory but definite amounts cannot be suggested because of lack of field experience.

NOTE 1: Maximum discharge period for dispensing the total amounts of both agents should not exceed 2½ 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 213 and 214.

NOTE 3: See also Paragraphs 308 and 309 for recommendations on auxiliary equipment.

305. The amount of water shown in Table No. 1 for each weight grouping is considered desirable for fire extinguishment based on conversion to foam and when the foam is applied in conjunction with carbon dioxide (see Paragraph 215). 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 other quick "knock-down" agents (other than carbon dioxide) are used in conjunction with foam, the amount of water (for conversion to foam) should be adequate to assure equal extinguishing efficiency within the same time period as may be achieved with the combined use of carbon dioxide and foam.

306. The amount of carbon dioxide shown in Table No. 1 for each weight category is the amount considered necessary for fire extinguishment when applied in conjunction with foam (see Paragraph 215). Other quick "knock-down" agents (see Paragraphs 213 and 214) may be utilized following a determination of their extinguishing efficiency and effectiveness and an assurance of reasonable compatibility with foam. When other such agents are used, however, their extinguishing efficiency or effectiveness when used in combination with foam should equal that of comparable amounts of carbon dioxide within the same time period.

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. These criteria will determine the suitability of the vehicle for the duties described. In this connection, it should be noted that with the larger type aircraft (particularly aircraft over 15,000 lbs. gross weight) it is desirable to have 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

*See also Paragraph 308 covering vehicles under 4 tons gross weight for special performance recommendations.

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, 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 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 and center clearance should be sufficient to permit the vehicle to cross depressions, such as ditches and gullies and to mount slopes, banks and high curbs which constitute obstructions to movement. The expected area of operation should be inspected to determine minimum

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

angles and clearance. Flat terrain obviously will permit small angles and low clearance. Particularly severe conditions might necessitate special bridging or access roads to avoid complications in truck design. As a guide, angles of approach and departure should be not less than 30 degrees and center clearance should be not less than 12 percent of the vehicle wheel base. In figuring angles of departures, overhanging platforms mounted on trucks should be considered.

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

(**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

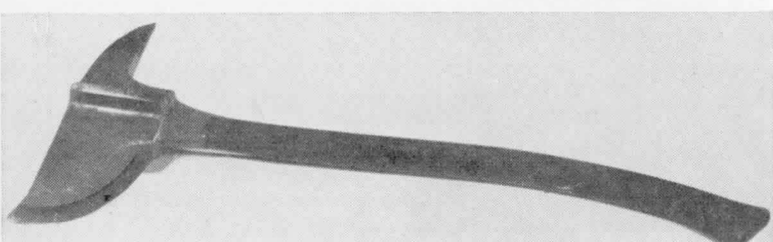

Fig. 1. Typical Forcible Entry Axe.

fire and knock down the bulk of the flames. Hand lines are used primarily for covering rescue parties, for controlling the fire in the rescue area, and for spot cooling of the fuselage to avoid heat suffocation to trapped occupants.

(f) Accessory equipment desirable includes:

(1) Manual Cutting, Opening and Access Tools*:
Large and small axes specially designed for piercing metallic fuselages (non-wedging) (See Fig. 1)
Bolt, bar, metal cutters
Metal and wood cross cut and hack saws
Rounded tip knives for cutting safety belts, parachute straps (See Fig. 2)
Vise and electrical wire cutting pliers
Access ladders (length depending on types of aircraft)
Screwdrivers and fasteners
Keys to aircraft compartments

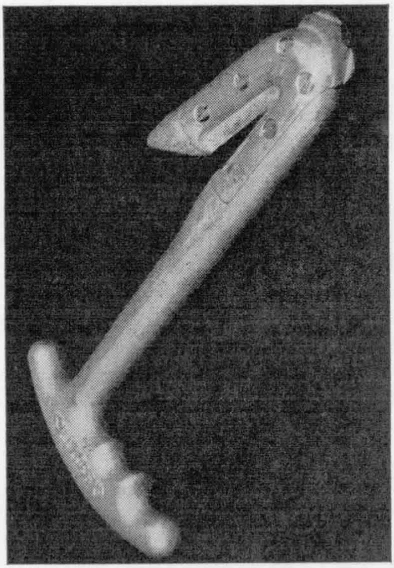

Fig. 2. Harness Cutting Tool.

(2) Manual Shifting Tools:
Crowbar and claw tool
Grappling hook and cable (for tow hooks mounted front and rear of truck)
Long handled shovels
Pike pole
Sledge hammer
Plugs and crimping tools for fuel 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

*See Figure 3 for typical crash tool kit.

(4) First Aid Equipment (May be on separate vehicle)
First aid fire extinguishers
First aid medical kit
Asbestos and wool blankets
Stretchers
Resuscitator

308. Light, mobile vehicles weighing under 4 tons gross, equipped with 100–400 gallons of water plus 10–40 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 individual-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 ambient 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.

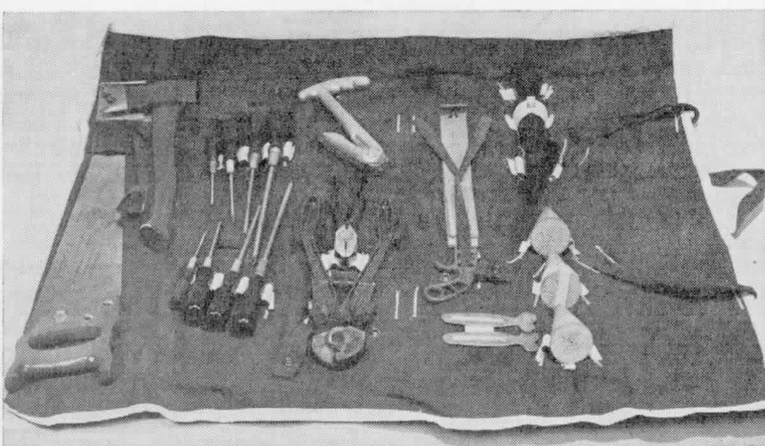

Fig. 3. Typical Crash Rescue Tool Kit.

309. 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.

310. 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 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.

311. 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.

312. Red is the traditional color for fire fighting apparatus and painting of aircraft rescue and fire fighting equipment red

---

*See NFPA Specifications for Motor Fire Apparatus (NFPA No. 19) published in National Fire Codes, Vol. IV, and in separate pamphlet form.

**See NFPA Suggested Standard Operating Procedures, Aircraft Rescue and Fire Fighting (NFPA No. 402) published in National Fire Codes, Vol. VI, and in separate pamphlet form.

is recommended in the U.S.A. in "Army-Navy-Civil Uniform Requirements for the Marking of Vehicles Used on Landing Areas"* and internationally by the "International Standards and Recommended Practices on Aerodromes."** In some locations, emergency vehicles of all types used on airport movement areas are painted chrome yellow or a similar color affording easier vehicle visibility from the ground, the control tower or by pilots from the air. The color of vehicles is a matter for local determination except where applicable state or federal regulations govern.

313. 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.

---

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

**See Annex 14, Second Edition, September 1953, Part V, Chapter 3, Paragraph 3. 2.7 published by the International Civil Aviation Organization, Montreal, Canada.

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

(**e**) That direct communication with Airport Control be available.

314. It is recommended that full crews (including auxiliaries) man the equipment and that this equipment be placed at predetermined emergency 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 "Suggested Standard Operating Procedures, Aircraft Rescue and Fire Fighting." (NFPA No. 402.)*

315. 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 recommended in Table No. 1 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 thor-

---

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

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

ough 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

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, their fire 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.

316. 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 gauntlet wrist protection.

(**c**) Standard fireman boots with wool lining.

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

Fig. 4. Typical Protective Suit.

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 affect 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 "D" 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

Revised 1956

Tire Size	Ply Rating	Load at 25 PSI	Tire Size	Ply Rating	Load at 25 PSI
6.50-17	6	1100	11.00-24	12	3050
6.50-18	6	1150			
6.50-20	6	1245	12.00-20	14	3040
			12.00-22	14	3240
7.00-17	8	1235	12.00-24	14	3430
7.00-18	8	1280			
7.00-20	8	1385	13.00-20	16	3630
7.50-17	8	1385	13.00-24	16	4070
7.50-18	8	1450			
7.50-20	8	1565	14.00-20	18	4270
			14.00-24	18	4750
8.25-18	10	1695			
8.25-20	10	1820	16.00-20	10	5635
			16.00-24, 25	12	6240
9.00-18	10	2020	16.00-18, 29	12	6930
9.00-20	10	2165			
			16.00-32, 33	12	7480
10.00-18	12	2250	18.00-24, 25	16	8055
10.00-20	12	2410	18.00-29	16	8825
10.00-22	12	2565	18.00-32, 33	16	9570
10.00-24	12	2725			
			21.00-24, 25	16	10340
11.00-20	12	2705	21.00-29	16	11220
11.00-22	12	2880	21.00-33	16	12100

APPENDIX "B"

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 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.