NFPA No.

402

S.O.P. AIRCRAFT RESCUE AND FIRE FIGHTING 1973

$2.00

NATIONAL FIRE PROTECTION ASSOCIATION
International
470 Atlantic Avenue, Boston, MA 02210

5M-6-73-FP
Printed in U.S.A.

Official NFPA Definitions

Adopted Jan. 23, 1964: Revised Dec. 9, 1969. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

SHALL is intended to indicate requirements.

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

APPROVED means acceptable to the authority having jurisdiction. The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of nationally recognized testing laboratories,* i.e., laboratories qualified and equipped to conduct the necessary tests, in a position to determine compliance with appropriate standards for the current production of listed items, and the satisfactory performance of such equipment or materials in actual usage.

*Among the laboratories nationally recognized by the authorities having jurisdiction in the United States and Canada are the Underwriters' Laboratories, Inc., the Factory Mutual Research Corporation, the American Gas Association Laboratories, the Underwriters' Laboratories of Canada, the Canadian Standards Association Testing Laboratories, and the Canadian Gas Association Approvals Division.

LISTED: Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

LABELED: Equipment or materials to which has been attached a label, symbol or other identifying mark of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling is indicated compliance with nationally recognized standards or tests to determine suitable usage in a specified manner.

AUTHORITY HAVING JURISDICTION: The organization, office or individual responsible for "approving" equipment, an installation, or a procedure.

Statement on NFPA Procedures

This material has been developed in the interest of safety to life and property under the published procedures of the National Fire Protection Association. These procedures are designed to assure the appointment of technically competent Committees having balanced representation from those vitally interested and active in the areas with which the Committees are concerned. These procedures provide that all Committee recommendations shall be published prior to action on them by the Association itself and that following this publication these recommendations shall be presented for adoption to the Annual Meeting of the Association where anyone in attendance, member or not, may present his views. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

Standard Operating Procedures

Aircraft Rescue and Fire Fighting

NFPA No. 402 — 1973

1973 Edition of No. 402

These Standard Operating Procedures for Aircraft Rescue and Fire Fighting were developed by a Subcommittee of the NFPA Sectional Committee on Aircraft Rescue and Fire Fighting. The following Subcommittee has been assigned current responsibility for this publication:

William T. Schmidt, *Chairman*
2216 Pershing St., South Bend, Indiana 46628

Chief Harry V. Burbridge, Seattle-Tacoma International Airport

Alfred W. DuBrul, U.S. Coast Guard

John E. Lodge, Civil Aviation Authority (United Kingdom)

Carl E. McCoy, International Fire Service Training Association

John T. Stephan, American Assn. of Airport Executives

Marvin C. Tyler, U.S. Dept. of the Air Force

The text was approved by the Sectional Committee and by the NFPA Committee on Aviation and then adopted at the 1973 Annual Meeting of the Association held May 14-18 in St. Louis, Mo.

The principal change in the body of the text is a complete revision of Article 800. The Appendix material has been extensively revised and updated.

Origin and Development of No. 402

These Standard Operating Procedures were first developed by the sponsoring NFPA committee in 1947 and were first adopted by the Association in 1951. The latest previous edition to this 1973 text was 1969. Companion publications of special importance are the NFPA Recommended Practice for Aircraft Rescue and Fire Fighting Services at Airports and Heliports (No. 403), the NFPA Guide on Aircraft Rescue and Fire Fighting Equipment Techniques for Fire Departments Using Conventional Fire Apparatus and Equipment (No. 406M), the Standard for Evaluating Foam Fire Fighting Equipment on Aircraft Rescue and Fire Fighting Vehicles (No. 412), the Standard for Aircraft Rescue and Fire Fighting Vehicles (No. 414), and the Aircraft Fire Investigator's Manual (No. 422M).

Committee on Aviation

Jerome Lederer,† *Chairman.*
Flight Safety Foundation, 1800 North Kent St., Arlington VA 22209

Harvey L. Hansberry, *Vice-Chairman,*
U.S. Dept. of Transportation, Federal Aviation Administration, NAFEC, Atlantic City, NJ 08405

George H. Tryon†, *Secretary,*
National Fire Protection Association, 470 Atlantic Ave., Boston, MA 02210

J. C. Abbott, British Overseas Airways Corp.

H. J. Badger, The Boeing Co.

J. J. Brenneman, Chairman, NFPA Sectional Committee on Aircraft Rescue and Fire Fighting

William L. Collier, International Federation of Air Line Pilots Assns.

F. P. DeGiovanni, Vice-Chairman, NFPA Sectional Committee on Aircraft Hangars & Airport Facilities

D. G. Dumper, American Airlines

P. M. Fitzgerald, Chairman, NFPA Sectional Committee on Aircraft Hangars and Airport Facilities and rep. Factory Mutual Research Corp.

W. Harris, Australian Dept. of Civil Aviation

B. V. Hewes, Vice-Chairman, NFPA Sectional Committee on Aircraft Rescue and Fire Fighting and rep. Air Line Pilots Assn.

Lt. Col. G. A. Hope, Canadian Forces Headquarters

R. L. Jackson, American Petroleum Institute

John E. Lodge, Civil Aviation Authority (United Kingdom)

A. J. Mercurio, Factory Insurance Association

J. A. O'Donnell, Chairman, NFPA Sectional Committee on Aircraft Fuel Servicing

H. B. Peterson, U. S. Naval Research Laboratory

Capt. Reuben P. Prichard, Jr., National Aeronautics & Space Administration

Victor B. Robinson, Jr., U.S. Dept. of the Air Force

John H. Sellers, Chairman, NFPA Sectional Committee on Aircraft Maintenance and Servicing and rep. American Insurance Association

John T. Stephan, American Assn. of Airport Executives

Kenneth A. Zuber, Vice Chairman, NFPA Sectional Committee on Aircraft Maintenance & Servicing and rep. Compressed Gas Association

Alternates.

Wm. L. Hanbury, National Aeronautics & Space Administration (Alternate to Capt. Reuben P. Prichard, Jr.)

D. A. Heine, Air Line Pilots Association (Alternate to B. V. Hewes)

Thomas A. Raffety, American Assn. of Airport Executives (Alternate to John T. Stephan)

Richard Southers, American Petroleum Institute (Alternate to R. L. Jackson)

Nonvoting Members

J. G. W. Brown, British European Airways

Stanley J. Green, General Aviation Manufacturers Association

V. Kidd, Ministry of Defence, Air Force Dept. (United Kingdom)

C. Hayden LeRoy, National Transportation Safety Board

Gene I. Martin, Aerospace Industries Association of America, Inc.

C. M. Middlesworth, Federal Aviation Administration, National Aviation Facilities Experimental Center

John A. Pope, National Business Aircraft Assn., Inc.

A. F. Robertson, National Bureau of Standards.

Dr. R. R. Shaw, International Air Transport Association

Edwin L. Thomas, Air Transport Association

Chief of the Aerodromes, A.G.A., International Civil Aviation Organization

†Nonvoting.

Sectional Committee on Aircraft Rescue and Fire Fighting

J. J. Brenneman, *Chairman,*
Fire Protection Engr., United Air Lines, Inc., P.O. Box 6 100, Chicago, IL. 60666

B. V. Hewes, *Vice Chairman,*
Air Line Pilots Association, 3581 N. Main St., College Park, GA 30337

J. C. Abbott, British Overseas Airways Corp.

Lt. George Augusto, Denver Fire Dept.

H. J. Badger, The Boeing Co.

Chief Harry V. Burbridge, Seattle-Tacoma International Airport

John J. Byrne, Battalion Chief, Los Angeles City Fire Dept.

Robert C. Byrus, Beltsville, Md.

Martin P. Casey, U.S. Dept. of the Air Force, AFSC

George R. Cooper, Jr., Walter Motor Trucks of Canada, Ltd.

Emmett T. Cox, International Assn. of Fire Fighters

Dan De Coursin, Fire Apparatus Manufacturing Div., Truck, Body and Equipment Assn.

Alfred W. DuBrul, U. S. Coast Guard

D. G. Dumper, American Airlines

Frederick H. Flagg, Airport Operators Council International

Capt. J. N. Pierre Gagne, Canadian Airline Pilots' Assn.

Harvey L. Hansberry (ex-officio), U.S. Dept. of Transportation

R. A. Harley, Dept. of Transport (Canada)

G. H. Hawes, Jr., Lochkeed-Georgia Co., Marietta, GA 30060

D. A. Heine, Air Line Pilots Association

Franklyn P. Kellogg, Chief, Fire Dept. Burke Lakefront Airport (Cleveland)

Chief Paul Kowall, Firemen's Training Center, (Nassau County, New York)

L. M. Krasner, Factory Mutual Research Corp.

Philip J. Landi, Helicopter Association of America

John E. Lodge, Civil Aviation Authority (United Kingdom)

Maj. W. G. MacDonald, Canadian Forces Training

Carl E. McCoy, International Fire Service Training Assn.

William J. McNamara, U. S. Army Mob. Equipment Research & Development Center

H. B. Peterson, U. S. Naval Research Laboratory

S. Harry Robertson, Arizona State University

W. D. Robertson, Seattle-Tacoma Airport.

Robert R. Rogers, Long Island MacArthur Airport

Capt. William T. Schmidt, South Bend, Indiana

Chief Arthur Scott, Metropolitan Transportation Authority

L. A. Simms, Apple Valley, Calif.

John T. Stephan, American Assn. of Airport Executives

H. R. Wesson, University Engineers, Inc.

Murray M. White, Jr., National Pilots Association

E. T. Williams, British Airports Authority

E. D. Zeratsky, Fire Equipment Manufacturers Association

Alternates.

William L. Collier, International Federation of Air Line Pilots Assns. (Alternate to B. V. Hewes)

T. L. Cowick, Dept. of Transport, (Alternate to R. A. Harley)

Maj. G. A. Hope, Canadian Forces (Alternate to Major W. G. MacDonald)

Herb Leppke, Air Line Pilots Association, (Alternate to D. A. Heine)

Frederick Newman, Fire Equipment Manufacturers Association (Alternate to E. D. Zeratsky)

Thomas A. Raffety, American Association of Airport Executives (Alternate to John T. Stephan)

(Continued)

Table of Contents

Standard Operating Procedures
Aircraft Rescue and Fire Fighting

NFPA No. 402 — 1973

INTRODUCTION

1. The purpose of these recommendations is to inform airport and municipal fire and rescue services of standard operating procedures designed to provide maximum effective use of aircraft rescue and fire fighting equipment provided at airports. Included herein is information on conditions that may exist at the scene of an aircraft accident and a guide that can be used as a basis for establishing training programs and operational procedures.

2. The recommendations set forth herein are based on the premise that the rescue of aircraft occupants takes precedence over all other operations and until it is established that there is no further life hazard, fire suppression is an important enabling supporting measure. It should be emphasized that speed and skill are of the utmost importance in situations where life hazards exist.

100. Location of Airport Fire Stations

101. In order to provide effective aircraft rescue and fire fighting protection at airports it is recommended that rescue and fire equipment meeting the NFPA Recommended Practice for Aircraft Rescue and Fire Fighting Services at Airports and Heliports (No. 403) be maintained and garaged in a suitable airport fire station on the airport (see Appendix E).

102. The location of the airport fire station is of prime importance. Emergency equipment should have instant access to airport movement areas and be capable of reaching the extremities of the airport and runways in minimum time.

NOTE: The geographical center may not be the best location; before selecting the actual location, distance-time trials should be run to determine the optimum location to assure the quickest response to all potential accident sites and an evaluation placed on present and future usage of the airport movement areas to assure proper selection of the fire station site. (See Paragraph 103).

103. Response time is of prime importance. The fire equipment should be located in such positions that the equipment can reach any point within the airport boundary within three minutes of the time of alarm under optimum visibility and surface conditions and initiate agent application within that time.

104. At large airports where a central location for the airport fire station is unavailable or undesirable, it may be necessary to have two airport fire stations located strategically on the airport. Accident statistics show that the greatest percentage of airport accidents occur on or just off the instrument runway(s) and locations to provide the quickest response to these areas are desirable.

105. Aircraft rescue is the prime purpose of the airport fire department. Locating the airport fire station for structural fire fighting utility is of secondary importance.

106. Care should be taken that access to or from the airport fire station cannot and will not be blocked by taxiing or parked aircraft. Fire equipment should not be required to cross active runway(s) to reach the principal operational ramp area(s) where aircraft may be serviced or parked.

NOTE: Paving in front of airport fire stations should be prominently marked to prevent unauthorized use.

107. Airport fire stations located close to taxiways and runways or adjacent to flight patterns have a noise problem. It is thus necessary to soundproof all training rooms, living quarters, and the alarm room. The high noise level of turbine engines can cause damage to the hearing senses; at airports handling turbine powered aircraft firefighters on duty outside of soundproofed areas should be provided with protective ear coverings.

200. Preplanning for Emergencies

201. Preplanning is a necessity for all emergencies.

202. A system for locating and reaching each accident site in minimum time, with adequate rescue, fire fighting and medical equipment, should be employed at each airport. A grid map (or similar useful equivalent) will be helpful in this connection. Such a map should be prepared for each airport, including the area contiguous to and surrounding the airport, as appropriate (a distance of 5 miles extending from the center of the airport is frequently shown). Copies of this map should be maintained at the airport operations office, at the air traffic control tower, at airport and local fire stations in the vicinity, at all local hospitals, at police and sheriff offices, at local telephone exchanges, and at other similar emergency and information centers in the area. In addition, copies of this map should be kept on all vehicles and liaison aircraft that may be utilized in an aircraft emergency. Maps of this type are ruled off in numbered grids and marked for easy identification of any point within the map area. Prominent local features and roads should be shown as well as compass headings to facilitate location of accident sites by aircraft. Such maps may need to be coordinated between other airports in the same geographical area to avoid confusion. Instruction classes on the use of such maps should be held periodically. (See Appendix E.)

NOTE: At some airports which experience dense fog conditions at critical frequencies, ground radar equipment may be necessary to assist in locating aircraft which may be in difficulty on the ground. Care must be exercised to avoid "blind spots" on airport ground radar surveillance scopes by interference from other airport radar equipment.

203. Quick access roads for use by emergency vehicles should extend to airport boundaries and to overrun areas wherever practical. They should be usable under all types of weather conditions. If necessary, bridges capable of supporting the heaviest emergency equipment should be constructed over deep gullies, streams or drainage canals. The responsible parties should be kept informed as to any impairment of these access roads, such as their being closed for repairs or unusable because of high water, snow, etc.

204. If the airport is fenced, gates should be placed in strategic locations to provide for the movement of rescue equipment to locations outside of the airport boundary. Gates with frangible locks or knock-down fence sections should

be installed. Keys to gate locks should be carried by each piece of emergency apparatus, by airport police and other appropriate local authorities.

205. If firehouse doors are electrically operated, rapid standby manual operation is imperative. Aircraft accidents and other emergencies can disrupt the electrical supply to the firehouse adding greatly to the response time.

206. A mutual aid program should be worked out with neighborhood fire and rescue units:

a. Local fire departments should be included in aircraft rescue and fire fighting training activities conducted at the airport by participating in drills, tests, and aircraft familiarization programs. Such activities should be specifically pointed toward increasing the utility of local fire defense personnel in handling off-airport accidents and assisting in a mutual aid capacity at serious on-airport accidents. Municipal and rural fire departments should train using the NFPA "Guide for Aircraft Rescue and Fire Fighting Equipment Techniques for Fire Departments Using Conventional Fire Apparatus and Equipment" (No. 406M).

207. If local fire department crews arrive at the scene of an aircraft fire first, they should be trained to proceed with the rescue and fire suppression work. In such situations, upon arrival of the specialized airport equipment and personnel, the Chief of the Airport Emergency Crew should consult with the officer in charge on what rescue efforts have not been successfully completed and should then assist in the furtherance of this aspect of the accident. After rescues are completed, all agencies should concentrate on final extinguishment. The division of responsibilities in any given situation is a matter for individual determination by those in charge in accordance with previous arrangements and with legal assignments.

208. Local public fire departments should be tied in closely with airport emergency alarm services, preferably by radio or direct line telephone. Having been provided with grid maps (as recommended in Paragraph 202) they should be able to quickly respond to the designated accident sites in minimum time. They should be encouraged to carry special equipment for aircraft rescue and fire suppression purposes (not uncommon to equipment carried for gasoline tank truck or other flammable liquid fire fighting).

209. **Emergency Medical Services:** Ambulance and medical services must also be considered in preplanning for aircraft emergencies, and are an integral part of the mutual assistance plan. In establishing guidelines for these services, it is best to consider the over-all program in the following phases:

a. **Immediate First Aid** to the injured should be provided by a well-equipped, well-trained group of available airport employees. Many airport employees have completed Red Cross or other similar first-aid courses. These persons should be organized into a group that can respond to the scene of an accident upon immediate notification. Their purpose would be to give immediate aid to the injured prior to transportation from the scene.

b. **A Field Hospital Unit** should be organized and equipped to provide care beyond the capability of the first-aid group. This unit should be staffed with doctors and aids who can classify injuries and determine a priority system for transportation of the injured to hospitals. In seeking a staff for this field hospital it may be well to consider assistance from a military base in the area. In many cases these military medical teams could be flown in as rapidly as civilian doctors could respond. A suitable location should be picked for this field hospital, and alternate sites must be considered for off-airport accidents. Supplies for such field hospitals are frequently available through your local Civil Defense representative, and the determination of such equipment should be made through coordination with the medical group which is to respond. In any case, it is suggested that sufficient supplies be provided to care for passengers anticipated aboard the largest aircraft normally scheduled to serve the airport. These supplies should be stocked in the building which is to serve as the field hospital, and a crew should be organized to assist in setting up the medical supplies for use by the staff.

c. **Ambulance Services** should be provided through prior arrangements with local, private and public ambulance services. It may also be necessary to utilize available airline vehicles or other vehicles as emergency ambulances to provide for the numerous persons usually involved. The transportation of litter patients to hospitals is often seriously hampered by traffic congestion, and for this reason it is well to consider the use of available helicopters, both private and military, for this purpose.

d. Hospital Services should also be previously arranged through the hospital administrators in order that they can establish a system of calling staff members in to handle the emergency. It is well to determine the approximate number of litter patients each hospital can handle under such conditions, in order that the injured can be dispersed to all available hospitals for immediate care.

e. A Temporary Morgue should also be considered, where fatalities can be properly placed for identification by the authority having jurisdiction. It will also be necessary to appoint a responsible person to maintain a record of all persons dispatched, in order that an accurate head count can be maintained.

210. Airport fire equipment essential for its primary mission should not be used for fires off the airport while flight operations are in progress.

211. The cooperation of local news media should be obtained to restrict the dissemination of news via radio or television during the critical period of response by the rescue, fire and medical services in the interest of traffic control.

212. Adequate security protection should be planned to handle the large crowds that always collect at the scene of an accident. It is necessary that this force be maintained for a long period of time to deter souvenir hunters and guard the wreckage under supervision of official investigating authorities. Measures should be taken to secure the crash area.

213. It is desirable that airport Fire Chiefs prepare and distribute to all parties concerned, an airport emergency plan. Such a document should list all agreements in Appendix F 1 through F 8 and in addition the following items:

a. Directory of all persons who may need to be contacted in emergency. This should include location and telephone number of at least the following:

(1) Fire departments providing mutual aid

(2) Police departments providing traffic control

(3) Medical personnel and facilities (doctors, hospitals)

(4) Airport officials

(5) Airport tenants concerned or representative of aircraft operator

(6) Appropriate governmental agencies having responsibilities (in the U.S.A. such agencies as the National Transportation Safety Board, Federal Aviation Administration, Federal Bureau of Investigation, U. S. Post Office Department, U. S. Department of Defense)

(7) Search and rescue agencies (if applicable)

(8) Clergy

(9) Coroner

This directory shall be checked constantly for accuracy and at least monthly each telephone number should be verified.

b. Availability of Heavy Equipment that can be used in an emergency situation such as cranes, jacks, heavy cable, generators, fork lifts, etc.

c. Method of Identification for all persons who may be called upon to respond in an emergency.

214. Due to the complexity of modern aircraft and the variety of types in service, it is virtually impossible to train rescue personnel on all the important design features of each one, although they should become familiar with the types normally using the airport being serviced. Information about the following design features is of special importance to rescue and fire fighting personnel to assure effective use of their equipment:

a. Location and operation of normal and emergency exits.

b. Seating configuration.

c. Location of fuel tanks.

d. Location of ejection seats and armament, if any.

General information on the above items can be found in the Appendix.

215. Aircraft crews are trained to handle in-flight fires but the airborne fire control agents are limited. Many emergency landings are the result of uncontrollable fires experienced in flight. In general, there are three types of in-flight fires, those involving (1) powerplants, (2) heaters, and (3) cabin fires. It is reasonable for fire fighters responding to aircraft fires to assume that the following has been accomplished by the flight crew in the event of an in-flight powerplant fire (see also Paragraph 307):

a. Powerplant stopped and prop (if any) feathered.

b. Fuels to affected powerplant turned off.

c. Electrical power to affected powerplant turned off.

d. Aircraft fire extinguishing system used.

e. Aircraft depressurized.

f. Oxygen systems deactivated.

These conditions should be orally or visually verified when conditions permit. Heaters located in wings, fuselage, and tail sections of aircraft are normally protected with a fire extinguishing system and it is assumed that in the event of such fires, these systems have been already activated.

216. All aircraft carry small portable fire extinguishers in addition to the extinguishing systems (see Par. 215), that could be of possible use to rescuers. Normally, a carbon dioxide extinguisher is carried in the cockpit, at galleys and sometimes in the cabins of cargo planes. Water extinguishers are normally carried in the cabins of passenger-carrying aircraft. Water and other beverages found in the buffet compartment provide an additional source of water for extinguishment purposes. It should be emphasized that these extinguishing agents are of secondary value and should not be relied on.

NOTE: Vaporizing liquid hand extinguishers are not normally carried on civil aircraft.

217. Flight crews will normally assume that airport evacuation facilities are not available and will carry out their own procedures using aircraft slides and ropes, etc. Airport emergency equipment, however, should be equipped with lightweight steps or stairs as these are often required where the aircraft equipment has failed to operate or evacuation from the leading edge of the wing is necessary.

218. Flight crews are trained in the use of emergency evacuation slides provided at normal and emergency exit doors to assist in the rapid evacuation of passengers. Where these slides are provided and are in use when rescue and fire fighting crews arrive, they should not be disturbed unless they have been damaged by use or fire exposure. In the latter case, ladders or emergency stairs, provided by the airport emergency crews, should be placed into immediate service.

The use of emergency slides will usually provide a much faster evacuation than conventional type steps or stairs and where speed of evacuation is mandatory it is preferable to use the aircraft equipment. Emergency crews should stand by at the foot of the slides to aid passengers to their feet and so keep the slide area clear for other evacuees. (See Figures A-18C in Appendix A and Figures in Part E-5 of Appendix E for further details.)

Passengers using overwing exits for evacuation will normally slide off the rear edge of the wing or down the wing flaps (if extended), and they should be given assistance to prevent leg injuries.

219. In order to better coordinate evacuation procedures, it is often desirable to establish direct contact with the flight crew. Most airport emergency equipment carries two-way radios, operating on ground control frequency. Pre-arrangement with the control tower will insure that the aircraft changes to this frequency, if time and the nature of the emergency permit (see Paragraph 703).

220. All rescue and fire fighting equipment should carry two-way radios. Portable "Walkie-Talkie" type radios prove invaluable in off-airport accidents. Where it is anticipated that apparatus of more than one agency will operate in mutual support, it is suggested that mutual radio frequencies be used or that there be cross monitoring by base stations.

NOTE: Should the aircraft captain request foaming of the runway, a decision on this request should be based on the considerations outlined in Section 1140.

221. Training Procedures and Hot Drills.

a. Training Procedures:

(1) Airport emergency crews should have a comprehensive training program to become familiar with such subjects as: aircraft construction, hazardous materials, use of hand and powered tools, first aid, preplanning for approaches, and operations at aircraft accidents (see Article 800 of NFPA No. 403).

(2) Regularly scheduled weekly drills are recommended for operation of equipment on dry runs. On occasions, night dry runs (when flight operations have ceased) will enable the emergency crews to determine the quickest

response route to any area of the airport. It is particularly important that during low visibility operations the emergency crews be familiar with locations of taxiways, apron areas, and active runways to be used; during such periods emergency crews should be doubly concerned with response times.

b. Minimum Hot Drills Requirements:

(1) Monthly hot drills shall be required for new emergency crew members in order to familiarize them with the operational features and extinguishing capability of equipment on hand. Only through a concerted effort on the part of the emergency crew members will they obtain the confidence in the equipment needed to handle such emergencies.

(2) It is further recommended that quarterly hot drills be conducted in the extinguishment of large fires, using various approaches and varying methods of extinguishment of the fires.

(3) During the quarterly hot drills and training sessions, the surrounding municipal and county fire departments should be included and invited to participate with the airport emergency crews.

c. Mutual Aid and Preplanning:

(1) Preplanning between the airport emergency crews and neighboring local fire departments as to mutual aid assignments should be constantly reviewed. While it is realized that structural fire fighting equipment does not normally carry great amounts of water as do aircraft rescue and fire fighting vehicles, such local departments could aid by laying a water supply line to the airport equipment with other personnel assisting with rescue, extinguishment, and overhaul operations. Checks should be made to assure fire hose thread compatibility and the possible need for adapters.

(2) It is also important that the surrounding fire departments have complete understanding of the accessibility of the airport movement areas, runway locations, taxiway markings, hydrant locations, etc.

(3) Radio communications may require special study. The neighboring local departments will normally have other radio frequencies than those used on the airport emergency equipment. Preplanning should permit interchange of radio facilities to facilitate movement of responding structural fire equipment on the airport.

300. Anticipated Accidents and Standbys

301. 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 or in the fire station, as conditions warrant.

302. The following information should be obtained as soon as possible from the Control Tower or airline personnel in the event of an anticipated accident (e.g., fire in flight, loss of gear, hydraulic failure, etc.):

a. Type of aircraft.

b. Nature of emergency.

c. Amount of fuel aboard.

d. Number of passengers and crew and injuries, if any.

(Determine, where feasible, the physical and/or emotional status of personnel.)

e. Runway to be used.

f. Nature and location of any cargo of critical significance.

303. Emergency equipment should then be positioned to provide the best possible coverage of the potential crash area with the view that at least one unit of rescue or fire fighting equipment is in position to reach the accident site in the briefest period of time. Detailed pre-emergency plans for each locality must be worked out in accordance with local factors.

304. Airport Control should have facilities to maintain continuous verbal, radio or other contact with the Chief of Emergency Crew to inform him of last-minute changes in the distressed aircraft's flight plan or emergency conditions existing. When advised of the situation, mutual aid to the extent needed or judged desirable should be put into effect by the Chief of Emergency Crew. Where advisable, Airport Control should then notify the pilot of the distressed aircraft of the emergency action being taken to receive the aircraft.

305. For emergencies involving gear malfunction or tire difficulty, there is always a possibility of the aircraft veering off the runway and possibly hitting emergency equipment. In such cases, it is preferable for the emergency equipment to be located near the point of touchdown and

then to follow the aircraft down the runway after ground contact.

306. Should a large fuel spillage occur without fire breaking out, it is important to eliminate as many ignition sources as possible while the spill is being neutralized or covered with foam*. Engine ignition sources should be inerted or cooled.

NOTE: There may be enough residual heat in turbine aircraft engines to ignite fuel vapors up to thirty (30) minutes after shutdown, or ten (10) minutes on piston engines.

307. It is reasonable to assume that, in the anticipated emergency, the aircraft crew has shut off the fuel and de-energized the electrical systems immediately prior to or upon touchdown. This information should be obtained from the crew as soon as possible. However, if unable to contact them, request the aid of competent personnel to re-check the systems.

NOTE: It is desirable to have trained personnel, if possible rated mechanics, who can perform this duty as it is almost impossible for fire personnel to know where the controls for these systems are located in today's complex aircraft.

308. Rescue and fire fighting personnel should stay at least 25 feet from the intake of an operating turbine engine to avoid being sucked in, and 150 feet from the rear to avoid being burned from the blast. On piston aircraft the propellers should never be touched, even when at rest.

309. An aircraft equipped with JATO (Jet-Assist-Takeoff auxiliary rocket engines), igniters and ignition cables should be removed from any unexpended units as soon as possible (see Paragraph 419).

*For routine fuel spill situations, see Standard on Aircraft Fuel Servicing (NFPA No. 407, ANSI Standard Z119.1).

400. Unexpected Emergencies and Features Common to All

401. Constant observation of flight and ramp activity should be maintained from the Airport Fire Station. Watchmen should be provided with every possible visual aid, and also should have communication facilities for prompt transmission of alarms. Proper location of the fire station is essential to afford maximum visibility of movement areas.

402. If facilities are provided, Emergency Crew personnel should alternate on watch during all hours of flight activity. Observation duties may include the following visual checks wherever feasible (on some large airports the areas are too large to permit performing one or more of these functions) :

a. Continuity of power in aircraft powerplants in the air and at time of take-off.

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

c. Availability of roads — runways and fire lanes. These are often blocked by parked aircraft awaiting take-off or taxi clearance.

NOTE: The load-bearing characteristics of the airport soil structure for various weather conditions should be known and drivers should be trained in off-road driving problems.

d. Effect of current weather conditions as a possible restriction on movement of emergency vehicles.

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

a. Wind direction.

b. Location and extent of fire.

c. Location of aircraft occupants relative to fire.

d. Relationship of wind, fire, personnel and fuel tanks.

e. Terrain conditions and exposures.

f. Flammable liquid spillages.

g. Position of fuselage exits.

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

404. All personnel operating directly in the involved area of the crash should be provided with adequate protective clothing. Standard protective clothing and accessories

("approach" or "proximity" clothing) are recommended for fire fighters (see NFPA No. 403 and NFPA No. 406M for further information). Supporting protective measures with foam hose lines are usually necessary to provide access and egress routes for both rescuers and victims. *When protective clothing is worn by the rescuers, adequate protective measures still should be taken to also protect the victims. In each case, rescue personnel should be fully trained in the value and limitations of their protective equipment to avoid a false sense of security and to recognize that they could unwittingly lead the occupants of the aircraft through a dangerous atmosphere.* Care should be taken to avoid direct application of foam on rescuers unless absolutely necessary as foam can cover face shields and thus impair vision. Intermittent drenching of protective clothing with liquid could cause steam scalds under high heat exposure conditions; in cases where this occurs, either accidentally or as a protective measure, application should continue until those affected are clear of the high heat area.

405. Lines to be used should be charged for use on the fire after equipment is properly positioned irrespective of the extent of the fire at time of arrival. This should assure an immediate discharge capability in case of fuel flash fire which would endanger emergency crews and equipment at the scene as well as occupants of the aircraft. If no fire is visible, all equipment should be placed in immediate readiness for service. All personnel should wear standard protective clothing in order to reduce the possibility of injury in case of a flash and also to save the valuable time it would take to don it.

406. All spills of flammable liquids should 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. Since a continuous water supply is essential and usually not available at all points on an airport, tankers or pumpers should be immediately alerted at the time of alarm, ready to relay water to the aircraft rescue and fire fighting equipment. In addition, general purpose vehicles should 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, an elevated platform truck, or portable emergency lighting equipment,

it is important that prearrangements also include their response when one or more may be needed.)

407. Rescue operations should 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 (see NFPA No. 403 and No. 414 for further information on tools).

408. Rescue of personnel involved in aircraft accidents should proceed with the greatest possible speed. While care is necessary in the evacuation of injured occupants so as not to aggravate their injuries, removal from the fire-threatened area is the primary requirement.

409. Broken fuel, hydraulic fluid (flammable type), alcohol and oil lines should be plugged or crimped when possible to reduce the amount of spill and extent of fire.

410. If the source of heat cannot be removed and flames threaten, fuel tanks exposed but not involved should be protected by appropriate agents to prevent involvement or explosion.

411. Aircraft windows may often be used for rescue or for ventilation. Some are designed to be used as emergency exits. On all aircraft these exits are identified and have latch release facilities on both the outside and inside of the cabin. Most of these exits open *towards the inside.* Most cabin doors are used as emergency exits except those incorporating air-stair facilities. With *a few exceptions* these doors *open outwards.* When exits are used for ventilation they should be opened on the downwind side. It is essential that the rescue crews have a sound knowledge of all design features on aircraft normally using the airport (see Appendices A and B).

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

413. Where the use of cables is necessary to expedite rescue or to assist in controlling fires, exercise discretion lest such procedure result in strains which might release quantities of fuel from partially damaged tanks or cause greater injuries to entrapped personnel.

NOTE: Care must be used in ventilating fuel tank areas. In a number of cases misuse of forcible entry tools has resulted in unnecessary fuel spills increasing the hazard.

414. Burning magnesium parts should be *isolated* where possible; otherwise cover with dry dirt, dry sand, or use special extinguishing techniques to prevent reflashes (see NFPA No. 403 for further information).

415. When the major fire and rescue vehicles have been dispatched to an accident, the control tower should be notified so that they can inform all inbound and outbound flights that substandard or no fire protection exists during the period of the emergency.

416. Response by aircraft rescue and fire fighting equipment to off-airport accident sites should be organized to avoid delays en route. Local police cooperation should be prearranged. Radio equipment should keep the major equipment, the Fire Station, and Airport Control within constant communication. Wherever possible, local fire departments should monitor these frequencies. The fastest and most mobile aircraft rescue and fire fighting equipment should proceed independently of slower heavier units, but the former should direct the latter by radio, supplying route information wherever necessary. Drivers must exercise alert caution in driving along routes that may be used by apparatus using intersecting roads.

417. Auxiliary water tank trucks and pumpers with auxiliary water tanks should 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. Careful 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.

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

419. Some civil and military aircraft are equipped with auxiliary rocket engines to provide standby thrust for emergency or for Jet-Assist-Takeoff (JATO) use. These are usually mounted in the nacelles, in the fuselage tail cone, in the belly of the fuselage, or on the sides or bottom of the fuselage.

The rocket engine operation is characterized by a noise similar to a small turbojet engine. The exhaust flame is bright blue with a column of hot gases beyond the visible flame pattern similar to that of a turbojet. Little smoke is visible except when the relative humidity is 70 percent or greater. Burning of internal residues (such as rubber and felt grain spacers) will normally result in a puff of black smoke at the end of thrust. However, in some cases, residual material may continue to burn slowly for 2 or 3 minutes, producing a small flame at the nozzle.

If a fire surrounds the rocket engines, caution should be used in approaching the area. No attempt should be made to extinguish the engines if they should ignite. Water or foam may be used effectively to control the fire around the rocket motors, but they cannot be extinguished because of the self-contained oxidizer in the propellant. They burn very intensely for a short duration; however, they will normally not contribute significantly to the damage, since their chambers are so well insulated that it takes several minutes of very intense heat to ignite them, which heat will normally have done irreparable damage or have caused any fatalities which will occur, before ignition of the JATO occurs.

If fire does not occur, igniters and ignition cables should be removed from any unexpended JATO on the crashed airplane as soon as possible to reduce the possibility of inadvertent ignition from stray voltage entering the ignition wiring.

420. **Confined Engine Fires (Piston).** When engine fires are confined within the nacelle, but cannot be controlled by the aircraft extinguishing system, dry chemical or carbon dioxide should be applied first as these agents are more effective than water or foam inside the nacelle. Foam or water spray should be used externally to keep adjacent aircraft structures cool.

421. **Confined Turbine Engine Fires (Jet).** Fires confined to the combustion chambers of turbine engines are best controlled if the crew is in a position to keep the engine turning over and it is safe to do so from the viewpoint of aircraft evacuation and other safety considerations. Fire fighters will have to stand clear of the exhaust but may have to protect combustibles from any impinging exhaust flames.

Fires outside the combustion chambers of turbine engines but confined within the nacelle are best controlled with the aircraft built-in extinguishing system. If the fire persists after the built-in system has been expended and the turbine shut down, carbon dioxide or dry chemical may be used to attempt extinguishment. Foam or water spray should be used externally to keep adjacent aircraft structures cool. Do not use foam in the intake or exhaust of turbine engines unless control cannot be secured with the other agents and the fire appears to be in danger of spreading.

NOTE: Some engines have magnesium or titanium parts which, if ignited, cannot be extinguished with the conventional extinguishing agents available to most aircraft rescue and fire fighting crews. If these fires are contained within the nacelle, it should be possible to allow them to burn out without seriously threatening the aircraft itself as long as (1) there are no external flammable vapor-air mixtures which could be ignited by the flames or hot engine surfaces and (2) foam or water spray is available to maintain the integrity of the nacelle and surrounding exposed aircraft structures. [See also Section 220 of the NFPA Recommended Practice for Aircraft Rescue and Fire Fighting Services at Airports and Heliports, No. 403.]

500. Accidents in the Water

501. Where airports are situated adjacent to large bodies of water such as rivers or lakes, or where they are located on coastlines, special provisions should be made to expedite rescue (see Appendix E).

502. In such incidents the possibility of fire is appreciably reduced due to the suppression of ignition sources. In situations where fire is present, its control and extinguishment present unusual problems unless the proper equipment is available.

503. It can be anticipated that the impact of the aircraft into the water might rupture fuel tanks and lines. It is reasonable to assume that quantities of fuel will be found floating on the surface of the water. Boats having exhausts at the waterline may present an ignition hazard if operated where this condition is present. Wind and water currents must be taken into consideration in order to prevent floating fuel from moving into areas where it would be hazardous. As soon as possible these pockets of fuel should either be broken up or moved with large velocity nozzles or neutralized by covering them with foam or a high concentration of chemical agents. Calm surfaces will usually present more of a problem than choppy or rough surfaces.

504. Diving units should be dispatched to the scene. When available, helicopters can be used to expedite the transportation of divers to the actual area of the crash. All divers who may be called for this type service should be highly trained in both SCUBA diving and underwater search and recovery techniques. In areas where there are no operating governmental or municipal underwater search and recovery teams, agreements may be made with private diving clubs. The qualifications of the individual divers should be established by training and practical examination.

505. In all operations where divers are in the water, the standard diver's flag should be flown and boats operating in the area should be warned to exercise extreme caution.

506. Where fire is present, approach should be made after wind direction and velocity, water current and swiftness are taken into consideration. Fire may be moved away from the area by using a sweeping technique with hose

streams. Foam and other extinguishing agents should be used where necessary.

507. It should be anticipated that victims are more apt to be found downwind or downstream. This should be taken into consideration in planning the attack.

508. Where the distance offshore is within range, dacron-covered, rubber-lined fire lines can be floated into position by divers or boats and used to supplement fire boats. In an emergency, rafts can be assembled by 2 men exhaling into a section of 2½-inch fire hose, coupling it to itself, folding and binding it with hose straps (see Appendix E).

509. Where occupied sections of aircraft are found floating, great care must be exercised to not disturb their watertight integrity. Removal of the inhabitants should be accomplished as smoothly and quickly as possible. Any shift in weight or lapse in time may result in its sinking. Rescuers should use caution so that they are not trapped and drowned in these situations.

510. Where occupied sections of the aircraft are found submerged, there remains the possibility that there may be enough air trapped inside to maintain life. Entry by divers should be made at the deepest point possible.

511. Where only the approximate location of the crash is established upon arrival, divers should use standard underwater search patterns marking the locations of the major parts of the aircraft with marker buoys. If sufficient divers are not available, dragging operations should be conducted from surface craft. In no instance should dragging and diving operations be conducted simultaneously.

512. A command post should be established at the most feasible location on adjacent shore. This should be located in a position to facilitate the in and out movement of emergency vehicles.

600. Post-Accident Procedures

601. After fire suppression and survivor rescue have been completed, the following procedures should be observed:

602. Rescue units should familiarize themselves with all regulations, national and local, regarding movement of wreckage and disposition of human remains (see Appendix D).

603. When it has been decided by authorities that the aircraft should be moved, interior portions of the aircraft should first be ventilated. Runway and ground surfaces should be thoroughly flushed of all flammable liquid spills before moving aircraft or permitting normal traffic to resume. Fuel tanks should be drained by qualified technicians (approved methods followed for fire safety — see NFPA No. 407) prior to removing aircraft if conditions necessitate and permit. One rescue and fire fighting unit should be retained at the site while this work is performed. If the aircraft or parts must be moved prior to completion of full investigation and safeting, 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. (In the United States, aircraft cannot be moved without the authority of the National Transportation Safety Board or their designated agents (see Appendix D).)

604. Removal of bodies of fatally injured victims remaining in wreckage after fire has been extinguished or essentially controlled should be accomplished only by responsible medical authorities. Premature body removal has, in many cases, interfered with identification and destroyed pathological evidence required by the medical examiner, coroner or authority having investigational jurisdiction. (If body removal is necessary to prevent further incineration, the original location should be noted, and the body so labelled, and reported to investigators.)

605. The wreckage of an aircraft involved in an accident, including controls, shall not be disturbed (moved) until released for removal by the investigational authority having jurisdiction. If the aircraft, parts, or controls must be moved because they directly present a hazard to human

life, efforts should be made to record their original condition, positions, and locations, and due care should be afforded to preserve all physical evidence.

606. The location of mail sacks and pouches should be observed and this information given to postal authorities. If necessary, the mail should be protected from further damage.

607. If hazardous cargoes are believed present (radioactive materials), procedures should be carried out as prescribed in Appendix C.

608. Aviation fuels and hydraulic fluids may cause dermatitis by contact with the skin. Emergency crew members who have had these fluids spilled on them should wash thoroughly with soap and water as soon as possible. Wet clothing should be changed promptly.

700. Flight and Airport Emergency Crew Duties and Responsibilities in Handling Aircraft "Incidents" and Minor Emergencies

701. The purpose of this guidance material is to eliminate much of the confusion evidenced in past operations and to bring about a better understanding between flight crews and airport emergency crews in handling aircraft "incidents" and *minor* emergencies. Unlike *major* aircraft emergencies where crew efforts are clearly directed to a common goal, many factors must be taken into consideration before action is taken on emergencies such as "hydraulic failure," "bomb scares," "fire warnings" and other such aircraft "incidents." This type of emergency often presents many opportunities for misunderstandings and lack of coordination between flight crews and airport emergency crews.

702. The responsibilities of each crew should be clearly defined and under all conditions the prime concern must be directed to the safety of those persons aboard the aircraft. In many cases, this will necessitate emergency evacuation procedures under various types of conditions. Duties and responsibilities can be generally defined as follows:

a. Flight Crews: Since conditions and facilities differ greatly on most airports, the flight crews must remain primarily responsible for the aircraft and occupants. The final determination to evacuate the aircraft and the manner in which the evacuation shall be carried out must be left to the discretion of the flight crew, provided they are able to function in the normal manner.

b. Airport Emergency Crews: Where airport emergency crews are available, it will be their duty and responsibility to assist the flight crews in any way possible. Since flight crew visibility is restricted, airport emergency crews should make an immediate appraisal of the external portion of the aircraft and report unusual conditions to the flight crews. Protection to the overall operation is the primary responsibility of the airport emergency crews. In the event the flight crew is unable to function, the airport emer-

gency crew will be responsible for initiating necessary actions.

703. Communications: Due to the necessity of communications between flight crew and the airport emergency crew, immediate steps should be taken to establish direct contact between persons in charge of each crew. This will assure that all factors are properly considered before actions are initiated. Several methods of providing this direct communication are generally available:

a. Radios: Most aircraft rescue and fire fighting equipment is on a fixed radio frequency and through cooperation with the control tower the aircraft can be requested to change to this frequency. Other frequencies may be available on equipment which will respond, such as airline vehicles which have radios on a "company" frequency. The officer in charge of airport emergency crews should make use of any of these radio frequencies.

b. Aircraft Intercom: Where aircraft engines are running, radio communication near the aircraft may be very difficult. Most aircraft are equipped with "intercom" systems where "jacks" are provided for use by ground personnel. These "jacks" are generally located under the forward portion of the aircraft, behind an access door. Airport emergency crews should investigate this possible means of communications and carry the necessary head-set and microphones to plug into these facilities. Even with the engines running, direct communications with the flight crew can be established by use of this system.

c. Other Communication Means: Where other means of communications cannot be established, it is advisable for the officer in charge of the airport emergency crews to report to the left side of the aircraft nose and establish direct voice communications with the captain of the flight crew. Portable amplifiers may prove valuable for this type of communication.

704. Static Grounding: It is always advisable for personnel on the ground to assure that proper grounding is provided before coming into contact with an aircraft away from the terminal area. Grounding devices built into the aircraft sometimes fail and excessive static charges can be present. It is advisable to provide the airport emergency crew with a short length of cable, about 6 feet long, which

can be placed over the aircraft landing gear, prior to any contact with the aircraft itself. This will bleed static charges which may be present.

705. Aircraft Fire Warnings: Since it is often impossible for the flight crews to make an accurate appraisal of aircraft fire warning indicators, it is advisable to bring the aircraft to a stop and allow airport emergency crews to inspect the area involved, prior to parking at the terminal where fire would endanger other aircraft or buildings. This inspection can usually be accomplished without opening aircraft compartment doors, by feeling the external skin for heat indications and visual inspections of affected areas.

706. Bomb Reports: Aircraft involved in "bomb scares" should be parked at an area at least 300 feet away from buildings and other aircraft until proper investigations are completed. This may make it advisable to evacuate passengers without the use of loading ramps provided at the terminal. Motorized loading ramps may be available which could be driven to the site, or emergency evacuation stairs carried on fire equipment or the aircraft's slides could be used.

707. Engines Running: It is often necessary to keep at least one engine operating after the aircraft has come to a stop in order to provide lighting and communications aboard the aircraft. This will hamper aircraft rescue operations to some extent and consideration should be given to this problem. On four engine aircraft, it would be advisable for flight crews to obtain any necessary power by use of the #4 engine, since most of the evacuation and rescue activities will take place on the left side of the aircraft, unless fire is a factor. Where the #4 engine is not available for this use, the #3 engine would be preferable to those on the left side of the aircraft. In addition to the normal hazards involved with propellers turning on the reciprocating engine aircraft, the turbojet engines present additional problems which may adversely affect rescue operations. Areas directly ahead of and for a considerable distance behind the turbojet engines, should be avoided by persons on the ground and evacuating passengers. In addition, the turbojet engines will turn for a considerable time after shut-down. This must be considered in positioning of

airport emergency equipment and in evacuating passengers from the aircraft.

708. Equipment Positioning: Reciprocating engine aircraft provide more diversification for approach positioning of airport emergency equipment than do the turbojet aircraft. Due to the swept-back wing configuration and because of the superheated atmospheres behind the turbine engines, most airport emergency crews favor an approach and set-up on the nose of the jet aircraft. This will not always be considered a standard approach as many factors influence this determination. Wind conditions, terrain, type of aircraft, cabin configurations and other factors dictate approaches. For this reason, it is necessary for flight crew members to inform airport emergency crews of the details regarding the particular aircraft in question. On combined cargo-passenger aircraft, the airport emergency crews should be notified of cabin configurations, since some cargo areas extend as far aft as the overwing exits, making them unavailable for emergency evacuation.

709. Evacuation: As previously stated, the final determination regarding evacuation of the aircraft must be made by the flight crew with the airport emergency crews acting under their direction. Since it is nearly impossible for airport emergency crews to become completely familiar with all aircraft and due to extensive training of flight crews in aircraft emergency procedures, they are in a much more favorable position to make decisions involved in evacuating the aircraft.

Nearly all aircraft are equipped with emergency evacuation equipment and the flight crew should be competent in the use of this equipment. Some of the airport emergency crews carry emergency aircraft evacuation stairs and in such cases, the flight crew should be informed of the availability of these stairs. Where evacuation slides are in use, they should not be disturbed unless they are damaged. Where they have not been placed in position, or if they have been damaged, evacuation stairs should be placed in use. These stairs could also prove beneficial in evacuation off-of-wing-surfaces where the distance from the wing to the ground is excessive.

Normal evacuation routes include both overwing window exits and available doors; however, the use of overwing exits presents hazards if the aircraft is in the normal posi-

tion with gear extended. The distance to the ground from the wing surfaces may be excessive and cause serious injury to those evacuating from the aircraft. Leading edge wing evacuation should be considered where fire may block the normal evacuation off the trailing edge of the wings. It is recommended that only the aircraft doors equipped with stairs or slides be used where immediate life safety is not a factor.

Most airline evacuation procedures call for evacuation to be achieved to the rear of the aircraft. However, in many severe accidents evacuation to the rear might be impossible due to fire and debris caused by the aircraft skidding along the ground. For these reasons, the flight crews must remain somewhat flexible in planning for emergencies and be prepared to change procedures in case exits are blocked. Airport emergency crews must likewise be prepared to provide proper protection during the evacuation and take the steps necessary to cope with different situations, such as, blocked exits, engines running, fires, and other abnormal situations.

710. Emergency Landings: Prior to any aircraft emergency landing, the flight crew should seriously consider passenger distribution in the cabin. With the advent of two and three class service it is entirely possible that some areas within the cabin may be subject to high density seating, while other areas contain relatively few occupants.

Several other factors will make it more desirable to plan for forward evacuation of the aircraft. As pointed out, most airport emergency equipment approaches will be made on the forward section of the aircraft. There is a trend toward "nose in" parking of the aircraft at terminals and since most passengers enter the aircraft through the forward doors, they will attempt to exit in the same manner in an emergency. The nose gear is generally considered more likely to fail in abnormal landings than the main gear. If this should occur, the aircraft would probably be in a tail high attitude, making forward evacuation even more favorable.

In all cases, prior to landing, the flight crew should relay information to the airport emergency crews which might have a bearing on firefighting and rescue operations. This should include information including fuel loads, number of persons aboard the aircraft, cabin configuration, passenger

distribution, disabled passengers and any other information which is pertinent to the particular situation.

711. Flight Crew – Airport Emergency Crew Coordination: Wherever possible, personal contact between flight crews and airport emergency crews should be encouraged. This personal contact has been very beneficial in the past and because of the complex operations involved with aircraft emergencies, it is advisable for all concerned to have a better understanding of individual problems and considerations. In many instances flight crews have no knowledge of available facilities at various airports from which they operate regularly.

800. Non-Operational Emergencies

801. The prime mission of airport emergency crews and equipment is fighting operational aircraft fires and rescue of people involved. Equipment and techniques recommended in NFPA Nos. 402 and 403 are generally directed toward this goal. However, many times airport emergency crews are called upon to fight aircraft fires that occur during servicing or in parked aircraft or to provide standing protection when a fire hazard exists. The recommendations in this section are for the guidance of the officer in charge when responding to such emergencies.

802. Aircraft Passenger Cabin Fires on the Ground (Class "A" Fires).

a. Aircraft passenger cabin fires on the ground normally involve ordinary combustibles (cabin upholstery, cabin liners, refuse, paper toweling, electrical insulation, etc.) regardless of the source of ignition. The intensity of any such fire at time of discovery will depend on a number of variables, such as the form of the materials ignited, the amount of air (oxygen) present or draft conditions, the involvement of other fire hazardous materials (flammable liquids, oxygen, incendiary devices, etc.), and whether there has been a delay in fire detection or fire suppression activity. Effective extinguishing action depends largely on how advanced the fire is when attacked, its accessibility to fire control efforts, and the availability of proper and adequate amounts of extinguishing agents.

b. Sometimes aircraft interior fires originate in aircraft system components below the cabin floors or in the cabin wall or ceiling cavities (between the interior cabin liners and exterior fuselage skin). Such concealed spaces may extend the length or width of the aircraft and may spread uncontrolled in the presence of combustible materials. It may be very difficult, under such conditions, to determine either the source of ignition or the extent of fire spread from either outside or inside the aircraft.

c. When cockpit or cabin fires on the ground occur while the aircraft is occupied (as during pre-flight checks, maintenance operations, or while passengers are embarking, debarking, or awaiting aircraft movement), they are normally detected promptly, permitting prompt alerting of the air-

port fire crew and utilizing portable fire extinguishers available aboard the aircraft. Aircraft flight crews should be trained in the utilization of all available fire extinguishing devices to handle such emergencies (see the Standard for Aircraft Hand Fire Extinguishers, NFPA No. 408) and should be trained in aircraft emergency evacuation procedures to restrict the potential life hazards involved. The toxicity of fire gases must be appreciated by flight crews, particularly in relation to the safety of uninstructed passengers.

d. Unoccupied aircraft on the ground present the particular problem of delayed detection. An idle aircraft with doors closed and unattended may sustain a smoldering fire resulting in buildup of fire gases and smoke which can go unnoticed for some period of time. Opening an aircraft for fire control under such conditions can be extremely hazardous both because of pressure buildup within the aircraft due to the combustion process, and because of the introduction of fresh air from outside which can result in a flash-over or a fire-gas explosion. The configuration of an aircraft is not dissimilar to a corridor in an ordinary structure, and where large amounts of combustibles are present, the flash-over potential can be very serious. Therefore, particular caution is needed in opening doors and emergency exit windows for fire control purposes.

e. Each fire situation will differ, therefore explicit guidance on fire extinguishing techniques for interior aircraft fires on the ground is most difficult. Normally, best results can be obtained by applying an indirect attack utilizing water spray through narrow openings at doors, etc. In this approach, care must be taken in the positioning of the water-spray nozzles to avoid merely driving the flame front to previously uninvolved sections. Multiple points of attack are preferred to a single point with the locations selected dependent upon the best evaluation of the interior conditions from exterior observations through cabin windows, by paint on the fuselage blistering, and smoke generation concentrations. Optional agents which might be used (assuming no occupants are aboard) would be high-expansion foam, Halon 1301, carbon dioxide, or all purpose dry chemical extinguishants.

NOTE: Where oxygen systems are damaged and create a localized oxygen-enriched atmosphere, only water fog should be used in fire control efforts.

f. In extreme cases, where it is obvious that fire has extensively involved an aircraft interior and where exposure fire problems do not mitigate against such action, breaching (forced ventilation) of an aircraft may be necessary and the only practical way to deal with the situation. This normally means cutting into the fuselage at selected points (avoiding fuel tank areas and oxygen lines) when the fire has obviously reached concealed spaces behind cabin linings, or by breaking windows at strategic points where fire is confined to the main cabin area.

g. Fire fighting crews should use their self-contained breathing apparatus whenever entering a burning aircraft and should *never* enter a burning aircraft without such self-contained breathing apparatus in service. Dangerous toxic gases can be produced by the burning or charring of many cabin interior materials.

h. Post-fire extinguishment operations may dictate prompt use of smoke ejector equipment and, following a thorough inspection, ventilation with clean air.

803. Hot Brakes and Wheel Fires:

a. The heating of aircraft wheels and tires presents a potential explosion hazard, greatly emphasized when fire is present. In order not to endanger the crew needlessly, it is important not to mistake hot brakes for brake fires.

b. Hot brakes will normally cool by themselves without the use of an extinguishing agent. Most aircraft operating manuals for propeller driven aircraft recommend that flight crews keep the propeller forward of the fire turning fast enough to provide an ample cooling airflow. Most jet aircraft wheels have fusible plugs which will melt at about 350°F. and deflate the tire before dangerous pressures are reached.

c. When responding to a wheel fire, emergency crews should approach the wheels with extreme caution in a fore or aft direction, never from the side in line with the axle. Since the heat is transferred to the wheel from the brake it is essential that agent be applied to this area; once the fire is extinguished, do not discharge further agent for cooling.

d. Too rapid cooling of a hot wheel, especially if localized, may cause explosive failure of the wheel. Solid streams of water and carbon dioxide should not be used except as a last resort. Water fog can be used but intermittent application of short bursts of 5-10 seconds every 30 seconds is recommended. Dry chemical has limited cooling capacity but is an effective extinguishing agent.

e. If further cooling is desired after extinguishment of the fire the agent should be directed at the brake area only.

f. Once the tires are deflated any extinguishing agent may be safely used, as there is no further danger of explosion.

900. Emergencies Involving Military Aircraft

901. General: Military aircraft on occasions make use of civilian airports. Civil airport emergency crews should thus possess a working knowledge of these specialized aircraft including such items as: canopies, life-support equipment, ejection seats (see Appendix B) on combat aircraft.

902. Rescue and Fire Fighting Protection for Aeromedical Evacuation Aircraft:

a. The following procedures will be observed when litter patients are aboard aeromedical evacuation aircraft:

(1) Prior to landing, the aeromedical evacuation aircraft commander will report the number of litter patients aboard his aircraft to the control tower and request aircraft rescue and fire fighting vehicles be alerted.

(2) One (or more as the situation warrants) fully manned aircraft rescue and fire fighting vehicle will be strategically positioned prior to aeromedical evacuation aircraft landings and takeoffs. Prior to takeoff, the vehicle will follow the aircraft to its run up position and stand by until the aircraft is airborne.

(3) Aircraft rescue and fire fighting vehicles and personnel enumerated in Paragraph 902.b. will be alerted if the aeromedical evacuation aircraft experiences even minor difficulty. One or more alerted aircraft rescue and fire fighting vehicles will follow the taxiing aircraft to the ramp. One fully manned vehicle will stand by while litter patients are offloaded. The recommended stand-by position for the vehicle is to the rear and slightly off the left wing tip. Whenever possible, the aircraft will be positioned so that its main exit faces up-wind:

b. Rescue and Fire Fighting Operations: Upon receipt of an "anticipated crash" call:

(1) The "alert" aircraft rescue and fire fighting vehicle standing by on the airfield will be situated in a strategic "action" position.

(2) The Fire Department dispatcher will immediately dispatch all available aircraft rescue and fire fighting vehicles and any available structural fire fighting vehicles to preassigned stand-by positions.

(3) The security and/or law enforcement officer will insure the immediate dispatch of police and/or security

guards to the scene of the emergency to establish a fire line. Personnel not required to actively participate in the actual rescue operations will not be permitted to cross the fire line. After the fire department officer-in-charge has declared the fire extinguished or the danger of fire eliminated, police and/or security guards will be detailed to:

(a) Prohibit unauthorized personnel from entering the area.

(b) Prevent tampering with material which might be needed in determining the cause of the accident.

(c) Guard against the unauthorized removal of cargo and/or personal effects.

1000. Low Visibility Operations (Category II Operations*)

1001. General. New and improved techniques for instrument takeoffs and landings have resulted in aircraft operations in weather conditions that could seriously delay the response of aircraft rescue and fire fighting equipment. Special considerations to response capability must be given at any time surface visibility drops to less than one-half mile.

1002. Stand-by Requirement.

a. At least one major aircraft rescue and fire fighting vehicle should be located approximately at the mid-point off each active runway during such low visibility operational periods. The distance from the runway centerline should be at least 1000 feet in order that the parked vehicle does not become a hazard to aircraft operations. Where the firehouse is located within 3000 feet of the midpoint of the main instrument runway, it is not necessary for the crash equipment to be repositioned, as it may be assumed that the vehicles can meet the normal maximum response time as specified in Paragraph 103.

b. The tower must be made aware of the exact location of all such vehicles.

c. All equipment, so deployed, should be fully manned during all periods of flight operations when surface visibility is less than one-half mile.

d. Surface navigational aids, such as ground radar (ASDE), should be fully utilized through coordination between the rescue personnel and the tower controllers. Frequent test exercises should be conducted by utilizing such navigational aids to guide aircraft rescue and fire fighting equipment to critical areas adjacent to the active runways. These tests should be conducted at night or during low visibility periods.

e. When temperatures do not permit the equipment to be left in the open, a temporary frangible cover can be

*"Category II Operation," with respect to the operation of aircraft, means a straight-in ILS (Instrument Landing System) approach to the runway of an airport under a Category II ILS instrument approach procedure issued by the Administrator of the Federal Aviation Administration or other appropriate authority.

provided. Another possible solution might be to provide electrical connections at these pre-selected positions so that engine heaters and/or other heating devices could be utilized.

f. A suitable hard surface access route should be provided from vehicle stand-by positions to active runways being protected.

1100. Foaming Runways for Crash Protection

1110. Introduction.

1111. A number of aircraft emergencies (mostly wheels-up landings or aircraft with defective nose gear) have occurred at airports where protein foam has been used on runways with the thought that such action would mitigate the extent of damage likely to result and reduce the likelihood of fire occurring following the impact. A number of these operations have been successful. Likewise, a number have not accomplished their purpose and appear to have been inadvisable (in most of these latter cases, aircraft have missed or overrun the foam blanket). During the same time period, and prior thereto, similar aircraft emergencies have occurred at airports on runways not coated with foam and in a number of these cases no major fire have occurred and the damages sustained by the aircraft have been moderate.

1112. The U. S. military services did much of the original work in connection with foaming of runways for crash protection and likewise have done much to advance the technique. The practice has also spread to other countries. It is also true that this idea has been advanced significantly by the publicity given to a number of isolated incidents, by television and newspaper glorification of the technique, and by the psychological and theoretical advantages which the technique seems to inspire.

1113. Unfortunately, it has not been possible to date to conduct full-scale tests of wheels-up aircraft landings on various types of runway surfaces with and without foam coatings. To evaluate the technique at this time, therefore, it is necessary to apply the test data that are available, to analyze aircraft impact behavior from actual incidents of record (where foam has and has not been used), and to relate the use of foam for this purpose to its known qualities.

1120. Theoretical Benefits of Foaming Runways.

1121. There appear to be four basic possible benefits from foaming of runways for crash protection. They are:

a. Reduction in Extent of Aircraft Damage. That the foam will reduce the extent of damage to an aircraft which may be forced to make a wheels-up emergency landing or where the nose gear is defective.

b. Reduction in Deceleration Forces. That a foam coated runway will reduce the coefficient of friction and thus decrease (by permitting slippage) either the deceleration forces imposed on the aircraft and its occupants or its ground looping tendencies.

c. Reduction in Friction Spark Hazard. That the foam or water retained by the foam at the runway interface will reduce the known friction spark hazard of certain aircraft metals on dry runways. Such friction sparks constitute a possible ignition source following impact-imposed damages to an aircraft's fuel tanks or system.

d. Reduction in Fuel Spill Fire Hazard. That a foam coated runway will reduce the extent of the fire hazard in the event of a fuel spill following impact-imposed damages to an aircraft's fuel tanks or system.

1130. Analysis of Theoretical Benefits.

1131. Analysis of the four basic possible or theoretical benefits described in Section 1120 on the basis of the test data available and the experience record to date leads to the following conclusions:

a. Extent of Aircraft Damage. A number of well executed emergency landings on foam coated runways have been accomplished with minimum damages to the aircraft involved. Unfortunately, these incidents do not prove that, conversely, the damage would have been appreciably greater had no foam been used. Controlled emergency landings on dry runways have also been completed with relatively minor damages to the aircraft. A number of variables are indicated:

(1) the design of the aircraft (such factors as "crush-resistance" of the fuselage, whether the aircraft is of high or low wing design, the hazard presented by propeller fragmentation, etc.);

(2) the skill of the pilot (his ability to land the aircraft under emergency conditions by virtue of his training and/or his psychological or physical state at the time the emergency occurs);

(3) the type and condition of the runway surface;

(4) the landing weight of the aircraft;

(5) the weather, temperature and visibility conditions, etc.

To date, no incident has occurred where foaming of the runways has *increased* the extent of damages so about all that can be said is that, under favorable conditions, foaming of the runway should *not* result in *greater* aircraft impact damages. No test data are available which permit a more complete evaluation of this feature.

b. Extent of Deceleration Forces. From what is known to date, the normal braking ability of aircraft on wet runways will be affected only slightly from the use of foam on runway surfaces, assuming nonfreezing weather.

c. Reduction of Friction Spark Hazard. Scale research tests have shown that aluminum alloy metals produce no friction sparks capable of igniting aircraft fuel vapors under the simulated bearing pressures and contact speeds likely to be encountered in actual aircraft emergencies on either dry or wet (foam covered) concrete or asphalt runway surfaces. According to these same scale research tests, foam, properly applied, is capable of holding a water layer at the runway interface which is effective in suppressing sparks in from 57 to 100 per cent of the tests where magnesium alloys, stainless steel and other aircraft steels produced sparks capable of igniting aircraft fuel vapors from friction with dry asphalt or concrete runways. Titanium friction sparks capable of igniting aircraft fuel vapors could not be effectively suppressed by runway foaming in any of the scale research tests and constitute the greatest hazard. The roughness of runway surfaces was found to be a factor in the production of the incendiary sparks generated by abrasion of all the metals (except aluminum) and the friction impact with expansion joints between concrete slabs was found to result in momentary increases in the energy release from the sparks.

d. Reduction of Fuel Spill Fire Hazard. From all that is known of the fire suppression qualities of foam and the scale research tests, it is clear that a foam coated runway would have no appreciable effect on the fire hazard of fuel vapors *in the atmosphere over* the foam. These vapors could still be ignited above the foam blanket by an engine fire, electrical arcs or sparks, static discharges or other ignition sources. Should liquid fuel be relased over the foam blanket, it will fall through and spread

under the foam, reducing the release of flammable vapors. In case of ignition, the burning area may be reduced, depending on the age and condition of the foam blanket. Fire crews should be prepared to fight such a fire.

1132. From the above analysis, it can be seen that foaming of runways for crash protection involves variables not easily assessed in advance of the incident and that its effectiveness in reducing the friction spark and fuel spill hazards likewise cannot be guaranteed. On the other hand, any possible means of mitigating the impact severity or the crash fire hazard should not be overlooked.

1140. Operational Problems.

1141. There are other considerations which should be evaluated to determine the feasibility of using foaming of runways for crash protection in any individual case. They are:

a. The actual nature of the airborne emergency; i.e., whether the aircraft cannot lower its main gear, whether only one gear is down and cannot be retracted, whether one or more tires or wheels have been damaged or lost, whether the nose gear is "cocked", or a combination of one or more of these circumstances or some other related condition exists.

b. The time element available for accomplishing the production and distribution of the foam covering (which may take up to an hour or more). This will be related to the nature of the aircraft emergency (the safety factors involved in the aircraft's remaining airborne during the foam laying operation), the number and the nature of the foam making appliances available.

NOTE 1: Airports not having adequate equipment should not attempt to lay a foam blanket.

NOTE 2: Other air traffic must be considered unless alternate landing areas are available.

NOTE 3: Normally the time required to lay a runway foam blanket permits the dumping of fuel by the air crew (where considered necessary or desirable) to reduce the hazard during the emergency landing.

c. The reliability of information on the landing techniques to be used. This will be related to wind and visibility conditions, pilot experience and skill, runway instrumentation factors and aircraft operational problems under the existing emergency conditions.

d. The foam-making capability of the equipment available on the airport for runway foaming (not including the minimum equipment for aircraft rescue and fire fighting — see Paragraph 1143) plotted against the prudent holding time of the aircraft involved in the emergency.

NOTE: At airports where foaming of runways is programmed as may be required (see Paragraph 1144) preplanning will be necessary to assure the availability of adequate foam liquid concentrate to meet this need in addition to the normal quantities required for fire control and training purposes.

e. The effect the foam laying and clean-up operations will have upon the aircraft movements at the airport and how this will affect the safety of all aircraft operations in progress.

f. Whether the ambient temperature conditions make the laying of a foam blanket feasible. During very cold weather, freezing could create a serious problem because of freezing of the liquid content of the foam on the cold runway surface. The foam itself would be slow to freeze but the formation of ice beneath the foam would be undesirable if subsequent aircraft braking was to be attempted and for further normal use of the runway after the emergency was over.

g. The length of the runway and the nature and condition of the runway surface at the time the emergency occurs.

1142. Considering the factors mentioned in Paragraph 1141, it is clear that initiation of a request to foam a runway for any given flight emergency situation should be a flight operational decision. The request to take such action should thus come from the pilot in command of the aircraft or the aircraft operator, assuming that they are familiar with the aforementioned considerations.

1143. Determination as to the feasibility of applying foam to a runway is a decision which the airport manager or his representative (the Chief of the Airport Fire Department) must make after receipt of the official request for such services from the pilot or operator and an evaluation of the fire protection and other airport operational problems involved. Due to the fact that aircraft operations are continuing elsewhere on the airport and the existing danger that circumstances beyond the control of the pilot of the disabled aircraft may require an emergency landing before the

foam blanket is ready, or before the foam-making units have been replenished, it is essential that the minimum aircraft rescue and fire fighting vehicles recommended in NFPA No. 403, Aircraft Rescue and Fire Fighting Services at Airports and Heliports, should be maintained in fully operational condition to perform their emergency function. Tank vehicles or specially designed equipment should normally be used for runway foaming (see Appendix G).

1144. The designation of one airport in a region or predetermined geographical area to which aircraft might be safely dispatched when in need of runway foaming is recommended. Selection of these regional airports should be based not only on the availability of adequate runway foaming equipment and supplies, emergency aircraft rescue and fire fighting services, and allied support services (cranes and aircraft repair services), but also on the physical condition of the runways to be employed, the climatic conditions, aircraft traffic interruption effects, and the security of the airport to assure control of curious spectators in event of public awareness of the impending emergency landing.

1150. Techniques of Runway Foaming.

1151. After evaluating the theoretical and operational problems involved as discussed in Sections 1120 through 1140, if foaming of a runway is to be accomplished in an attempt to safeguard a particular emergency landing, the following recommendations are advanced for considerations by those responsible:

NOTE: Each case will differ depending on the numerous variables involved but the following basic principles are important considerations.

a. That radio contact be maintained between ground crews laying the foam on the runway and the pilot of the distressed aircraft to assure full understanding and knowledge of the operating plans and the protection established.

b. Primary aircraft rescue and fire fighting vehicles as recommended in NFPA No. 403, Aircraft Rescue and Fire Fighting Services at Airports and Heliports, should *not* be used to foam runways unless the number of such vehicles held in reserve is sufficient to provide the minimum protection recommended in No. 403 for that particular airport. Auxiliary tank trucks equipped to dispense

foam through ground sweep nozzles or special boom nozzles or other additional specialized foaming equipment should be used for runway foaming (see Appendix G).

c. That a time study be conducted prior to any emergency to work out the scheduling of the foam laying operation and the vehicle reload requirements. Under any condition, adequate extra quantities of foam compound must be preplanned and prearrangements made for rapid vehicle re-servicing.

d. Previous experience has shown that, when making a gear-up landing, the aircraft contacts the runway much further from the threshold than normal. This is due to increased lift caused by "ground effect" and, in some cases, by the reduced stalling speed of the aircraft with the gear up. The point of aircraft touchdown can be 500 to 2000 feet further down the runway than normal, depending on the size and speed of the aircraft involved.

e. When visibility conditions are such that the pilot cannot distinguish from the air where the foam applied to the runway starts, a reference point should be established in a clearly distinguishable manner to indicate where the foam pattern commences to aid the pilot in getting the aircraft positioned for the landing.

f. All unnecessary people, press and photographers be advised to stay clear until all evacuation and occupant counts have been accomplished and full fire control or fire preventive measures taken. (This is a function of airport police or guards as may be augmented by local police and volunteers.)

g. The length, width and depth of the foam pattern will vary with the type of emergency, the type of aircraft, the length of the runway, the quantities of agent available, and the time factors involved. The following Table 1 may be used for estimating the approximate water and foam liquid requirements for foaming a runway for piston or jet aircraft. The needed supplies for longer or wider strips may be readily calculated from the figures in the Table by using an appropriate multiplying factor.

h. For a wheels-up landing, the foam pattern should be laid down the center line of the runway beginning at a point agreed to by the pilot and should be so calculated to run continuously the full length of the projected slide.

Table 1

Water and Foam Liquid Requirements for Runway Foaming

Factors	Malfunctioning Nose Wheel	Wheels-Up Landing 2-3 Engine Piston or Jet	4-Engine Piston	4-Engine Jet
Width of Blanket in Feet	10	40	75	75
Length of Blanket in Feet	1,500	2,000	2,500	3,000
Runway Area Covered in Square Feet	15,000	80,000	187,500	225,000
Water Required in Gallons	1,500	8,000	18,750	22,500
Foam Concentrate Required in Gallons				
3 Per Cent Type	45	240	562	675
6 Per Cent Type	90	480	1,124	1,350
Distance from Threshold to Leading Edge of Foam Blanket in Feet	2,500	1,000	1,000	1,500

NOTE: Due to variations in foam metering devices, possible inaccurate proportioning of the foam-liquid concentrate, and the varied characteristics of local water supplies, it is normally prudent to increase the amount of foam-liquid concentrates to above those theoretically required, figuring perhaps on 10% foam-liquid concentrate for the 6% type and 5% for the 3% type. Figures on foam liquid concentrate quantities are based on forming a 2-inch depth of finished foam.

i. For a defective or "cocked" nose wheel with main gear fully operational, it is recommended that the runway foam pattern should be approximately ½ the width of the main gear tread, but not more than 10 feet, laid down the center of the runway, beginning at a point agreed to by the pilot (usually further down from the threshold than for a main gear or wheels-up landing) and calculated to run continuously the full length of the projected landing. It is essential that the main gear be clear of the foamed area to insure that full braking can be utilized without fear of skidding or hydroplaning.

j. Where gear malfunction involves only one main gear and the pilot elects to land with only that gear retracted, the foam pattern should be laid down on the appropriate side of the runway, beginning at a point 3000 feet from threshold and run continuously a further 3000 feet. Width of foam strip and placement from center line should take into account the type of aircraft involved and

the anticipated distance and width of metal contact of either the wingtip and/or engine pod with the runway.

k. Aging of the foam prior to use for a period of 10 to 15 minutes is desirable to permit water to drain from the aqueous foam and create effective runway surface wetting within the foam pattern. Aging for too long a period (say over 2½ hours) prior to use on a hot summer day may be disadvantageous due to excessive drying and water runoff.

l. To be effective a *continuous* layer of foam in the proposed slide path is essential as any interruptions, holes or breaks might result in the formation of incendiary sparks of sufficient duration and intensity to cause ignition of any flammable vapors which were present.

m. Depth of the foam should preferably be two inches to achieve even distribution and so that the foam has good "holding" characteristics (capable of holding the water at the runway interface without excessive drain-off due to runway slope or because of its "crown"). Foam of less depth may be satisfactory if continuous, if it drains properly, and if it has the ability to retain the water content at the runway surface. Foam expansions of 8 to 12 appear to be satisfactory for this purpose.

n. That following foam laying operations, airport fire crews leave the aircraft operational runway and take up stand-by positions out of range of all collision hazards. After the aircraft touches down, rescue and fire fighting vehicles should follow the aircraft and be ready to operate.

Appendix A

Civil Aircraft Data for Fire Fighters and Rescue Crews

This Appendix presents information on the *principles* of rescue and fire fighting incident to aircraft fire emergencies and data on *representative* air carrier aircraft which are in common current usage. The purpose is to give those concerned *some* of the essential information needed to permit them to assess the true nature of the specialized problems involved in performing effective aircraft rescue and fire fighting services.

It is *strongly* emphasized that *personal* inspections by aircraft rescue and fire fighting personnel of the aircraft in service at the airport on which they serve is essential to assure proper operational techniques and to conduct realistic drills.

The following listing identifies the contents of Appendix A:

Figures A1 through A-3	Principles of Rescue
Figures A-4 through A-7	Principles of Fire Fighting
Figure A-8	Boeing 747
Figures A-9A and B	Boeing 707
Figure A-10	Boeing 727
Figure A-11	Boeing 737
Figure A-12	Douglas DC-10
Figure A-13	Douglas DC-9
Figure A-14	Douglas DC-8
Figure A-15	Douglas DC-3
Figure A-16	Douglas DC-4
Figure A-17	Lockheed 1011
Figures A-18A, B, C	Convair 880
Figure A-19	Fairchild F-27/FH227
Figure A-20	Vickers-Armstrong VC-10
Figure A-21	Vanguard
Figure A-22	BAC One-Eleven
Figures A-23A, B, C, D, E, F, G,	Lockheed JetStar
Figure A-24	Canadair CL-44D4

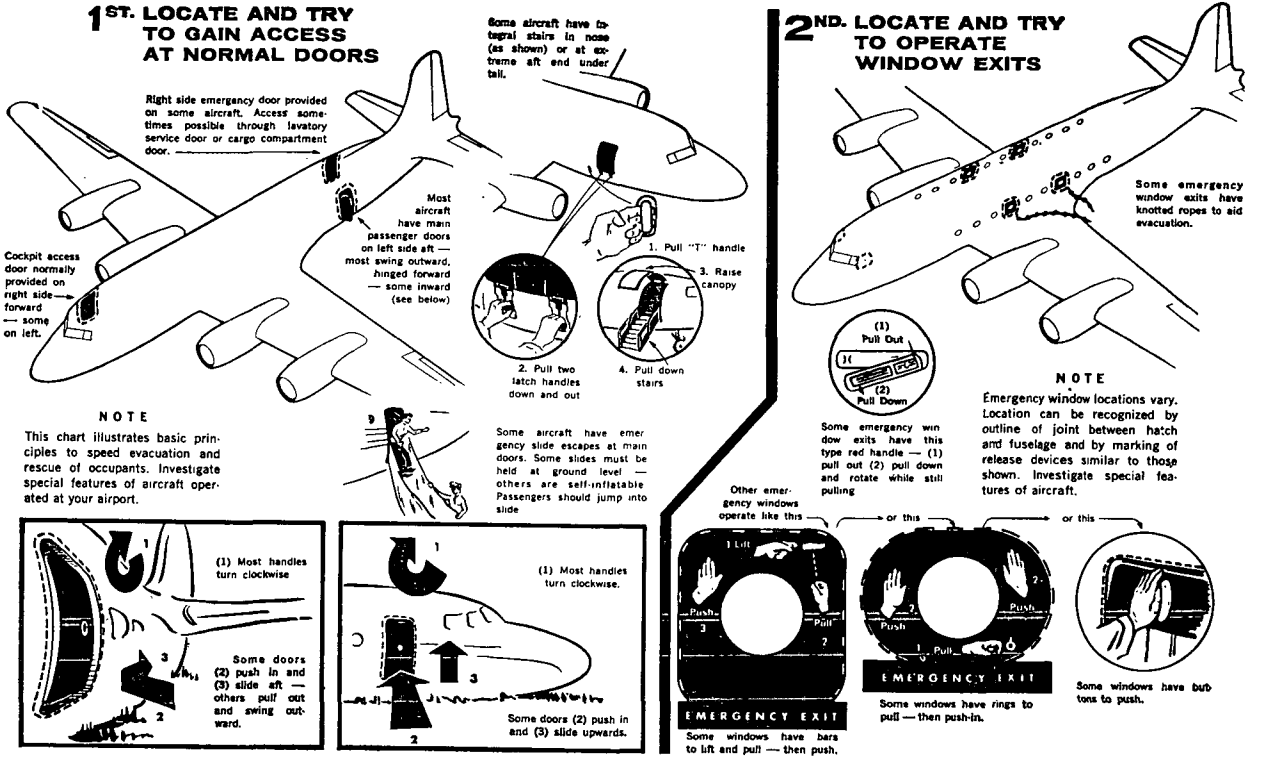
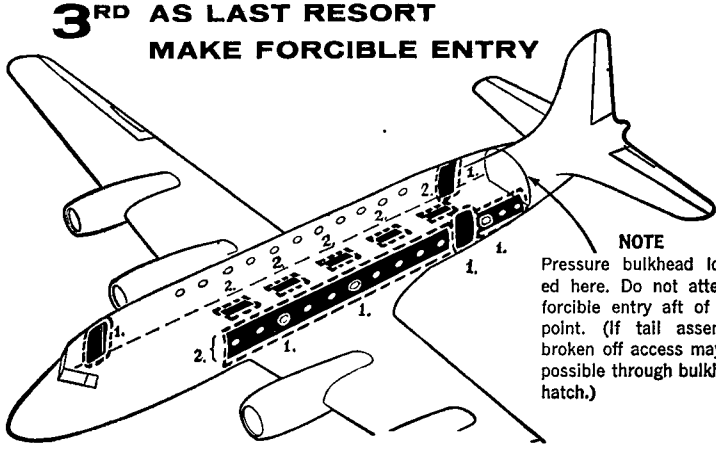


Figure A-1. The principal points to consider in gaining access to civil transport aircraft. Each aircraft must be examined individually to know how doors and windows may be most easily opened from outside.

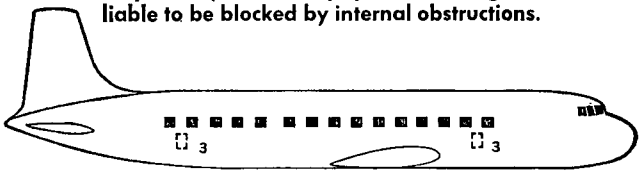


PREFERRED FORCIBLE ENTRY LOCATIONS

NOTE

This chart illustrates basic principles to speed evacuation and rescue of occupants. Investigate special features of aircraft operated at your airport.

1. **Force normal or emergency doors or windows if possible.**
2. **Saw or cut in at or between windows above seat arm level and below the hat rack or on either side of center line of top fuselage section (some aircraft marked in this area for "cut-in" as below). Remember when cutting-in, occupants may be exposed to injury from cutting tools. Other areas liable to be blocked by internal obstructions.**



3. **Saw or cut in at locations marked on some aircraft with red or yellow corner marks and/or words: "cut here".**

Figure A-2. These illustrations show reciprocating-engine aircraft. See other Figures for forcible entry locations on modern turbine-powered transport aircraft. These latter aircraft are most difficult to cut into because of the thickness of the metals used, the extensive framing of the fuselage, the insulation, etc.

ALWAYS KNOW THE PRINCIPAL FIRE HAZARD ZONES IN CIVIL AIRCRAFT

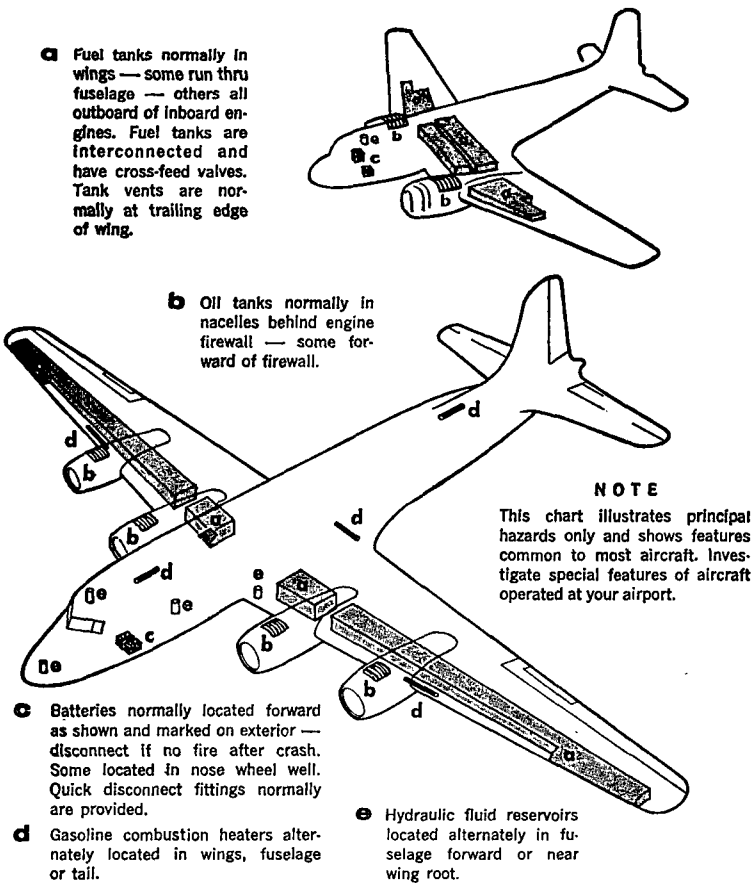


Figure A-3. These are simplified drawings of the principal fire hazard zones on reciprocating engine aircraft. Typical turbine aircraft are illustrated elsewhere in this Appendix.

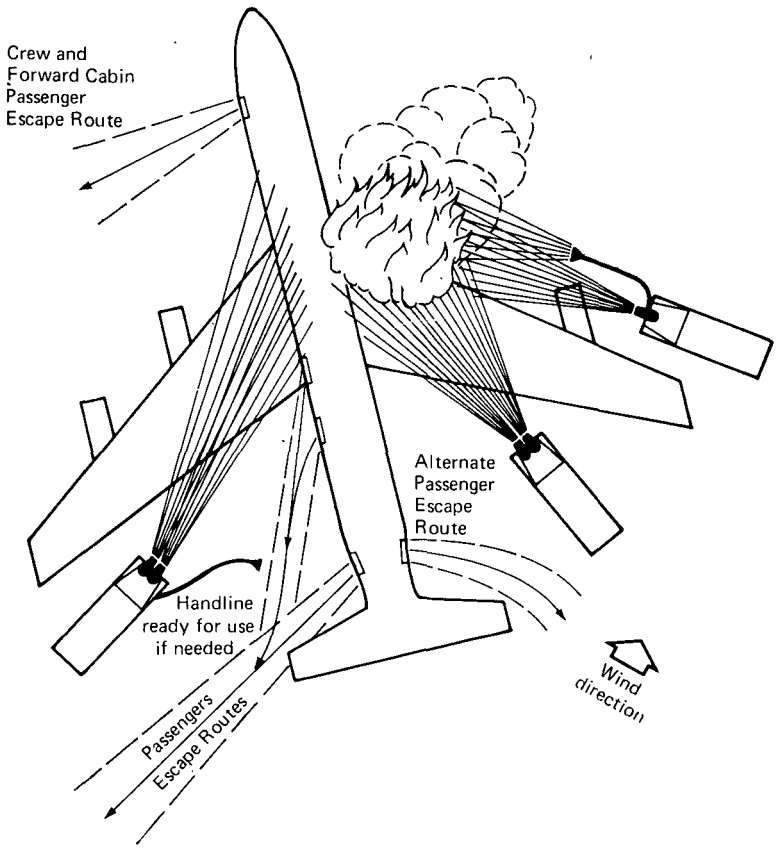


Figure A-4. Principles of fire fighting for civil transport aircraft using two major vehicles dispensing foam with fire in wing-root area on one side and a near cross wind. See paragraph 308 regarding blast from turbine aircraft engines; if port engines are still operating at time fire fighting commences, the attack from the port side would have to be shifted forward of the wing.

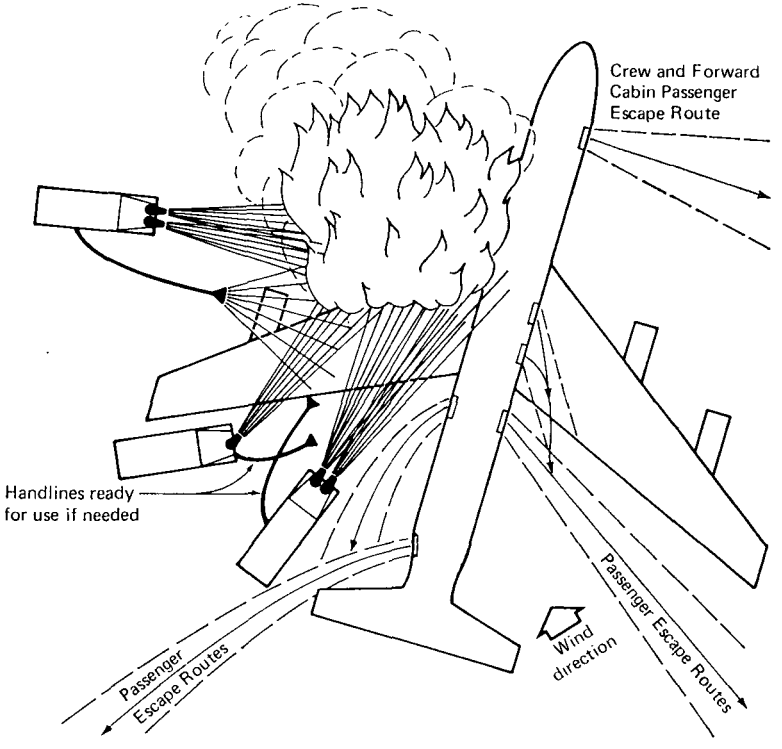


Figure A-5. Principles of fire fighting for civil transport aircraft using three major fire fighting vehicles with fire involving port inboard engine and integral fuel tank area. See comment re operating turbine engines in caption to Figure A-4. Maintaining fuselage integrity is the first principle to allow passenger evacuation.

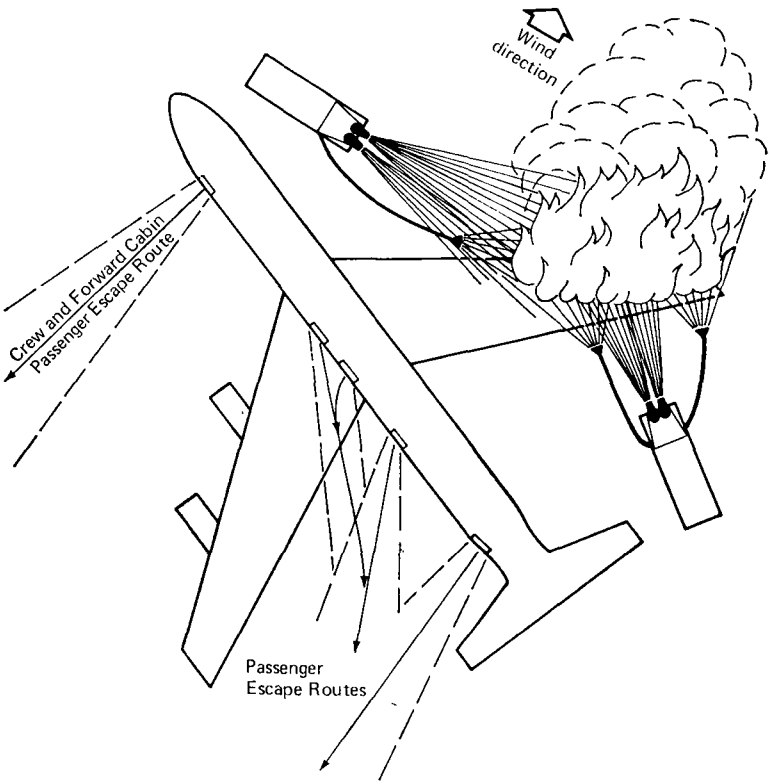


Figure A-6. Principles of fire fighting for civil transport aircraft with fire in the outboard engine on starboard side. Here the attack is with three major fire fighting units concentrating on controlling the fire and keeping the fuselage shielded from radiant heat and avoiding any direct flame contact which could cause breaching of the fuselage.

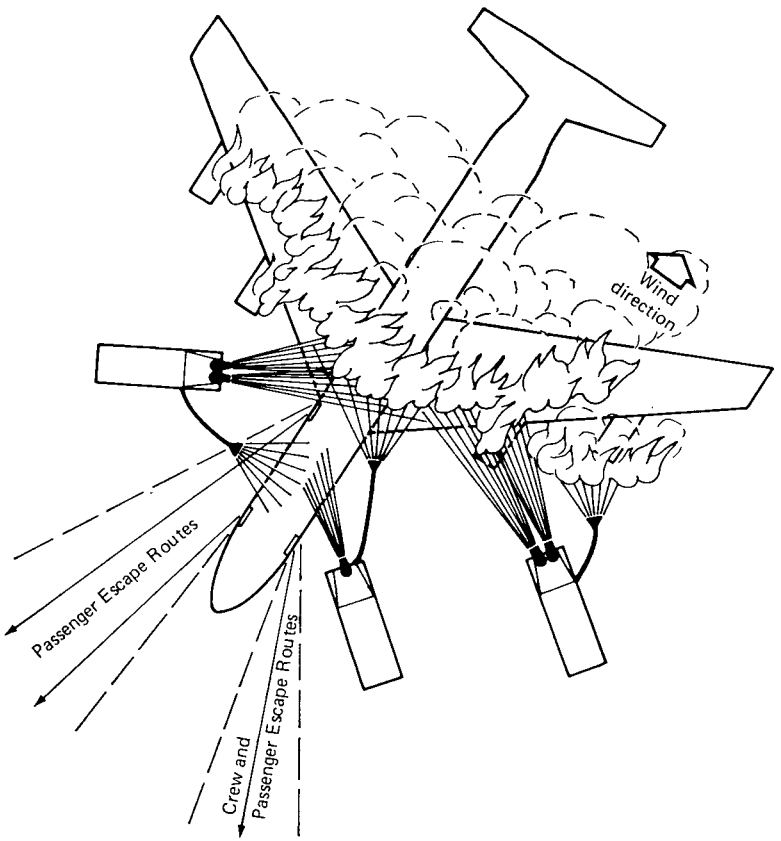


Figure A-7. Principles of fire fighting for civil transport aircraft using three major rescue and fire fighting vehicles under one of the most adverse conditions where fire involves the entire wing-span of the aircraft. The attack is aimed with the wind and the effort is to keep the fuselage intact while the crew and passengers escape via the forward doors.

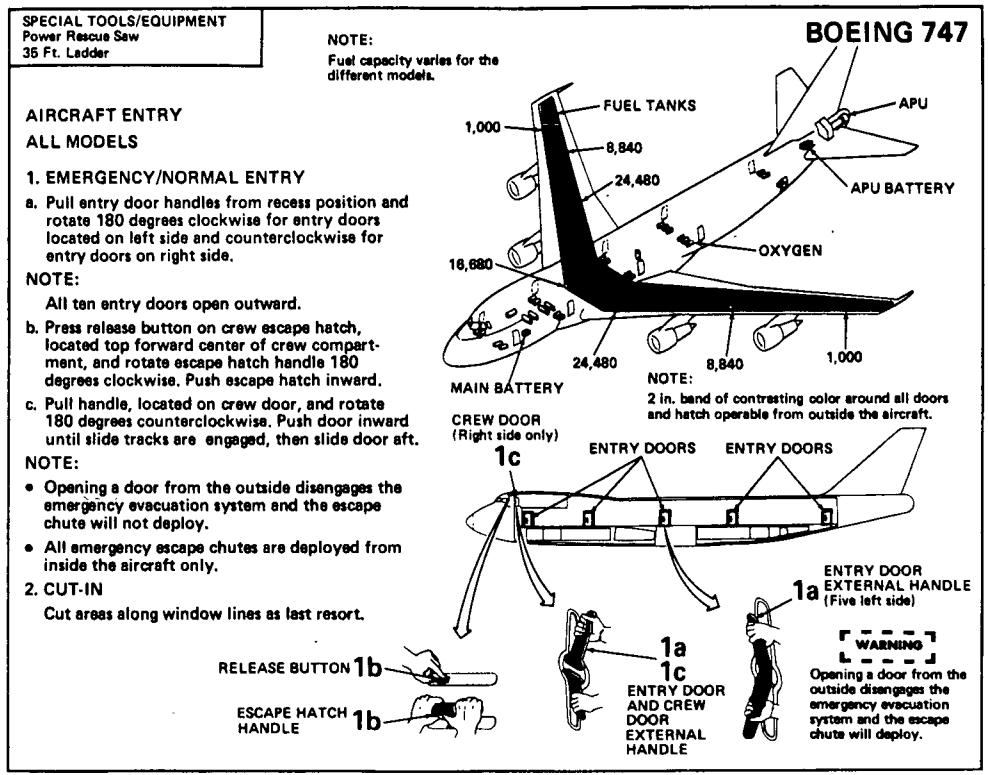
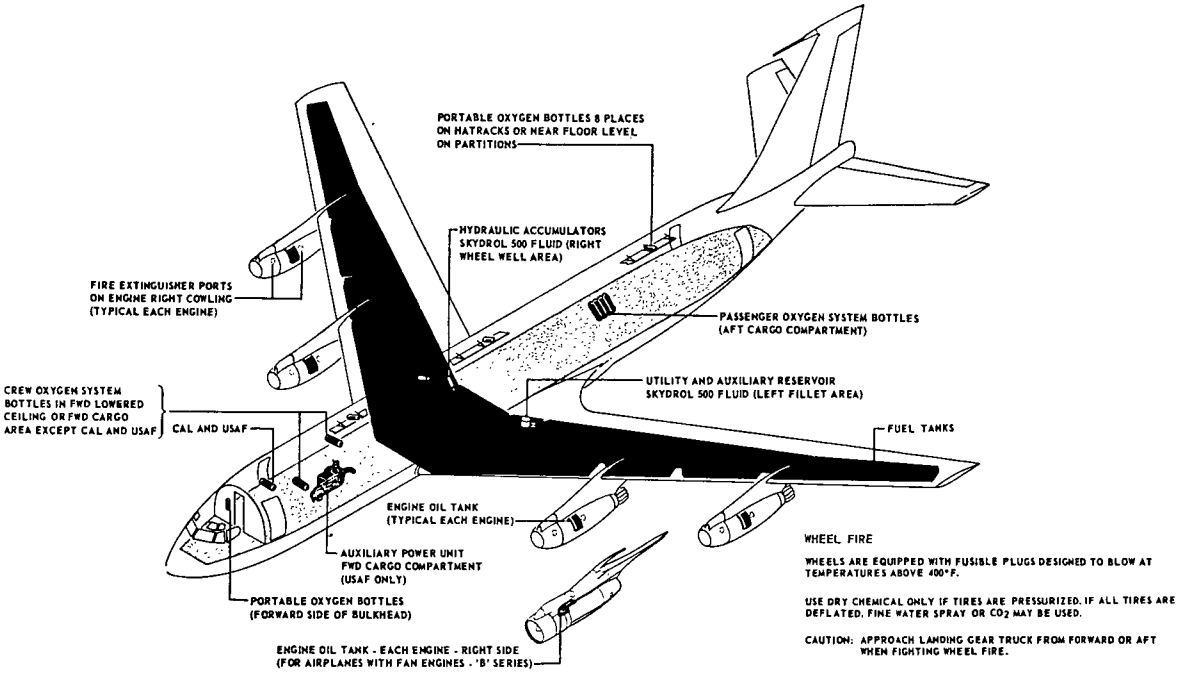
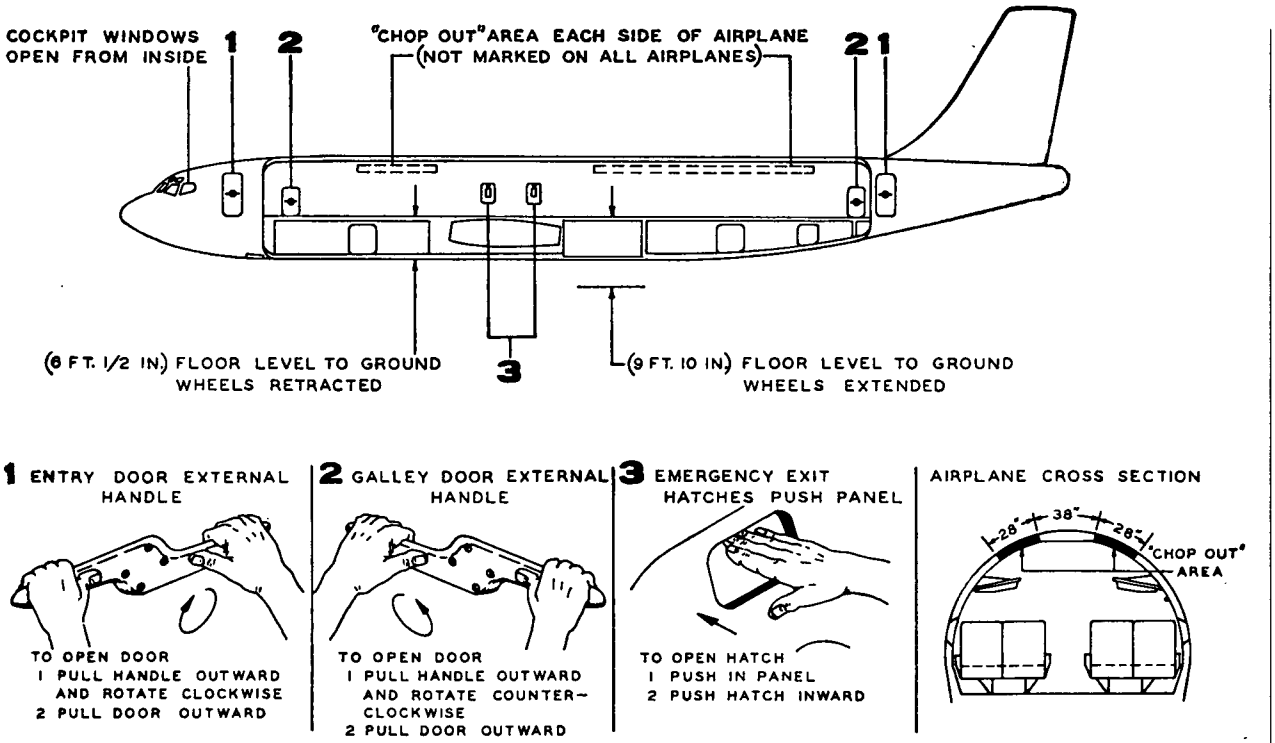


Figure A-8. The Boeing 747 "wide-bodied" jet transport.



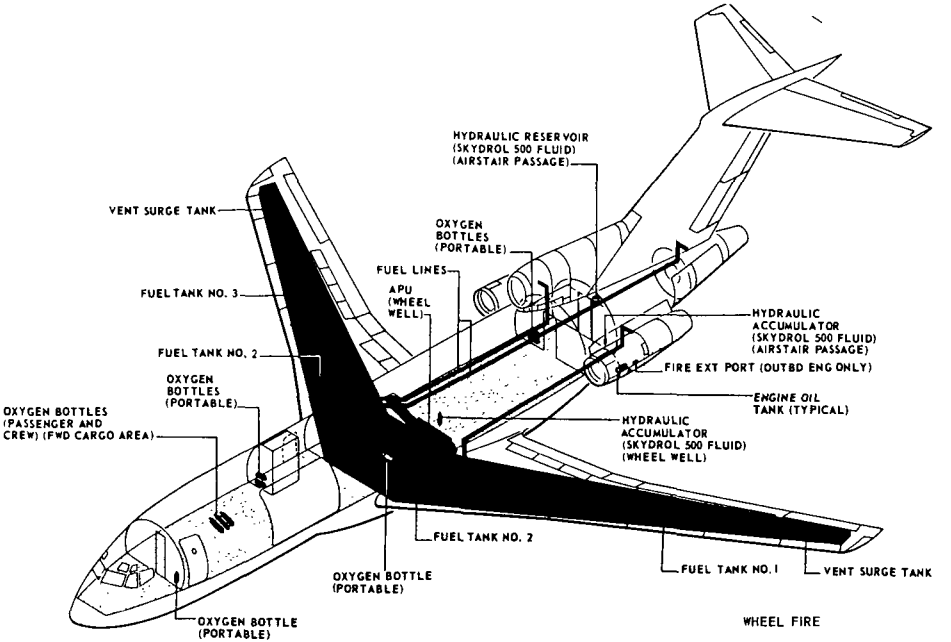
The Boeing Company

Figure A-9A. The Boeing 707 Stratoliner showing the flammable material locations. Other models (the Intercontinental and the 720 series) vary somewhat in size and fuel capacity.



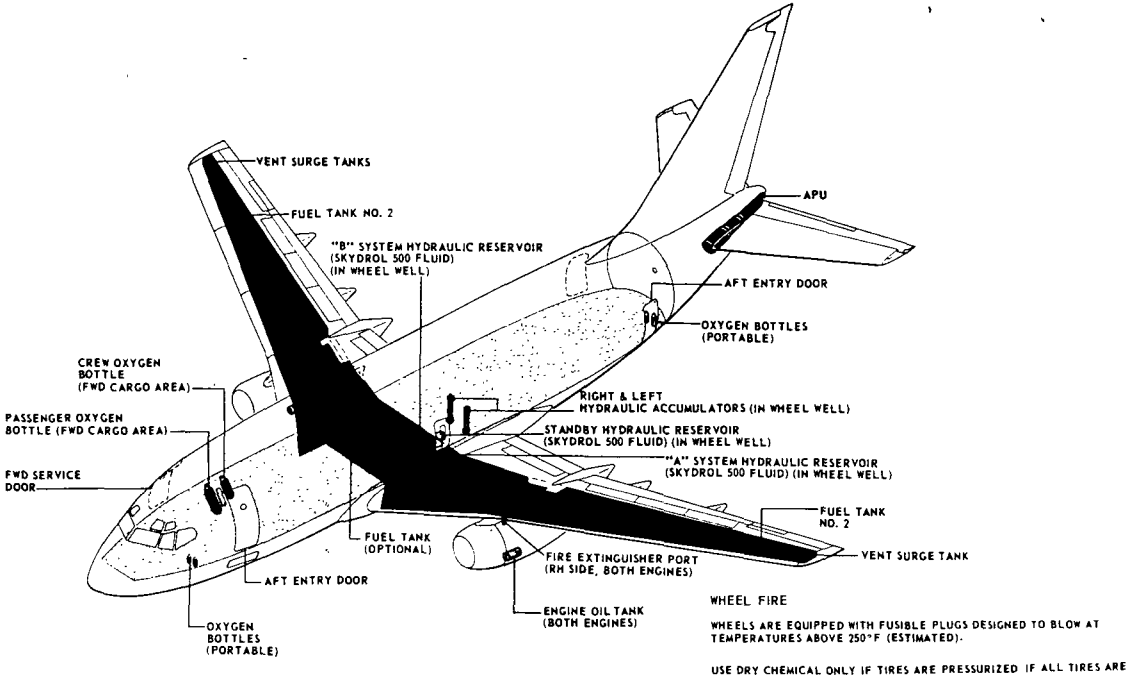
The Boeing Company

Figure A-9B. The Boeing 707 Stratoliner showing emergency rescue access points and how they are operable from the exterior.



The Boeing Company

Figure A-10. The Boeing 727 100-200 Series turbine transport.



The Boeing Company

Figure A-11. Boeing 737 (100-200 Series).

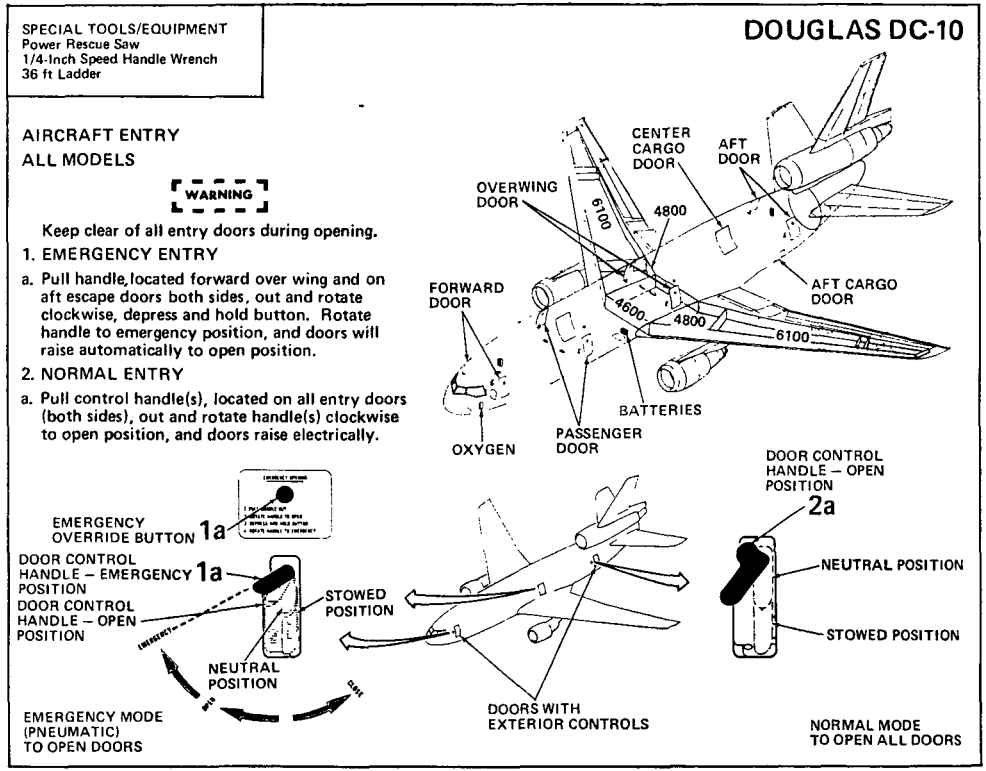


Figure A-12. The Douglas DC-10 wide-bodied transport.

SPECIAL TOOLS/ EQUIPMENT
Power Rescue Saw
12 Foot Ladder

DOUGLAS DC-9

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY/NORMAL ENTRY

a. Pull handle, located on overwing hatches (both sides), outward and push hatches inward.

b. Pull handle, located on left forward entry door, out, rotate counterclockwise and pull door outward.

c. Pull stairway handle, located forward left bottom side of fuselage, outward, press the open button to extend stairway.

CAUTION

When doors are opened from outside slide chutes automatically deploy.

d. Pull handle located on right forward service door, out, rotate clockwise and pull door outward.

NOTE:

Some models in commercial use are equipped with rear airstairways and entry door. Other models are equipped with jettisonable tail cone.

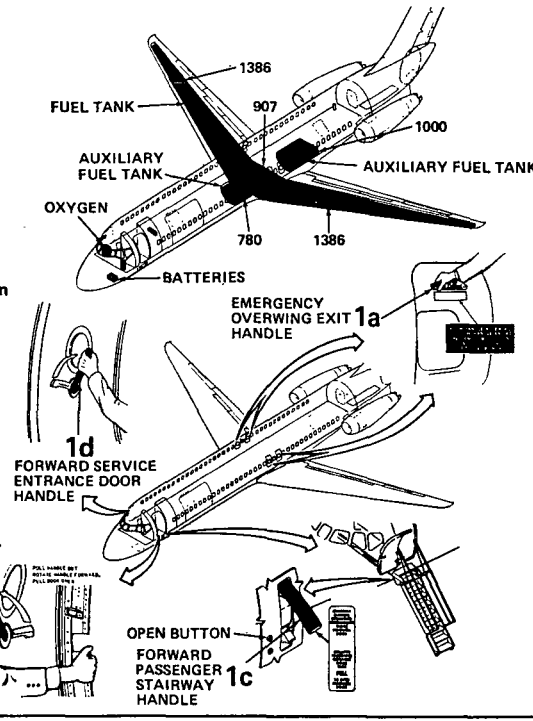


Figure A-13. The Douglas DC-9 twin engine jet.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
24ft Ladder

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY/NORMAL ENTRY:

a. OVERWING ESCAPE HATCHES, both sides - To open push in on plate to unlock, push inward and lift upward.

b. LEFT FORWARD AND AFT ENTRY DOORS - To open pull handles out, rotate counterclockwise, push front door edge in, pulling rear edge out and swing door forward.

c. RIGHT FORWARD AND AFT SERVICE DOORS - To open pull handles out, rotate clockwise, push rear door edge in, pulling front edge out and swing door forward.

d. EMERGENCY EXIT DOORS - Pull handle, located top center of door, down and door lowers to open position.

NOTE:
Doors are hinged at bottom edge.

WARNING

When doors are opened from outside, slide chutes automatically deploy.

2. CUT - IN
Cut along window line as last resort.

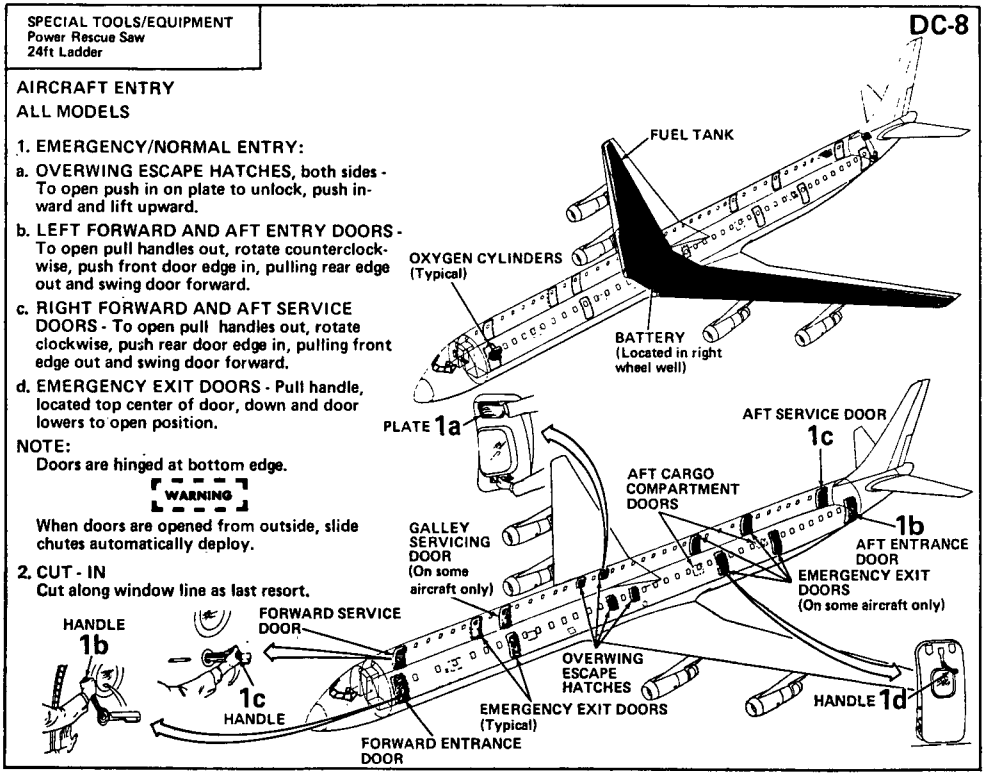
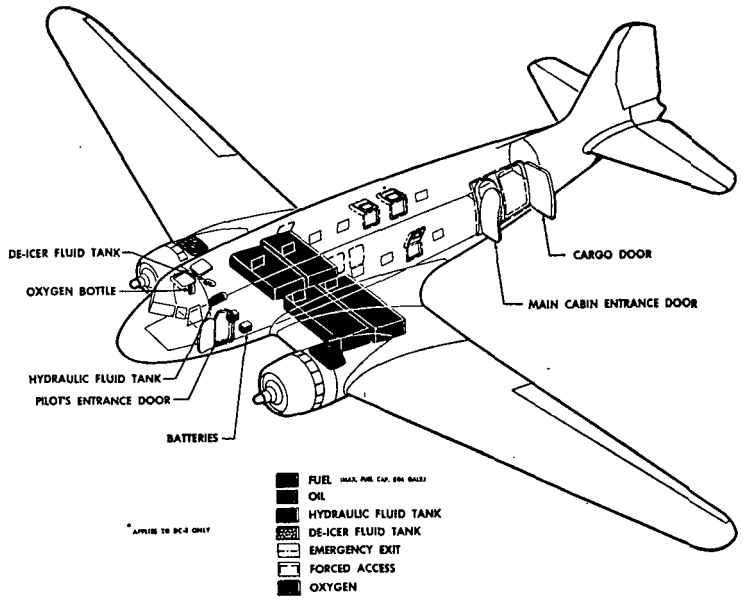
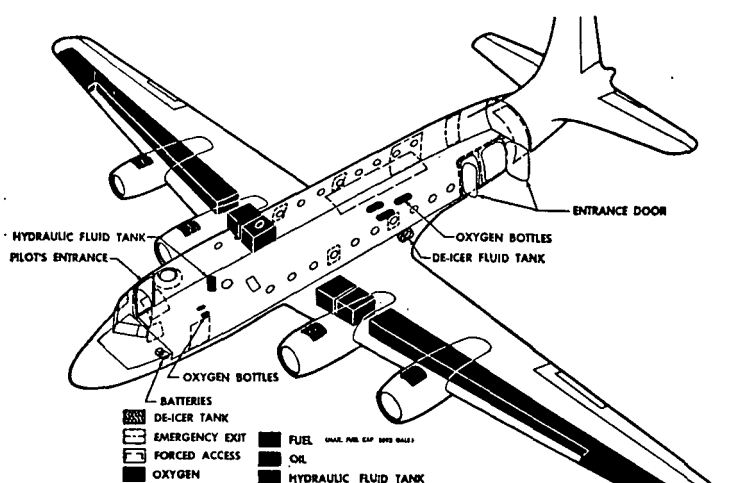


Figure A-14. The Douglas DC-8 four-engine jet.



Courtesy Douglas Aircraft Co., Inc.

Figure A-15. The DC-3 (C-47) crash crew chart.



Courtesy Douglas Aircraft Co., Inc.

Figure A-16. The DC-4 (C-54) crash crew chart.

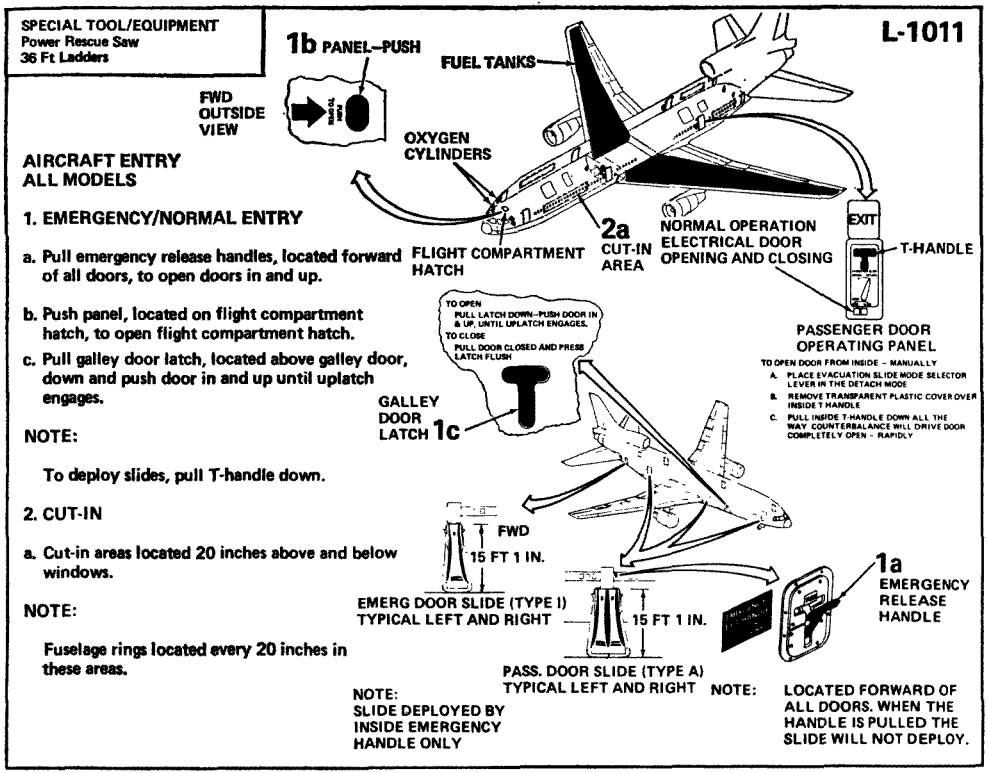
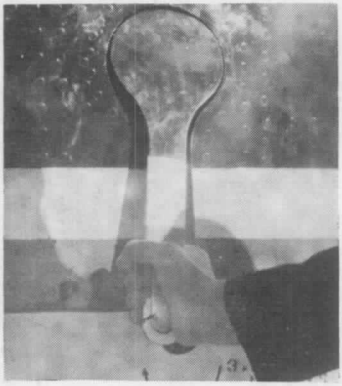


Figure A-17. The Lockheed L-1011 "wide-bodied" jet.



Upper Left

Figure A-18A

Upper Right

Figure A-18B

Courtesy Delta Air Lines

Figures A-18A, B and C illustrate the main cabin door opening mechanism from the exterior on the Convair 880 Jet Airliners and the integral self-inflating slide used for emergency evacuation. This aircraft has these slides at forward and rear main doors. The emergency window hatches have an exterior plate which should be pushed; the hatch will then release inwards.

Lower Left

Figure A-18C

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
24 ft Ladder

FAIRCHILD F-27/ FH-227

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY/NORMAL ENTRY

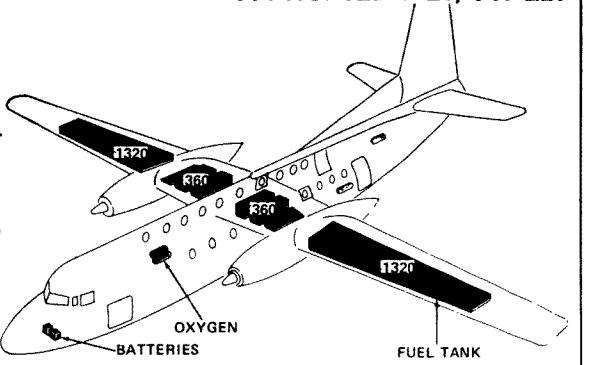
a. Push button and rotate handle, located on over-wing escape hatches both sides, counterclock-wise and push hatches inward.

b. Pull handles from recessed position, located on left forward cargo compartment door and aft entry door, and rotate counterclockwise. Raise doors to stowed position.

c. Rotate handle, located on right aft cargo door, counterclockwise and pull door outward.

2. CUT-IN

Cut along window lines as last resort.



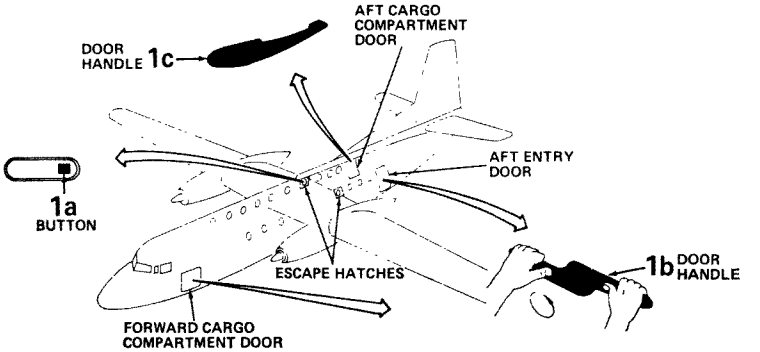


Figure A-19. Fairchild F-27/FH-227 twin (high wing).

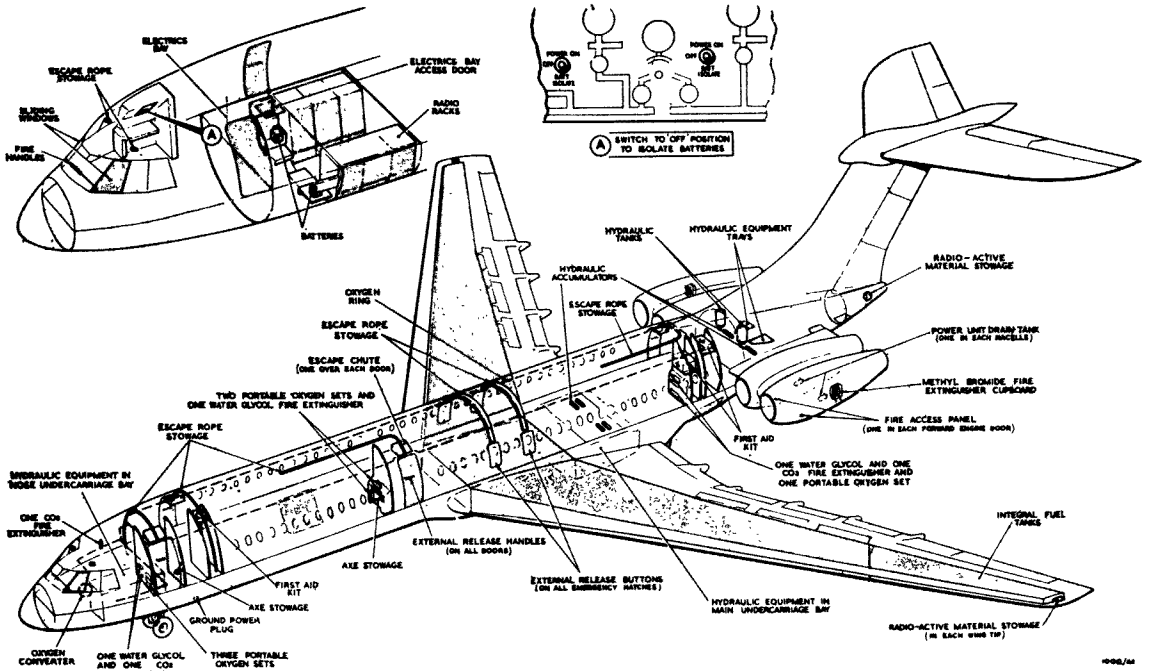


Figure A-20. Vickers-Armstrongs' VC-10 four engine turbine-powered aircraft showing emergency equipment and fire protection features.

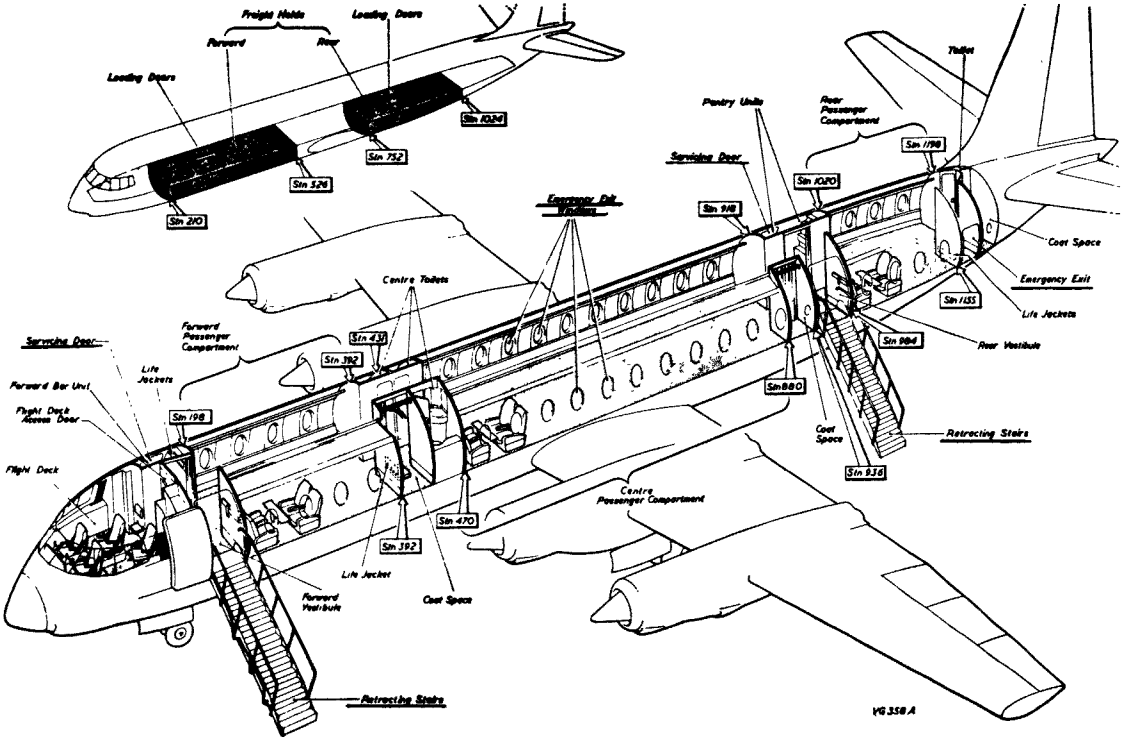


Figure A-21. The Vanguard aircraft showing general arrangements and emergency equipment.

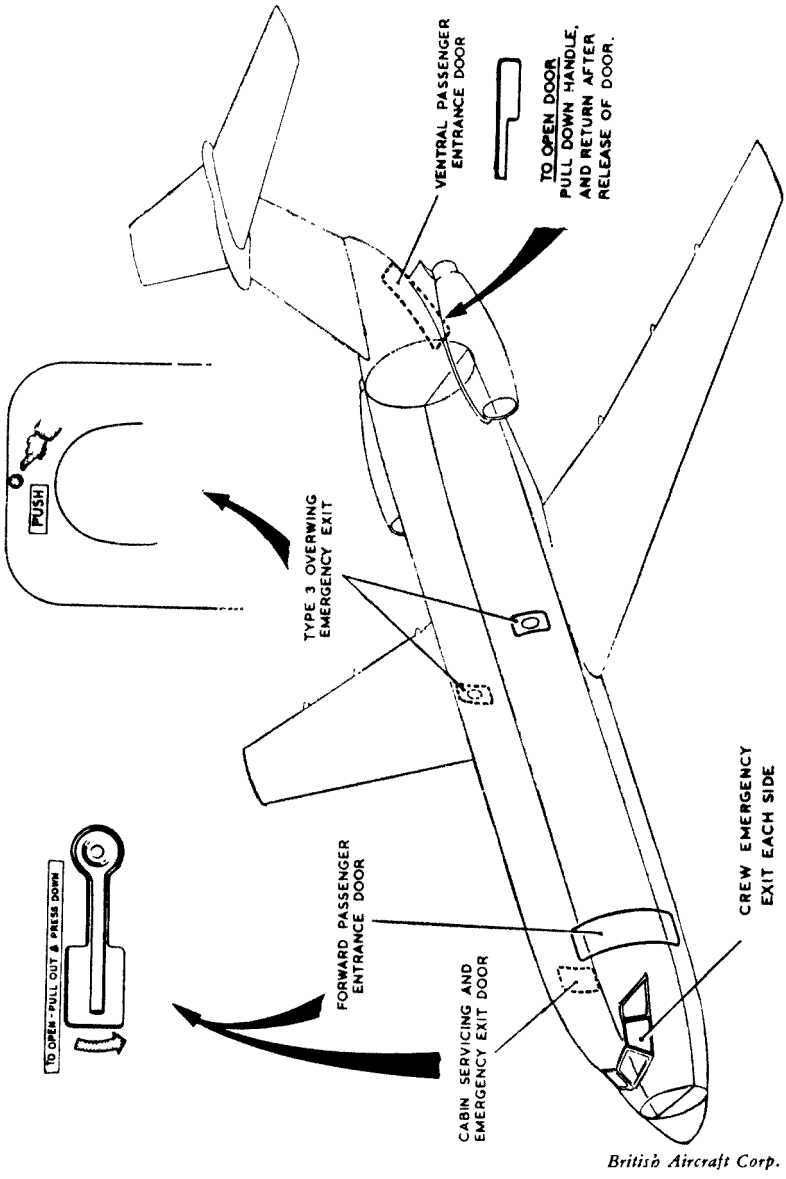
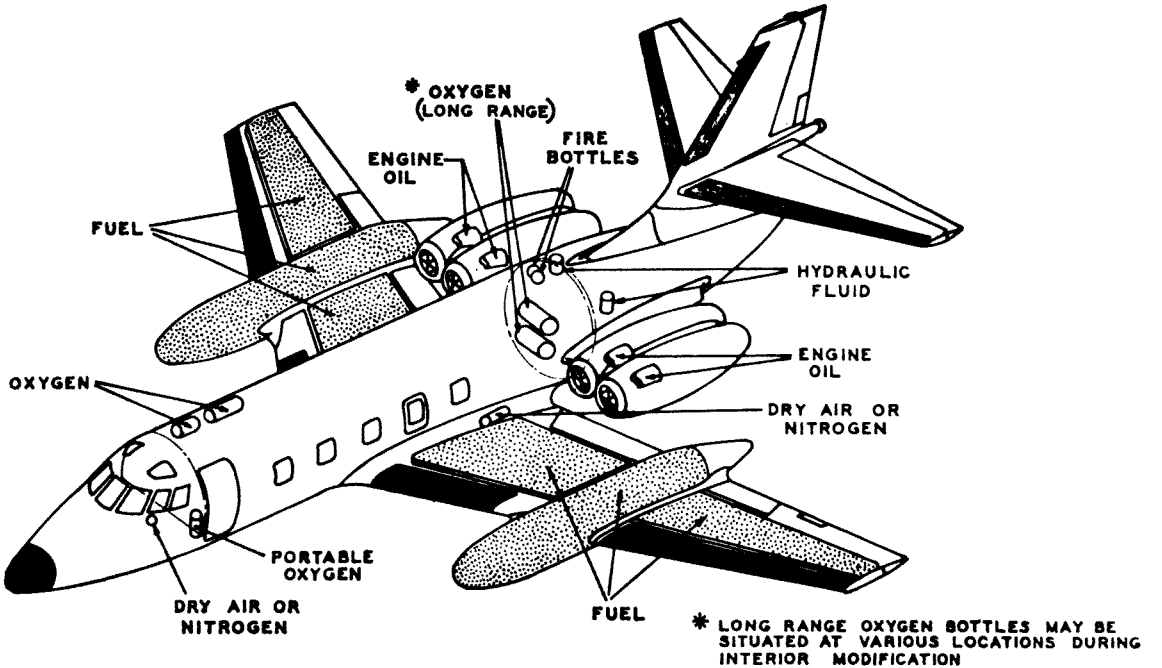


Figure A-22. The emergency doors and hatches on the BAC One Eleven.



Courtesy Lockheed Georgia Company

Figure A-23A. The Lockheed JetStar's total fuel capacity is 2,654 gallons.

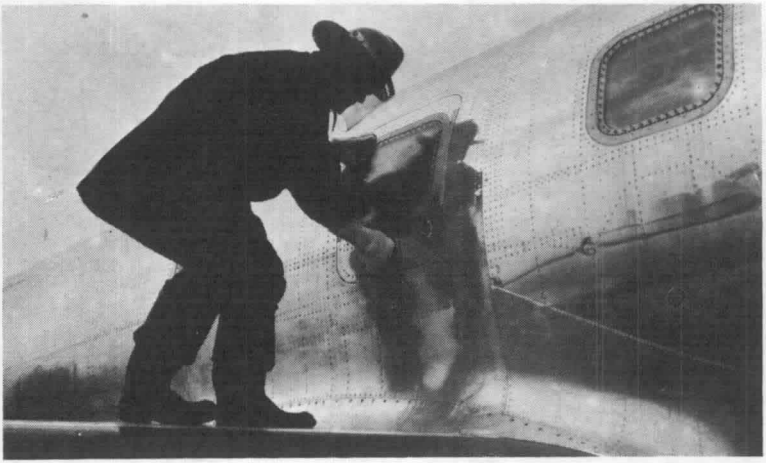
Courtesy Lockheed Georgia Company

Figure A-23B. The JetStar is typical of modern turbine powered jet transports carrying a two-man crew and up to eight passengers.

Figure A-23C. Normal entry at main entry door — first pull door handle outward.

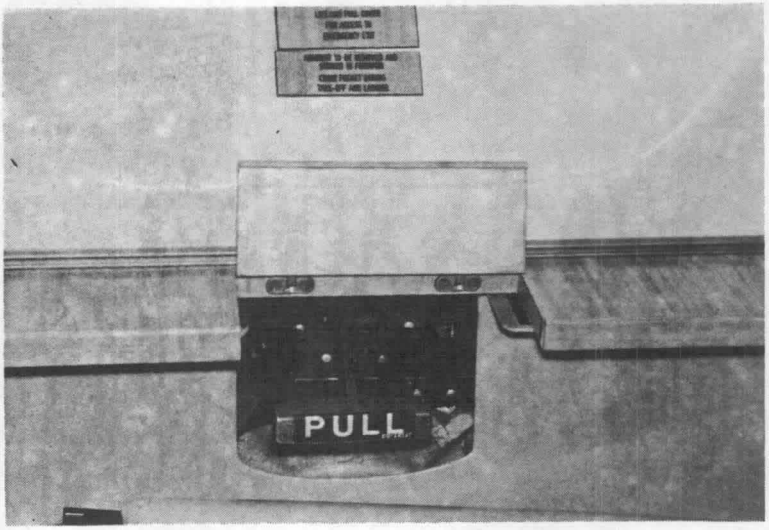
Figure A-23D. (Cont'd. from Fig. A-23C.) Then rotate one quarter turn clockwise.

Figure A-23A. (Cont'd. from Fig. A-23D.) Then push in, slide aft.



Courtesy Lockheed Georgia Company

Figure A-23F. The fourth window from the front on each side of the JetStar fueslage is an emergency hatch. To open from the outside, push in on the bottom of the flush latch plate underneath the bottom edge of the window. Push inward.



Courtesy Lockheed Georgia Company

Figure A-23G. From the inside of the JetStar pull on release handle to unlock and release the hatch (will fall inward).

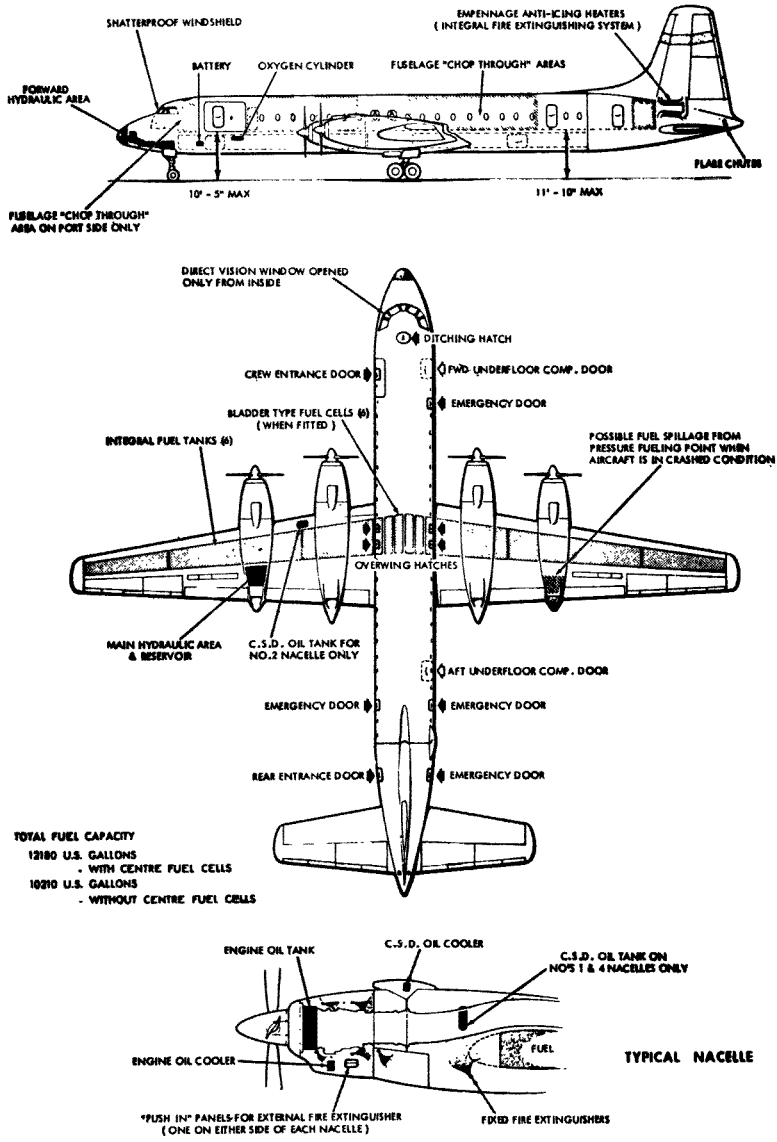


Figure A-24. Canadair CL-44D4 cargo/passenger aircraft rescue and fire fighting data. (Courtesy: Canadair Ltd.)

Appendix B

U.S. Military Aircraft Data for Fire Fighters and Rescue Crews

This Appendix presents information on some U.S. Military aircraft that provides *general* guidance on the unique features of these aircraft which are of concern to fire fighters and rescue crews. The material herein is largely extracted from the Air Force Technical Manual "Aircraft Emergency Rescue Information (Fire Protection)" (T.O. 00-105E-9), dated 1 July 1972. Non-military organizations which accept military aircraft may obtain copies of the T.O. 00-105E-9 through the local military organization (if any) or may obtain same by sending a request to MMSTD, Robins Air Force Base, Georgia 31093. Include on your request that your airport does have facilities for landing of military aircraft. Copies of the T.O. are also authorized for local civil fire organizations which provide mutual aid to military organizations.

Appendix B has the following figures:

Figure B-1	Hatch Locations for One Type of Military Aircraft
Figure B-2	Types of Canopies (Hinge, Clamshell and Sliding) Commonly Used On Military Aircraft
Figure B-3	Type of Full Pressure Suit and Helmet Used by Military Crews
Figure B-4	Examples of Ejection Seat Firing Mechanisms Found on Military Aircraft
Figure B-5	Diagram of All Models of B-52 Bomber
Figure B-6	C-5 Crash Rescue and Fire Fighting Chart
Figure B-7	Emergency Entrance Into the C-130A Troop Transport
Figure B-8	Location of Fuel Tanks and Entry and Escape Hatches for the C-135
Figure B-9	Location of Fuel Tanks and Entry and Escape Hatches for the C-140
Figure B-10	Location of Fuel Tanks and Entry and Escape Hatches for the C-141
Figure B-11	Location of Fuel Tanks and Entry and Escape Hatches for the F-4
Figure B-12	Location of Fuel Tanks and Entry and Escape Hatches for the F-105
Figure B-13	Location of Fuel Tanks and Entry and Escape Hatches for the F-106B
Figure B-14	Location of Fuel Tanks and Entry and Escape Hatches for the F-111
Figure B-15	Rescue Information for the UH-1 Helicopter
Figure B-16	Rescue Information for the CH-3 Helicopter
Figure B-17	Rescue Information for the H-19 Helicopter
Figure B-18	The H-43B Helicopter Crew and Passenger Positions
Figure B-19	Normal and Emergency Entrance into H-43B
Figure B-20	Location of Fuel Tanks and Emergency, Normal and Manual Entries for the T-33 Trainer

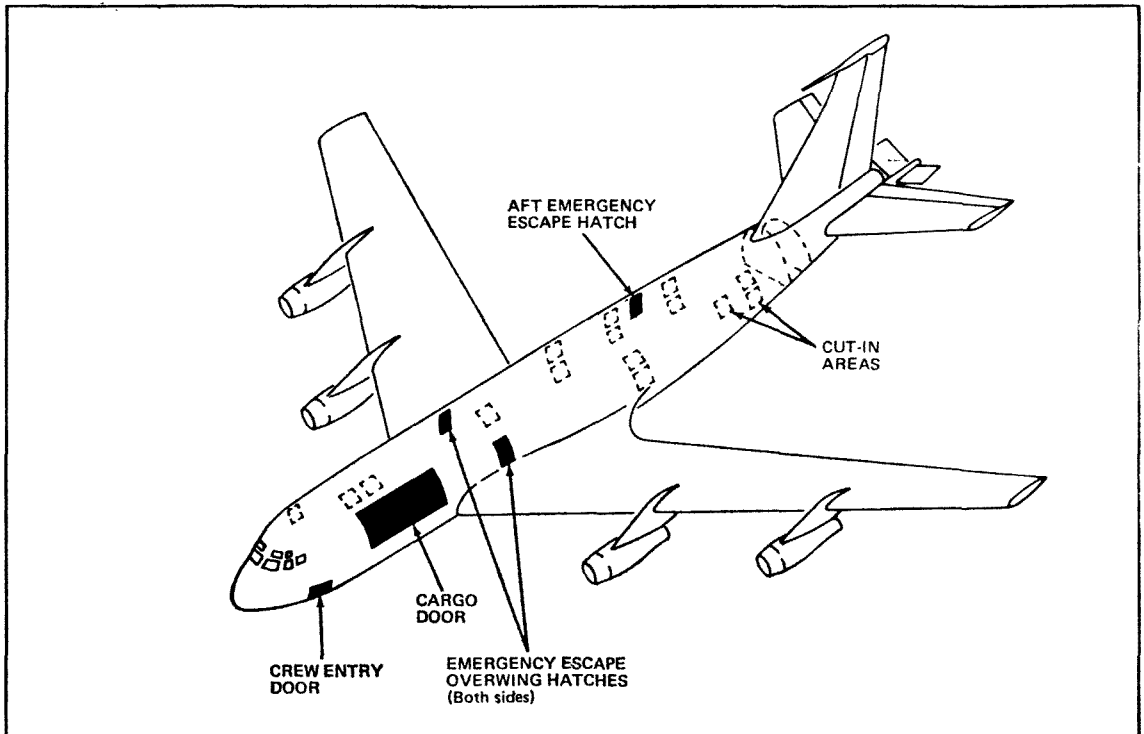


Figure B-1. Hatch locations and cut-in areas on one type military aircraft.

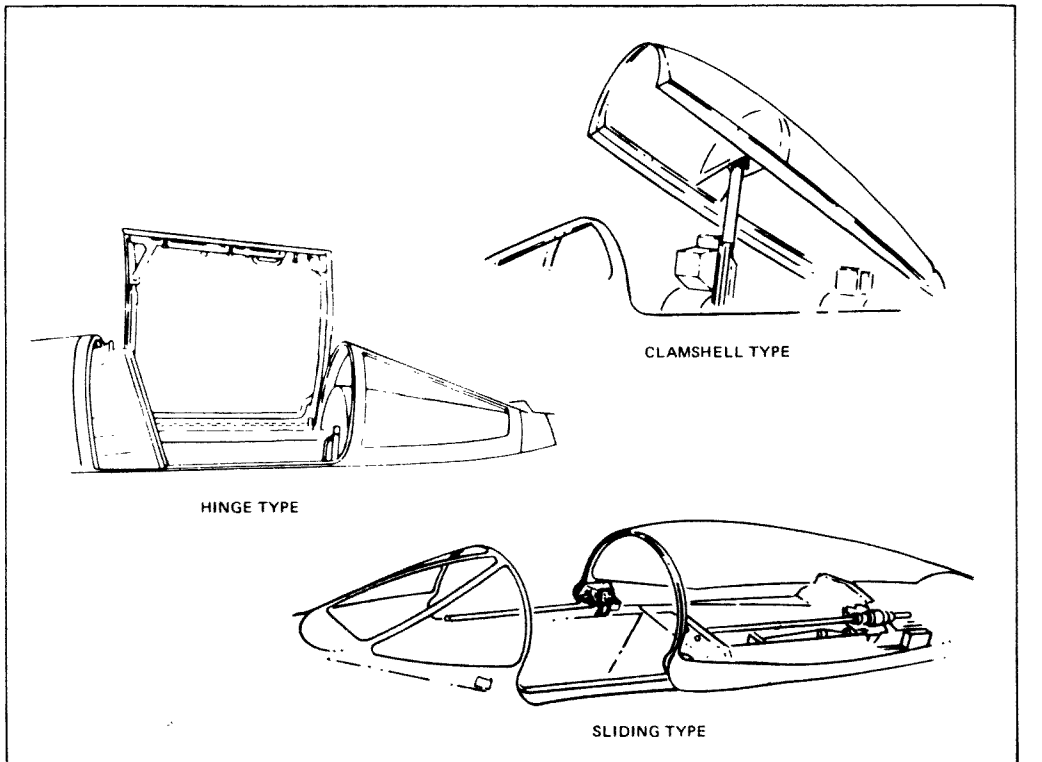


Figure B-2. Types of canopies used on U.S. military aircraft.

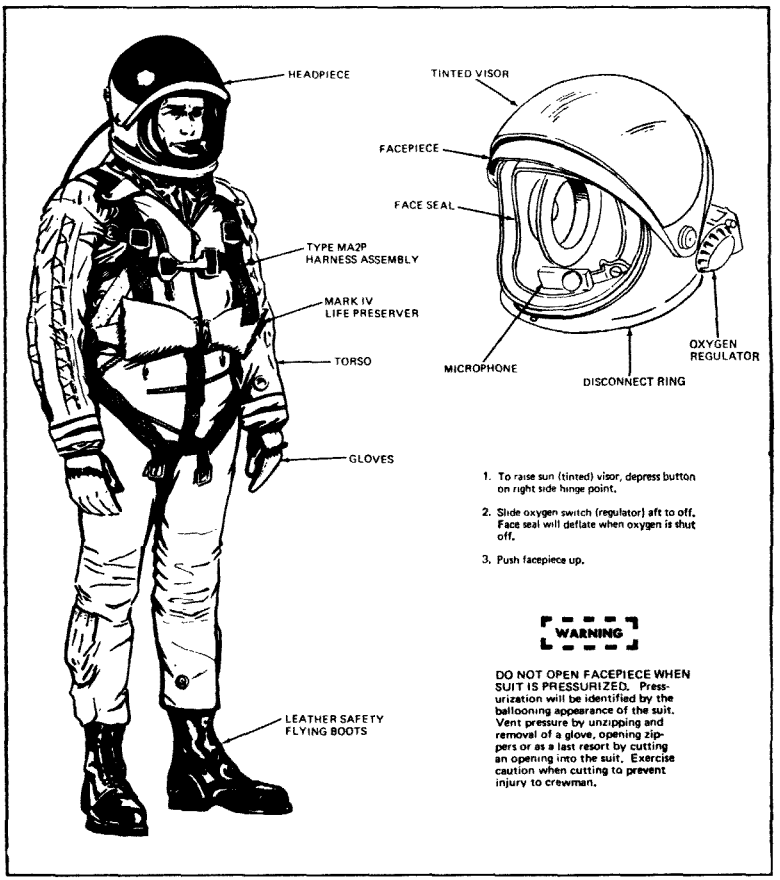


Figure B-3. Type of full-pressure suit and helmet used by U.S. military crews. The facepiece should not be opened when the suit is pressurized. Instructions on how to depressurize the suit is given in the note in the lower right.

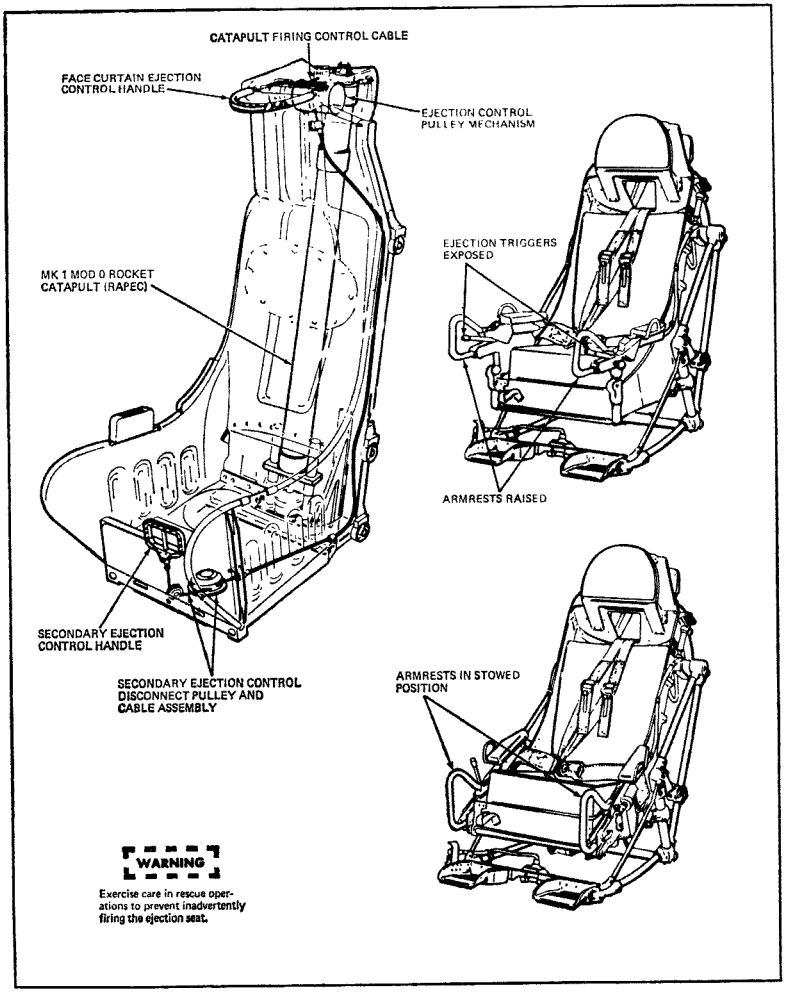


Figure B-4. Examples of ejection seat firing mechanisms found on some U.S. military aircraft. Extreme care is necessary in rescue operations to prevent inadvertent firing of such a seat. Get instructions from your military authorities.

SPECIAL TOOLS/EQUIPMENT
Cowling Key
A-frame Ladder
Disarming Tool
Rescue Harness (Local Mfg)
14 ft Ladder
36 ft Ladder
Crash Axe

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY FORWARD COMPARTMENT

a. PILOT'S, COPILOT'S, EW OFFICER'S AND GUNNER'S ESCAPE HATCHES – Push release button(s) in and pull handle(s) up, open hatch(es).

b. Lift and rotate aft until hatch(es) disengage and separates from hinge points.

WARNING

Cut ejection seat catapult hoses.

2. NORMAL ENTRY FORWARD COMPARTMENT (Normal entrance hatch, located lower right side forward fuselage, on B-52B, C, D, E, and F. On B-52 G and H forward of landing gear).

a. Push release button in and pull handle down, open hatch.

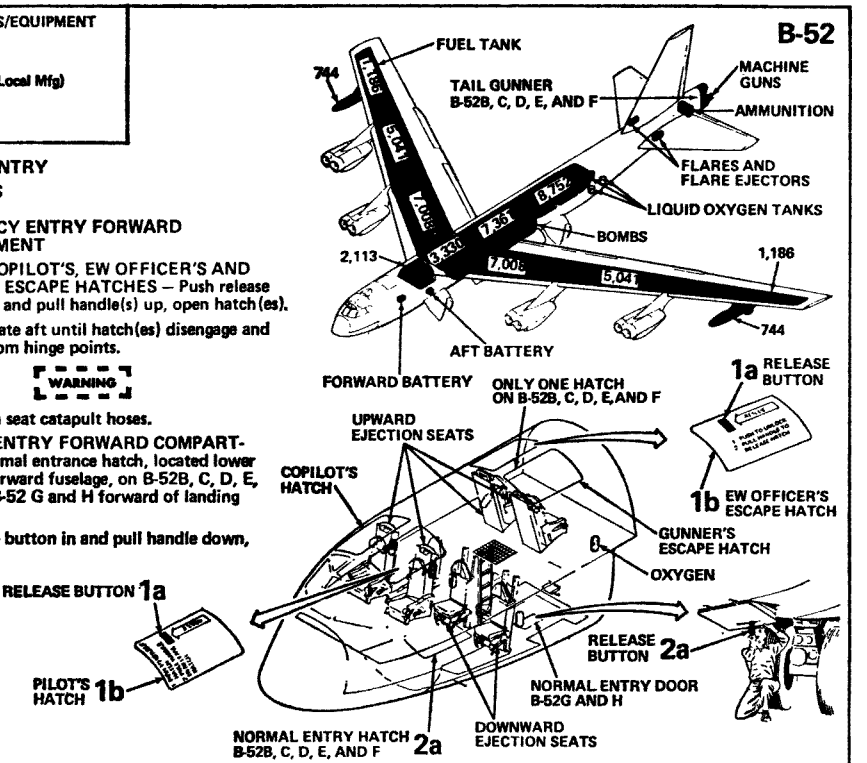
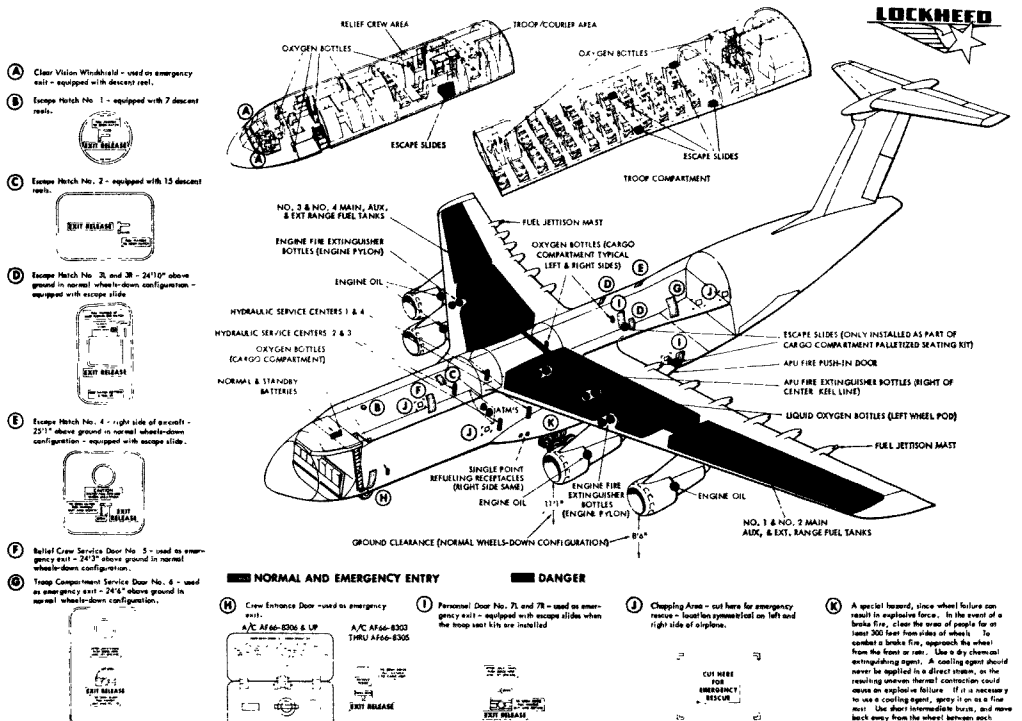


Figure B-5. Diagram of the B-52 showing hazards and entry points.

C-5 CRASH RESCUE & FIRE FIGHTING



(A) Clear Vision Windshield - used as emergency exit - equipped with descent reel.

(B) Escape Hatch No. 1 - equipped with 7 descent reels.

(C) Escape Hatch No. 2 - equipped with 15 descent reels.

(D) Escape Hatch No. 3L and 3R - 24'10" above ground in normal wheels-down configuration - equipped with escape slide.

(E) Escape Hatch No. 4 - right side of aircraft - 25'1" above ground in normal wheels-down configuration - equipped with escape slide.

(F) Relief Crew Service Door No. 5 - used as emergency exit - 24'3" above ground in normal wheels-down configuration.

(G) Troop Compartment Service Door No. 6 - used as emergency exit - 24'6" above ground in normal wheels-down configuration.

(H) Crew Entrance Door - used as emergency exit.

(I) Personnel Door No. 7L and 7R - used as emergency exit - equipped with escape slides when the troop seat kits are installed

(J) Chopping Area - cut here for emergency rescue - location symmetrical on left and right side of airplane.

(K) A special hazard, since wheel failure can result in explosive force. In the event of a brake fire, clear the area of people for at least 300 feet from sides of wheels. To combat a brake fire, approach the wheel from the front or rear. Use a dry chemical extinguishing agent. A cooling agent should never be applied in a direct stream, as the resulting uneven thermal contraction could cause an explosive failure. If it is necessary to use a cooling agent, spray it on as a fine mist. Use short intermediate bursts, and move back away from the wheel between each application.

Figure B-6. This is the world's largest aircraft, largely used for cargo purposes.

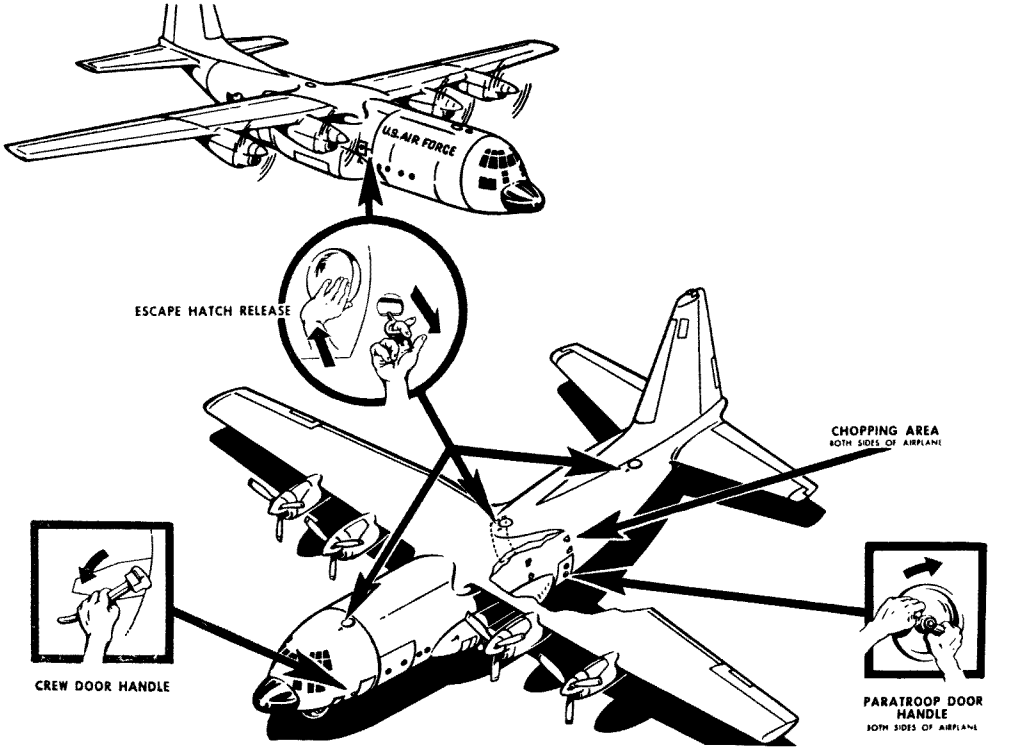


Figure B-7. Emergency entrance into the USAF C-130A troop transport.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
24 Ft. Ladder

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Depress button(s), located on emergency escape hatch(es), over wing both sides of aircraft, to release handle(s). Pull handle(s) out and rotate clockwise to release hatch(es).

b. Push emergency escape hatch(es) in.

c. Depress button, located on aft emergency escape hatch, right side of aircraft, to release handle. Pull handle out and rotate clockwise to release hatch.

d. Push hatch in and aft.

2. NORMAL ENTRY

a. Press latch, located aft of crew entry door, to open access door.

b. Rotate handle upward to release door.

CAUTION

Door opens down and forward.

3. CUT-IN

a. Cut in areas as marked on fuselage.

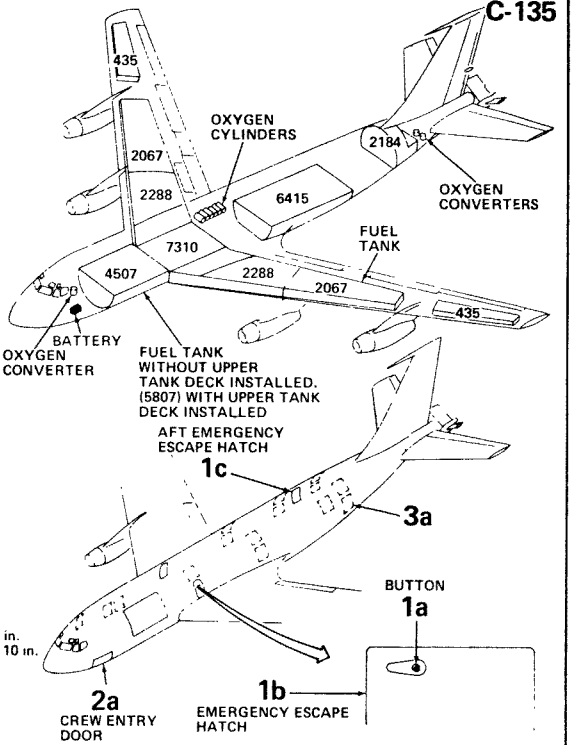


Figure B-8. The flying "tanker" plane, formerly called KC-135.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Push external release plate, located left and right side over wing, to open emergency escape windows.

CAUTION

Emergency escape windows must be handled with extreme care while pushing inward.

NOTE:

VC-140B models have four emergency escape windows. Only the right front forward window is equipped with a foldout step.

2. NORMAL ENTRY

a. Depress exterior handle release button and rotate handle, located on left forward side of fuselage, clockwise.

b. Extend stairway by releasing the locking latch, located left top side of stairway frame, downward and slide stairs forward to stop position. Lower stairs outward.

3. CUT-IN

a. Cut in areas as marked on fuselage.

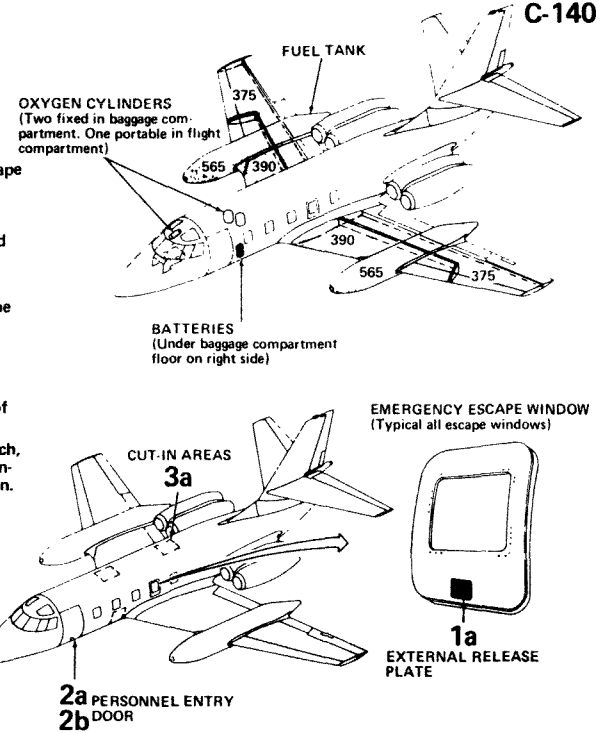


Figure B-9. Diagram of essential features of the C-140.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
Extension Ladder, 35 ft

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Press emergency exit release triggers, rotate handle counterclockwise and push hatch, located one forward and one aft wing root each side, inward.

b. Lift release ring and pull upward to open emergency exits, located top left forward of flight deck, top forward and aft of cargo compartment.

c. Strike rectangular bump plate, located above and inboard of hatch, to open.

2. NORMAL ENTRY–CREW DOOR, TROOP DOORS

a. Pull T-handles, one forward left side and two aft, one on each side of fuselage, out and rotate clockwise.

3. CUT-IN

a. Cut-in areas located aft of forward emergency exits and aft of both troop doors.

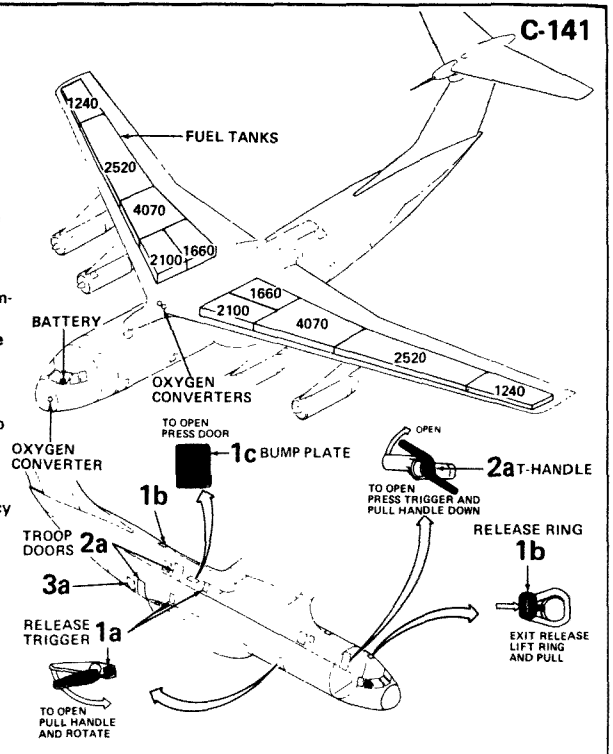


Figure B-10. Design features of the C-141 USAF cargo transport.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

WARNING

If left engine is running, access must be gained over the left wing to the aft cockpit and throttles retarded to idle position.

a. Press button to open access door, located on left side of fuselage forward of left intake, and remove T-handle.

b. Pull T-handle to full length sharply to jettison canopies.

2. NORMAL ENTRY

a. Push canopy buttons, located left side of fuselage to unlock both canopies.

b. Install canopy safety struts and pins.

3. MANUAL ENTRY

a. Push forward canopy button and handle release button on manual release handle, located left side of fuselage, and turn handle counterclockwise to open position.

b. Push aft canopy button and handle release button on manual release handle, located left side of fuselage, and turn handle clockwise to open canopy.

c. Lift canopies and install safety struts and pins.

4. CUT-IN

a. Cut canopy along canopy frame.

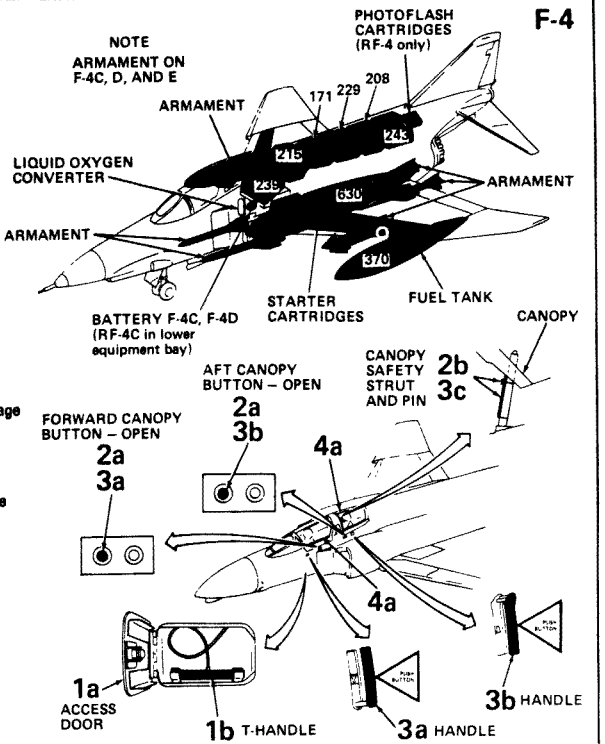


Figure B-11. The USAF F-4 fighter aircraft.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
Dearming Tool
Screwdriver

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Push latch to open access door, located left side of fuselage below and aft of canopy, and pull handle out approximately 6 feet to jettison canopy.

NOTE:

Canopy entry controls are 10 feet above ground level when gears are extended.

2. NORMAL ENTRY

a. Depress top end of canopy lock control, located below canopy each side, and raise to the upward position to unlock canopy.

b. Depress top control button located below canopy lock control and raise canopy to full open position.

3. MANUAL ENTRY

a. Depress top end of canopy lock control located below canopy each side, and raise to the upward position to unlock canopy.

b. Depress canopy actuator release button located on top of canopy, and raise canopy to full open position. Canopy must be held or propped open.

NOTE:

Two fire protection personnel are required to raise canopy manually.

4. CUT-IN

a. Cut canopy along canopy frame.

NOTE:
Model F-105F and G is a two place aircraft.

F-105

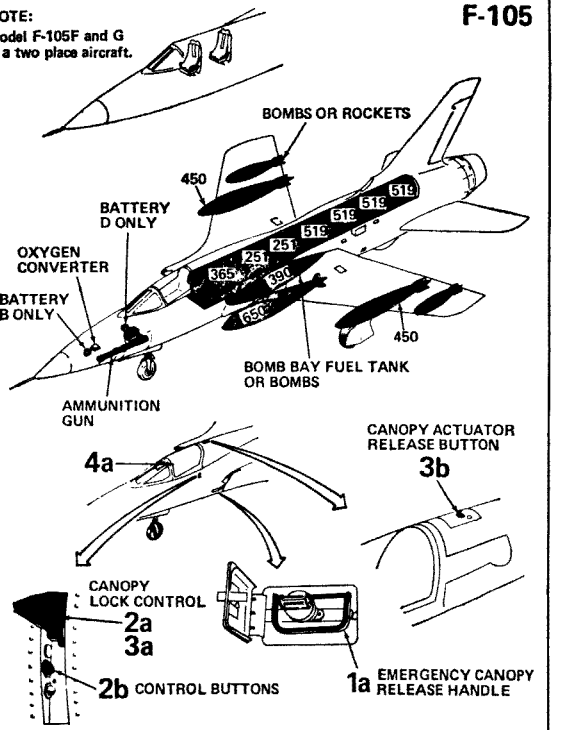


Figure B-12. The F-105 fighter aircraft showing canopy operation.

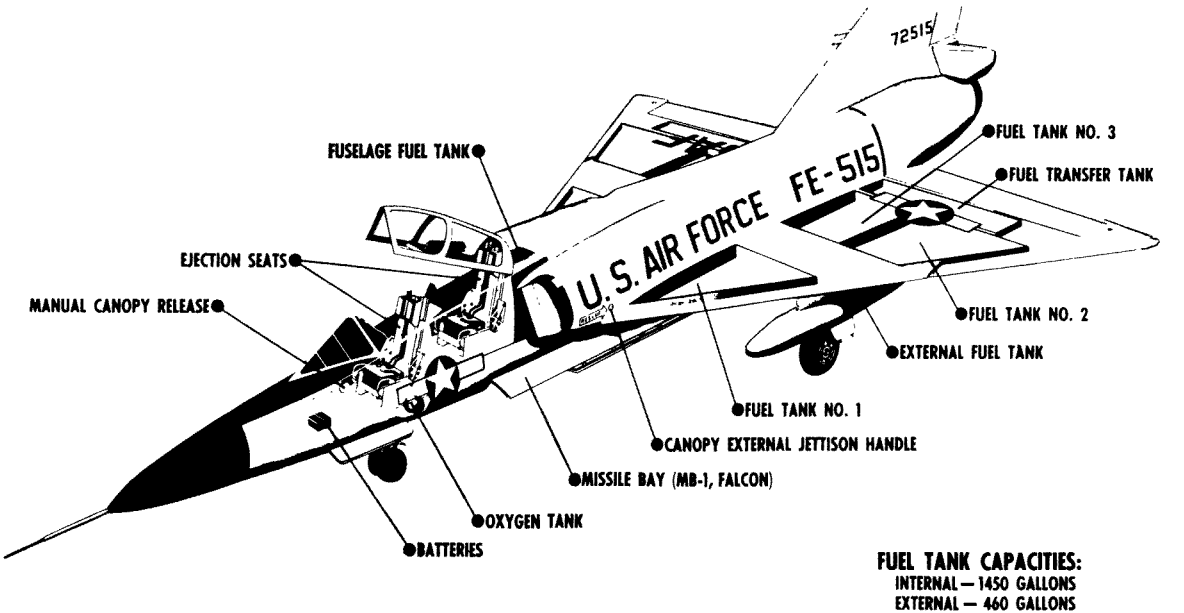


Figure B-13. This is the F-106B showing general arrangements of this USAF fighter aircraft.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
Dzus Key/Screwdriver

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY/NORMAL ENTRY

a. Push internal lock release button, located both sides of aircraft below canopy rails.

b. Push forward end of external handle, located aft of internal lock release button, pull external handle and raise canopy to locked position.

2. CUT-IN

a. Cut canopy along canopy frame.

CAUTION

Do not cut canopy frame.

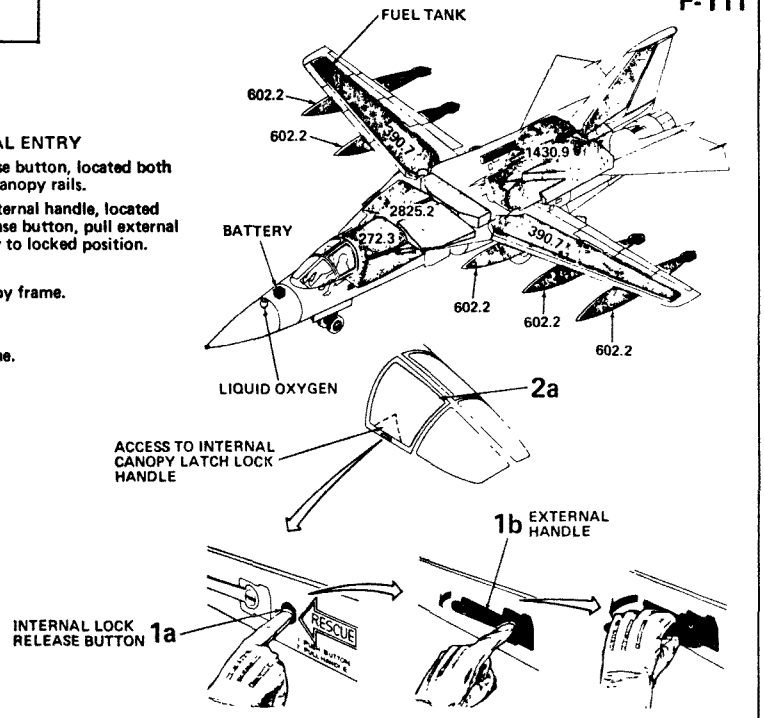


Figure B-14. Location of fuel tanks and hatches on the F-111.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw

AIRCRAFT ENTRY
ALL MODELS

WARNING

Caution must be exercised when entering rotor blade area. Entry must be from side of aircraft.

1. EMERGENCY ENTRY

a. Slide, break or cut crew door window, located left and right forward fuselage.

b. Pull jettison handles, located forward of right and left crew door frames, aft to jettison doors.

c. Pull doors outward.

2. NORMAL ENTRY

a. Rotate crew door handle, located left and right forward fuselage, down to unlatch door.

b. Pull out and forward to open position.

c. Rotate passenger-cargo door handle, located left and right fuselage, down to unlatch and release door.

d. Slide door aft to open position.

3. CUT-IN

Cut windows and windshield to gain entry.

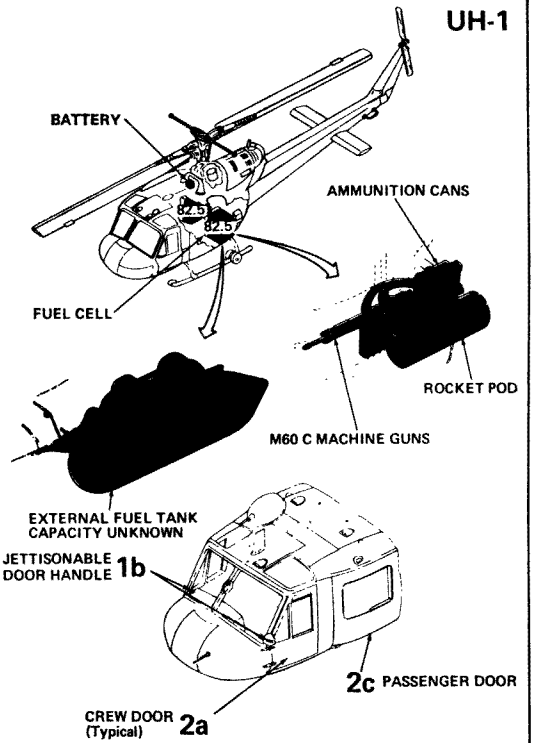


Figure B-15. The UH-1 helicopter showing entry points and fuel tankage.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw

CH-3

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Pull ramp release handle, located on tail pylon under cover, down. Ramp will open by its own weight.

b. Pull release tab, on three side windows located left and right fuselage, out and pull window outward.

c. Pull release tab, located on personnel entry door, down and pull door aft.

d. Press button to release handle, on crew compartment side windows, located on right and left fuselage, rotate down and forward. Pull window out and up.

e. Pull release tab on emergency escape hatch, located forward left fuselage, down and remove hatch.

2. NORMAL ENTRY

a. Rotate handle, located on personnel entry door right forward fuselage, down and slide door aft.

3. CUT-IN

a. Cut forward fuselage windows, and crew compartment door.

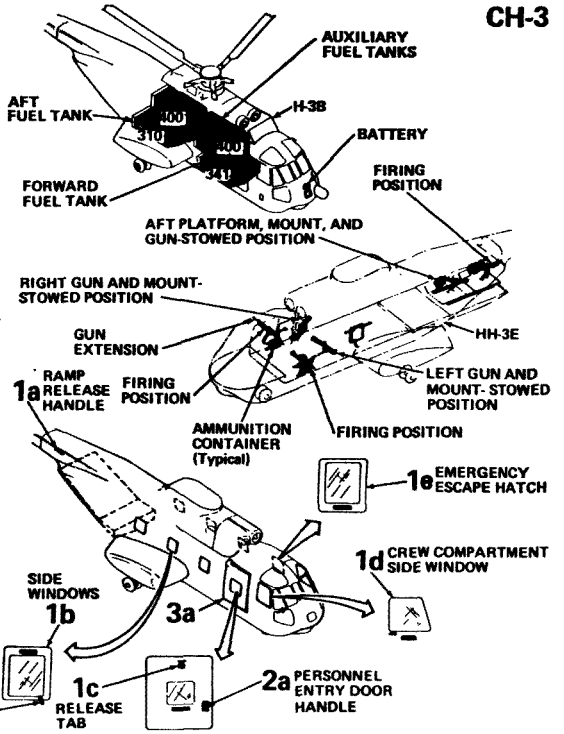


Figure B-16. The CH-3 USAF helicopter with rescue entry data.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw

H-19

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Pull emergency release handle, located upper forward of pilot's compartment sliding windows, pull windows out.

b. Rotate emergency release handle, located upper forward corner of cabin door, down and pull door out.

c. Rotate emergency escape hatch release handle, located below emergency escape hatch on left hand side of fuselage, down and pull hatch out.

d. Pull emergency escape window tab, located bottom rear of windows on both sides of fuselage, pull window out.

2. NORMAL ENTRY

a. Rotate cabin door handle, located forward center of cabin door, slide door aft.

b. Enter through pilot's compartment sliding windows (both sides).

3. CUT-IN

No cut-in areas are provided.

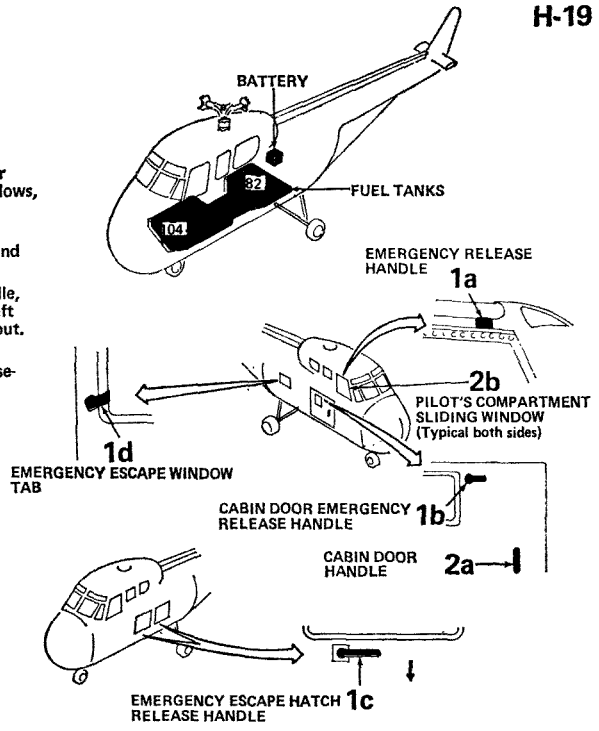


Figure B-17. Rescue information for the H-19 helicopter.

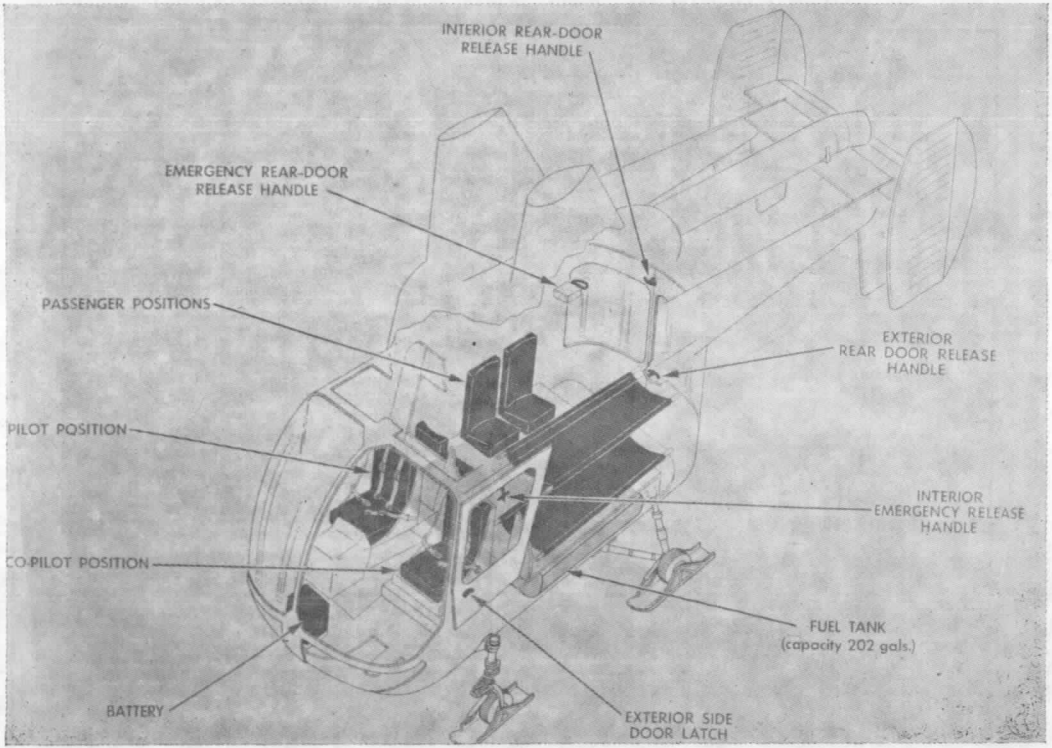


Figure B-18. The H-43B helicopter as operated by the USAF. Note that fuel tank is located under the passenger compartment over rear landing gear.

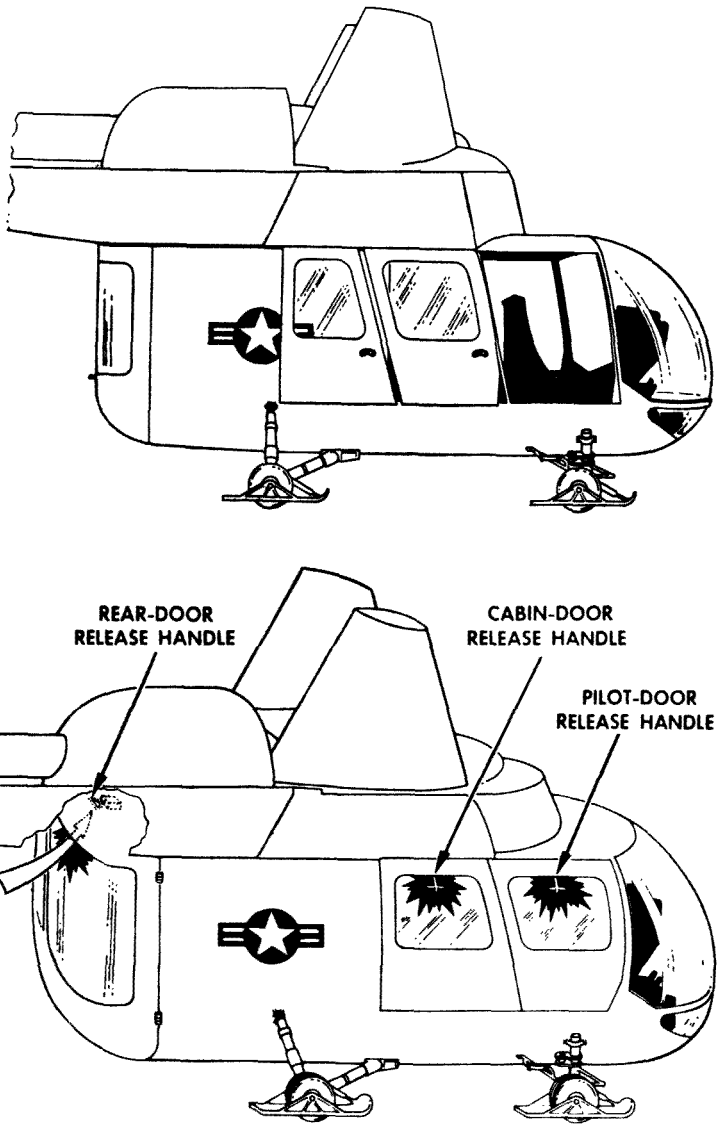


Figure B-19. Normal and emergency entrance into H-43B.

SPECIAL TOOLS/EQUIPMENT
Power Rescue Saw
Dearming Tool

AIRCRAFT ENTRY
ALL MODELS

1. EMERGENCY ENTRY

a. Push latch and open access door, located on upper right side of fuselage center of aft cockpit, and pull canopy jettison handle full length to jettison canopy.

2. NORMAL ENTRY

a. Press latch and open access door, located on upper right side of fuselage between forward and aft cockpit, and remove handcrank.

b. Insert handcrank into locking shaft opening, located upper center of fuselage right side, and rotate counterclockwise.

c. Push canopy switch to OPEN position and hold until canopy reaches full open position.

3. MANUAL ENTRY

a. Press latch and open access door, located on upper right side of fuselage between forward and aft cockpit, and remove handcrank.

b. Insert handcrank into locking shaft opening, located upper center of fuselage right side, and rotate counterclockwise.

c. Remove handcrank from locking shaft and insert onto handcrank stud, located above canopy switches, and rotate clockwise until canopy is raised to full open position.

4. CUT-IN

a. Cut canopy along canopy frame.

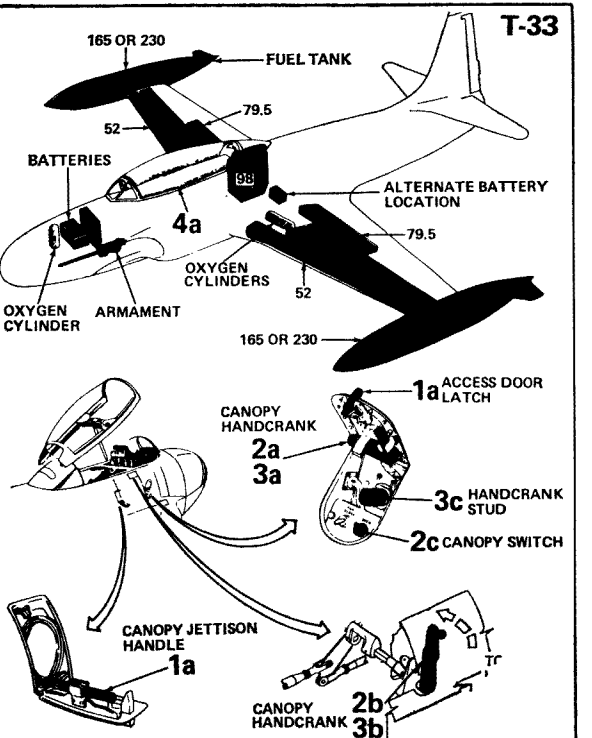


Figure B-20. The most widely used T-33 USAF Trainer.

Appendix C

Air Transport of Radioactive Materials and Nuclear Weapons

C-10. Commercial Air Transport of Radioactive Materials

C-11. The carriage in commercial transport aircraft of radioactive cargo is closely controlled by national and international regulations.* Reference should be made to the applicable regulations for full details.

C-12. Radioactive materials are being carried in commercial transport aircraft, particularly in cargo aircraft, regularly. While the containers used to transport these materials are rugged, the possibility of breakage cannot be overlooked and this introduces the hazard of radioactive contamination of an accident site.† By knowing and recognizing the radioactive symbols (see references), firemen can be alerted to this hazard. The following procedures should then be followed in the U.S. (similar procedures are followed in other countries) :

a. Notify the nearest Atomic Energy Commission office or military base of the accident immediately. They in turn will respond with a radiological team to the accident scene.

b. Restrict the public as far from the scene as practical. Souvenir collectors should be forbidden in all accidents.

c. Segregate fire fighters who have had possible contact with radioactive material until they have been examined further by competent authorities.

---

*In the U.S. an Official Air Transport Restricted Articles Tariff has been issued by the Airline Tariff Publishers Inc., 1825 K Street, N.W., Washington, D. C. 20006. Code of Federal Regulations, Title 14, Part 103 on Transportation of Dangerous Articles and Magnetized Materials is published by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402 in Title 14, Parts 40 to 199. Policy decisions on all transportation modes in the U.S.A. are promulgated by the Hazardous Materials Regulations Board, U. S. Department of Transportation, 400 Sixth Street, S.W., Washington, D. C. 20590. The International Air Transport Association has issued "IATA Regulations Relating to the Carriage of Restricted Articles by Air"; this is available from IATA, Terminal Centre Building, Montreal 3, Quebec, Canada.

†See "Fire Protection Handbook" for a discussion of radiation hazards, available from the NFPA and "Radiation Control" by A. A. Keil, also published by the NFPA.

d. Remove injured from the area of the accident with as little contact as possible and hold them at a transfer point. Take any measures necessary to save lives, but carry out minimal (no more than necessary) first aid and surgical procedures until help is obtained from the radiological team physicians or other physicians familiar with radiation medicine. Whenever recommended by a doctor, an injured individual should be removed to a hospital or office for treatment, but the doctor or hospital should be informed when there is reason to suspect that the injured individual has radioactive contamination on his body or clothing.

e. In accidents involving fire, fight fires upwind as far as possible, keeping out of any smoke, fumes, or dust arising from the accident. Handle as a fire involving toxic chemicals (using self-contained gas masks and gloves). Do not handle suspected material until it has been monitored and released by monitoring personnel. Segregate clothing and tools used at fire until they can be checked by the radiological emergency team.

f. Do not eat, drink or smoke in the area. Do not use food or drinking water that may have been in contact with material from the accident.

g. The use of instruments such as Geiger counters, ionization chambers, dosimeters, etc., is the only accurate means of determining if radioactive radiation is being given off.

C-20. Military Aircraft Carrying Nuclear Weapons

C-21. While most military aircraft will attempt to return to a military airbase in case of emergency, this is sometimes impossible and landings are frequently made at non-military airports. There are also many cases where "joint-use" airports serve both the military and civil aircraft operations. For these reasons it is advisable for aircraft rescue and fire fighting crews to be familiar with the various types of military aircraft operating in the area. For this purpose, training visits to promote knowledge of the special features of military aircraft at nearby military installations are of value. Such liaison is encouraged by the military.

C-22. Any person receiving information of a military aircraft accident should immediately notify the base operations office at the nearest military establishment giving all relevant information. Telephone numbers of such military

installations should be kept on hand at civil airport and nearby municipal fire stations and in airport control towers.

C-23. Care should be exercised by the rescue and fire fighting crews when approaching any military aircraft involved in fire. Armament, ejection seats, hazardous or other dangerous cargoes may present severe hazards during such operation.

C-24. The possibility of a nuclear contribution (atomic explosion) from the detonation of a nuclear weapon or warhead involved in a fire, inadvertent release, or impact accident, is so small as to be practically non-existent. Safety features and devices have been carefully designed and incorporated in nuclear weapons and warheads to make this assurance possible. The danger from a nuclear weapon is associated with the high explosive (HE) used plus radiation from the components.

C-25. The presence of nuclear weapons in aircraft generally creates no greater hazard than does the presence of conventional high explosives. Most weapons do contain a high explosive which could detonate upon moderate to severe impact or when subject to fire. In fact, exposure to heat may make the high explosive more sensitive. In nuclear weapons the amount of high explosive is considerably less than that found in conventional high explosive bombs. Chemical and/or radiological hazards may exist during and after an accident or fire where a nuclear weapon is involved.

C-26. Basically, the same techniques are used for fighting aircraft fires involving nuclear weapons as those in which conventional high explosive bombs are involved; special extinguishing agents are not required to control and extinguish such fires. The brief length of time available to control or extinguish the fire, before an explosion might be expected, is the only special factor to be considered.

a. **Description.** In general, nuclear weapons resemble conventional bombs in that they are enclosed in a shell or casing that is generally cylindrical in shape, with tail fins. The weapon or warhead casings are of various thickness and may or may not break up upon impact. Most weapons contain a conventional type of high explosive which may detonate upon moderate to severe impact or when subject to fire. The quantity of high explosive involved in a detonation, if one occurs, may vary from a small amount to several hundred pounds and constitutes the major hazard

in such an accident. If the casing breaks upon impact, the exposed and unconfined pieces of high explosive can ignite and burn or may explode if stepped on or run over. Some minor radiological hazards may exist regardless of the type of weapon, if the weapon burns or if detonation of high explosive occurs.

b. Time Factors. The length of time available to fight a fire involving nuclear weapons safely, depends largely upon the physical characteristics of the weapon or warhead case, the intensity of the fire and the proximity of the fire. Since weapon and warhead cases vary in thickness, fire fighting "time factors" range from three minutes to an indefinite period if the fire-impact incident does not detonate the high explosive immediately. The time element for each type of nuclear weapon and/or component is an important factor in fighting these fires. As soon as fire envelops the weapon area these "time factors" become effective. For weapons or warheads within a fire impact incident area, and subject to extreme heat but not enveloped in flames, a time factor of fifteen minutes will apply; if the fire fighting time factor is unknown to the fire fighters, the minimum time factor should be observed. Military flight communications procedures normally provide for notification of control towers of pertinent information regarding such time factors. When a weapon or warhead has been involved in fire and the time factor has expired, even though the fire has been extinguished or burned out, safe evacuation distances should be observed until the arrival of authorized Explosives Ordnance Disposal personnel.

c. High Explosive Blast and Fragmentation. The radius of a weapon high explosive blast varies, depending on the amount of high explosive which actually detonates; high explosive blast fragmentation distances for these weapons range from a minimum radius of 400 ft. to a maximum of 1000 ft. Personnel within these areas may be seriously injured from blast or fragmentation upon detonation of the high explosive. These areas and distances must be considered in evacuating fire fighting personnel and during the initial fire department approach to an accident where weapons have been enveloped in flames for a period approximating or exceeding the weapon time factor limitations. All except experienced fire fighting personnel should immediately evacuate to a minimum distance of 1500 feet for protection against blast or fragmentation.

d. Precautionary Measures. Under no circumstances should any high explosive material from ruptured weapons that have been exposed to fire (or any components that have been scattered) be handled, stepped on, driven over, or disturbed in any manner. This material is extremely sensitive to minor detonations from shock or impact and may cause serious injury. Protective clothing and breathing apparatus (self-contained) must be worn during fire fighting operations to provide the fire fighter maximum protection from any chemical or minor radiological hazards that may be present. Additional protection is afforded by fighting any fire from an upwind position. All exposed clothing, apparatus, and equipment used during a fire or impact incident where nuclear weapons or components have been involved, should be monitored for possible radiological contamination by specialized recovery personnel equipped for this purpose.

e. Associated Hazards.

(1) Radiological. In the event of a high explosive detonation or burning of a weapon, one has to concern himself principally with Alpha-emitting contamination which is serious only when ingested. Other types of radiation, which are harmless at the low levels produced in a weapon, may be detected with the use of sensitive detection instruments. (The effect of this radiation may be likened to the effects of radiation emanating from a luminous dial wristwatch.) Since Alpha-emitting particles are so fine that they are carried as smoke or dust from the burning or high explosive detonation of a nuclear weapon, some Alpha-emitting contamination may be expected in the immediate accident area and downwind. Although this material may present a minor radiation problem, danger from these particles exists only when they are inhaled in significant amounts. Protection against highest expected Alpha levels from such burning or high explosive detonation incidents is afforded fire fighting personnel by the prescribed protective clothing and breathing apparatus.

(2) Fire. Hazards associated with the burning of nuclear weapons and components are generally the same as those presented by conventional high explosives.

(3) Impact. Weapon or warheads may break up and the high explosive detonate from impact. Detonation

and break-up is contingent to a large degree upon the characteristics of the weapon or warhead case, the impact velocity, and the location of aircraft suspension devices.

(4) Sympathetic Detonation. Detonation of a weapon or warhead, by fire or by impact, is also likely to induce detonation (non-nuclear) of any other weapon or warhead in the open within a 50 to 300 foot radius of the incident area.

(5) High Explosive Burning Characteristics. Flame and smoke characteristics of burning high explosives vary, and provide no specific pattern upon which to determine when the high explosive is about to detonate. Burning high explosives produce flames of various colors; they may be bright red, yellow, greenish-white or combinations of no predominant color. Some give off a white smoke, while others burn with no trace of smoke.