Automated External Defibrillators

General
Civil Aviation Authority Advisory Circulars contain information about standards, practices, and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate Advisory Circular.

An Advisory Circular may also include guidance material (GM) to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

Purpose
This Advisory Circular serves to act as guidance for airline operators in carrying out a risk assessment on the value of automated external defibrillators (AEDs) for air operations.

Related Rules
This Advisory Circular relates to air operations conducted in accordance with Civil Aviation Rule Part 121.

Change Notice
This is the initial issue of AC121-5.
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1. Introduction

There are currently no specific rules providing for the carriage of an Automated External Defibrillator (AED) in an aeroplane conducting an air operation in New Zealand. This AC serves to act as guidance for airline operators in carrying out a risk assessment on the value of AEDs for air operations.

The comparative overseas situation is as follows:

- Since 2004, the FAA has required ‘all Part 121 air carriers’ typically operating aircraft of 30 passengers or more with at least one flight attendant to carry AEDs.

- The International Civil Aviation Organisation (ICAO) has the carriage of AEDs under active consideration but does not as yet mandate it. ICAO Annex 6 Part I Attachment B paragraph 1.2 states the following:

  “Based on the limited available evidence, only a very small number of passengers are likely to benefit from the carriage of automated external defibrillators (AED) on aeroplanes. However, many operators carry them because they offer the only effective treatment for cardiac fibrillation. The likelihood of use, and therefore of potential benefit to a passenger, is greatest in aircraft carrying a large number of passengers, over long duration sector lengths. The carriage of AEDs should be determined by operators on the basis of a risk assessment taking into account the particular needs of the operation.”

- Generally, other international evidence suggests that the carriage of AEDs on board transport aircraft reflects this individual assessment approach.

New Zealand is a typical contributor and service provider to the 1.5 to 2 billion passengers who fly on the world’s civil aircraft every year. As the aviation industry grows, air travel becomes both more readily available and more frequently utilised by New Zealand’s (particularly ageing) population. Logically, as the industry experiences greater demand and with longer routes being flown by bigger aircraft, the number of in-flight medical events involving passengers is also on the rise.

New Zealand’s remote location, combined with the use of Extended Diversion Time Operations (EDTO) often means that air operations to/from New Zealand result in aircraft being far from alternate airfields and consequently emergency medical response facilities.

A 2006 study conducted by the Australian Transport Safety Bureau (ATSB), found that the most common cause of in-flight death (44%) was caused by heart attack. It was also found that the most common cause of flight diversion (33 out of 95 cases) was also due to instances where a passenger was believed to be suffering from a heart attack.

It is therefore considered that the preservation of life onboard, coupled with the limitation of commercial loss due to diversion, could be improved by carrying an AED as part of the onboard Emergency Medical Kits on large commercial airliners in the New Zealand theatre of operations.

It is also considered that the ICAO stance suggesting operators carry out their own risk assessment of their own particular needs relating to their own particular operations as outlined above is appropriate in considering whether or not AEDs are carried.

AEDs are used for ventricular fibrillation. This is when the heart beats at an abnormal rate, which in turn stops the heart pumping blood throughout the body. This usually occurs during a heart attack, but can also occur with a number of other heart conditions. Death will usually result in a

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few minutes if a normal heart rhythm cannot be restored. An AED causes an electric shock to be passed through the body, which is intended to return the heart to its normal beating rhythm.

Modern AEDs are automatic in operation, combining an electrocardiograph device to measure the electrical activity of the heart, a computer to analyse that activity and decide what heart rhythm is present, and a unit to give an electric shock if deemed necessary.

Once the AED has been attached to the patient the procedure is automatic, simple - generally voice instructed - and the computer determines whether or not to administer a shock. The automatic nature of the machine therefore means that a person does not have to be medically trained to use it however they should be generally trained to operate its functions.

2. Applicability

This AC applies to New Zealand Part 119 certificated operators exercising privileges under Part 121 – large aeroplane operations, and some Part 125 - medium aeroplane operations, who will assess the risks associated with their operations to consider the carriage of an AED on their aircraft.

3. Risk Assessment

This AC will closely follow the ICAO guidance stated previously on the carriage of AEDs on aeroplanes carrying large numbers of passengers, and conducting air operations over long duration sector lengths.

Specifically, this AC strongly recommends that Part 121 operators – and possibly some Part 125 operators - conduct a risk assessment of their operation with regards to the carriage of AEDs to assess the requirement of such equipment.

It is worth noting that the FAA has effectively considered that a standard outcome to such a risk assessment is the need for an AED in-flight and hence have mandated the carriage of an AED for US based operators.

It is also worth noting that the availability of aircraft fitted AEDs has successfully assisted in medical emergencies occurring within Airport Terminals.

The following factors should be considered when carrying out a risk assessment in relation to carrying an AED during Part 121 operations:

(a) Lengths of routes flown

The New Zealand aviation industry is constantly expanding in response to a growing demand. The majority of aeroplane operations carried out in New Zealand is conducted in large aeroplanes.

The previously referred 2006 (ATSB) study on in-flight medical conditions in turn referred to an associated Korean study which determined that approximately half of in-flight medical events occur on flights which last longer than six hours. Of the case studies in this Korean paper, 17% of these instances were related to vascular issues.

(b) Demographic of passengers

It is important to consider that New Zealand has an ageing population. In the same Korean study mentioned above it was also found that most medical events in-flight involved passengers who were aged 60 years and over.

2 Han HM, Chae DH, Kim JH. In-flight medical emergencies in civil airline. Aviat Space Environ Med 2000; 71: 330
Rising obesity rates within the general populations of New Zealand and the Pacific Islands should also be considered.

Passengers travelling on aircraft generally also have an increased likelihood of cardiac arrest due to the stress of travel, exertion of carrying luggage, reduced oxygen levels in the cabin, and changes in circadian rhythms.

(c) In-flight medical emergencies

The 2006 (ATSB) study on in-flight medical conditions found that the most common medical event on board an aeroplane was heart attack (43% of all types of medical event or injury).

A French study showed that serious emergencies are rare, with cardiopulmonary resuscitation being required very rarely\(^3\). The authors calculated the rate of one emergency per 20,000 passengers and found that, of the three cardiac arrests cases considered, none of the passengers survived. (Whether this could have been prevented by the availability and use of an on-board AED was not assessed).

New Zealand’s remote location, combined with the use of Extended Diversion Time Operations (EDTO) often means that air services to/from New Zealand result in aircraft being far from diversion airfields and consequently emergency facilities. Therefore readily available ground based support medical facilities may not always be an option.

(d) Time of day of operations

The time a medical emergency occurs can also affect the physical and financial repercussions. Cost, efficiency and convenience of a diversion could vary depending on the circumstances on the ground of the chosen diversion destination.

(e) Diversions

It has been noted in several studies that a diversion occurs approximately once in every million passengers. In the Australian and French studies, the findings both stipulated that one of the most common causes for diversion was cardiac disease.

In the French report it was determined that out of 100% of in-flight medical emergencies, 33% resulted in a diversion. Diversions cause great inconvenience to both passengers and crew as well as imposing additional costs to airlines which include, but are not limited to fuel dumping, extra landing charges, passenger accommodation as well as the financial implications of the flow-on effects on the airlines remaining network and timetable.

(f) Training Costs

A British Airways study found that 70% of all in-flight medical emergencies were handled successfully by cabin crew.

In general terms, it is also reasonable to assume that expert medical assistance is possibly available from fellow passengers.

The cost of providing an AED machine and the training requirement for at least one crew member on-board can be weighed up against the possible cost of a diversion. The on board availability of an AED increases the likelihood of successfully handle a cardiac arrest and prevent the need to divert.

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The general ‘automatic’ operation of the typical AED means that specialist training requirements should be comparatively minor.

4. Methods for risk assessment


Other international aviation bodies, and or regulators have developed risk management guidelines which may be useful for New Zealand operators when assessing risks associated with the carriage of an AED in-flight during air operations and these are:

a) The United Kingdom Civil Aviation Authority (UKCAA):
   UKCAA Safety Management Systems
b) The European Aviation Safety Agency (EASA):
c) The Civil Aviation Safety Authority (CASA):
   CASA risk assessment methodologies
d) Transport Canada:
   Transport Canada risk assessment principles
e) The International Aviation Transport Agency (IATA):
   IATA link to Safety Management Systems

5. Carriage/Storage Requirements for an AED

For guidance, FAA AC 121-33B does not specify storage requirements, but recommends that if AEDs are required in-flight, the devices should be in locations in the passenger cabin that are suitable for quick emergency response. In particular, it does not recommend storage in cockpits.

Otherwise, no specific storage methods or requirements are nominated.

AEDs are also invariably powered by batteries incorporating lithium cells which in themselves are not intrinsically safe.

Safety concerns that should be considered when selecting storage areas include:

   (a) Possibility of battery rupture;
   (b) Fire;
   (c) Explosion; and
   (d) Venting of toxic or flammable gases from the battery.

6. Servicing/Maintenance

In accordance with the FAA requirements in its Part 121 Appendix A, an AED should be maintained in accordance with the manufacturer’s specifications and this maintenance standard is endorsed for New Zealand operators.

An AED is generally powered by a lithium-type battery. The FAA recommends that new AEDs be powered by batteries to TSO C142 although earlier batteries may not be to this standard. The life-span or replacement of these earlier batteries has not yet been determined by the FAA or other AED operators, however the FAA has stated that there are no safety issues in allowing the original
batteries to remain in operation until replacement by the later TSO standard is warranted. This is because all lithium power sources for electronic equipment used on aeroplanes are subject to agency oversight during their design and manufacture.

7. Training of crew members for in-flight medical events

Rule 121.555 “Syllabus for crew member training programme” provides a training syllabus for Part 121 crew members for both normal, and abnormal situations, including knowledge on access to locations for medical equipments.

The FAA, under Title 44 of Part 121 Operating Requirements: Domestic, Flag, and Supplemental Operations in rule 121.805 “Crewmember training for in-flight medical events” specifies training elements in a training programme for flight attendants.

The training elements include the following as quoted:

For each flight attendant—

(i) Instruction, to include performance drills, in the proper use of automated external defibrillators;

(ii) Instruction, to include performance drills, in cardiopulmonary resuscitation;

(iii) Recurrent training, to include performance drills, in the proper use of an AED and in cardiopulmonary resuscitation at least once every 24 months.

The crewmember instruction, performance drills, and recurrent training required under this section are not required to be equivalent to the expert level of proficiency attained by professional emergency medical personnel.

Operators may consider the inclusion of all flight crew members other than just flight attendants in the training advocated above. This is to ensure every flight crew member on board the flight is at least familiarized with the minimum use and application of an AED should it be required in a medical event in-flight.

8. Visual Inspection

For operators mandating an AED to be carried on board an aircraft, it is important that they consider visual inspection to ensure the AED is on board, and usable as part of:

(a) the first check at the beginning of an operation in a pilot’s pre-flight check;

(b) a flight attendant’s routine pre-flight procedures.

9. Minimum Equipment List

Operators may need to consider whether or not an AED must be listed as a ‘no-go’ item. Factors to consider when determining this are:

(a) the risks in association with an AED not on board the aircraft;

(b) the costs involved should a flight cannot depart or is cancelled due to an AED not being readily available, or unserviceable.
10. **Approved AED**

An approved AED means that it must meet the standards specified in the AS/NZS 3200.2.4:2006.⁴

In the United States, an approved AED means it is legally marked in the United States in accordance with the Food and Drug Administration (FDA) requirements.

The FAA is not responsible for regulating the safety standards for the manufacture and use of AEDs.

However, the FAA requires the power source of an AED to comply with all requirements specified in applicable Flight Standards Information Bulletins for Airworthiness, such as FSAW 98-05, and in applicable TSOs such as TSO C142.

11. **Used AED**

Operators need to develop a protocol for AED use, post-resuscitation guidelines, and any post use AED serviceability needs.

After use, and before any subsequent flights, operators need to ensure that—

(a) the AED remains operative;

(b) there is one spare battery available; and

(c) there is a spare set of pads available.

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⁴ AS/NZS 3200.2.4:2006 Australian/New Zealand Standard Medical electrical equipment Part 2.4: Particular requirements for safety—Cardiac defibrillators