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CIVIL AVIATION AUTHORITY OF THE PHILIPPINES

Advisory Circular

AC 139 – RFFS - 01

GUIDELINES FOR THE DEVELOPMENT OF AN RFFS TRAINING PROGRAMME FOR AERODROMES

February 2017

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CAAP will generally accept that when the provisions of an Advisory Circular have been met, compliance with the relevant regulatory obligations has been satisfied.

Where an AC is referred to in a "Note" within regulatory documentation, the AC remains as a guidance material.

ACs should always be read in conjunction with the referenced regulations.

1. PURPOSE

This Advisory Circular (AC) provides guidance and reference materials for the development of an RFFS Training Programme.

2. APPLICATION

The material contained in this AC is applicable for use on all categories of civil aerodromes except where otherwise specified. The guidance contained in this AC is recommended to be used for aircraft Rescue and Firefighting Training Programs.

3. REFERENCES:

3.1 Civil Aviation Regulations - Aerodromes.
3.2 Manual of Standards for Aerodromes (MOS)
3.3 ICAO Annex 14
3.4 ICAO Airport Services Manual Doc 9137:
- Part 1: Rescue and Fire Fighting (4th Edition)

4. REQUIREMENTS FOR AERODROMES

The CAR-Aerodromes requires that:

"All RFFS personnel shall be trained to perform their duties in an efficient manner and shall participate in live fire drills commensurate with the types of aircraft and types of rescue and firefighting equipment in use at the aerodrome, including pressure-fed fires. The RFFS training shall include training in human performance and team co-ordination"

The Manual of Standards for Aerodromes - Chapter 14, Section 14.1.2 also specifies that:

"*The most important factors bearing on an effective intervention in a survivable aircraft accident are the training received, the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and firefighting purposes can be put to use."*

The recommendations in this AC comprise a method for meeting this provision. The minimum requirements for a training program are listed below. These recommendations are not intended as proficiency standards for airport fire fighters, but are provided to assist the airport operators in establishing an adequate training program. However, proficiency is the key to a successful RFFS training program. The number of hours of training will vary from individual to individual. We recommend that, as a minimum, no less than 40 hours of annual recurrent training be accomplished for each RFFS personnel.

Initial training is defined as that training provided to a new employee to enable him/her to identify and interpret advanced theories, facts, concepts, principles, requirements, procedures, equipment, and components of RFFS as applied to the aircraft serving the airport and to demonstrate all required tasks safely and accurately and in accordance with established procedures while functioning independently.

Recurrent training is defined as that training provided to an employee as often as necessary but not less than 12 consecutive calendar months to enable him/her to maintain a satisfactory level of proficiency. Appropriate frequencies for recurrent training will vary widely from airport to airport and from one employee to another. Training in several areas will require coordination with airlines and other organizations on the local airport.

4.1 General

Personnel whose duties consist solely of the provision of RFFS for aircraft operations are infrequently called upon to face a serious situation involving lifesaving at a major aircraft fire. They will experience a few incidents and a larger number of standbys to cover movements of aircraft in circumstances where the possibility of an accident may reasonably be anticipated but will seldom be called upon to put their knowledge and experience to the test. It follows, therefore, that only by means of a most carefully planned and rigorously followed programme of training can there be any assurance that both personnel and equipment will be capable in dealing with a major aircraft fire should the necessity arise.

The core (initial) training programme can be organized into nine faculties as follows:

a) fire dynamics, toxicity and basic first aid;

b) extinguishing agents and firefighting techniques;

c) handling of vehicles, vessels and equipment;

d) airfield layout and aircraft construction;

e) operational tactics and manoeuvres;

f) emergency communication;

g) leadership performance;

h) physical fitness; and

i) auxiliary modules (e.g. rescue in difficult terrain, response to biological/chemical threats, etc.).

The core training curriculum should include initial and recurrent instruction. The scope of instruction should vary with the degree of intelligence of the trainees. In most cases the simpler this form of instruction is kept, the more successful it is likely to be. In no case should enthusiasm, engendered by the interest value of the subject, be allowed to carry the instruction beyond its practical application. Nevertheless, the officer responsible for the training programme must endeavor to maintain the interest and enthusiasm of the crew at all times. In certain respects this will not be too difficult. There are many factors affecting RFF procedures at an aircraft accident which may be anticipated, staged, and practiced so that the officer has an opportunity of sustaining the interest indefinitely. Each new type of aircraft brings with it new problems which must be assessed and incorporated in the training programme. As certain routine aspects of training may become less interesting over a long period, it is therefore essential that the officer ensure each crew member realizes the need for such training. For example, it is a fundamental practice in the RFF service that each crew member, when on duty, be satisfied that the equipment which may be used is serviceable. This particular aspect of a crew member's duty could deteriorate after a long period of comparative inaction unless that person is really convinced of the importance of this task.

The entire training programme must be designed to ensure that both personnel and equipment are at all times fully efficient. This represents a very high standard of achievement but anything less than full efficiency is unacceptable and may be dangerous both to those in need of aid and also to those who are seeking to give such aid. In addition, the training programme must also be designed to build cohesiveness between key functional units of an RFF team in order to deliver a consistent level of proficiency during emergencies. To ensure a high standard of operational readiness, RFF services should develop a competency audit framework to assess the effectiveness of RFF training at both individual and team levels.

4.2 Core Training Programme

4.2.1 Fire Dynamics, Toxicity and First Aid

All RFF personnel should have a general knowledge of the cause of fire, the factors contributing to the spread of fire and the principles of fire extinction. Only when armed with this knowledge can they be expected to react effectively when confronted with a serious fire situation. It must be known, for instance, that certain types of fire require a cooling agent while others need a blanketing or smothering action. RFF training should also touch on the toxicity of thermal decomposition products. This will enable firefighters to better understand the importance and limitations of their protective equipment. In doing so, firefighters will avoid a false sense of security and take extra precautions when leading the occupants of the aircraft through a dangerous atmosphere. In addition, every member of the rescue team should, if at all possible, be trained and periodically recertified in basic medical first aid, as a minimum. The prime reason for this qualification is to ensure that casualties are well handled so as to avoid the infliction of additional suffering and/or injury in the removal of the occupants from a crashed aircraft.

4.2.2 Extinguishing Agents and Firefighting Techniques

It is essential that a thorough knowledge should be acquired of the agents employed. In particular, every opportunity should be taken to practice the application of agents on fires in order to understand by experience not only the virtues but also the limitations of each agent. Each occasion of a routine equipment test should be used for a training exercise in the proper handling of equipment and the correct application of the particular agent involved. The combination of routine test procedures with training periods will minimize the costs involved in the discharge of extinguishing agents.

To carry out fire suppression at different phases of combustion, RFF personnel should be well versed in three types of extinguishment.

1) Direct straight stream firefighting method using a straight stream or solid hose stream to deliver water directly onto the base of the fire.
2) Indirect firefighting method; used in situations where the temperature is increasing and it appears that the cabin or fire area is ready to flash over. Attack is made from small fuselage openings such as slightly opened exits or openings made in cabin windows. An indirect method is based on the conversion of water spray into steam as it contacts the super-heated atmosphere. Firefighters direct the stream in short bursts of water at the ceiling to cool super-heated gases in the upper levels of the cabin or compartment. This method can prevent or delay flashover and allow the firefighters time to apply a direct stream to the base or seat of the fire.
3) the three-dimensional method is deployed in the event that the fire is fuel fed, as in the case of an engine fire. Firefighter one directs semi-fog at the fire while firefighter two discharges a dry chemical or clean agent into the semi-fog stream starting at ground level and moving upward to the source of the fire. In cases of deep-seated aircraft fires, penetrating nozzles could be used. Penetrating nozzles could be in the form of vehicle turrets (monitors) or handlines capable of injecting extinguishing agents that provide wide angle coverage.

4.2.3 Handling of Vehicles, Vessels and Equipment

All RFF personnel must be capable of handling their vehicles, vessels, and equipment, not only under drill- ground conditions, but also in rapidly changing circumstances. The aim must always be to ensure that every individual is so well versed in the handling of all types of vehicles, vessels, and equipment that, under emergency conditions, operation of these mission-critical resources will be automatic, leaving capacity to deal with unexpected scenarios. This can be accomplished in the initial stage of training by employing the snap "change-round" technique during standard drills, and later by training involving the use of two or more fire vehicles simultaneously. Particular attention should be paid to pump operations, high-reach extendable turrets, and other specialized rescue equipment. RFF crew should also be adequately trained in handling complex instrumental panels on board vehicles and vessels. This form of training is, of course, a continuing commitment.

Possessing in-depth knowledge of all vehicles, vessels, and equipment is essential in order to ensure thorough maintenance which is essential to guarantee operational efficiency under all circumstances. It is important that every firefighter be satisfied that any piece of equipment which may be used will work satisfactorily and, in the case of ancillary equipment, it is in its correct stowage position. The importance of correct stowage of small equipment to ensure that it can be instantly located cannot be over-stressed. Officers responsible for training are advised to hold periodic locker drills where individual crew members are required to produce a particular item immediately. All vehicles, vessels, and equipment must be regularly tested or inspected and records must be maintained of the circumstances and results of each test.

4.2.4 Airfield Layout and Aircraft Construction

A thorough knowledge of the airport and its immediate vicinity is essential. To counter the effects of complacency, it is recommended that vehicle operators practice mental mapping techniques to supplement routine on-site familiarization. The training programme should encompass those areas of operations dealing with:

1) thorough familiarization of the movement area so vehicle drivers can demonstrate their ability to:

   a) select alternative routes to any point on the movement area when normal routes are blocked;
   b) know the existence of ground which may become from time to time impassable in any part of the area to be covered by the service;
   c) recognize landmarks which may be indistinctly seen;
   d) operate vehicles over all types of terrain during all kinds of weather.

The training programme may be conducted using vehicles other than the RFF vehicles provided they are radio controlled and have similar operating characteristics;

e) select the best routes to any point on the airport; and

f) use detailed grid maps as an aid in responding to an aircraft accident or incident; and

2) the use of guidance equipment when it is available. Normally air traffic control may be assistance in providing information on the location of the accident site and position of other aircraft or vehicles on the airport which may obstruct or impair vehicle movement.

The importance of this aspect of training cannot be over-emphasized. RFF personnel may be called upon to effect a rescue from an aircraft cabin in conditions of great stress working in an atmosphere heavily laden with smoke and fumes. If self-contained breathing apparatus is supplied, careful training in its use is essential. It is essential that every person have an intimate knowledge of all types of aircraft normally using the airport.

Appendix 1 provides an electronic link to the websites of the various aircraft manufacturers. The websites contain diagrams that provide, inter alia, general information on principles of rescue and firefighting procedures, as well as detailed information of concern to rescue and firefighting personnel on representative aircraft commonly used in the market. The knowledge cannot be acquired solely on a study of the diagrams. There is no substitute for a periodic inspection of the aircraft. Due to the complexity of modern aircraft and the variety of types in service, it is virtually impossible to train RFF personnel on all the important design features of each aircraft although they should become familiar with the types normally used at the airport. Priority training should be given to the largest passenger aircraft as it is likely to carry the highest number of occupants and incorporate unique features such as upper deck seating capacity. Information about the following design features is of special importance to RFF personnel to ensure effective use of their equipment:

a) location and operation of normal and emergency exits;

b) seating configuration;

c) type of fuel and location(s) of fuel tank(s);

d) location of batteries and isolation switches; and

e) position of break-in points on the aircraft.

As far as is practicable, RFF personnel should be allowed to operate the emergency exits and should certainly be fully conversant with the method of opening all the main doors. In general, the majority of the doors open forward. Some containing stairs will swing downwards and, on some wide-bodied aircraft, the doors retract into the ceiling area. Most large aircraft are fitted with inflatable emergency evacuation slides affixed to cabin doors and large emergency exit windows. If the emergency evacuation slides are not automatically disengaged, or if the system equipment malfunctions, the slides may become inflated when the exit is opened. The doors of large aircraft are normally operated from the inside. There are occasions, however, when responding RFF personnel may have to open doors from the outside of the aircraft to gain access to the cabin interior. In view of the variables noted above, the opening of the normal and emergency exits may be hazardous for the airport firefighter if the appropriate cautionary measures are not taken. For example, it is hazardous to open armed aircraft doors if the firefighter is standing on a ladder or to rest the ladder against the door to be opened.

Aircraft operators and flight crew members should be requested to cooperate to the fullest extent in arranging inspection by RFF personnel the different types of aircraft using the airport. An elementary knowledge of aircraft construction is highly desirable since such knowledge is invaluable if, as a last resort, forcible entry is necessary. The cooperation of the appropriate staff of the airline operators should be sought on this aspect of training.

All aircraft carry small portable fire extinguishers that could be of use to rescuers. Extinguishers containing carbon dioxide, a halon agent or water are usually located on the flight deck, in galleys and at other points within the cabin. All extinguisher positions are indicated and the extinguisher body normally carries a label stating the type of fire for which its contents are suitable. 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.

4.2.5 Operational Tactics and Maneuvers

When personnel are well versed in the handling of firefighting equipment they should receive training in operational tactics to be adopted at aircraft fires. This training is a continuing commitment and must be absorbed to the point where compliance with the initial action called for is instinctive, in the same sense that hose-running to a well-trained regular firefighter is automatic and will therefore follow even when working under stress. Only when this is achieved will the officer-in-charge be in a position to assume complete control of the situation. Operational tactics training is designed to deploy personnel and equipment to advantage in order to establish conditions in which aircraft occupants may be rescued from an aircraft which is involved in, or liable to become involved in, fire. The objective is to isolate the fuselage from the fire, cool the fuselage, establish and maintain an escape route and achieve the degree of fire control necessary to permit rescue operations to proceed. This is fundamental and must be stressed in the training programme. The service to be provided is primarily a lifesaving organization, one, however, that must be trained in firefighting because aircraft involved in a serious accident are frequently involved in fire. The firefighting operations must be directed to those measures which are necessary to permit rescue to be carried out until all the occupants of the aircraft are accounted for. This includes precautionary measures at those incidents where no fire has broken out. When the life-saving commitment has been met it is necessary, of course, to utilize all available resources to secure protection of property.

The main attack on the fire should usually be by means of mass application of foam in an endeavor to achieve maximum cooling and the rapid suppression of the fire. Since, however, foam, like every other agent, has limitations, a suitable back-up agent must be available to deal with those pockets of fire which are inaccessible to direct foam application. This will generally be provided in the form of dry chemical powder. The use of these should be confined to running liquid fuel fires, fires in enclosed spaces such as wing voids, or for dealing with a special fire such as a fire in an engine nacelle or undercarriage well.

Points which should be covered in the operational tactics training programme are described below.

The Approach. Equipment should approach the accident site by way of the fastest route in order to reach the site in the shortest possible time. This is quite frequently not the shortest route because, in general, it is preferable, where possible, to travel on a man-made surface than to approach over rough ground or grassland. The essence is to ensure that RFF vehicles get there and are not subjected to unnecessary hazards en route. When nearing the scene of the accident a careful watch must be maintained for occupants who may be dashing away from the aircraft or who may have been flung clear and are lying injured in the approaches. This applies particularly at night and calls for competent use of spot or search lights.

Positioning of equipment. The positioning of equipment both from the airport and from any supporting local fire department is important in many respects and regard should be given to several factors. Correct positioning of equipment must permit the equipment operator an overall view of the fire area. The equipment must not be placed in a position of hazard due to fuel spills or ground slope or wind direction. It must not be positioned too close to the fire or to other equipment and thus restrict working space (this applies particularly to foam tenders and their attendant auxiliary water tenders). Other factors which should be taken into account are the location of aircraft occupants relative to the fire, the impact of wind, fire, locations of personnel and fuel tanks and the location of emergency exits.

In certain circumstances, it may be advantageous to leave the equipment on hard standing, though this may mean an additional length of fire hose. More time can be lost attempting to reach a closer position to the fire by negotiating rough ground than would be taken to run an additional length of fire hose. Moreover, if parked on hard standing the equipment is capable of being moved rapidly if conditions demand. Aircraft accidents frequently occur in circumstances where equipment cannot be positioned in the immediate vicinity. Consequently, it is recommended that all firefighting and rescue equipment should be designed so that it can be brought to bear at some distance from the parent equipment. Operational tactics training can do much to reduce the problems of positioning equipment, can be conducted at very little cost and should be performed frequently to develop acceptable practices. For this particular phase of operational tactics training, it is not always necessary to produce water or foam; it is an example of how “dry drills” can help to raise efficiency standards.

In order to achieve the main initial objective of isolating and cooling the fuselage and to safeguard the escape route, it is evident that the positioning of foam streams is of the utmost importance. The number of streams available will vary with the type and the scope of the equipment provided.

Foam streams should be positioned as close as possible to the fuselage, the initial discharge being directed along the line of the fuselage and then directed to drive the fire outwards. When selecting the ideal position for the stream it should always be remembered that the wind has considerable influence upon the rate of fire and heat travel. The position should be chosen with this in mind, thus utilizing the wind, wherever possible, to assist in the main objective. Except in exceptional circumstances, foam streams should not be directed along the line of the wind towards the fuselage as this may tend to flush free fuel into the danger area. Similarly, care must be exercised to avoid the possibility of one stream disturbing the foam blanket laid down by another stream.

There are two basic methods of applying foam. One is to use a long straight stream to allow fall on the desired area. The other is to apply a diffused stream at close range. Often foam can be applied to a fire area by deflecting it from another surface such as the contour of the fuselage or main plane. Whenever foam, dry chemical powder, or other complementary agent equipment is being subjected to a periodic routine check, the opportunity should be taken to train emergency crew members in the methods of application. It is important that this be carried out on a fire so that each person will obtain an assessment of the value as well as the limitations, of each agent so applied, and be familiar with the heat conditions that will be experienced. These drills should be carried out at intervals of not more than one month. Increasingly, firefighting equipment is designed to provide high output through monitor/turrets to deal with accidents involving the largest aircraft currently in service. Monitor/turret operators must be highly skilled in the application of foam to be able to avoid wastage, through misdirection of aim, to know when to change from straight stream to diffused stream, and to readily appreciate how to avoid damage or injury to others by the potential force of the foam stream.

It is vital that the RFF fleet maneuvers in a coordinated formation and concentrate foam streams at areas where large numbers of passengers may be trapped. With precision maneuvers, continuous mass application of foam will be met with the least wastage. For this reason, officers responsible for training should decide which particular pattern of equipment positioning is best suited to their available resources and then take steps to train crew members in its positioning and layout. At a fire there is little time for individual briefing of crew members and the initial layout may well be adjusted to cope with the existing circumstances, but it is necessary for the crew members to know exactly what their first action should be well in advance through a predetermined tactical plan as dictated by the circumstances. It should always be remembered that this layout of equipment should be standard practice at an aircraft accident even when fire has not broken out and that at least one monitor/turret should be staffed and in readiness to go into instant action should the occasion arise.

The main objective of the firefighting activity must be to extinguish the fire and secure it against re-ignition in the shortest possible time. It is also pertinent that RFF crew maintain a good sense of situational awareness at all times during an emergency. This demands skill, teamwork and understanding by all those involved. The first responding fire vehicle may carry agents which can achieve some rapid knockdown of an area of the fire, but this will in most cases require the early support of any other vehicle to continue the effort and secure the entire area against re-ignition and to promote the necessary cooling effect in the vicinity of the passenger compartment. The entire effort must be concentrated on this area since the misapplication of foam or other agents is wasteful and could mean the difference between the success and failure of the operation. Where foam production through a monitor/turret is undertaken with the vehicle in motion (i.e. pump and roll mode), considerable skill is required to achieve maximum effect.

Great care must be exercised by monitor operators in the application of foam in straight streams in the vicinity of escape slides deployed from the aircraft. RFF personnel must also anticipate that evacuating occupants may become distressed and disoriented by the presence of dry chemical powder clouds or by the impact of foam streams and should therefore conduct their operations so as to minimize these effects.

The training programme should provide instruction in search procedures, not only in enclosed spaces of an aircraft, but also in procedures for systematic searching of the area in the immediate vicinity of an aircraft accident and also in the path of the aircraft. As a broad principle, it should be taught that the persons involved in a fire are most frequently found near an exit, i.e. doors and windows, or will have sought shelter, however inadequate in lavatories and lockers, etc. Rescue is always best effected by way of a normal channel, if available. For example, it is easier to carry a person through a doorway than to manipulate that person through a window. The main cabin door of an aircraft should always be attempted first. Should the door be jammed, it will usually be quicker to force it by applying leverage at the right spot than to achieve entry and rescue through another form of opening. Success in this form of operation requires a full knowledge of the locking mechanism and direction of travel of the door concerned. Only when everything else has failed should forcible entry be attempted. External markings are now provided on many aircraft showing suitable points at which entry can be made.

Pressurized cabins will offer tough resistance to penetration by forcible entry tools, although entry can be made by a person well trained in the use of such tools and possessing a working knowledge of aircraft construction. The practice of providing power-operated saws and other similar forms of forcible entry tools on all airports normally handling these types of aircraft has increased. All operational staff should be trained in rescue procedures. The working space inside a cabin is somewhat restricted and it will generally be found advisable to limit the number of rescuers working inside the aircraft and to work on a chain principle. Where possible, the airport emergency plan should provide for the availability of staff other than RFF personnel, for the handling of casualties from the moment they are removed from the aircraft. All rescue staff should be trained in lifting and carrying casualties, and other forms of rescue.

4.2.6 Emergency Communication

Emergency communication refers to the information flow between various responding agencies during an emergency. Accurate and relevant information provides the RFF crew with shared real-time knowledge. This in turn empowers RFF teams to plan or initiate rescue efforts in an integrated manner. To ensure swift and accurate transmission of information, it is stressed that RFF staff be adequately trained in operating the primary and secondary communication systems installed at the fire stations and in fire vehicles/vessels. Equally important, RFF personnel should learn to converse succinctly using appropriate telephony language. RFF personnel should also be trained to communicate with the flight crew through internationally accepted ground-to-aircraft hand signals.

4.2.7 Leadership Performance

The leadership qualities exhibited by an RFF team commander often determines the outcome in an emergency response. The commander leads and motivates the staff in achieving peak performance under a challenging operating environment. In this regard, a robust leadership training programme should be instituted to better prepare RFF leaders in assuming command during crises.

4.2.8 Physical Fitness

During protracted rescue operations, the ability of RFF personnel to perform strenuous activities over an extended period of time influences the overall operational effectiveness. Therefore, firefighters must be aerobically and anaerobically fit to withstand the rigors of a variety of operations. Clearly, physical fitness training requirements should be designed to be commensurate with the equivalent fitness intensity generated in the performance of RFF operations, which include the use of breathing apparatus, hand-lines, ladders, heavy equipment and other associated rescue operations such as casualty handling.

4.2.9 Auxiliary Modules

Depending on the aerodrome operating environment, it may be necessary for RFF crew to be trained in dealing with difficult environments such as water rescue and handling biological/chemical threats. While RFF services should continue to strengthen their core capabilities, it is worthwhile to explore and train beyond the immediate operational responsibilities to deal with unexpected contingencies at or in the vicinity of the airport.

4.3 Additional Training

a) If the airport emergency plan calls for fire fighters to respond to special situations, such as water or treetop rescue, training specific to such situations should be provided.
b) If a Surface Movement Guidance and Control System (SMGCS) plan is in place at the airport, training specific to operations in low visibility should be provided.
c) Fire fighters should also receive training in recognition of aircraft ballistic parachute systems during emergency operations. (I.e. joint training with Philippine Air Force).

4.3.1. Live-Fire Drills

All rescue and firefighting personnel must participate in at least one live-fire drill every 12 months. This drill must include a pit fire with an aircraft mock-up or similar device, using enough fuel to provide a fire intensity that simulates realistic firefighting conditions. The conditions would simulate the type of fire that could be encountered on a scheduled aircraft at the airport. It is intended that the drill provide an opportunity for the firefighting team to become familiar with the use of all fire extinguishment equipment they will use in the event of an accident. If possible, a simulated rescue of aircraft occupants will help in creating a realistic simulation. During the drill, each fire fighter must demonstrate the following:

(a) the control and extinguishment of a simulated aircraft fire using handlines and turrets, given an airport-type foam firefighting vehicle. The decision to train on handlines or turret should be based on whether the trainee is assigned a handlines or whether the trainee is a driver/operator who would normally operate the turrets. Many training programs may have all the participants working the handlines, and it would be acceptable for the driver/operator to meet the annual requirement in this fashion. However, it would not be acceptable for a handlines firefighter to use training on the turrets to meet the annual requirement;

(b) the control and extinguishment of a simulated aircraft fire using handlines and turrets, given each type, other than foam-type, firefighting vehicle [see (a) above for guidance on acceptability of handlines and turret operation]; and

(c) using fire streams to protect fire fighters and aircraft occupants, given an airport firefighting vehicle.

4.3.2 First Aid

At least one person trained and current in basic emergency medical care must be on duty during air carrier operations. In this context, on duty does not mean that the emergency medical person be one of the regular RFFS personnel, but that there must be some assured means of having the individual available within a reasonable response time. This training must include 40 hours covering at least the following areas:

(1) Bleeding;
(2) Cardiopulmonary resuscitation;
(3) Shock;
(4) Primary patient survey;
(5) Injuries to the skull, spine, chest, and extremities;
(6) Internal injuries;

(7) Moving patients;
(8) Burns; and
(9) Triage.

4.3.3 Hands-On Training

It is highly recommended that fire fighters receive hands-on training on the aircraft that regularly serve their airport. Such a feat is very difficult unless there are aircraft that remain overnight or there is an aircraft maintenance facility on the airport. Where such hands-on training is not feasible, it is recommended that RFFS crews be given access to aircraft schematics and to computer-based training that are available in the commercial market.

5. HUMAN FACTORS PRINCIPLES

5.1 General

The subject of human factors is about people. It is about people in their working and living environments. It is about their relationship with equipment, procedures and the environment. Just as importantly, it is about their relationships with other people. Human Factors involve the overall performance of human beings within the aviation system; it seeks to optimize people's performance through the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.

Human Factors is essentially a multidisciplinary field, including but not limited to: psychology; engineering; physiology; sociology; and anthropometry. Indeed, it is this multidisciplinary nature and the overlapping of the constituent disciplines that make a comprehensive definition of Human Factors difficult.

5.2 The Software, Hardware, Environment and Liveware (Shel) Model

Human factors specific to RFF services encompass a wide spectrum of activities, ranging from training and operations to station routine and audits. The study of human factors principles can be described as both an art and a science and must be associated with the entire range of RFF activities in order to achieve a higher level of professionalism, a higher state of operational effectiveness and a higher standard for safety.

The SHEL model (see Figure 18-1) provides a conceptual framework to help understand Human Factors. It illustrates the various constituents and the interfaces — or points of interaction — which comprise the subject. Human Factors elements can be divided into four basic conceptual categories:

a) Software: plans, procedures, documentation, etc.;
b) Hardware: machine, equipment, etc.;
c) Environment: internal (e.g. workplace), external (e.g. surroundings), etc.;
d) Liveware: the human factor.

Interactions between people and the other elements of the SHEL model are at the heart of Human Factors, which involve the interfaces between:

a) People and machines — "Liveware vs. Hardware";
b) People and procedures — "Liveware vs. Software";
c) People and colleagues — "Liveware vs. Liveware";
d) People and workplace — "Liveware vs. Environment";

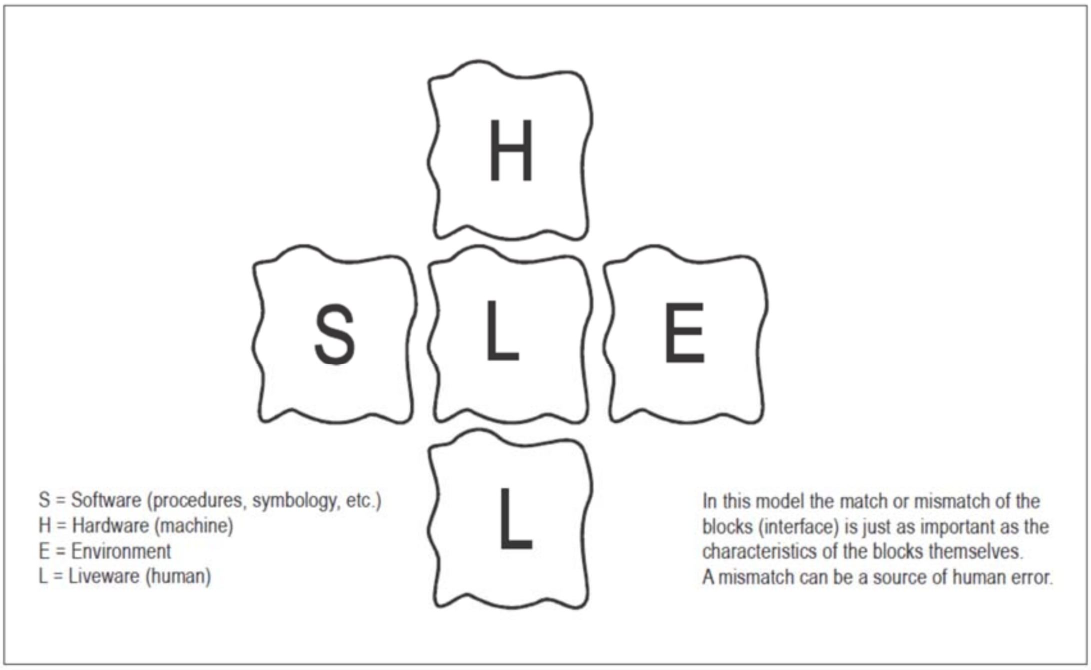


Figure 18-1. The SHEL model as modified by Hawkins

5.3 Human Factors Issues in RFF Services

A competent and professional RFF service must rely on a comprehensive and relevant set of training modules, coupled with an internal audit framework to regularly check the effectiveness and efficacy of these programmes. However, in the process of promulgating the training framework, one must not be overly fixated with the "hard" skills component of the training outcomes. Thought must be given to the "soft" human factor components during the promulgation and execution of the training programmes. Similarly, any assessment of the operational effectiveness of RFF personnel must take into account human factor principles such as team coordination.

Human factors principles are not only confined to the development of RFF training programmes; consideration must also be given to the formulation of drawer plans such as the aerodrome emergency plan and the unit tactical plans of the RFF service.

The application of human factor principles to RFF services can therefore be classified into two broad pillars as follows:

a) operational effectiveness and standards; and

b) safety and well-being of RFF personnel

5.4 Operational Effectiveness and Standards

As the success of any RFF operations relies very much on teamwork, the importance of building mutual trust and team coordination among staff during training cannot be overstressed (Liveware vs. Liveware). Training must therefore be designed to guide RFF personnel towards achieving these objectives.

In order for RFF training to be as realistic as possible, live fire training is crucial in helping RFF personnel acclimatize to a heated and smoke-filled environment (Liveware vs. Environment), so that in the event of an actual emergency, RFF personnel will be able to execute their tasks more confidently and effectively. Where possible, simulators replicating different facades of RFF operations (e.g. vehicle driving and operations; command and control, etc.) should be made available for RFF personnel to be trained in a controlled, safe and realistic environment.

RFF operations require firefighting personnel to be proficient in the operation of fire vehicles and other rescue equipment (Liveware vs. Hardware). This is crucial as it enables the RFF service to control any aircraft fires swiftly and effectively, in order to facilitate the evacuation and rescue of survivors. The airport fire vehicle is therefore an extremely vital asset that must be designed to take into account the human instinct and intuition of the vehicle operator. Therefore, RFF services must place sufficient emphasis on the design ergonomics of fire vehicles during the prefabrication stage in order to optimize human performance during training and operations.

The design of fire stations is another important factor that could affect the human performance of RFF personnel when responding to aircraft accidents or incidents (Liveware vs. Environment). This is especially relevant for large aerodromes which provide a high category of runway fire protection. Fire stations in such aerodromes are typically larger, thus requiring RFF personnel to travel a longer distance before reaching their fire vehicles. Such considerations must therefore be taken into account during the design phase of a fire station so that the RFF service is able to meet the stipulated response time in the event of an aircraft emergency.

Communication is possibly the most important human factor in RFF operations. Operational readiness and safety standards will be compromised without effective communication among RFF personnel, air traffic control and pilots. Therefore, the type of communications equipment and the transmission of messages must allow critical information to be conveyed, assimilated, processed and executed (Liveware vs. Hardware and Liveware vs. Liveware). Therefore, RFF training programmes must incorporate components to ensure the accurate and timely transmission of information to avoid miscommunication which could result in serious consequences.

It is obvious that any RFF service will need to be kept up-to-date with the constant development and innovation of more sophisticated rescue equipment and fire vehicles (Liveware vs. Hardware). It is equally important for RFF personnel to be well acquainted with the different configurations of various aircraft types operating at the particular aerodrome. Improving the knowledge of RFF personnel in these areas would indirectly enhance human performance during a response to any aircraft emergency.

The RFF industry is a highly specialized one which compels the management and leadership team of RFF services to promulgate a system of self-audit. Such systems must not only include the ratings and revalidation of individual standards. More importantly, as we recognize the importance of teamwork and team coordination in RFF operations, RFF services should place heavy emphasis on the collective performance of an RFF outfit during such an audit (Liveware vs. Liveware). The audit can then reveal observations and findings about the effects of human behavior on pre-stipulated procedures. Similarly, such audits can also highlight human reaction to any unforeseen circumstances in the form of disruptions during a unit proficiency test. Results from the audits can then be used to modify, tweak and improve training programmes in order to enhance human performance during RFF operations.

5.5 Safety and Well-being of RFFS Personnel

In the aftermath of an aircraft accident, it is often necessary to provide psychological treatment for the survivors. However, airport operators and RFF services must also not neglect the mental and psychological well-being of emergency responders such as RFF personnel who may suffer from post-traumatic stress disorders. Appropriate counselling of psychological therapy may need to be provided to RFF personnel who responded to such emergencies and who subsequently were not able to cope with the stress they faced thereafter. Such situations may arise from the gruesome sight of a crash scene making them unable to carry on with their normal lives. It will therefore be essential to also provide psychological treatment for RFF personnel after a major crisis (Liveware vs. Liveware) both from a welfare perspective and also from a business continuity standpoint. Such treatment and counselling can be provided by other RFF or airport personnel who have undergone the proper training, or more likely, by external medical institutions. Arrangements for the latter should then be formalized in the form of mutual aid agreements or can be incorporated into the airport emergency plan (Liveware vs Software).

The nature of the RFF job/role poses numerous potential hazards (Liveware vs. Environment). The risk of inhalation of carbon or smoke particles when extinguishing a fire, either during an incident or during training, is very high. Therefore, RFF services must provide all firefighters with the appropriate personal protective equipment (PPE) such as self-containing breathing apparatus (SCBA), helmets, boots, protective clothing, etc. In relation to day-to-day operations, the uniform worn by RFF personnel should also be of a suitable material depending on the local climate and conditions.

To ensure that RFF personnel are able to perform their roles effectively, thought needs to be put into designing an appropriate physical fitness programme to condition them for the physical rigors of the job (Liveware vs. Environment). In the process of designing any physical fitness programmes, due consideration must be given to individual human limitations. RFF management must also accept that not all personnel can perform at the same level of physical fitness standards. The key is to establish the minimum physical fitness requirements of a firefighter and design a programme that can best replicate these demands.

Noise is an important human factor (Liveware vs. Environment) that is omnipresent in an airport environment and cannot be ignored. Most fire stations are located within close proximity of the runway and aircraft movement areas, thus exposing RFF personnel to constant loud noises. Besides posing as disruptive interferences during the transmission of messages, long term and regular exposure to noise can have serious implications on one’s health (e.g. temporary, partial or permanent hearing loss). To address this issue, RFF services should issue and mandate the use of suitable hearing protection devices. In addition, personnel who are subjected to constant exposure to noise should be sent for regular noise induced deafness (NID) hearing tests.

Fatigue is one important factor that directly affects human performance and is greatly influenced by the shift system of RFF services (Liveware vs. Software). Besides the need to conform to local labor rules and regulations of individual States, there must be considerations to ensure that RFF personnel can have sufficient rest despite the need to be on 24-hour operational readiness at most airports.

A leader is an individual whose ideas and actions influence the thoughts and behaviors of others (Liveware vs. Liveware). Through the use of motivation and persuasion, and an understanding of the goals and desires of the team, the leader becomes an agent of change and influence. Skilled leadership may be needed to understand and handle various operational, training and administrative situations. For instance, personality clashes within a team complicate the task of a leader and can affect both safety and efficiency.

7. RELATED RULES

This Advisory Circular relates specifically to the requirements of Civil Aviation Regulations Governing Aerodromes (CAR-Aerodromes) Part 2.5.005 (3) Aerodrome Rescue and Fire Fighting Services.

8. ACKNOWLEDGEMENT

The AANSOO of the Civil Aviation Authority of the Philippines acknowledges the valuable information from the ICAO guidance materials from which this advisory circular is adopted.

9. CHANGE NOTICE

This is the initial issue.

10. COPIES OF THIS AC

The Regulatory Safety Standards Division of AANSOO makes ACs available to the public through the Internet. These ACs may be found through the CAAP home page (www.caap.gov.ph). A printed copy of this and other ACs can also be ordered from the Aerodrome and Air Navigation Safety Oversight Office (AANSOO), Civil Aviation Authority of the Philippines, MIA Road, Pasay City 1301, Telefax: (632) 944-2286.

End of Advisory Circular

CAPTAIN. JIM C. SYDIONGCO
Director General
Civil Aviation Authority of the Philippines
Date of Issue: 20 APR 2017

Appendix 1

INTRODUCTION

This appendix provides the following general information:

a) Principles of rescue and firefighting procedures — the purpose is to give rescue and firefighting personnel some of the essential information needed to permit them to assess the true nature of the specialized problems involved in performing effective aircraft rescue and firefighting operations. However, as the quantity of flammable liquids and combustible materials aboard an aircraft varies according to the aircraft model and the operations in which it is engaged, this material can provide only representative information. Personal inspections are necessary to appreciate the variations likely to be encountered in aircraft operations at a particular airport.

b) Principal fire hazard zones in aircraft — this includes simplified drawings of the principal fire hazard zones on aircraft.

c) Detailed information of concern to firefighting and rescue personnel on representative aircraft — information on the characteristics of commonly used aircraft and other relevant information can be found in the link below:

http://www.icao.int/safety/Pages/Rescue-Fire-Fighting.aspx

The table in the link above contains useful information for rescue and firefighting such as wingspan, fuselage length and width, overall length and maximum passenger capacity. To obtain further information about each aircraft model, including the crash charts, from their respective manufacturer, click on the corresponding hyperlink under the column “Aircraft Model”.

The websites of the various aircraft manufacturers contain diagrams that provide, inter alia, general information on principles of rescue and firefighting procedures, as well as detailed information of concern to rescue and firefighting personnel on representative aircraft commonly used in the market.

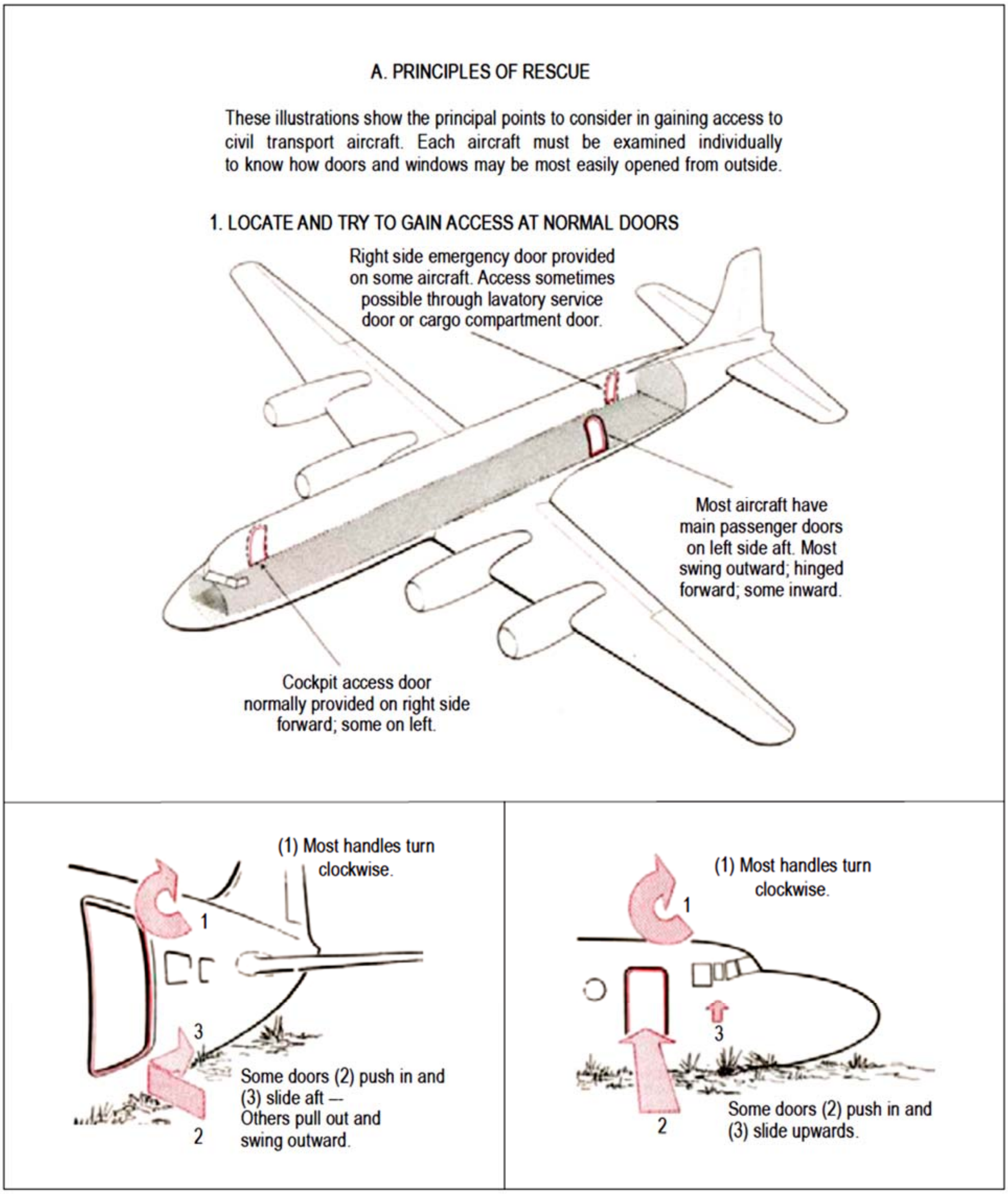


Figure App 1-1. Principles of rescue and firefighting

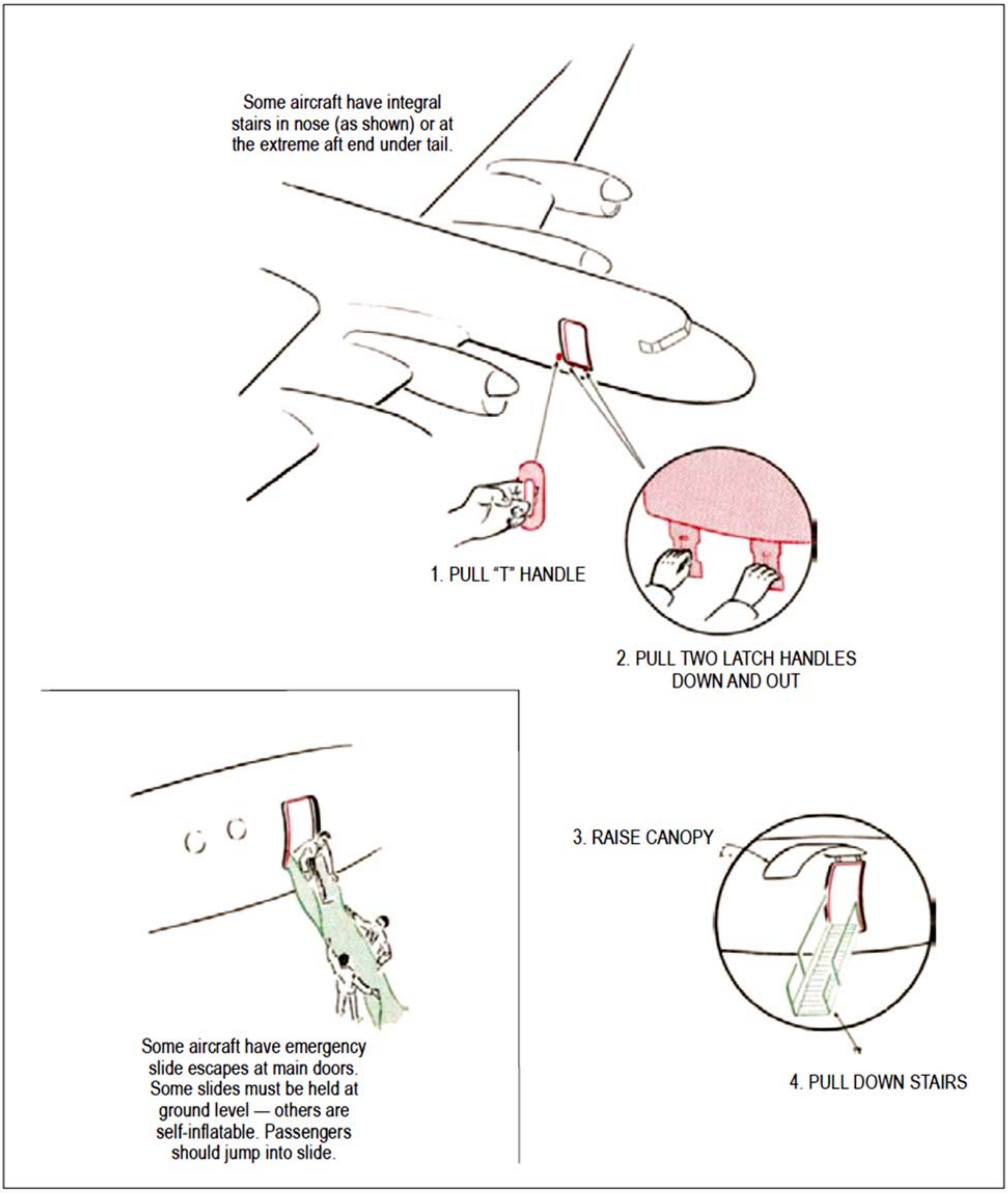


Figure App 1-1. Principles of rescue and firefighting (cont.)

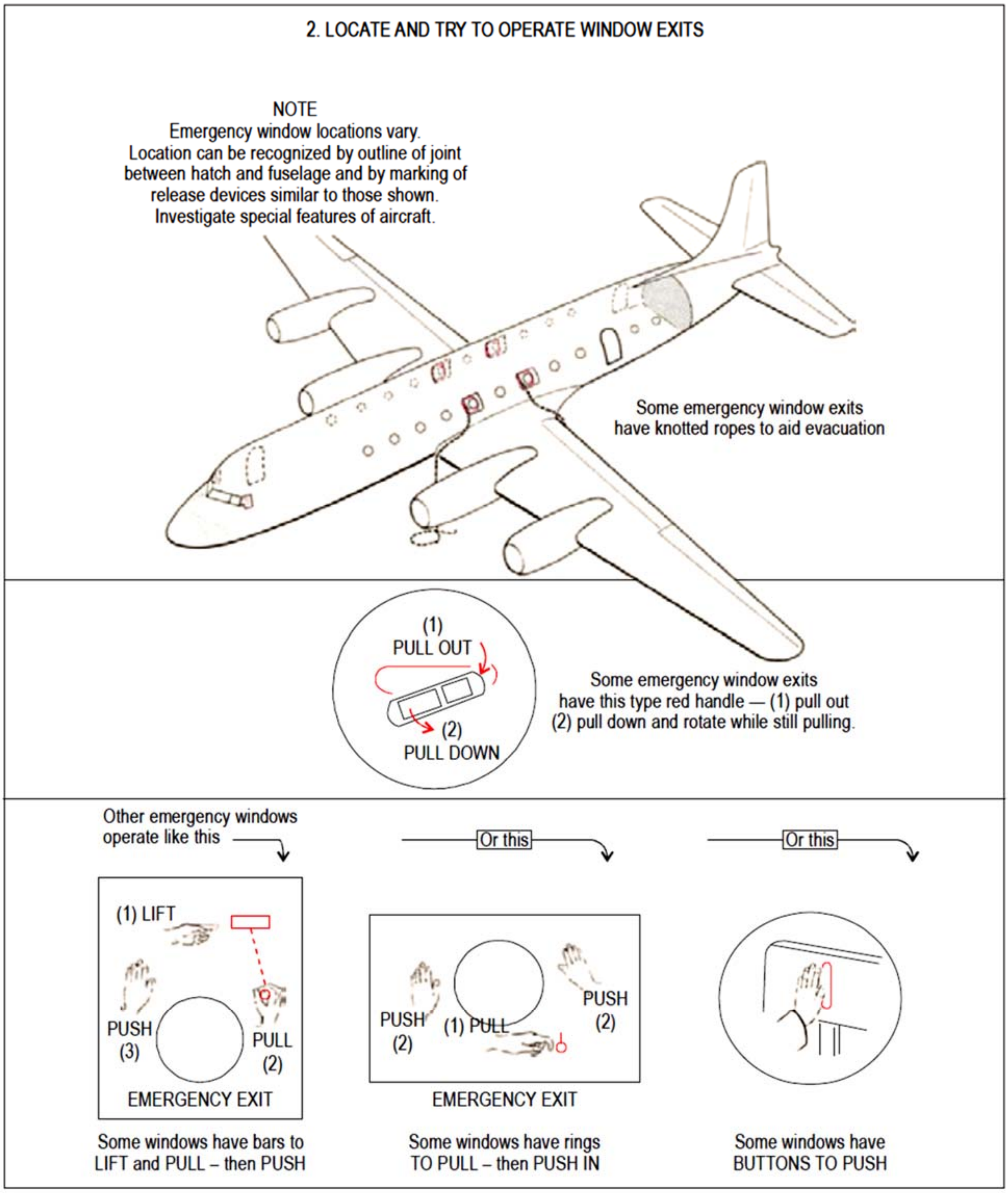
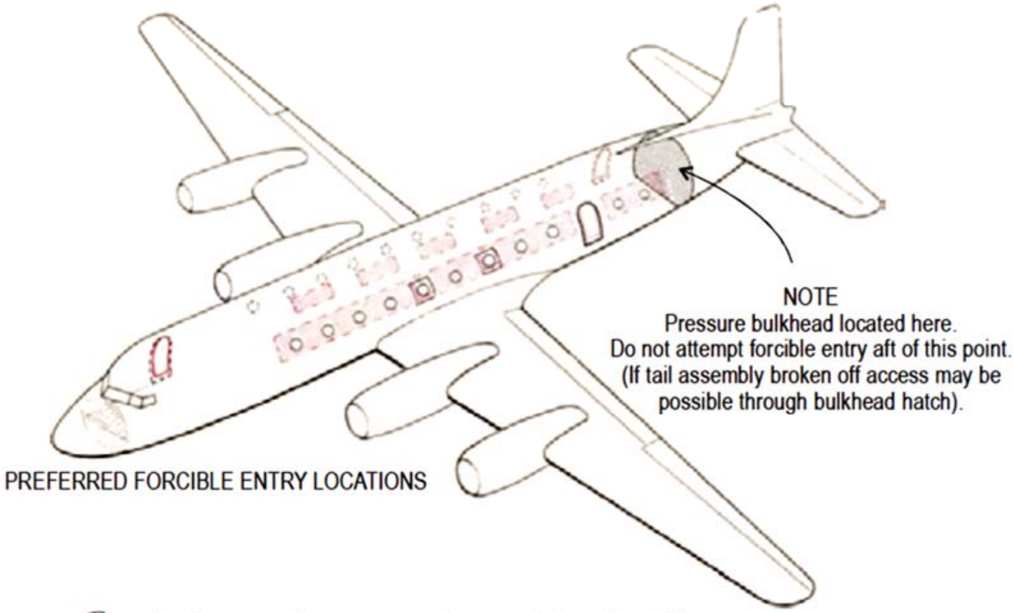


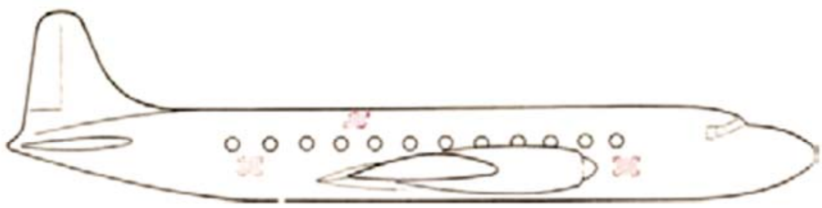
Figure App 1-1. Principles of rescue and firefighting (cont.)

3. AS LAST RESORT MAKE FORCIBLE ENTRY

These illustrations show reciprocating-engine aircraft. Forcible entry locations on modern turbine-powered transport aircraft are most difficult to cut into because of the thickness of the metals used, the extensive framing of the fuselage, the insulation, etc.



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 centre line of top fuselage section. Some aircraft have break-in points. Remember when cutting in, occupants may be exposed to injury from cutting tools. Other areas liable to be blocked by internal obstructions.

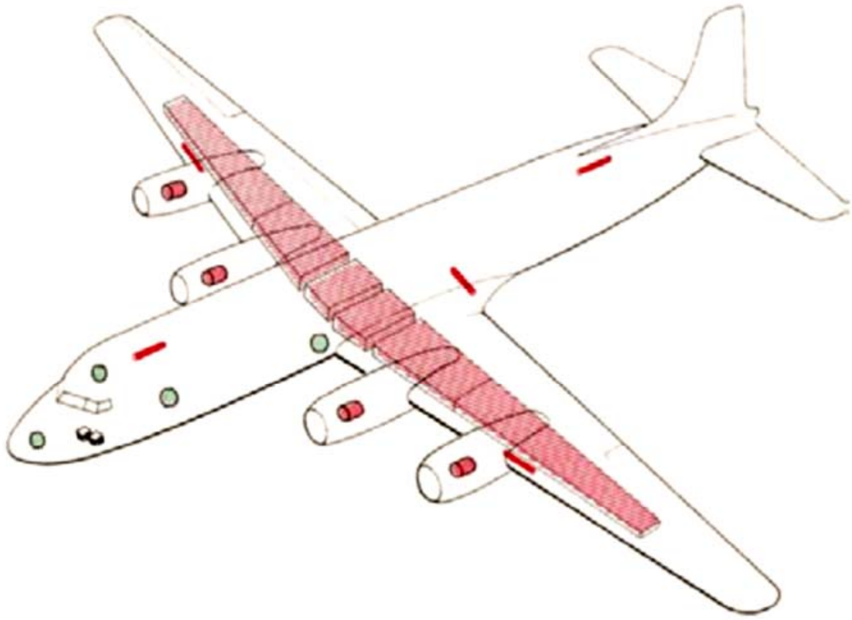


3. Saw or cut in at or break-in points. These points are marked with red or yellow corner markings, and, if necessary, are outlined in white to contrast with the background.

Figure App 1-1. Principles of rescue and firefighting (cont.)

B. PRINCIPAL FIRE HAZARD ZONES IN AIRCRAFT

This is a simplified drawing of the principal fire hazard zones on aircraft.



Fuel tanks normally in wings – some run through fuselage - others all outboard of inboard engines. Fuel tanks are interconnected and have cross-feed valves. Tank vents are normally at trailing edge of wing.

Oil tanks normally in nacelles behind engine firewall – some forward of firewall.

Batteries normally located forward as shown and marked on exterior – disconnect if no fire after crash. Some located in nose wheel well. Quick-disconnect fittings normally are provided.

Gasoline combustion heaters located in wings. Fuselage or tail (reciprocating-engine aircraft only).

Hydraulic fluid reservoirs located in fuselage forward or near wing root.

Figure App 1-1. Principles of rescue and firefighting (cont.)

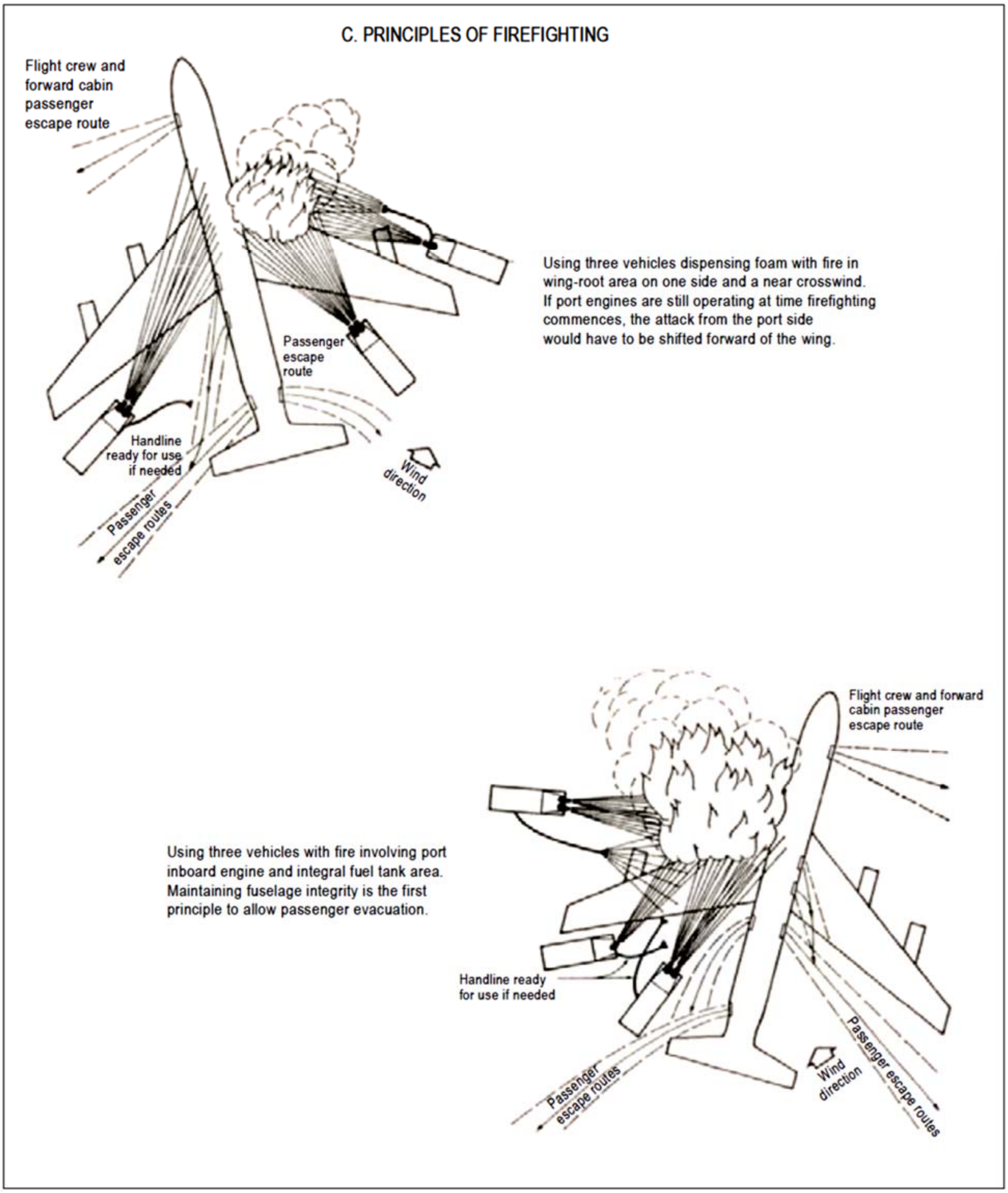


Figure App 1-1. Principles of rescue and firefighting (cont.)

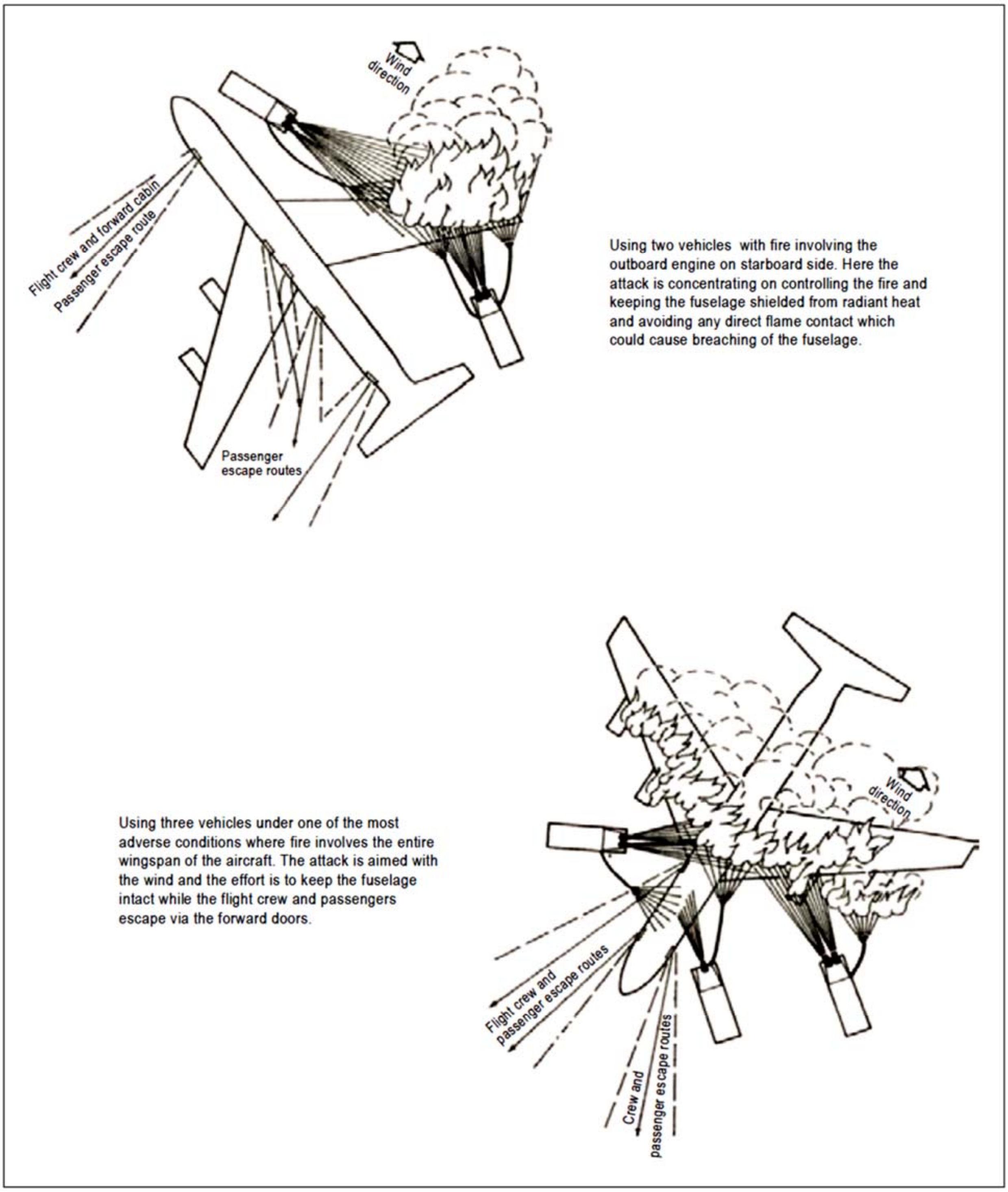


Figure App 1-1. Principles of rescue and firefighting (cont.)