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CRASH FIRE AND RESCUE EQUIPMENT AT AERODROMES

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I N T R O D U C T I O N

At the Third Session (1947) of the Aerodromes, Air Routes and Ground Aids Division of ICAO, a special working party of experts was appointed to prepare a paper on the subject of "Crash Fire and Rescue Equipment at Aerodromes". The Division considered this paper and expressed its appreciation of the speed and effectiveness of the work performed by the United Kingdom, United States and Canadian experts who made up the group.

The Division decided, however, that the stage had not yet been reached when International Standards or Recommended Practices on this subject could be recommended for adoption by the Council. It proposed instead that the paper referred to above, together with a bibliography of relevant technical papers procurable from various States, be issued as an ICAO Circular. The President of the ICAO Council, acting under special authority delegated to him by the Council, approved this recommendation.

In addition, the President approved the following recommendations which the Division made with a view to facilitating the development of International Standards and Recommended Practices on this subject at its 1949 session:

1. That the subject be further studied by Contracting States and by the Secretariat and that States be requested to supply ICAO with information on the subject for further study, as it becomes available and without being specifically requested so to do;
2. That the material submitted by Contracting States should include information relevant to the initiation and the progress of research or developmental work on the subject;
3. That the Secretariat be given the task of collecting, studying, and disseminating information and data relevant to the subject.

Action on the part of States working in collaboration with the Secretariat should greatly simplify the problem of developing / suitable Standards and Recommended Practices at the next session of the Division. All information and data received will be studied with a view to issuing further circulars on the subject.

CRASH FIRE AND RESCUE EQUIPMENT AT AERODROMES

General Considerations

1. Where aircraft are involved in accidents on or in the vicinity of the aerodrome, experience has shown that the most severe problems in rescue operations are encountered when fire occurs. The outstanding characteristic of aircraft crash fires is their tendency to reach lethal intensity within a very short time of the outbreak, and not only severely handicap rescue efforts, but present a severe hazard to the lives of those involved in the accidents and anyone attempting rescue. Fire is an ever present threat and occurs very frequently in aircraft accidents. Fire may occur immediately following an incident or at any time during rescue operations owing to the nature of the fuel involved, and the possibility of sparks being created through movement of the wreckage or disturbance of electric circuits.

2. The possibility of aircraft accidents is constantly present throughout the extent of air routes. The accident potential is greatest, however, at and near aerodromes. For this reason, the provision of special means to deal with incidents on and in the vicinity of aerodromes is of primary importance, as it is within such limits that there are the greatest opportunities of saving life.

The Responsible Authority

3. The responsibility for ensuring the provision of crash fire-fighting and rescue facilities at aerodromes should rest primarily upon the aerodrome management.

Considerations Affecting Measure of Protection to be Afforded

4. In deciding on the scale of equipment for crash, fire-fighting and rescue purposes, no regard should be had to the particular function for which the aircraft using that aerodrome

are employed, viz., whether for passenger carrying, freight carrying, or other form of aerial activity. The main objective is to save the lives of passengers and crew, and it may be necessary to effect complete control or extinction of the fire to ensure rescue from an aircraft or any particular part of it.

5. The potential extent of the fire in an aircraft is governed mainly by the quantity of fuel carried which varies, usually, in proportion to the gross weight of the aircraft. The load-carrying capacity of the aircraft, which will set limits to the extent of the rescue facilities required at a crash, has also a direct relationship to the gross weight of the aircraft.

6. The scale of crash, fire-fighting and rescue facilities should, therefore, be related to the largest type of aircraft normally using the aerodrome.

7. It is realized, however, that the cost of providing the suggested scales of crash fire and rescue facilities will be great and that in the case of remote aerodromes the cost may be materially increased. The scale of facilities actually provided may, therefore, have to be related to the revenue produced by the traffic using the aerodrome, and the overall requirements of the situation. On the other hand, conditions of traffic density or other factors, may require an increase in the scale of facilities to be afforded.

8. For the purpose of assessing the scale of crash, fire-fighting and rescue facilities to be provided at aerodromes, the following grading, based on the gross weight of aircraft normally or recurrently using those aerodromes, is suggested:

- Grade 1: Aircraft of over 200,000 lbs. gross weight.
- Grade 2: Aircraft of 100,000 lbs. and over, but less than 200,000 lbs. gross weight.
- Grade 3: Aircraft of 60,000 lbs. and over, but less than 100,000 lbs. gross weight.
- Grade 4: Aircraft of 25,000 lbs. and over, but less than 60,000 lbs. gross weight.
- Grade 5: Aircraft of 10,000 lbs. and over, but less than 25,000 lbs. gross weight.
- Grade 6: Aircraft less than 10,000 lbs. gross weight.

Extinguishing Media

9. In view of the lack of uniformity in the size and type of the crash and fire-fighting vehicles and appliances in use throughout the world, the scale of extinguishing media to be provided is most conveniently expressed in terms of volume and rate of production.

10. It is recognized that precise methods of operation, details of design, and techniques will vary with regard to crash, fire-fighting and rescue equipment. However, in order to establish a suitable minimum estimate of extinguishing media required for such purposes, it is necessary to consider certain basic principles of effective operation as established from actual experience. These may be summarized as follows:

a) Water used as water-fog, or otherwise, is the best universally available cooling agent for the control of fire and for protection from heat. However, except under very special conditions, the extinguishing ability of water on highly inflammable liquids is poor;

b) Introduction of foam to water-fog discharge increases the extinguishing quality of fog for such types of fires. However, for ultimate control of large aircraft fires, the use of foam in combination with a suitable inert gas is indicated, because this method produces more positive and permanent extinction;

c) Two or more compatible extinguishing agents must ordinarily be applied in combination, quickly and in large quantity, completely to effect rescue from, and control or extinction of, even relatively small aircraft fires;

d) Actual experience indicates that techniques involving rapid application of large quantities of a suitable quality of foam and an inert gas, such as carbon dioxide (CO₂) supplied from either high pressure or low pressure sources, are superior to other known methods for obtaining effective results.

11. The types and quantities of extinguishing media, detailed in Appendix A hereto, are based on the experience referred to in Paragraph 10, and are related to the particular requirements of civil aerodromes and aircraft. They are recommended as the minimum quantities to be held in readiness for instant operation to meet technical requirements without regard to economic or other factors (see Paragraph 6) at each grade of aerodrome.

Crash, Fire-Fighting and Rescue Vehicles

12. Vehicles must be provided for conveying the extinguishing media and equipment immediately and rapidly to an accident, and in the event of fire, for applying the media speedily and effectively. Vehicles used for this purpose should have the following characteristics:

- a) Full "cross-country" performance;
- b) High rate of acceleration with a cruising speed of not less than 45 miles per hour;
- c) Lowest possible centre of gravity compatible with adequate ground clearance;
- d) Minimum unit ground load;
- e) Simplicity of operation and maintenance;
- f) Adequate and convenient stowage for all equipment and appliances;
- g) Adequate two-way radio communication facilities as mentioned in Paragraph 21;
- h) Adequate lighting facilities for search and rescue operations and for illumination of the crash.
- i) Overall dimensions and gross weight of vehicles should be within practical limits having regard to the necessity for passage through gates, lanes, and over bridges, and to obviate the necessity for the provision of new housing accommodation.

13. The particular nature of the terrain in the vicinity of an aerodrome may necessitate the provision of special vehicles or equipment capable of reliable movement in the operating area. For instance in certain conditions, a fast highly manoeuvrable vehicle carrying a small proportion of the extinguishing media may be of advantage for quick reserve operation.

Static Water Tanks and Water Mains

14. The availability of a sufficient quantity of water for crash, fire-fighting and rescue purposes, from water supply services along aprons and in front of administration and service areas, is most desirable. Furthermore, the extension of such supplies to strategic points on the movement area is a great

advantage, especially at aerodromes of very high traffic density, because it ensures adequate quantities of water for foam production or other uses.

Personnel

15. Sufficient crash fire and rescue personnel to bring into immediate operation at least one-third of the total extinguishing media or a minimum of one crash vehicle, whichever is the greater, should be available at all times while flight operations are in progress. At aerodromes which, from their nature or the density of their traffic, do not warrant the employment of full-time personnel, it is desirable that at least one full-time employee be provided for the proper maintenance and operation of the fire equipment provided.

16. All crash fire and rescue personnel, whether full-time or part-time, should be fully trained for the performance of their duties. They should also be proficient in medical first aid, in order to avoid the infliction of additional suffering and injury in extricating personnel from aircraft. They should participate frequently in fire and rescue drills in order to maintain a high standard of efficiency, and their training should include instruction in the layout and general structure of the aircraft with which they may have to deal, in order that on arrival at an incident they may be able to decide immediately on the best method of attack. Particular attention must be paid to the training and detailing for duty of the driver-operators of crash fire vehicles.

Rescue Equipment

17. No attempt has been made to be specific in indicating the exact type and quantity of rescue tools and equipment to be provided. Categories and types of tools and equipment at present available are listed hereunder and these should be provided for all crash fire and rescue vehicles. Development and research may show the need for improvement and extension in the tools and equipment indicated, and further study on the development of suitable equipment should be made. Further study is also required in the use and development of power-operated tools as an aid to rescue.

Rescue Tools and Equipment to be
carried on Crash Vehicles

Cutting Tools

Large and small regular and special axes
Hand and hack saws
Bolt, bar and metal cutters
Special release knives
Snippers and wire cutters, chisels, pliers, etc.

Shifting Tools

Crow and pry bars
Grapnel and cable assembly
Pole and hand hooks
Shovels
Hand and sledge hammers

Miscellaneous Equipment

Blankets
Electric hand lamps and portable floodlights of
type suitable for use in explosive atmosphere
Access ladders
First aid medical equipment

Protective Clothing

18. It is essential that adequate protective clothing and equipment be provided and maintained and be readily available to each member of a rescue crew. Such clothing and equipment should be capable of giving protection against radiant heat and limited protection against direct flame and should include gloves, helmet and a suitable face shield which must allow full vision and freedom of movement.

Crash Fire and Rescue Station

19. The crash fire and rescue vehicles should be housed at all times in buildings (which should be heated when necessary for insuring immediate starting) and the access to the movement area should be unobstructed. The station should be in a position which is most convenient having regard to the following factors:

a) The desirability for maintaining observation of flight activity and aircraft movement on the ground;

b) The necessity for maintaining direct communication with the air traffic control;

c) The necessity for immediate response to an alarm by auxiliary firemen forming part of the crews of fire and rescue vehicles.

Dispatch of Crash Fire and Rescue Vehicles

20. The air traffic control supervisor on duty should normally be responsible for directing the movement of the crash fire and rescue vehicles to an aircraft accident, whether it be within or beyond the boundary of the aerodrome. From his knowledge of the probable movements of other aircraft at the airport, the air traffic control supervisor is best qualified to decide upon the extent to which the protection on the aerodrome may be reduced for the purpose of attendance at an accident outside the aerodrome boundary.

Supervision of Crash Fire and Rescue Activities

21. Responsibility for direction of all crash, fire-fighting and rescue activities, subsequent to arrival at an incident, should rest entirely with the individual in charge of the crash fire and rescue crews at the time.

Alarm and Communication Systems

22. The provision of adequate and suitable communications facilities to ensure dependable and supervised transmittal of essential emergency and routine operating information with regard to crash, fire-fighting and rescue, is necessary at each aerodrome. Such facilities should include provisions for the following purposes, consistent with the individual requirements of each situation:

a) Direct reserved communication between appropriate air traffic control and crash fire station for the purpose of ensuring prompt dispatch of crash vehicles and personnel;

b) Emergency signals, to ensure immediate summoning of designated non-full-time personnel as appropriate;

c) Summoning essential related services on the aerodrome as necessary;

- d) Maintaining communication by means of two-way radio with the crash fire and rescue vehicles in attendance at an incident;
- e) Summoning desired supporting assistance from services outside the aerodrome.

Accidents outside Aerodrome Boundaries

23. The problem of dealing with accidents which occur beyond aerodrome boundaries must necessarily be considered in more general terms. The provision of easy access to the areas surrounding the boundary of the aerodrome should be given consideration by the aerodrome management. When the accident occurs at a site which is not accessible within a short space of time to the crash fire and rescue vehicles from the aerodrome, effective action will depend largely on the efficiency and measure of liaison with local fire and ambulance services. The determination of the division of responsibility between aerodrome crash rescue services, the Air Search and Rescue Organization and any other fire ambulance services should rest with the aerodrome management.

Break-in points on Aircraft

24. Crash fire and rescue personnel should be familiar with the normal and emergency exits on all aircraft normally using their aerodrome. They should also know the location of all points available for effecting forcible entry into the fuselage.

Water Aerodromes

25. The problem of crash fire-fighting and rescue at water aerodromes is similar to that at land aerodromes and the principles of organization, equipment and facilities specified for land aerodromes will, in general, apply. The crash fire and rescue appliances and equipment should be mounted on a boat or boats, incorporating the characteristics of high rate of acceleration, speed and seaworthiness in all conditions normally experienced on or near the aerodrome. Development work, however, is required particularly in relation to quantitative requirements, design of crash boats and related equipment and operation technique.

APPENDIX A

	<u>Grade 1</u>	<u>Grade 2</u>	<u>Grade 3</u>	<u>Grade 4</u>	<u>Grade 5</u>	<u>Grade 6</u>
	Aircraft over 200,000 lbs. (Over 90,000 kilogrammes)	Aircraft 100,000 to 200,000 lbs. (45,000 to 90,000 kilogrammes)	Aircraft 60,000 to 100,000 lbs. (27,000 to 45,000 kilogrammes)	Aircraft 25,000 to 60,000 lbs. (11,000 to 27,000 kilogrammes)	Aircraft 10,000 to 25,000 lbs. (4,500 to 11,000 kilogrammes)	Aircraft under 10,000 lbs. (under 4,500 kilogrammes)
Extinguishing Media	Foam CO ₂	Foam CO ₂	Foam CO ₂	Foam CO ₂	Foam CO ₂	Foam CO ₂
Quantities	32,000 gals. 4,500 lbs. (14,500 litres) (2,050 kg)	24,000 gals. 3,400 lbs. (109,000 litres) (1,550 kg)	18,000 gals. 2,400 lbs. (81,750 litres) (1,100 kg)	12,000 gals. 1,200 lbs. (54,500 litres) (550 kg)	6,000 gals. 1,200 lbs. (27,250 litres) (550 kg)	3,000 gals. 300 lbs. (13,600 litres) (135 kg)
Rate of Discharge	6,400 g.p.m. 1,500 lbs. per min. (29,000 l.p.m.) (680 kg p.m.)	4,800 g.p.m. 1,100 lbs. per min. (21,700 l.p.m.) (500 kg p.m.)	3,600 g.p.m. 800 lbs. per min. (16,350 l.p.m.) (360 kg p.m.)	2,400 g.p.m. 400 lbs. per min. (10,900 l.p.m.) (180 kg p.m.)	1,200 g.p.m. 400 lbs. per min. (5,450 l.p.m.) (180 kg p.m.)	600 g.p.m. 100 lbs. per min. (2,750 l.p.m.) (45 kg p.m.)
Period of Discharge	5 mins 3 mins	5 mins 3 mins	5 mins 3 mins	5 mins 3 mins	5 mins 3 mins	5 mins 3 mins
Estimated Water Requirement	3,200 gallons (14,550 litres)	2,400 gallons (10,900 litres)	1,800 gallons (8,200 litres)	1,200 gallons (5,450 litres)	600 gallons (2,700 litres)	300 gallons (1,350 litres)

- Note: 1) Quantities expressed in gallons represent Imperial Gallons
2) Required quantities of foam produced indicated above are based upon an approximate expansion ratio of between 8 to 1 and 10 to 1.

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