

Subject: **Escape and egress systems**

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1. GENERAL. Civil Aviation Authority advisory circulars (AC) contain information about standards, practices and procedures that the Authority has found to be acceptable for compliance with the associated rule.

Consideration will be given to other methods of compliance which may be presented to the Authority.

When new standards, practices or procedures are found to be acceptable they will be added to the appropriate advisory circular.

In addressing a subject the use of the imperative *must* or *is to*, terms not normally welcome in an AC, is because it is associated with mandatory provisions of the Rule itself.

Each reference to a number in this AC, such as 43.15, is a reference to a specific rule within Part 43.

2. PURPOSE. This Advisory Circular (AC) provides methods acceptable to the Authority for showing compliance with the general maintenance rules set out in Part 43.

3. CANCELLATION. There was no previous issue, so there is no cancellation.

4. FOCUS. This material is intended for persons responsible for maintenance on New Zealand registered aircraft. It provides acceptable techniques, methods, and practices in relation to escape and egress systems.

5. RELATED CAR. This AC relates specifically to Part 43 - General Maintenance Rules.

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Introduction

The objective of Part 43 is to establish, for all aircraft, the minimum standard of maintenance considered necessary to ensure the continued validity of their Airworthiness Certificate. The rule will also ensure that all aircraft are maintained to a standard that assures safe operation.

This is achieved by prescribing—

- the minimum standard of maintenance required for aircraft
- the minimum standards for the performance of maintenance
- the persons who may certify maintenance
- the manner in which maintenance is to be recorded and certified

This advisory circular provides acceptable methods, techniques, and practices for the maintenance of escape and egress systems, in particular ejection seats and escape parachutes.

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General

Historic and ex-military – warbird – type aircraft have increased in popularity in recent years. As the types of ex-military aircraft available for purchase increase also more and more high performance aircraft are entering the New Zealand system. Many of these aircraft, particularly the turbine powered aircraft, are equipped with crew egress systems.

Aircraft fitted with explosively operated egress systems are a source of potential danger to persons and damage to aircraft and equipment. Serious injury and death can result from incorrect or inadvertent operation of the systems on the ground.

This advisory circular provides information for persons performing maintenance on aircraft equipped with an egress system.

Definitions

Egress system

An egress system includes any ejection seat or device used to assist a crew member in escaping from a stricken aircraft and placing that crew member under a fully deployed parachute in the shortest possible time, including—

- a canopy removal device
- an ejection seat
- explosive or ballistic cartridges
- a parachute
- a personal survival pack
- an ejection gun and guide rails

Eject

To eject means to initiate an automatic aircraft system that—

- jettisons or shatters the canopy
- propels a seat and occupant from the aircraft
- separates the occupant from the seat
- deploys the occupant's parachute

Description of system

Canopy jettison or canopy shattering

For an occupant of an ejection seat to successfully leave an aircraft the canopy must first be jettisoned or shattered.

Canopy jettison are activated through the main egress system handle. Explosively operated jettison systems utilise cartridges to force the canopy into the air stream which in turn removes the canopy from the aircraft.

Canopy shattering systems can be explosive or mechanical. Explosively operated shattering systems use miniature detonating cord (MDC) as a shaped charge to shatter the canopy prior to the seat travelling up the seat rails. Mechanical shattering is performed physically by the top of the seat impacting the canopy as it travels up the seat rails.

Ejection seat

The ejection seat is a device in common use amongst military jet and training aircraft. The seat performs automatically once activated by the pilot or crew member. The seat operates explosively and, using the explosives or gases formed by those explosive, extracts that occupant from the aircraft and deploys a parachute. The seat itself comprises several components, including—

- a harness retraction unit
- a time delay unit
- a barometric release unit
- a 'g' force unit
- leg and, possibly, arm restraints

Earlier variants of seats may differ in their method of operation but generally a seat, once activated—

- retracts the occupants torso and legs into the seat
- departs the aircraft either—
 - via a gun system that uses explosives fitted to the aircraft to fire the seat out of the cockpit
 - via a rocket system that uses a rocket motor to launch the seat from the cockpit

- a combination gun and rocket system
- is stabilised with the occupant still attached to the seat by a drogue parachute
- determines the altitude of the seat and separates the seat from the occupant immediately, or once a certain altitude is reached
- deploys the main parachute

The seat normally includes a manual override system to force the occupant/seat separation and the deployment of the main parachute.

Because of the nature of the seat the volumes available for packing parachutes is normally minimal and strict procedures must be followed to ensure the correct operation of the parachute when needed.

Safety pins

Safety devices, commonly safety pins, are a set of pins associated to each seat that physically prevents—

- the explosive initiation of any part of the seat
- if initiated, the further action of the egress system

A set of pins will be associated with the complete system, including—

- canopy jettison components
- the ejection seat

Seat guns and rails

Most egress systems utilise a gun and rail setup to propel the seat from the aircraft. The gun is a tube fitted to the aircraft with a series of cartridges that are initiated by the occupant. Once initiated the cartridges generate a volume of gas within the tube that propels the seat from the aircraft.

To ensure the seat leaves the aircraft correctly a set of rails guide the seat up the gun tube and out of the cockpit.

Parachutes

An ejection seat will normally have two parachutes fitted, a drogue chute and a main chute.

The drogue chute stabilises the seat after ejection and draws the main chute from its container when the system permits the extraction.

The main chute is provided solely for the occupant. In most cases the main parachute is extracted by the drogue chute but some systems incorporate an explosive charge that spreads the main parachute quickly. These ballistic spreader parachutes incorporate an explosive charge and should be treated accordingly.

Survival pack

Ejection seats are fitted with survival packs that, once an occupant is separated from the seat, may be deployed by the occupant during descent.

The survival pack normally forms an integral part of the seat and may contain items such as—

- life raft
- flares
- food
- space blankets

For civilian use the survival pack is not required to be complete although operators may wish to fit suitable equipment for their operation. Operators should note that, as the pack forms part of the seat design—

- an ejection seat should not be operated without a survival pack
- any change in contents of the pack should be assessed for suitability with respect to the size and weight of contents

Maintenance procedures

General

Maintenance should be completed in accordance with the procedures of the manufacturer or the original military operator of the aircraft.

Duplicate inspections

The maintenance of the egress system requires duplicate inspections. For duplicate inspections of egress systems the provisions of Part 43 relating to the duplicate inspection of flight controls apply.

Records

Maintenance record entries should include batch numbers and serial numbers of all components fitted to each system, including explosives.

Safety precautions during servicing

Persons should not enter an aircraft fitted with an egress system unless they are fully conversant with the safety precautions relating to the type of equipment fitted.

The safety devices used on different egress systems may have various positions depending on the activity that the aircraft is involved in, including positions that render the system safe for—

- maintenance
- operation
- storage

On entering an aircraft fitted with an egress system a person should ascertain that the position of the safety devices and operating handles are appropriate for the intended activity.

Egress systems should be treated as live until proven otherwise.

When maintenance is to be performed on the egress system, the person performing that maintenance should—

- ensure that the aircraft batteries have been disconnected
- ensure that no ground power is connected
- ensure that all safety devices are fitted and operating handles are in the correct positions
- ensure that the explosives are removed as appropriate for the maintenance involved

When installing or removing egress system explosives—

- only the persons required for the task should be in the immediate vicinity of the aircraft
- clear warning signs should be displayed outside the aircraft and outside the hanger

- no other maintenance should be performed on the aircraft

Storage and control

Aircraft fitted with an egress system should be secured at all times to prevent entry by unqualified persons. The security shall include—

- a lockable canopy or canopy cover
- a secured hanger
- warning placards on the aircraft indicating that an egress system is fitted



Figure 1. Placard for egress system equipped aircraft

System components, when removed, should be stored in suitable containers painted red with clear labelling indicating their contents.

The requirements of the Department of Labour must be complied with for any explosives used in an egress system. The requirements are prescribed in—

- The Explosives Act
- The Explosives Regulations

In general these requirements entail licensing the storage and servicing areas involved in the maintenance of explosive egress systems and aircraft those systems are fitted to.

Personnel

The egress systems on ex-military aircraft are a specialised task and only persons holding maintenance approvals for the system, or components of the system, should perform the maintenance. Persons wishing to perform egress system maintenance should apply to the

CAA for a maintenance approval for the system involved.

Maintenance approvals will be required for—

- explosive operated systems
- emergency parachute systems

The only realistic experience for the granting of the maintenance approval will be that of the RNZAF or other acceptable military service.

Other persons performing maintenance on an aircraft fitted with an egress system should be fully briefed by a maintenance approval holder. This briefing should cover—

- safety precautions on entering a cockpit
- what safety devices look like and where they should be found
- what to do if a person suspects a fault
- any other requirements that minimise the risk to maintenance personnel

Operations

For the operation of an aircraft fitted with an egress system the aircraft operator should be fully conversant with the system.

Before and after each flight suitably trained personnel should ensure that the necessary safety pins are fitted to the aircraft.

When operating away from their normal base, the operator should ensure that—

- the aircraft is—
 - roped off
 - attended at all times unless secured in an appropriately licensed hanger
- danger placards are posted around the aircraft
- no untrained persons are permitted to enter the aircraft

Accidents

All incidents relating to the egress system should be reported in accordance with Part 12.

If an aircraft fitted with an egress system crashes a person holding a maintenance approval for the system should be contacted immediately. The persons attending the site should be advised as to the possibility of explosives at the crash site and that the crash site should be cordoned off.

If the occupant and/or seat(s) are still in the aircraft no attempt should be made to approach the aircraft, even to extract the occupant(s), until the system can be made safe by the appropriate person.

The operator of an aircraft fitted with an egress system should provide a crash recovery kit at all airfields to which the aircraft normally operates. If operations are to an airfield not normally visited, a pre-site visit should be considered to brief rescue personnel on the aircraft and egress system. The crash recovery kit should include—

- a complete list of explosive or ballistic cartridges and their respective positions within the system and the aircraft
- a complete breakdown and material specification of each explosive or ballistic cartridge
- tools required for de-arming the egress system
- a suitable explosives transport case
- a full set of safety devices for the egress system