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Units of Measurements

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters. One foot = 0.3048 meters. One inch = 25.40 millimeters. One pound per square inch = 0.06805 atmospheres = 2.307 feet of water. One pound = 453.6 grams.

Standard Operating Procedures

Aircraft Rescue and Fire Fighting

NFPA No. 402 — 1965

1965 Edition of No. 402

These Standard Operating Procedures for Aircraft Rescue and Fire Fighting were developed by the following Subcommittee of the NFPA Sectional Committee on Aircraft Rescue and Fire Fighting:

Vic Hewes, *Chairman,* Air Line Pilots Association

J. A. O'Donnell, American Airlines

W. D. Robertson, Seattle-Tacoma Airport

W. T. Schmidt, South Bend Fire Department

J. T. Stephan, American Association of Airport Executives

The text was approved by the Sectional Committee and the NFPA Committee on Aviation and then adopted at the 1965 Annual Meeting of the Association held May 17-21 in Washington, D.C.

Additions found in this 1965 Edition not in the last previous edition (1963) are: Paragraphs 212 and 213 (old Paragraph 212 having been renumbered as 214), 309, 419-421, 608, 700-711, and 800-803. Paragraph 211 is a revision of the previous text. In addition the Appendix material has been updated with new diagrams, photographs and references.

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 1965 text was 1963. Companion publications of special importance are the NFPA Suggestions for Aircraft Rescue and Fire Fighting Services at Airports and Heliports (No. 403), the NFPA Guide on Aircraft Rescue and Fire Fighting Techniques 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 Guide on Foaming Runways for Crash Protection (No. 420M).

Committee on Aviation

Jerome Lederer,† *Chairman,*
Flight Safety Foundation, 468 Park Avenue South, New York, N. Y. 10016

Harvey L. Hansberry (SFPE), *Vice-Chairman,*
Federal Aviation Agency, Aircraft Branch RD-740, Systems Research & Development Service, Federal Aviation Agency, Atlantic City, N. J. 08405

George H. Tryon (SFPE), *Secretary,*
National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 02110

J. C. Abbott, British Overseas Airways Corp. (Personal)

H. F. Blumel, Jr., American Airlines. Chairman of Sectional Committee.

Henry G. Bone, Jr., The Boeing Co. (Personal)

E. Thomas Burnard, Airport Operators Council.

H. L. Butler, Eastern Air Lines. (Personal)

R. C. Byrus, University of Maryland. Chairman of Sectional Committee.

John J. Carroll, Civil Aeronautics Board.

J. M. Chase, Flight Safety Foundation. Chairman of Sectional Committee.

N. L. Christoffel, United Air Lines. (Personal)

C. W. Conaway, Factory Insurance Association.

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

Robert F. Farrell, United States Aviation Underwriters.

B. V. Hewes, Airline Pilots Assn.

H. Prater Hogue, The Boeing Company. (Personal)

Charles H. Kaman, Vertical Lift Council, Aerospace Industries Assn. of America, Inc.

G. C. Koth, Factory Mutual Engineering Division.

R. Dan Mahaney,† Federal Aviation Agency.

James S. Mathews, Associated Aviation Underwriters.

C. M. Middlesworth,† Federal Aviation Agency.

J. A. O'Donnell, American Airlines. Chairman of Sectional Committee.

F. E. Parker, Australian Dept. of Civil Aviation.

R. C. Petersen, Port of New York Authority. (Personal)

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

W/C B. C. Quinn, Canadian Department of National Defence.

E. E. Reed, American Petroleum Institute.

George Schrank, Fire Equipment Manufacturers Association.

S. W. Sheat, United Kingdom, Ministry of Aviation.

John T. Stephan, American Association of Airport Executives.

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

Douglas C. Wolfe, American Association of Airport Executives.

Alternates.

Alternate to Mr. Burnard
Ross A. Knight (Airport Operators Council)

Alternate to Mr. Hewes
William L. Collier (Air Line Pilots Association)

Alternate to Mr. Conaway
F. J. McClain (Factory Insurance Association)

Alternate to Mr. Cook
Roscoe L. Bell (Dept. of the Air Force)

Alternate: American Ins. Assn.
Charles S. Rust (Appointment of Principal Pending)

Alternate to Mr. Tabisz
G. L. Toppin (Underwriters' Laboratories of Canada)

Alternate to Mr. Reed
W. V. Paulus (American Petroleum Institute)

Liaison Representatives.†

Allen W. Dallas, Air Transport Association
S. Krzyczkowski, International Air Transport Association
W. A. McGowan, National Aeronautics and Space Administration
J. A. Pope, National Business Aircraft Association
Dr. A. F. Robertson, National Bureau of Standards
E. J. C. Williams, Air Ministry, United Kingdom
Chief, Aerodromes, Air Routes and Ground Aids Section, International Civil Aviation Organization

†Non-voting member.

Sectional Committee on Aircraft Rescue and Fire Fighting.

Robert C. Byrus (SFPE), *Chairman,*
Fire Service Extension, University of Maryland, College Park, Md. 20742

J. C. Abbott, British Overseas Airways Corp.
Lt. George Augusto, Denver Fire Department.
Deputy Chief Charles W. Bahme, Department of Fire, City of Los Angeles.
J. J. Brenneman, United Air Lines.
John W. Bridges, Federal Aviation Agency.
Martin P. Casey, Air Force Systems Command.
N. L. Christoffel, United Air Lines.
Gifford T. Cook, Headquarters. USAF.
John Dando, Fire Apparatus Manufacturers Association.
John F. Dowd, Westover Air Force Base.
H. A. Earsy (SFPE), United Aircraft Corp.
Francis W. Flagg, Monroe County Airport (Rochester, N. Y.)
Harvey L. Hansberry (SFPE), (ex-officio) Federal Aviation Agency.
Vic Hewes, Air Line Pilots Association.
H. Prater Hogue, The Boeing Company.
W. S. Jacobson (SFPE), North American Aviation Fire Dept.
Harold M. Karrmann, Aircraft Crash Rescue, Sperry Gyroscope Co.
Ross A. Knight, Airport Operators Council.
H. C. Langenfeld, Vertical Lift Aircraft Council, Aerospace Industries Association of America, Inc.
K. R. Laidley, Fire Extinguisher Manufacturers' Institute of Canada.
Hervey F. Law, Personal.
Jerome Lederer† (ex-officio), Flight Safety Foundation.
Capt. R. Macdonald, Canadian Air Line Pilots Association.
Donald G. MacKinnon (SFPE), Canadian Department of Transport, Air Services.
R. Dan Mahaney,† Federal Aviation Agency.
Chief Claude J. McGlamery, Chance Vought Aircraft, Inc.
J. A. O'Donnell, American Airlines.
John A. Peloubet, The Dow Metal Products Co.
H. B. Peterson, U. S. Naval Research Laboratory.
W/C B. C. Quinn, Royal Canadian Air Force, Dept. of National Defence.
W. D. Robertson, Seattle-Tacoma Airport.
James Rogers, Firemen's Training Center, Nassau County (N. Y.).
J. K. Schmidt, Air Proving Ground Center, Eglin Air Force Base.
William T. Schmidt, South Bend Fire Dept.
George Schrank, Fire Equipment Manufacturers Association.
E. Sorensen, The Port of New York Authority.
John T. Stephan, American Association of Airport Executives.
E. F. Tabisz (SFPE), Underwriters' Laboratories of Canada.
Douglas C. Wolfe, American Association of Airport Executives.

Alternates.

Roscoe L. Bell, Headquarters, USAF. (Alternate to G. T. Cook.)
William L. Collier, Air Line Pilots Association. Alternate to B. V. Hewes.)
Flight Lt. A. E. Graham, Royal Canadian Air Force, Dept. of National Defence.
Don Heine, Air Line Pilots Association. (Alternate to B. V. Hewes.)
Chief Paul Kowall, Firemen's Training Center, Nassau County (N. Y.). (Alternate to James Rogers.)
G. L. Toppin (SFPE), Underwriters' Laboratories of Canada. (Alternate to E. F. Tabisz.)

Liaison Representatives.†

G. A. Brelie (SFPE), The Ansul Company.
George R. Cooper, Jr., Walter Motor Truck Company.
J. P. Dunne, Chicago-O'Hare International Airport.
Henry W. Marryatt (SFPE), Wormald Brothers Industries Ltd.
D. N. Meldrum, National Foam System, Inc.
James O'Regan (SFPE), Rockwood Sprinkler Company.
L. E. Rivkind, Mearl Corporation.
George Scharbach, Willys Motors Inc.
M. S. Stuart, Chrysler Corp.
Marvin C. Tyler, Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio.
H. V. Williamson (SFPE), Cardox, Division of Chemetron Corp.
J. H. Yankie, Yankee Walter Corp.

†Non-voting member.

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Standard Operating Procedures

Aircraft Rescue and Fire Fighting

NFPA No. 402 — 1965

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 Suggestions 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.

103. 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.

104. 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.

105. 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.

106. 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 firemen 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 addi-

tion, 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, Figure E-4.)

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. 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 on Aircraft Rescue and Fire Fighting Tech-

niques Using Conventional Fire Apparatus and Equipment" (No. 406M).

b. Confidence in handling aircraft fires can only be attained by frequent training sessions of realistically simulated accidents.

c. 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.

d. 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).

e. Ambulance and medical services, like rescue and fire fighting services, are necessary to administer aid to victims. Response of such aid to aircraft accident sites should be automatic regardless of whether or not it is apparent that medical services are required. Some ambulance and medical services may be an integral part of the airport rescue and fire fighting organization and this is recommended where feasible (see NFPA No. 403). Such services should be available during all operating periods on an identical schedule with the companion activity. Where a permanent airport-based ambulance service is not feasible and to supplement any such services, prearrangements with local, private or public ambulance and medical services should be arranged to assure prompt dispatch of a satisfactory assignment of personnel, equipment, and medical supplies. It is of special importance that aircraft rescue and fire fighting

crews be well trained in first-aid practices by completing the Red Cross Advanced First Aid Course as a minimum.

f. Prearrangements are also needed to assure that doctors are available for any aircraft emergency. A current roster for enlisting such assistance should be established in cooperation with the nearest local medical association. The responsibility for alerting those needed in any particular case should be assigned to a representative of airport management, airport control, or an appropriate local medical official.

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

206. 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.

207. 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.

208. 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.

209. 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 experi-

enced 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 extinguishers 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 bottles have been already used.

210. All aircraft carry small portable fire extinguishers in addition to the fixed extinguishers mentioned above, 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.

211. 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 (see Appendix E, Part E-5).

212. 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-10, A-11 and A-12 in Appendix A and Figures E-12, E-13 and E-14 in 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.

213. 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).

214. 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 the NFPA "Guide on Foaming Runways for Crash Protection" (NFPA No. 420M).

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 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 NFPA Standard on Aircraft Fueling on the Ground (No. 407).

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 Appendix 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. Many 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 JATOS occurs.

If fire does not occur, igniters and ignition cables should be removed from unexpended JATOS 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 Paragraph 253 of the NFPA Suggestions 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, Figure E-11).

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 Civil Aeronautics 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. Class A Fires: Fires involving cargo, upholstery and similar solid combustibles are Class A, which require cooling and quenching for extinguishment. If no flammable liquids are involved, the officer in charge may find it advantageous to use water, preferably water fog, on fires of this type. Experience, planning and a knowledge of how to use available equipment to best advantage are the best guide in making a decision.

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.

Appendix A

Civil Aircraft Data for Fire Fighters and Rescue Crews

This Appendix presents information on the principles of rescue (Figures A-1, A-2, and A-3) and the principles of fire fighting (Figures A-4, A-5 and A-6) in aircraft fire emergencies. Also included as typical are Charts and Figures on some particular *Civil* aircraft in common usage including the following:

Boeing 707	Figures A-7 and A-8
Douglas DC-8	Figure A-9
Convair 880	Figures A-10, A-11, A-12
Lockheed JetStar	Figures A-13 through A-19
Douglas DC-3 (C-47)	Figure A-20
Douglas DC-4 (C-54)	Figure A-21
Douglas DC-7	Figure A-22
Canadair CL-44D4	Figure A-23
Vanguard	Figure A-24
Convair 340	Figure A-25
Caravelle	Figure A-26
Douglas DC-9	Figure A-27
Boeing 727	Figure A-28
BAC One Eleven	Figure A-29

This material is published solely to give basic information on rescue and fire fighting procedures of *representative* aircraft. Personal inspections of each type are necessary to have all the desired data on any one type of aircraft, and fire department personnel are urged to make such inspections to increase their opportunity to preplan their operations.

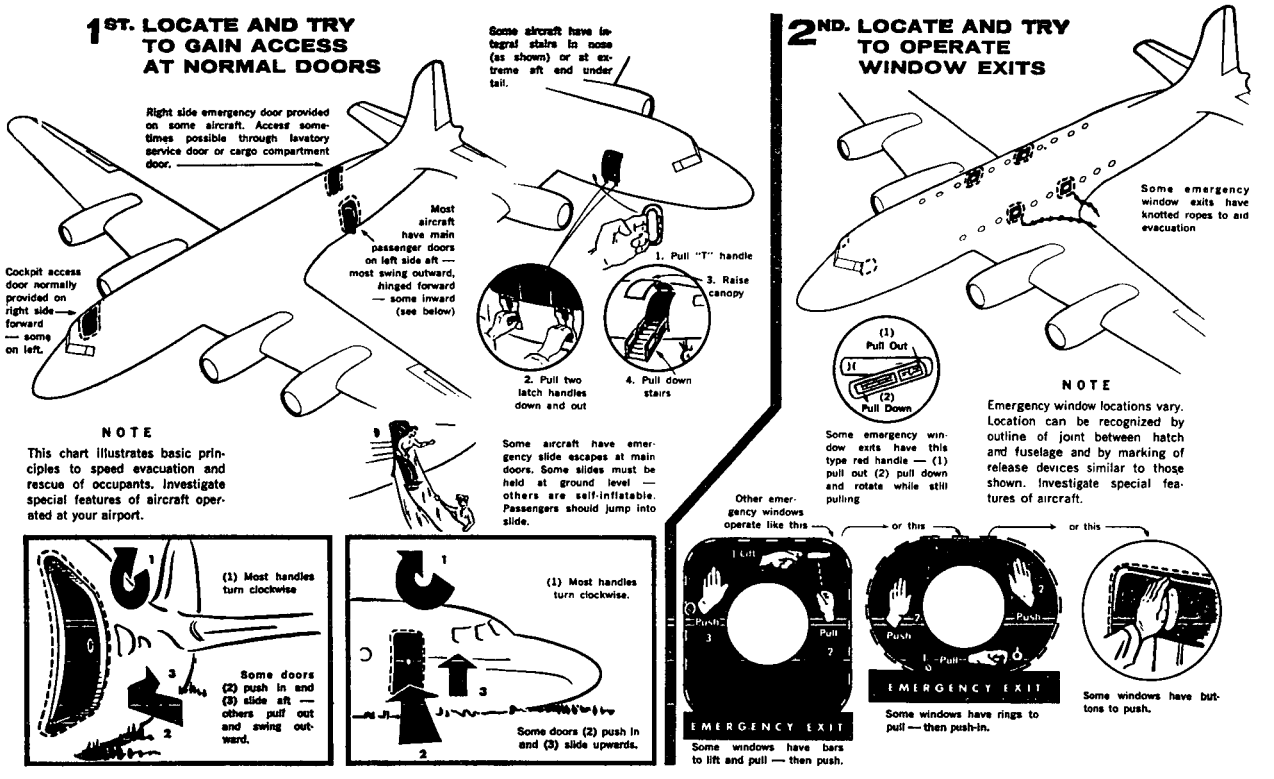
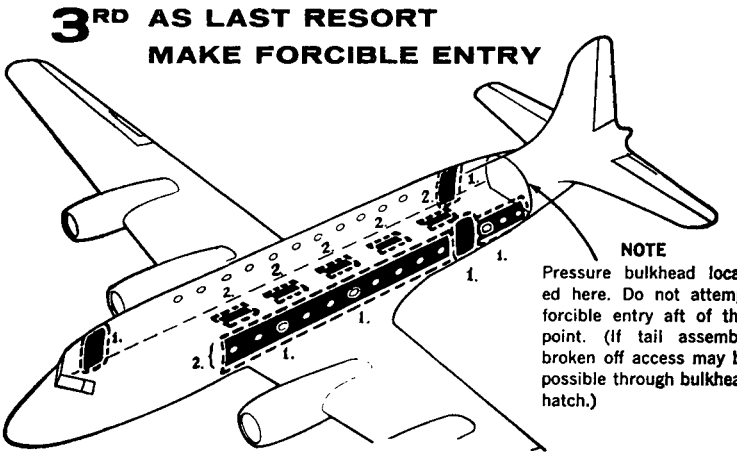


Figure A-1. The principal points to consider in gaining access to civil transport aircraft. Each aircraft must be examined individually to know how doors and windows may be most easily opened from outside.

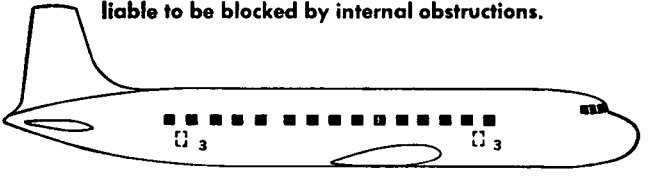


PREFERRED FORCIBLE ENTRY LOCATIONS

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 Figures A-8 and A-9 for forcible entry locations on modern turbine-powered transport. 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

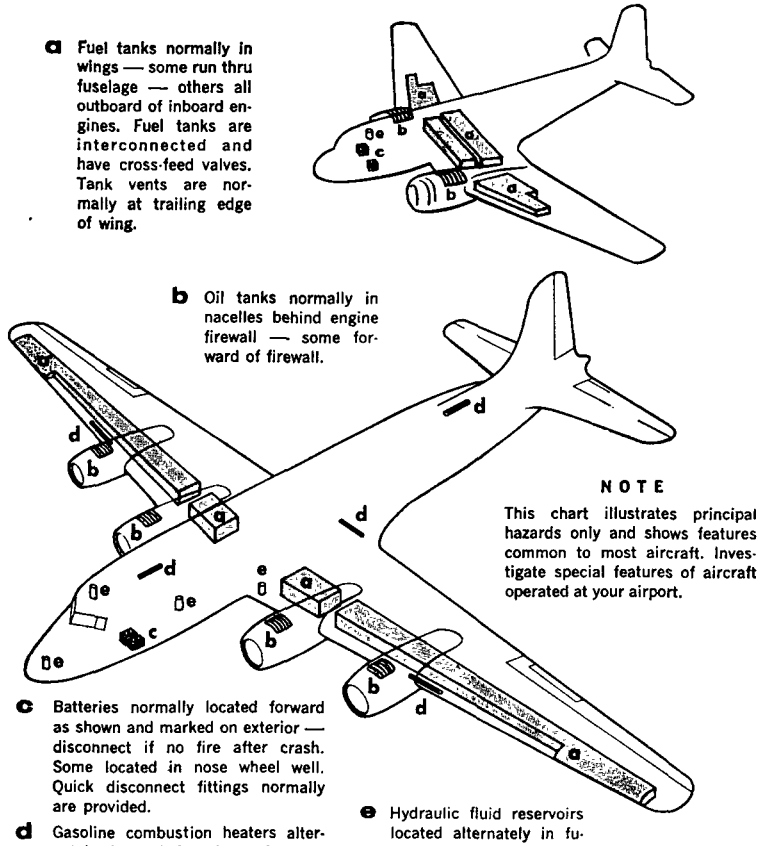


Figure A-3. These are simplified drawings of the principal fire hazard zones on reciprocating engine aircraft. Typical turbine aircraft are illustrated elsewhere in this Appendix.

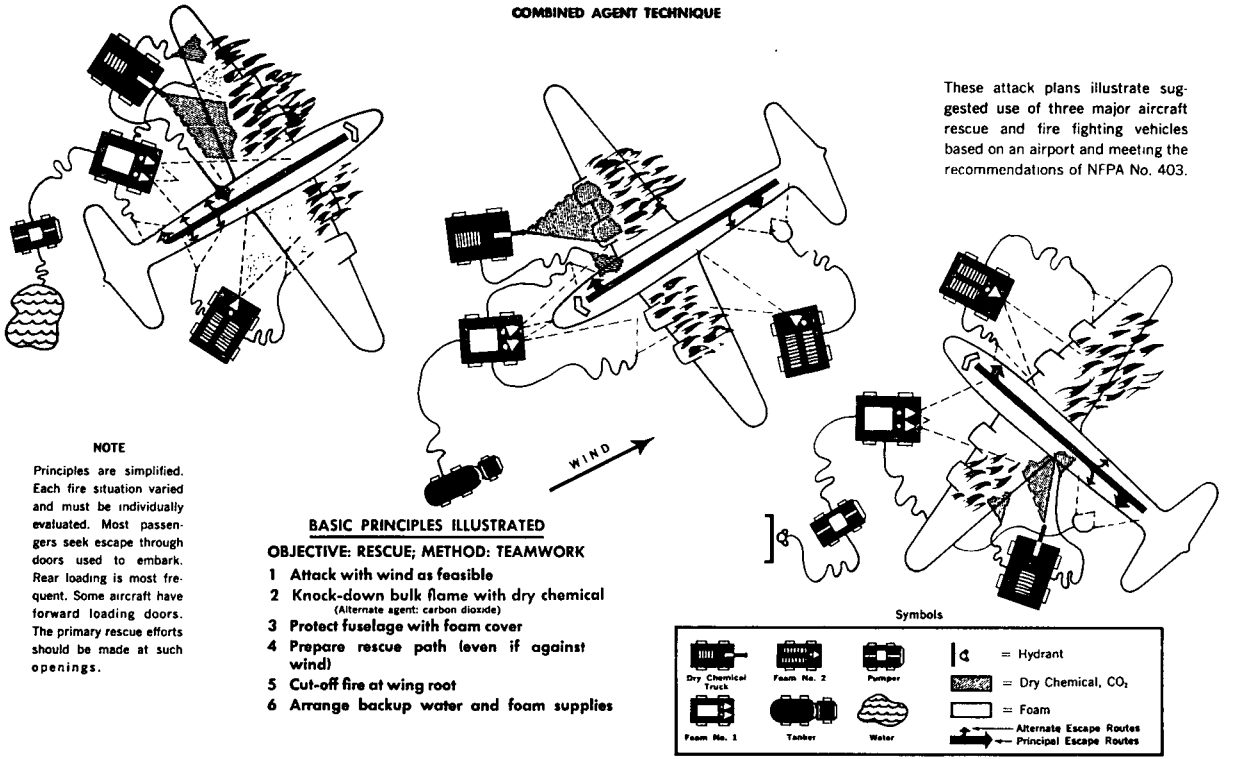


Figure A-4. Principles of fire fighting for civil aircraft using two foam trucks and one dry chemical or carbon dioxide unit. Dry chemical usage is limited to handline applications. If turbine powered, see warning in Paragraph 308.

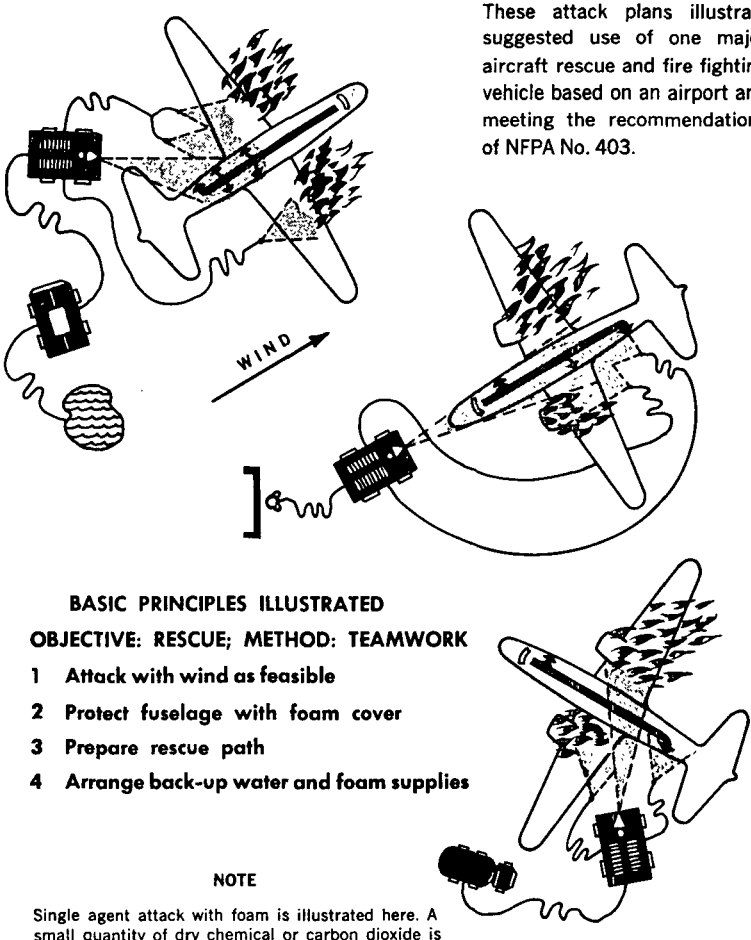
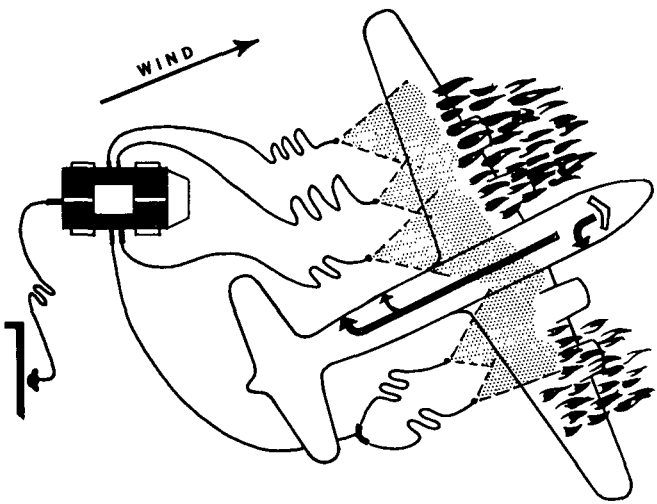


Figure A-5. Principles of fire fighting for civil aircraft using one foam truck and a back-up supply of water. If turbine powered, see warning in Paragraph 308.

This attack plan illustrates suggested use of equipment generally available in municipal and rural fire departments and are based on the recommendations of NFPA No. 406M.



BASIC PRINCIPLES ILLUSTRATED

1 Attack with wind as feasible

2 Approach along fuselage and wet fuselage with water fog

3 Drive flames outward to side perimeters

4 Protect rescue path

5 Arrange back-up water supplies

Key

Water Fog

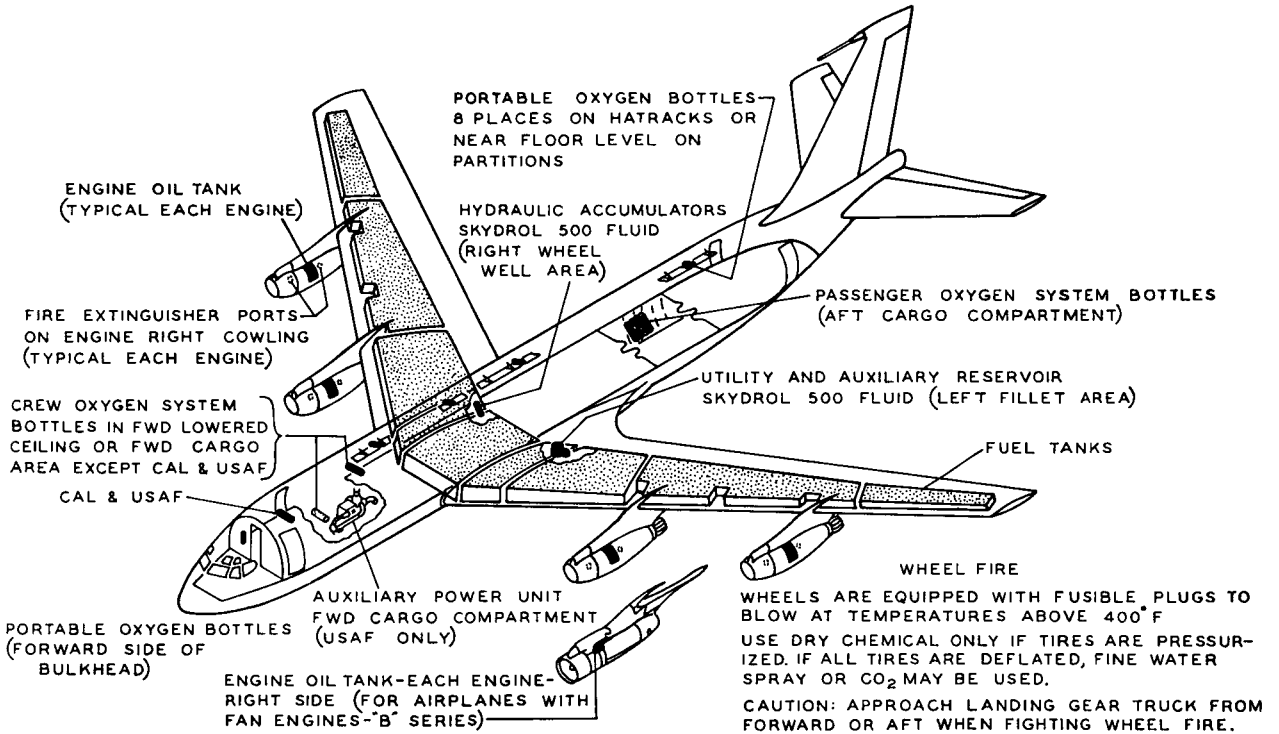
Alternate Escape Routes

Principal Escape Routes

NOTE

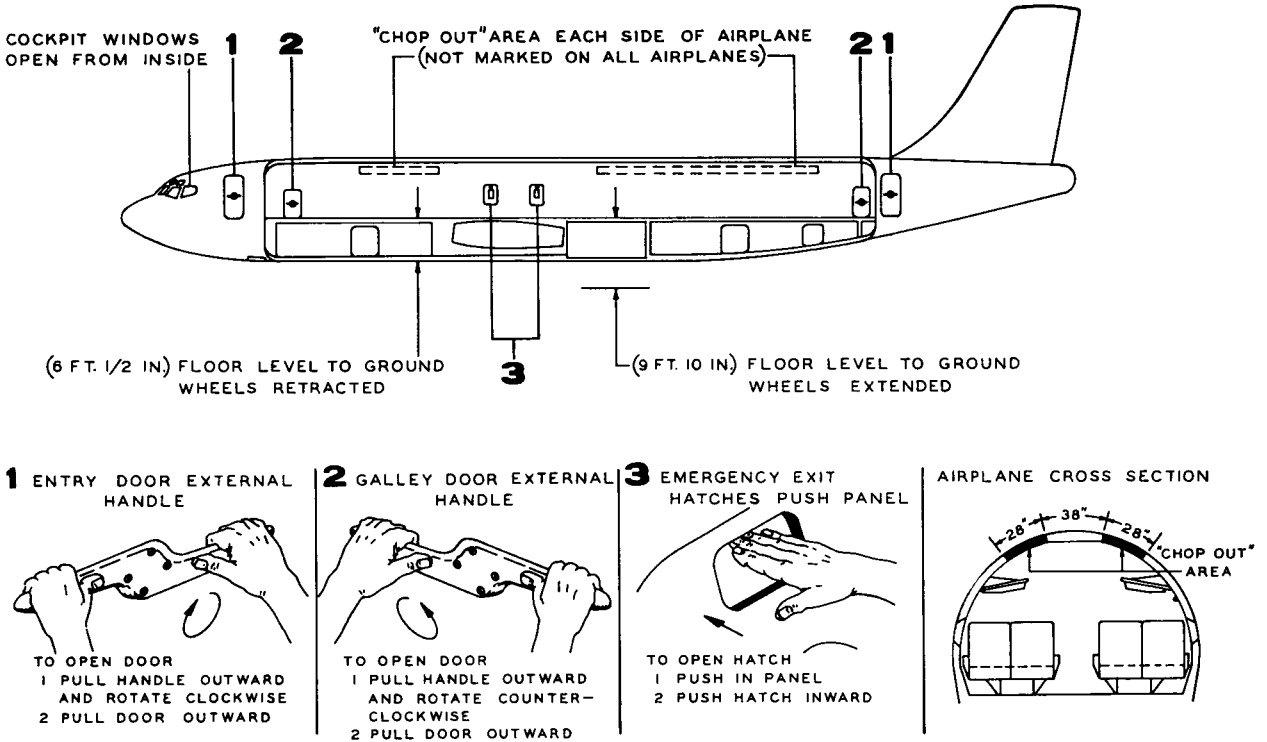
Technique shown assumes only water available dispensed as fog from multiple 1½ inch hose lines at about 100 psi nozzle pressure.

Figure A-6. Principles of fire fighting for civil aircraft using one standard fire department pumper with back-up supply of water. If turbine powered, see warning in Paragraph 308. NFPA No. 406M gives procedures for aircraft rescue and fire fighting using conventional fire apparatus.



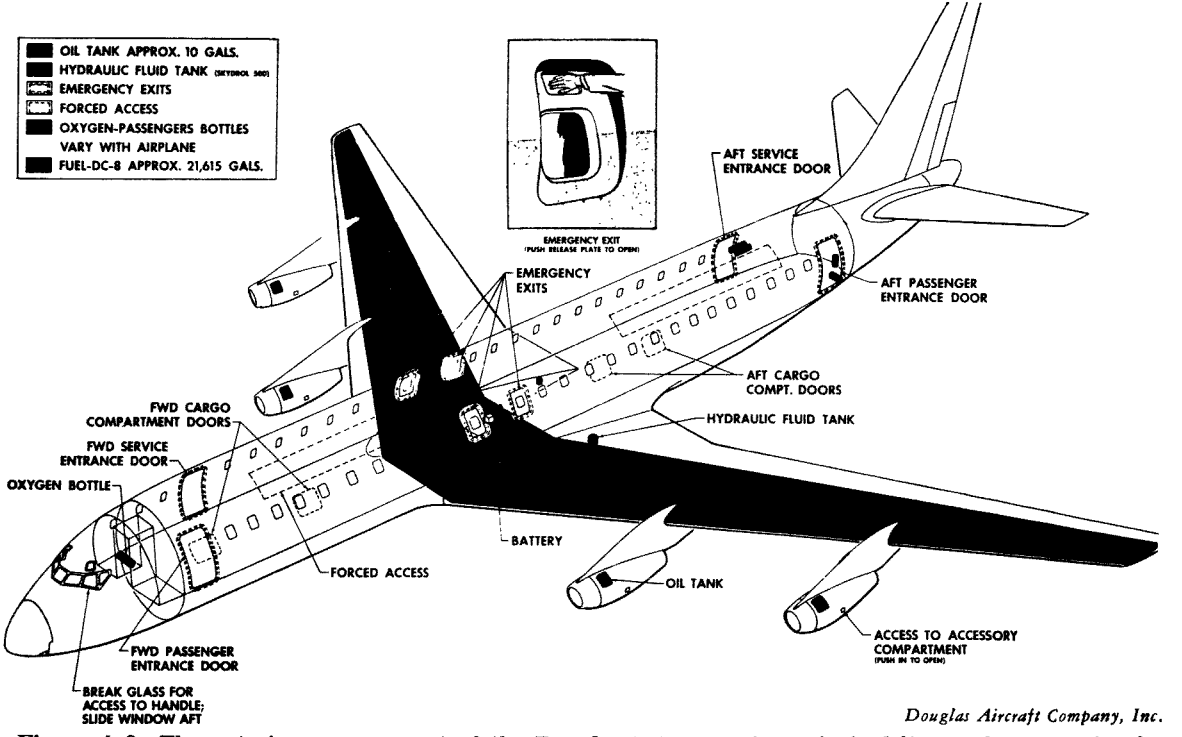
The Boeing Company

Figure A-7. The Boeing 707 Stratoliner showing the flammable material locations. Other models (the Intercontinental and the 720 series) vary somewhat in size and fuel capacity.



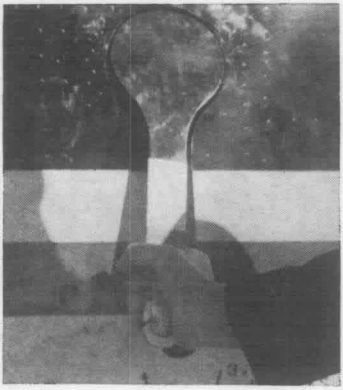
The Boeing Company

Figure A-8. The Boeing 707 Stratoliner showing emergency rescue access points and how they are operable from the exterior.



Douglas Aircraft Company, Inc.

Figure A-9. The exterior arrangement of the Douglas DC-8 showing principal items of concern to aircraft rescue and fire fighting crews.



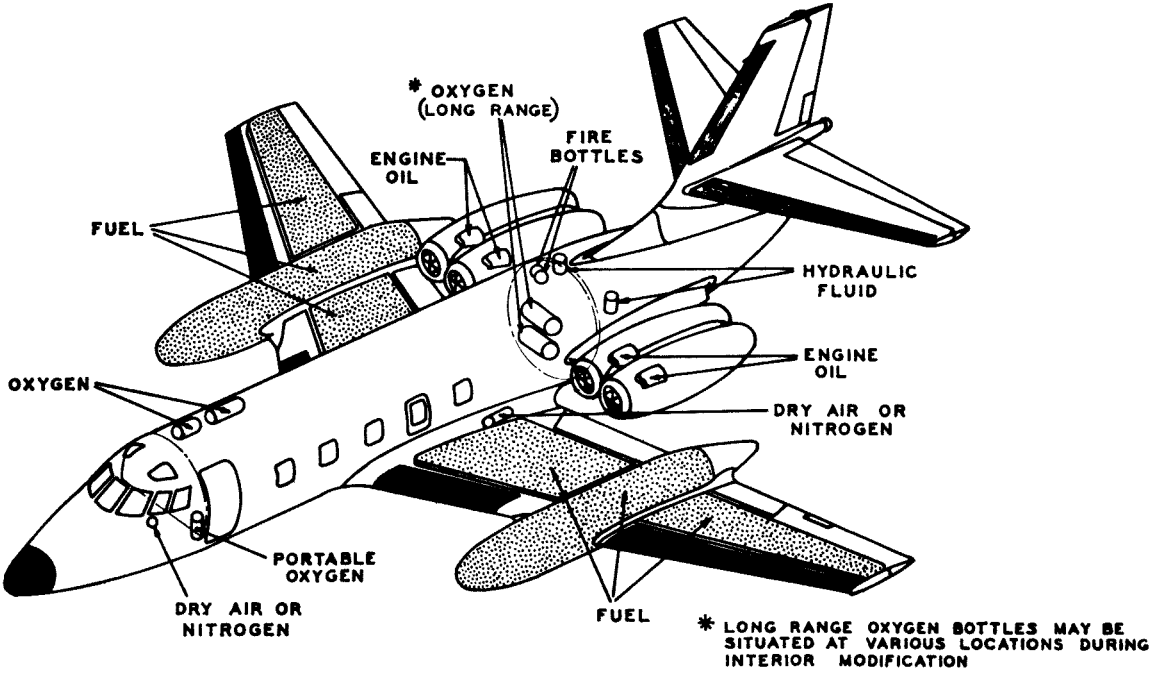
Upper Left
Figure A-10

Upper Right
Figure A-11

Courtesy Delta Air Lines

Figures A-10, A-11 and A-12 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. Most other turbine transports have similar slides.

Lower Left
Figure A-12



Courtesy Lockheed Georgia Company

Figure A-13. The Lockheed JetStar's total fuel capacity is 2,654 gallons.

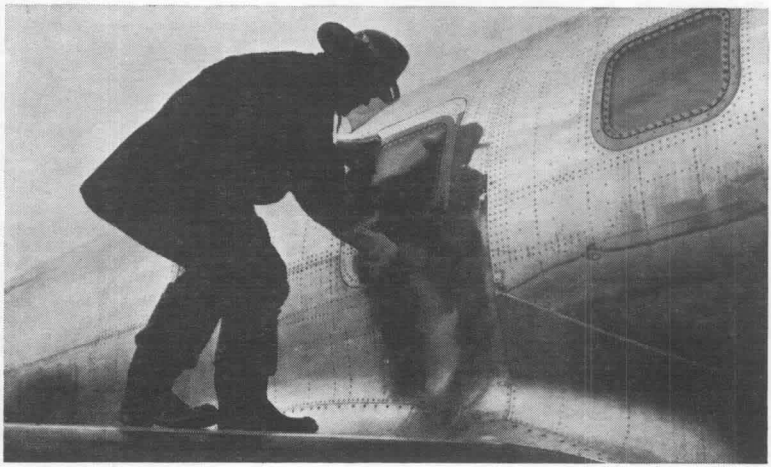
Courtesy Lockheed Georgia Company

Figure A-14. The JetStar is typical of modern turbine powered jet transports carrying a two-man crew and up to eight passengers.

Figure A-15. Normal entry at main entry door — first pull door handle outward.

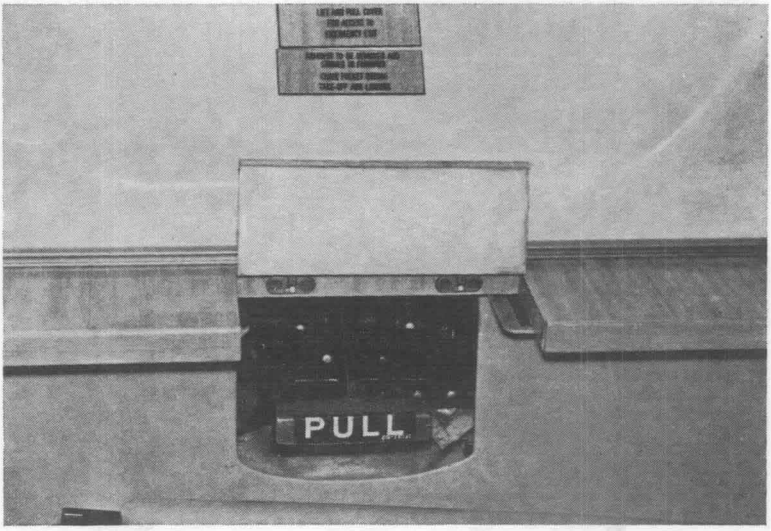
Figure A-16. (Cont'd. from Fig. A-15.) Then rotate one quarter turn clockwise.

Figure A-17. (Cont'd. from Fig. A-16.) Then push in, slide aft.



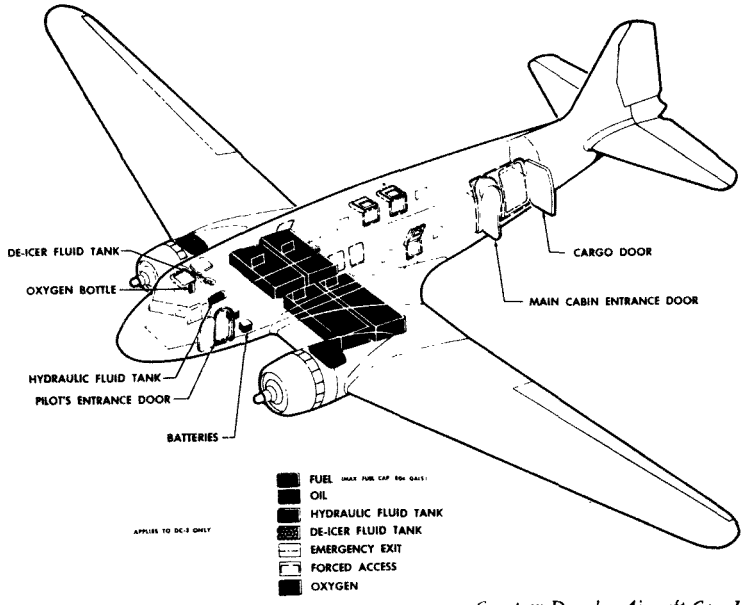
Courtesy Lockheed Georgia Company

Figure A-18. The fourth window from the front on each side of the JetStar fuselage 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.



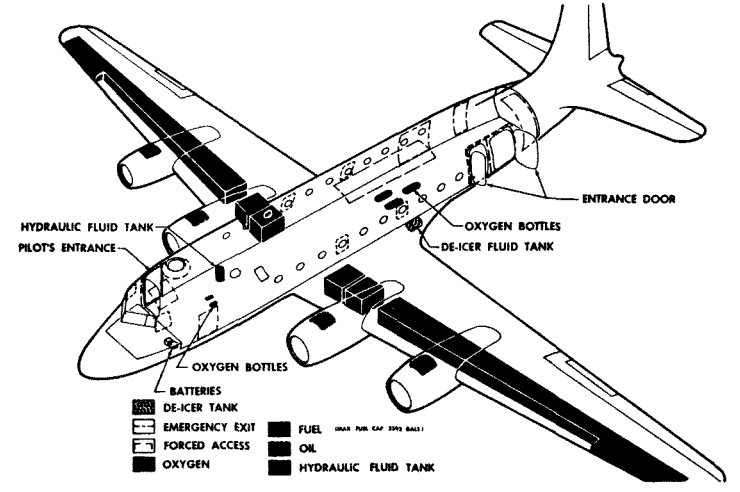
Courtesy Lockheed Georgia Company

Figure A-19. From the inside of the JetStar pull on release handle to unlock and release the hatch (will fall inward).



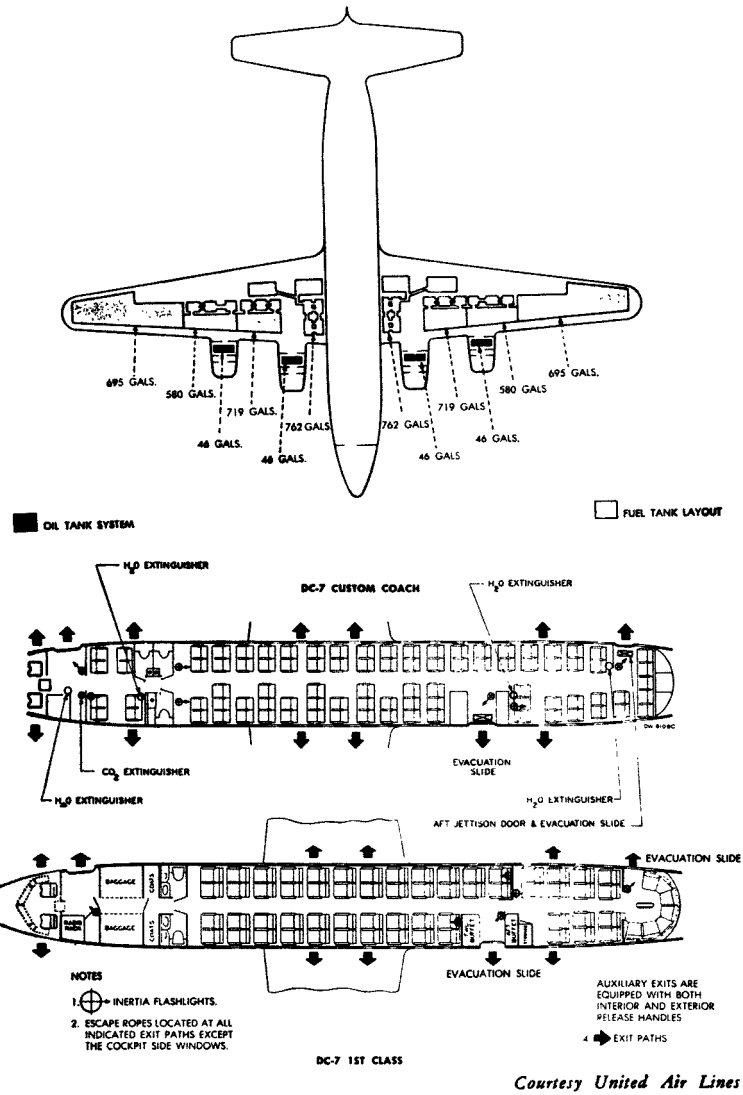
Courtesy Douglas Aircraft Co., Inc.

Figure A-20. The DC-3 (C-47) crash crew chart.



Courtesy Douglas Aircraft Co., Inc.

Figure A-21. The DC-4 (C-54) crash crew chart.



Courtesy United Air Lines

Figure A-22. The DC-7 as operated by United Air Lines showing general arrangement and two seating arrangements.

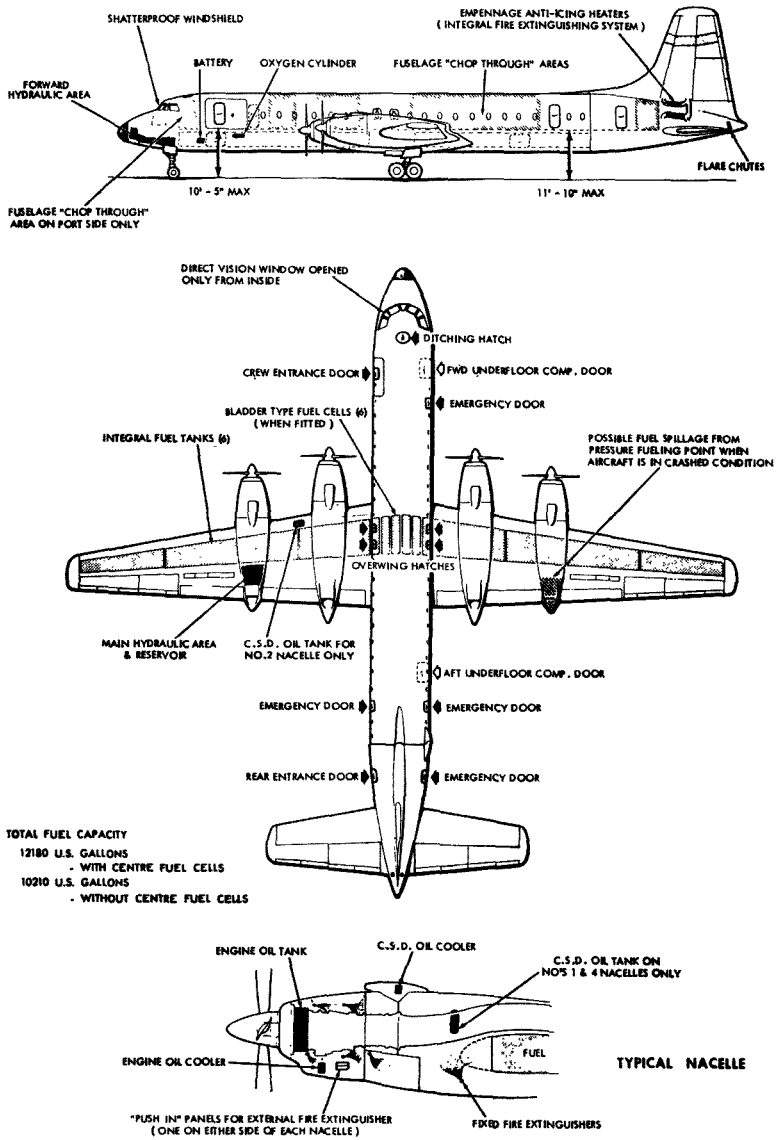


Figure A-23. Canadair CL-44D4 cargo/passenger aircraft rescue and fire fighting data. (Courtesy: Canadair Ltd.)

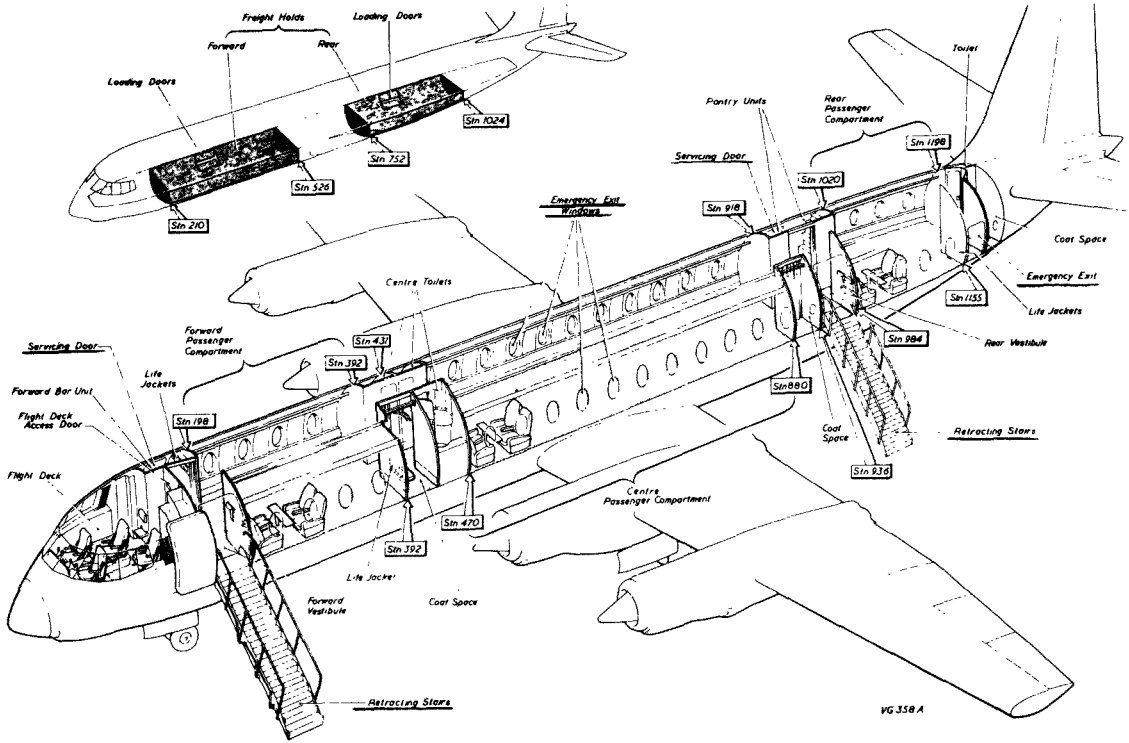


Figure A-24. The Vanguard aircraft showing general arrangements and emergency equipment.

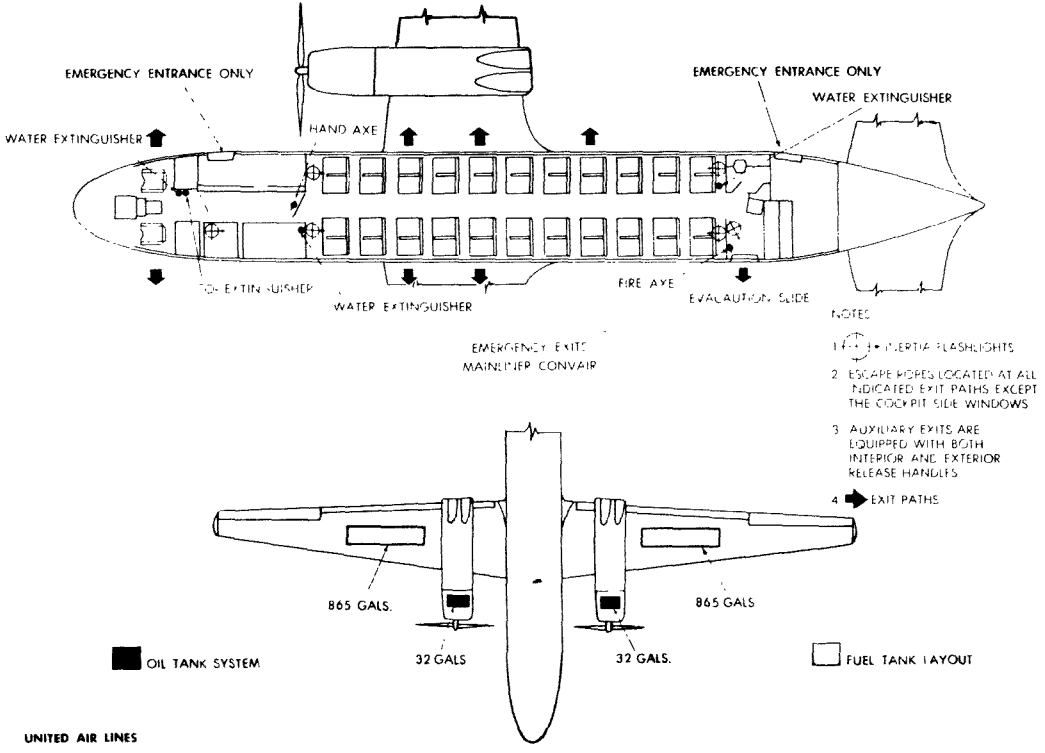
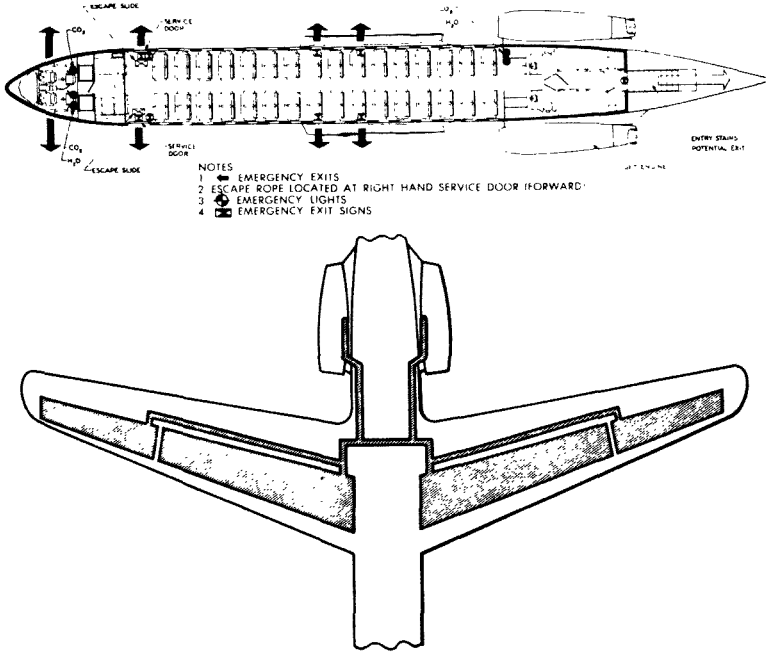
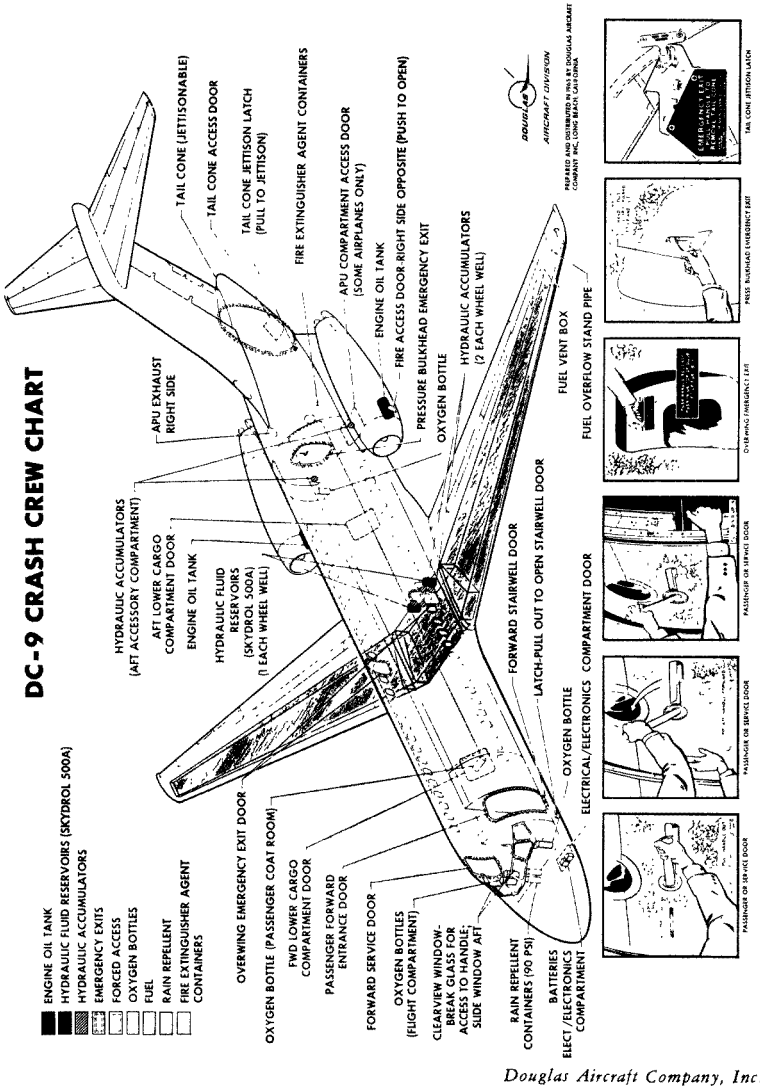


Figure A-25. The Convair 340. Note that fuel tanks are outboard of engine nacelles.



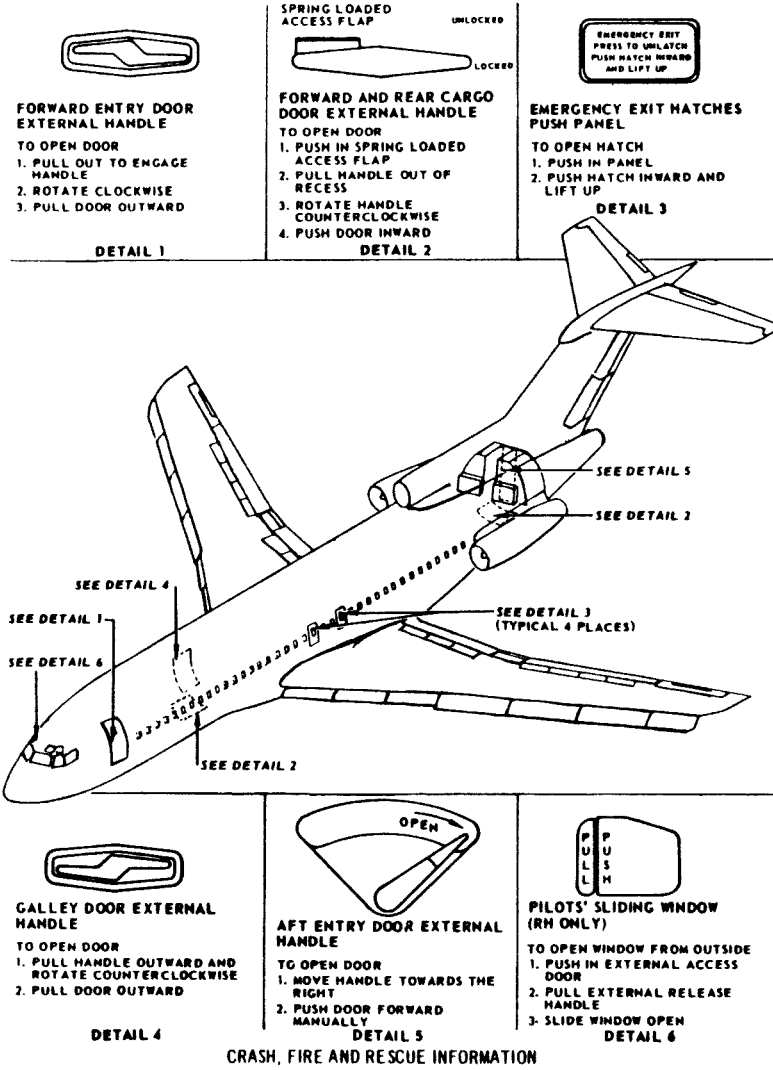
Courtesy United Air Lines

Figure A-26. The new Caravelle as operated by United Air Lines. The turbine engines are mounted on the rear fuselage with the fuel tanks in the sweot-back wings. Fuel lines run from the tankage to the engines in the unpressurized portion of the fuselage.



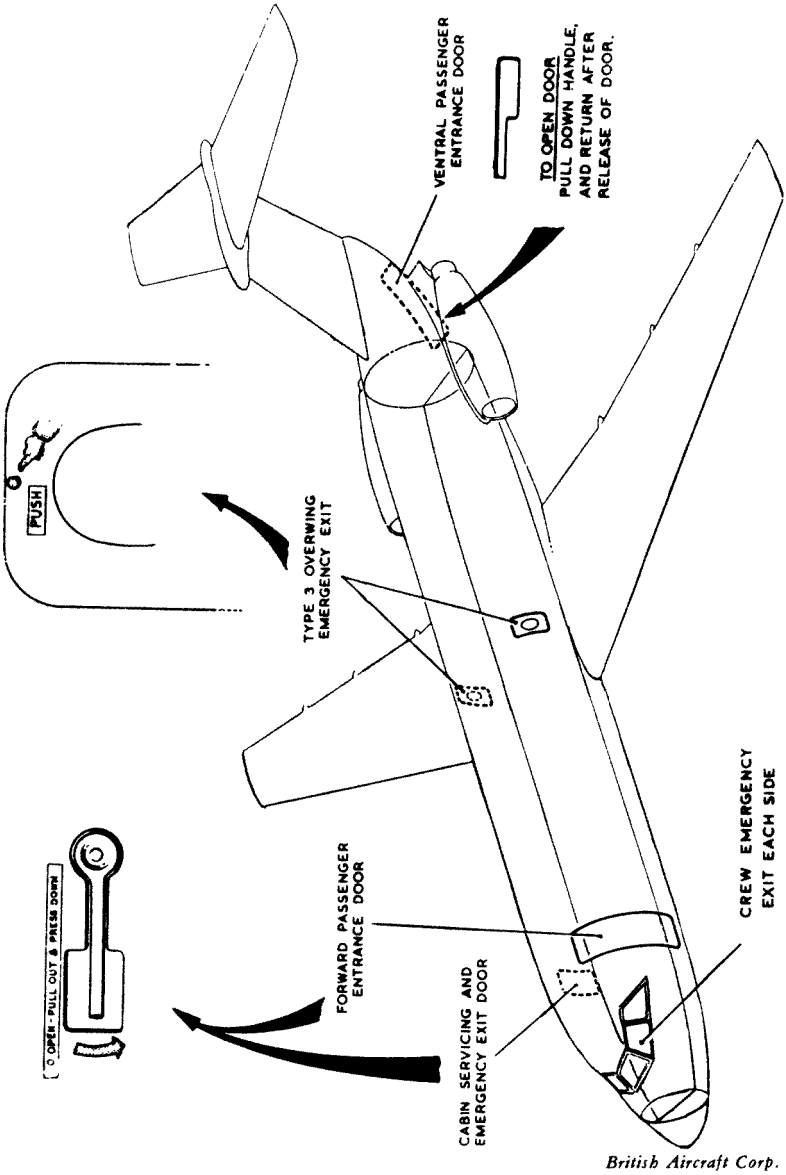
Douglas Aircraft Company, Inc.

Figure A-27. The Douglas DC-9 crash-crew chart.



The Boeing Company

Figure A-28. The Boeing 727 turbine transport.



British Aircraft Corp.

Figure A-29. The emergency doors and hatches on the BAC One Eleven.

Appendix B

Military Aircraft — Aircrew Rescue Data

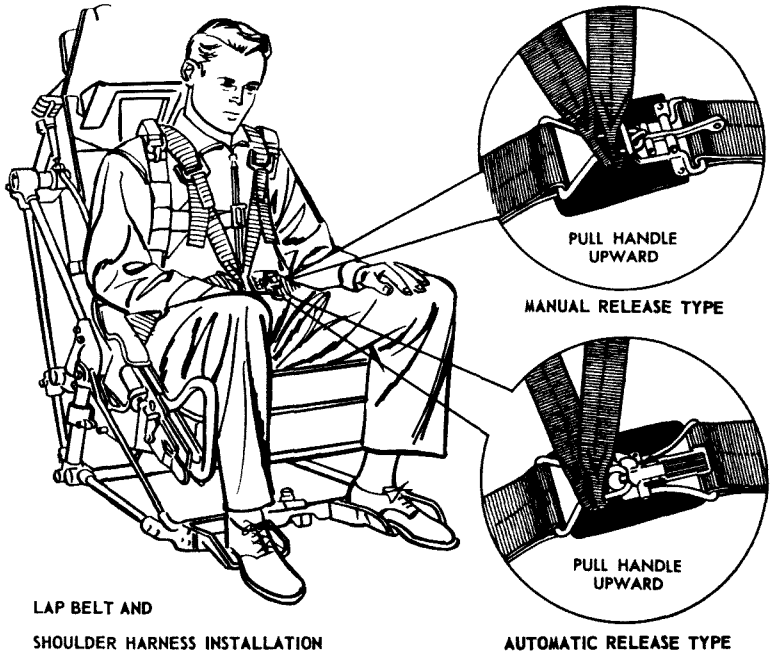


Figure B-1. One USAF lap belt and shoulder harness installation.

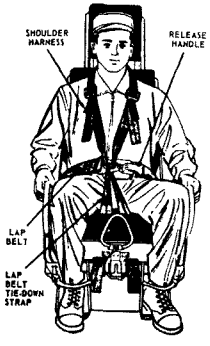


Figure B-2 (Left). One downward ejection seat lap belt and shoulder harness used on many USAF aircraft.

NOTE

The lap belts and shoulder harnesses are strong webbed material which is difficult to cut. Knowledge of release mechanisms is important. Inspection of actual installations will increase needed knowledge of operating principles.

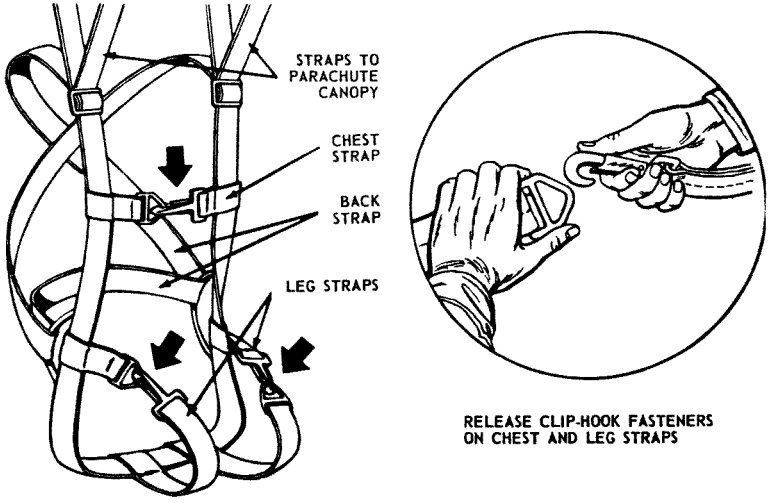


Figure B-3. One type USAF parachute harness release.

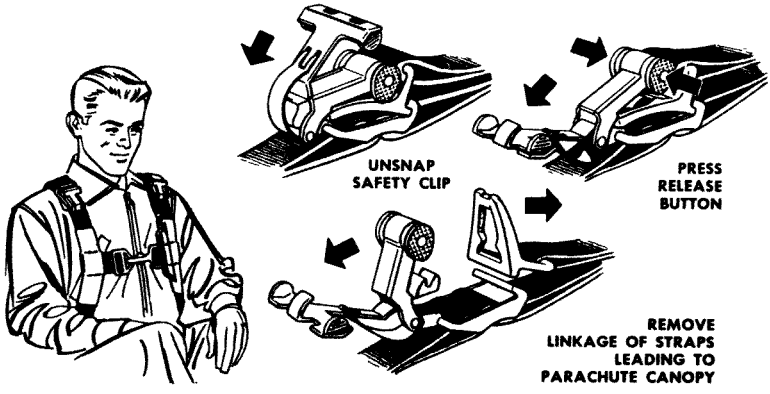


Figure B-4. Release mechanism on one type canopy release type harness.

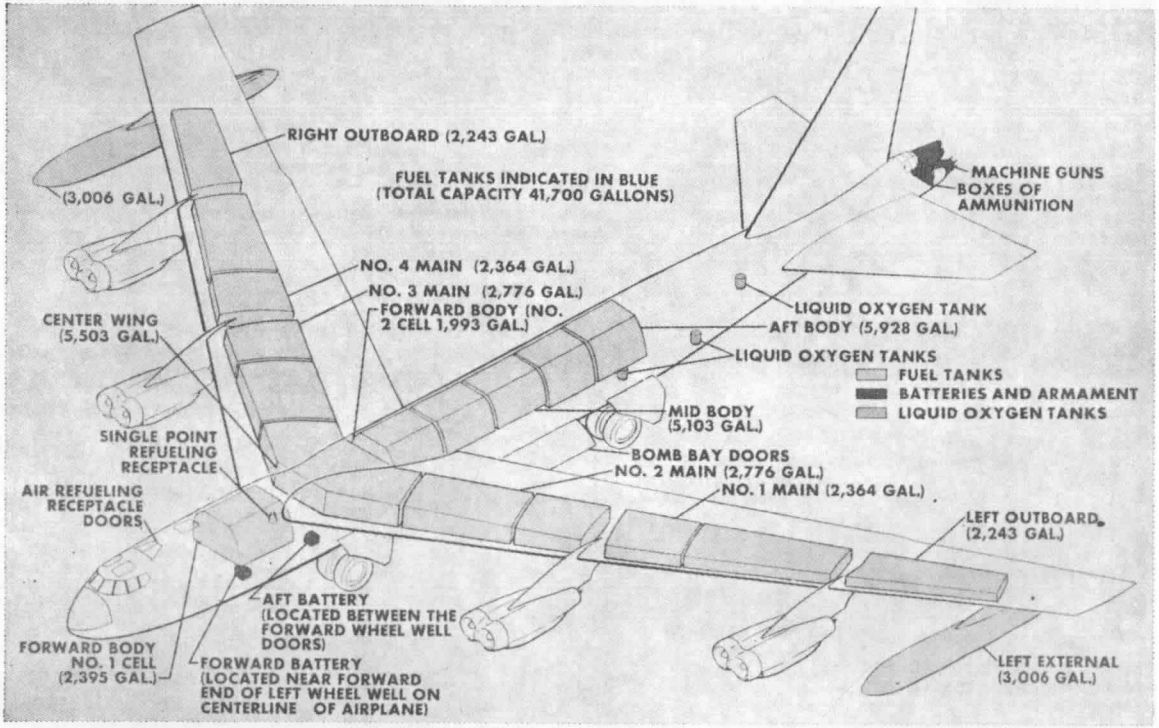


Figure B-5. The general arrangement of the B-52F aircraft is typical of the larger type USAF bomber type aircraft.

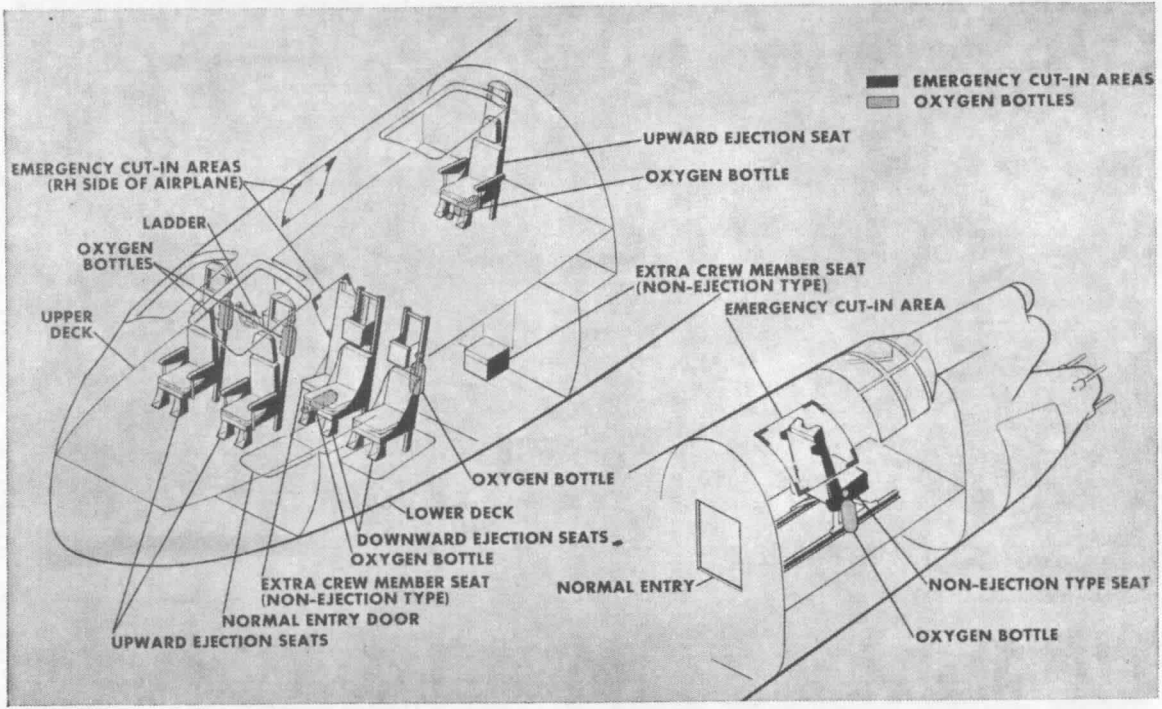


Figure B-6. Emergency entrance to crew compartments on the B-52F USAF bomber aircraft.

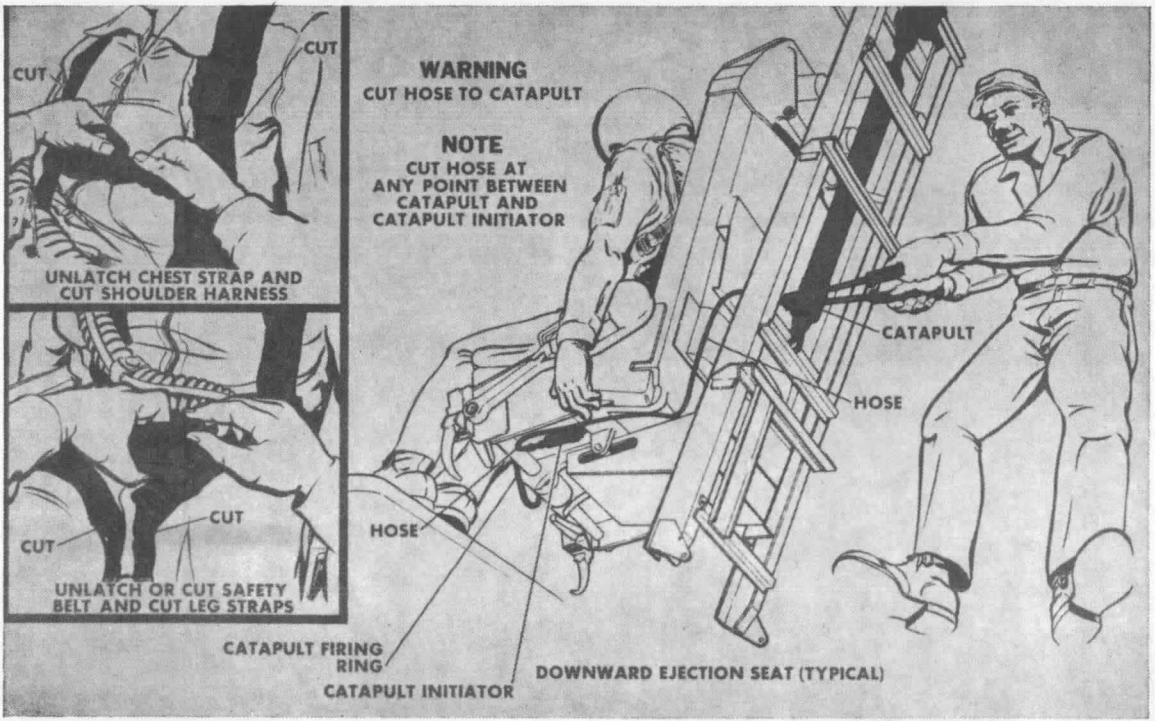


Figure B-7. Emergency rescue of B-52F crew members in downward ejection seats (typical).

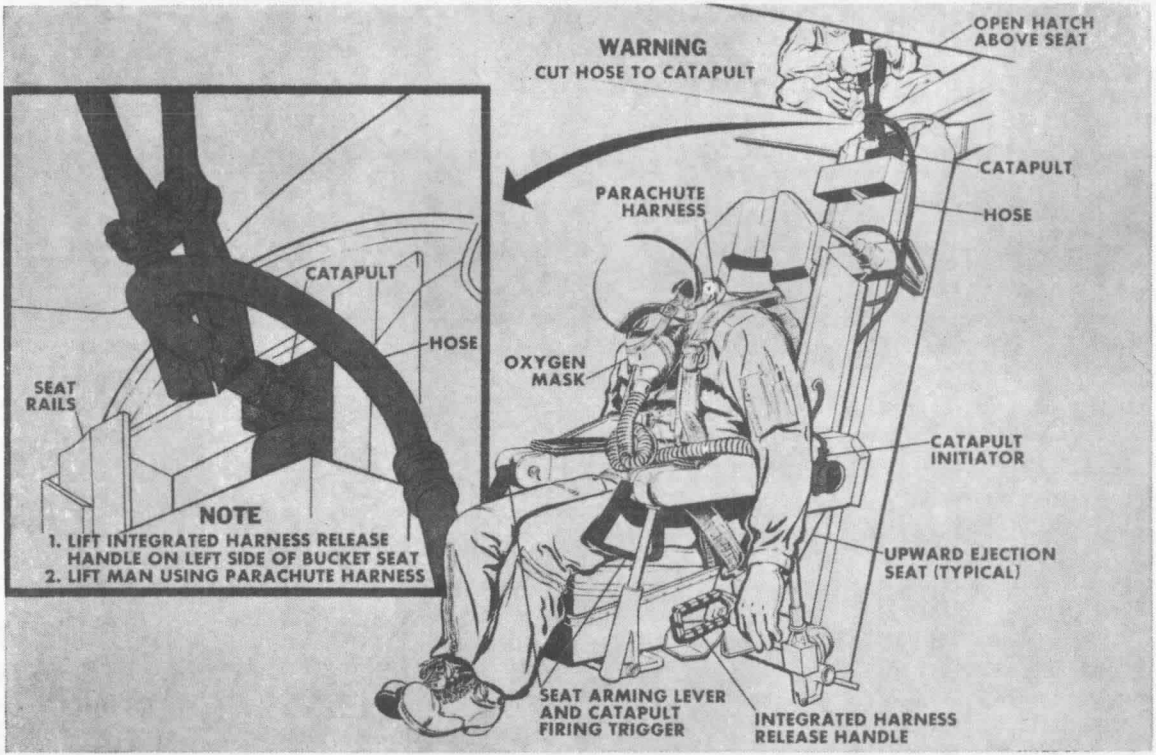


Figure B-8. Emergency rescue of B-52F crew members in upward ejection seats (typical).

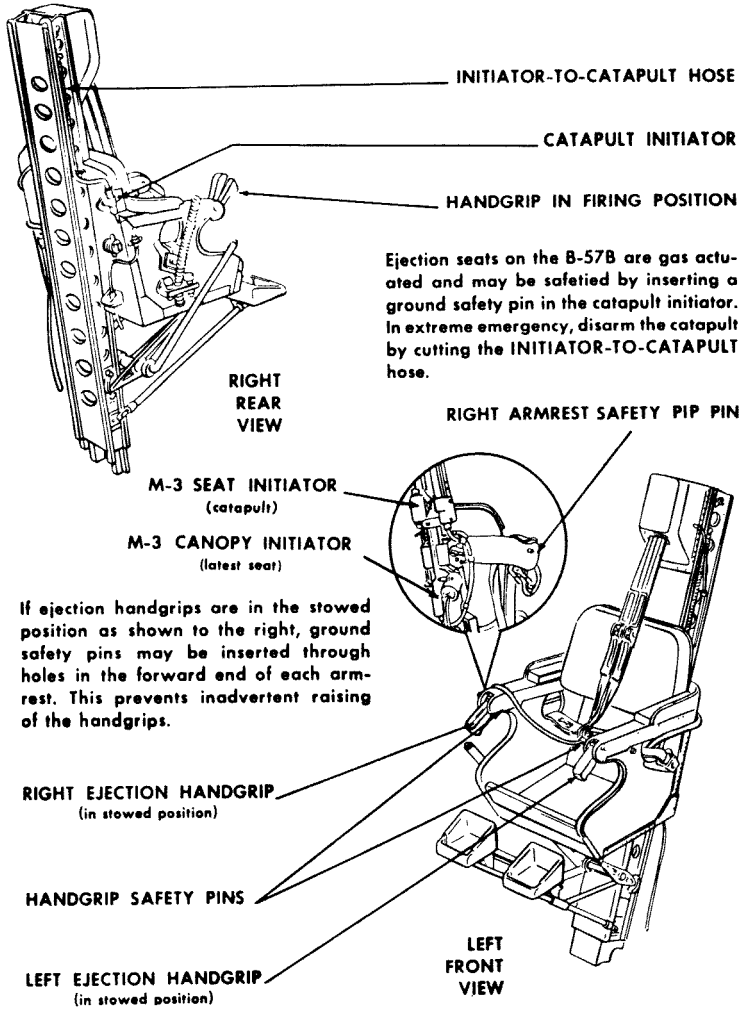


Figure B-9. Ejection seat of the B-57B type military aircraft shown as an example of operating principles and techniques to safeguard against unintentional operation during rescue operations. This seat is gas actuated and may be safetied by inserting a ground safety pin in the catapult initiator. Under severe fire conditions cut the initiator to catapult hose to disarm.

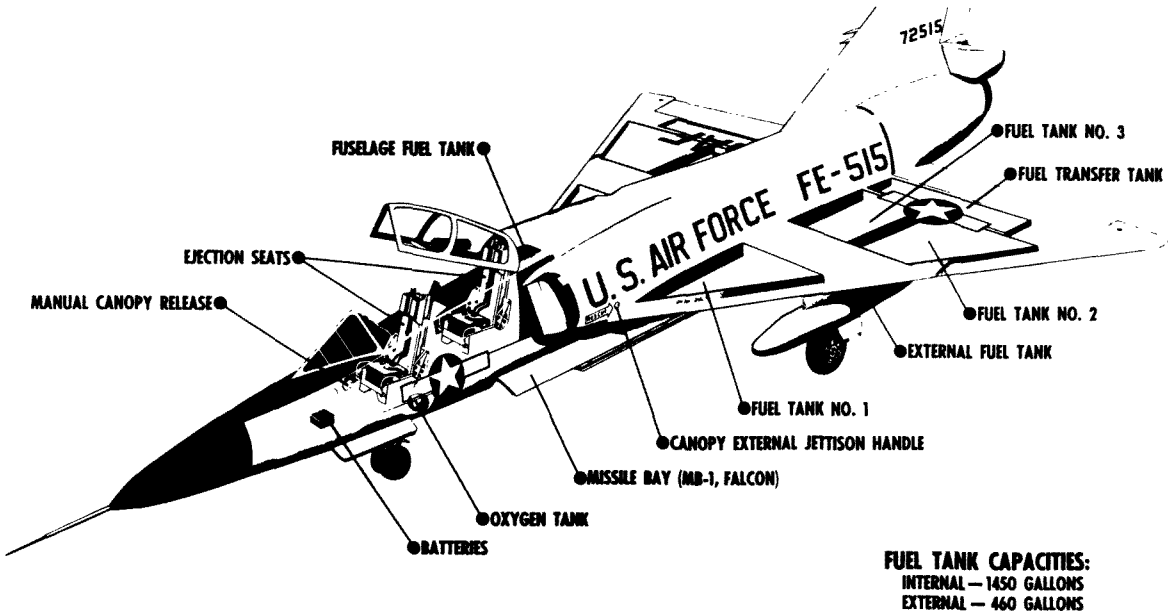


Figure B-10. This is the F-106B showing general arrangements of this modern USAF fighter aircraft.

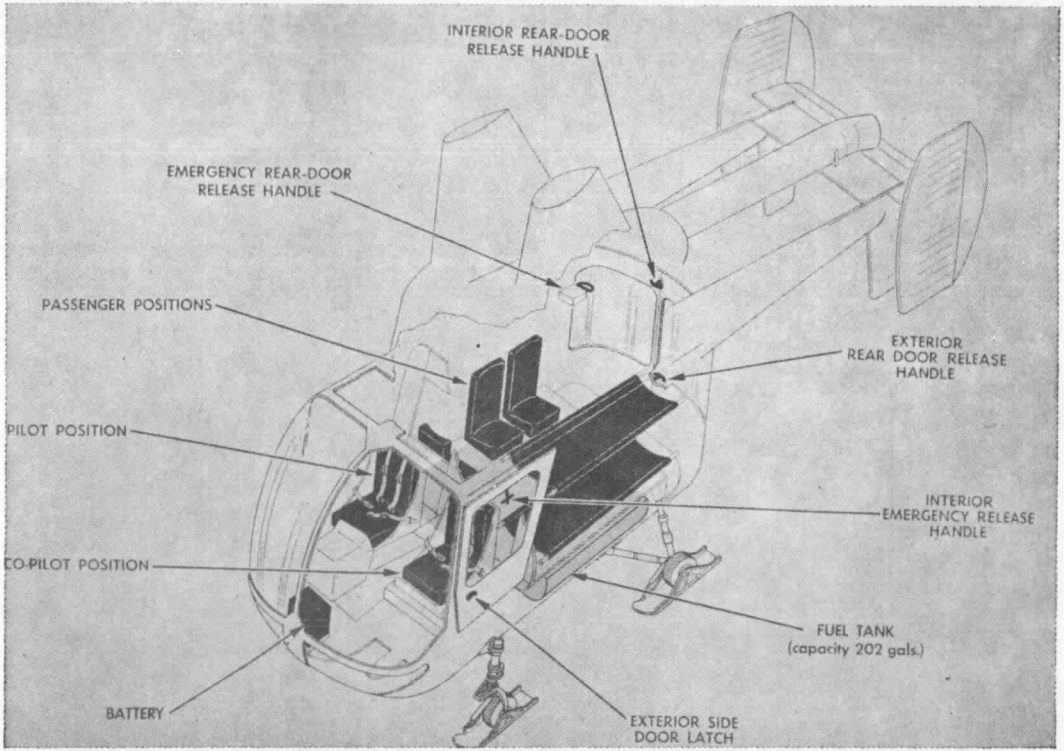


Figure B-11. The H-43B helicopter as operated by the USAF. Note that fuel tank is located under the passenger compartment over rear landing gear.

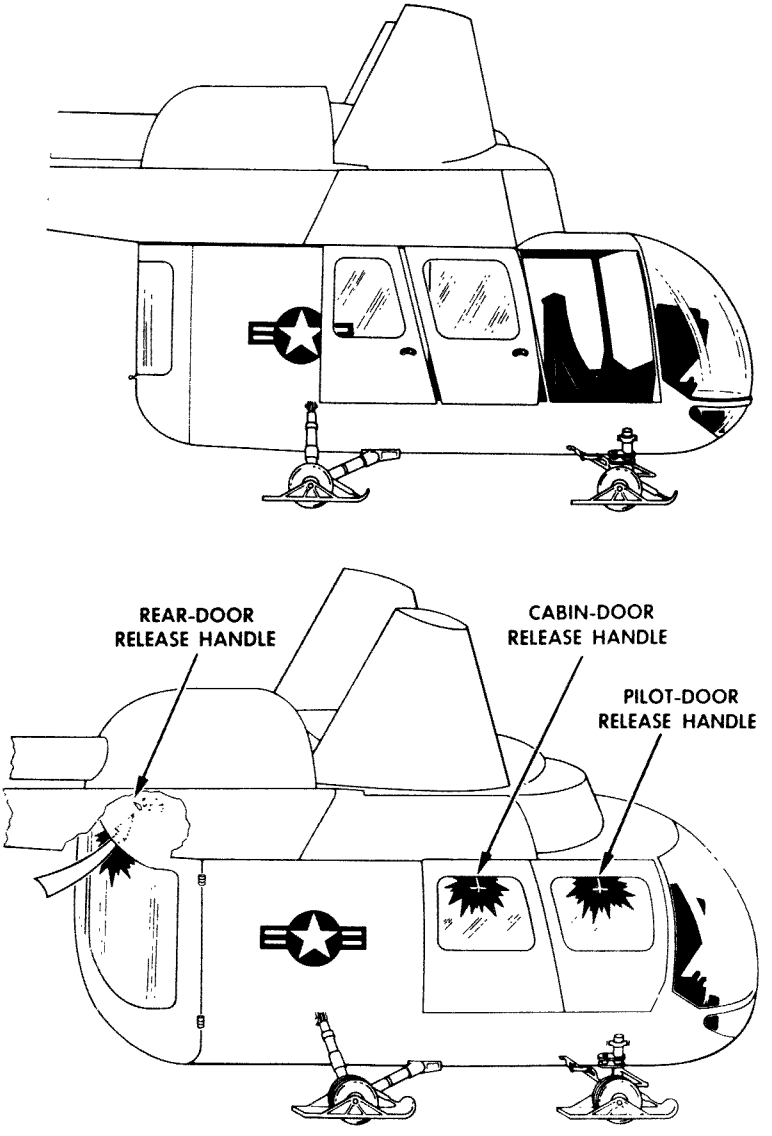


Figure B-12. Normal and emergency entrance into H-43B.

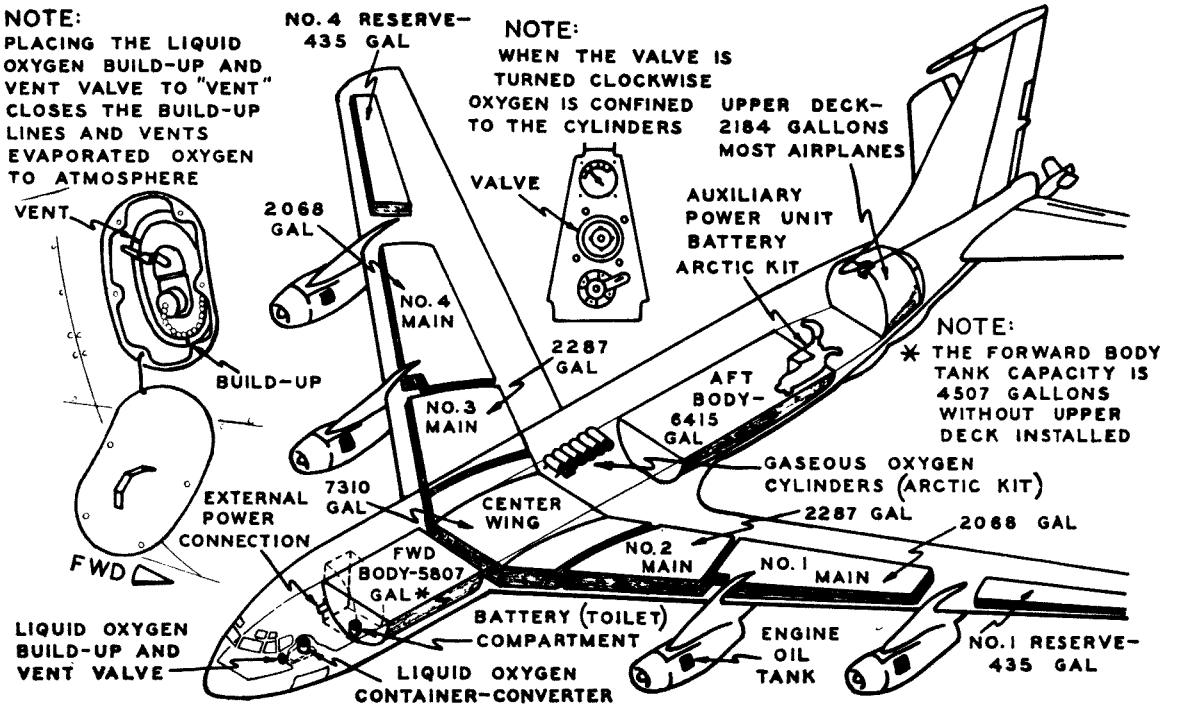


Figure B-13. The KC-135A aircraft "tanker" plane for mid-air refueling operations.

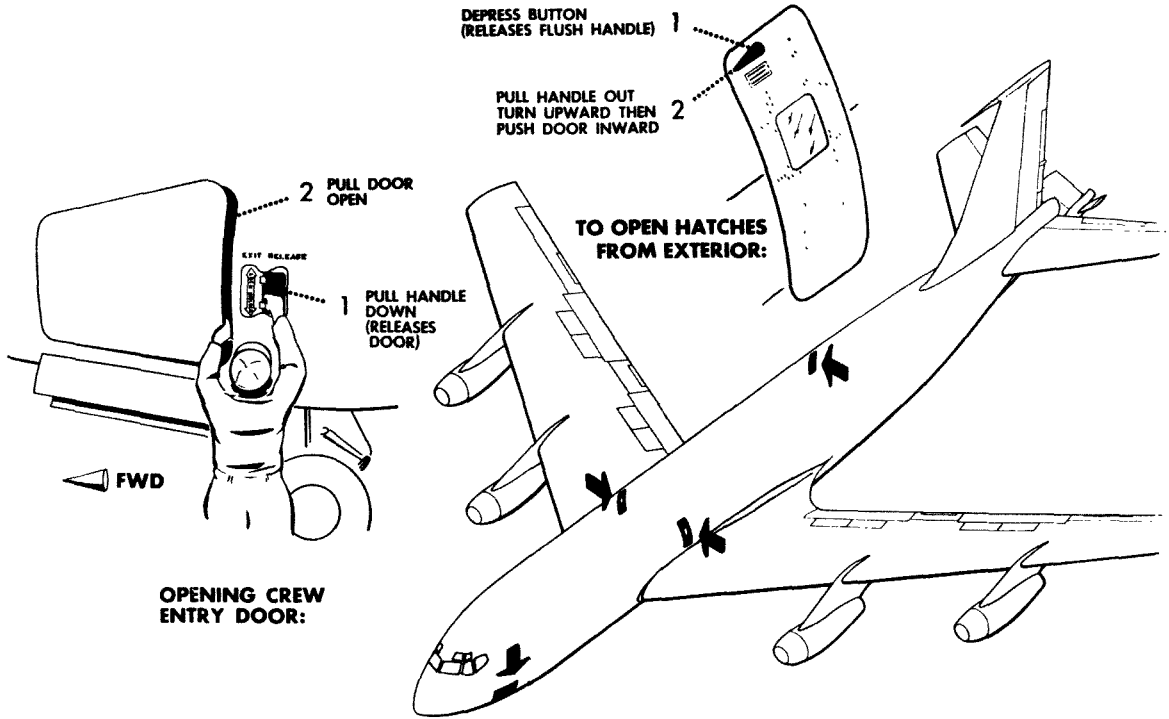


Figure B-14. Emergency entrances into the KC-135A crew positions.

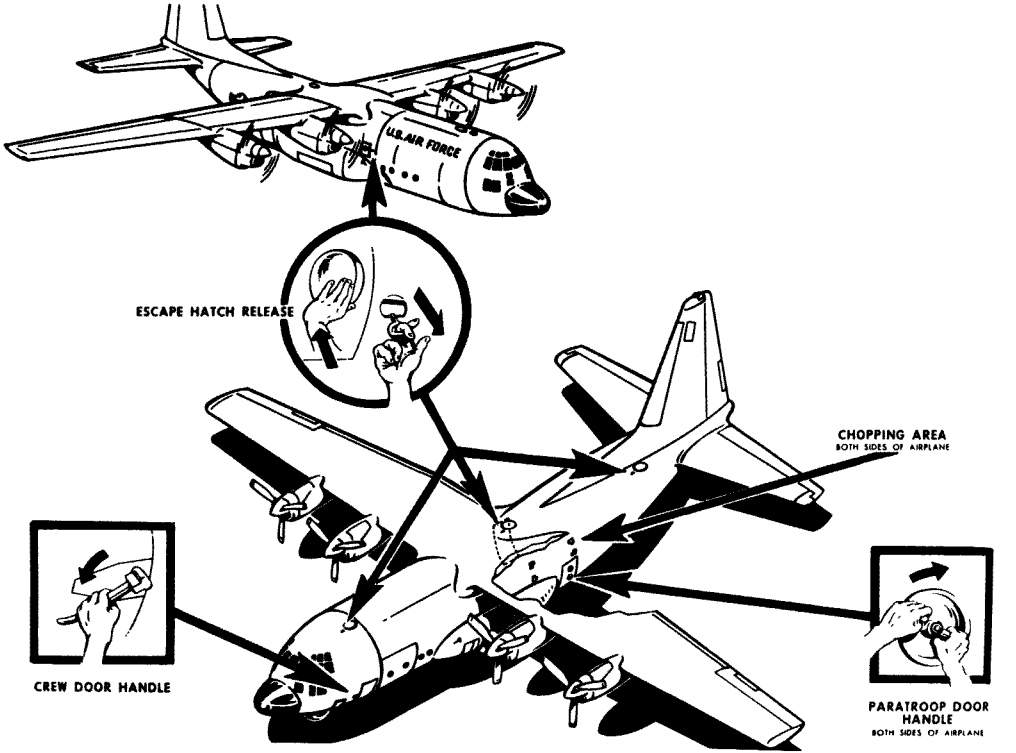


Figure B-15. Emergency entrance into the USAF C-130A troop transport.

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.

d. Remove injured from the area of the accident with as little contact as possible and hold them at a transfer

*In the U.S. an Official Air Transport Restricted Articles Tariff has been issued by the Airline Tariff Publishers Inc., 1000 Connecticut Ave., N.W., Washington, D. C. 20036. (Subscription price: $2.50 annual). Code of Federal Regulations, Title 14, Part 103 on Transportation of Dangerous Articles and Magnetized Materials is issued by the Federal Aviation Agency. 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" (Section 19) for a discussion of radiation hazards, available from the NFPA for $17.50 a copy (2216 pages) and "Radiation Control" by A. A. Keil, also published by the NFPA ($4.75 a copy, 256 pages).

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 (see Appendix B).

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.

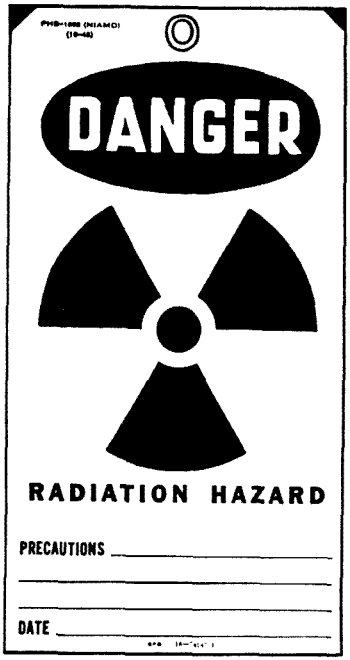
(1) Radiological. In the event of a high explosive detonation or burning of a weapon, one has to concern himself principally with Alpha-emitting contamination which is serious only when ingested. Other types of radiation, which are harmless at the low levels produced in a weapon, may be detected with 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.

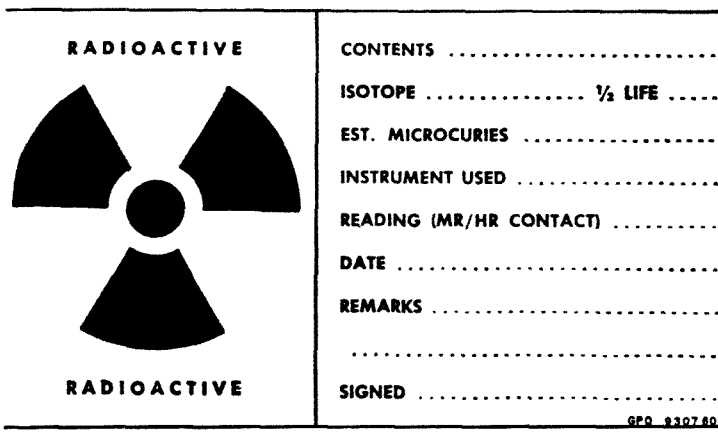


← Left

An Atomic Energy Commission (USA) Radiation Symbol. The tag has a yellow background with the printing purple in color.

Below

An Atomic Energy Commission (USA) Radioactive Materials Symbol which is applied to packages containing materials of this type. The tag has a yellow background with the printing purple in color.



Above

Radioactive Materials for hazardous cargoes shipped by air use this Symbol for Group I or Group II Materials.* The label is diamond shaped 4 inches square, and has red printing on a white label. The use of this Symbol is international.

Below

This label is used for Radioactive Materials Group III internationally. It is diamond shaped 4 inches by 4 inches, with blue printing on white.**

*Group I Radioactive Materials emit gamma rays only or both gamma and electrically charged corpuscular rays. Group II Radioactive Materials emit neutrons and either or both the types of radiation characteristic of Group I Materials. The external radiation emanating from shipping containers is required to be maintained at safe limits. The maximum allowable radiation from the surface of a container is 200 milliroentgens per hour. The Atomic Energy Commission reports that 95 per cent of the shipments have an exterior radiation level of 15 milliroentgens per hour or less. It is unlikely that any hazard would exist where the shipping container is intact.

**Group III Radioactive Materials emit electrically charged corpuscular rays only; i.e., Alpha or Beta, etc., or any other that is so shielded that the gamma radiation at the surface of the package does not exceed 10 milliroentgens for 24 hours at any time during transportation. These materials present a radiation hazard only when the shipping container is broken or damaged. It is unlikely that any hazard would exist where the shipping container is intact.

Appendix D

Civil Aircraft Accident Investigation

D-10. Civil aircraft accident investigation is normally conducted by a number of investigators interested in establishing the probable cause. Federal or State governments are usually charged with the official responsibility but the operators, pilot groups, airport management, and others may be active in accident investigation work. Fire officials normally make their own investigation and most use the NFPA Aircraft Fire Report form to guide them in their study of the fire factors involved (see NFPA No. 403 for reproduction of this form) and cooperating agencies send one copy of this form to the Association to aid in the international study conducted by the NFPA in this field.

D-11. It is the duty of firemen to extinguish fires and to protect property and life from fires. No person, including the owner of the property or any governmental regulatory authority, has the right to interfere with or hinder a fireman in the performance of his duty and a fireman has the right to resort to any reasonable measures, including force, necessary to enable him to perform his duties as a fireman. In aircraft accidents where investigation of cause is most important, efforts consistent with the duty described above may involve moving parts and operating controls. When this is done, firemen should be prepared to subsequently advise responsible investigative authorities of the actions they took in carrying out their rescue, fire control, or fire prevention responsibilities which may be of importance in the accident investigation work.

D-12. In the United States, the Federal Aviation Act of 1958, as amended, Title VII Aircraft Accident Investigation, states in Section 701(d):

> "Any civil aircraft, aircraft engine, propeller, or appliance affected by, or involved in, an accident in air commerce, shall be preserved in accordance with, and shall not be moved except in accordance with, regulations prescribed by the Board."

The "Board" referred to is the Civil Aeronautics Board, Washington, D. C. The CAB's Safety Investigation Regulations, Part 320, Sections 320.15 through 320.17 read:

"PRESERVATION OF WRECKAGE AND RECORDS. Aircraft wreckage and records thereof involved in or pertaining to an aircraft accident shall be preserved for the Board by the operator."

"PROHIBITION AGAINST REMOVING OR DISTURBING WRECKAGE AND RECORDS. Aircraft wreckage or records thereof involved in or pertaining to an aircraft accident shall not be disturbed or removed, unless specific permission is granted by an authorized representative of the Civil Aeronautics Board, except where necessary (a) to give assistance to persons injured or trapped therein, (b) to protect such wreckage from further serious damage, or (c) to protect the public from injury."

"RECORDING OF ORIGINAL POSITION AND CONDITION OF WRECKAGE. Whenever wreckage is moved in accordance with the provisions of Section 320.16, prior to the removal, sketches or photographs shall be made of the original position and condition of the wreckage and marks on the ground, and any pertinent data which cannot be effectively photographed shall be recorded, unless the resultant delay would endanger the lives of persons injured or trapped, or unless essential public interest can be protected only by immediate movement. In any event, movement of the wreckage shall be so accomplished as to entail the minimum possible disturbance thereof, and shall be preserved in accordance with the provisions of Section 320.15."