

STATEMENT OF ISSUE

CS 23.805 (b) requires the emergency exit located to allow rapid evacuation of the crew and having a size of at least 48 by 51 cm of unobstructed rectangular opening.

CS 23.807 (b)(5) requires for acrobatic category aeroplane to allow each occupant to abandon the aeroplane at any speed between V_{S0} and V_D .

BACKGROUND

The aircraft affected is a small two-seater aircraft for training purpose. The two pilot seats are located behind each other (trainee in the forward seat and instructor in the rear seat). The aircraft shall be certified in *Normal* and *Acrobatic* category. The aircraft is equipped with a canopy which serves as the cockpit entrance and may serve as emergency exit for normal category aircraft certification. The canopy is openable with the aircraft on the ground from each pilot station as well as from the outside.

In order to comply with 23.807 (b)(5) the canopy is equipped with Canopy Fracturing System for each pilot station. The Canopy Fracturing System can be initiated from each pilot station, by ejecting the seats, and by external activation means installed on both sides of the fuselage aft of the cockpit.

Special Condition

While certification is requested for *Normal and Acrobatic Category* the Canopy Fracturing System is an unusual and novel design for an aircraft to be certified under CS 23.

In the absence of detailed requirements for the design of a Canopy Fracturing System the UK Ministry of Defence document Def Stan 00-970 section 4 subsection 23 or similar source meeting the intent that standard may be used for certification exercise. Compliance demonstration shall be shown with at least the following parts of the standard:

1. 4.23.1

The requirements of this clause are, unless otherwise specified, applicable to all types of aeroplanes and aim to ensure that all the occupants will be able to leave an aeroplane quickly and safely in an emergency.

The conditions covered relate to emergency escape:

(a) in flight, under:

- (i) all conditions of symmetric flight within the specified flight envelope,
- (ii) all conditions of asymmetric flight, and
- (iii) all conditions likely to arise after control has been lost including a spin (unless the aeroplane is characteristically incapable of spinning),

(b) after crash landing or ditching (see 4.22).

(c) from the aeroplane on the ground.

2. 4.23.2 (a)

GENERAL PRINCIPLES		
REQUIREMENT	COMPLIANCE	GUIDANCE
Every occupant, when wearing the clothing and personal equipment specified in the Aircrew Equipment Assembly Schedule for the aeroplane, shall be able to leave the aeroplane safely, irrespective of its altitude, by his appropriate exit in the shortest possible time under the following conditions: (a) for the crew members of all aeroplanes, the	On aeroplanes with assisted escape, an escape envelope shall be agreed between the aeroplane manufacturer and the Integrated Project Team Leader. This envelope shall depend on the escape system proposed.	

conditions of 4.23.1(a), (b),		
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3. 4.23.6

SIZE OF EXITS		
REQUIREMENT	COMPLIANCE	GUIDANCE
Each exit shall be of the largest practicable size and shall in every case be such as to give a freedom of passage not less than that provided by a rectangular opening 609.6 mm x 609.6 mm. To permit the evacuation of injured personnel from multi-seat aeroplanes, of the exits provided at least one for every nine occupants shall give a freedom of passage not less than that provided by a rectangular opening 762 mm x 762 mm.		

4. 4.23.7

CONTROLS		
REQUIREMENT	COMPLIANCE	GUIDANCE
Each emergency exit shall be openable and jettisonable, when applicable, by one hand by a single positive movement of a single control, operated by a pull of between 111 N and 178 N.	(a) When the exit is jettisonable directly outwards the control shall be such that there is no risk of the operator's hand being pulled outward by the cover. (b) The control for jettisoning the pilot's hood shall be in accordance with 4.19 and shall be operable under all conditions specified in 4.23.1 (c) In addition to the requirements of 4.23.8 consideration should be given to the operation of external controls by members of crash/rescue crews who may be wearing bulky protective clothing. Crash rescue crew members should be able to operate the external controls whilst wearing the full protective clothing outfit. For this purpose the Design Authority should use Anthropometric data for Metacarpal Breadth relative to 95th percentile man, making due allowance for the wearing of protective gloves/gauntlets. The Integrated Project Team Leader shall be approached to confirm details of the protective clothing outfit to be catered for unless this information is provided in the Aircraft Specification.	DEF STAN 00-25 and Leaflet 63 cover anthropometric data.

5. 4.23.8 (a)

CONTROLS		
REQUIREMENT	COMPLIANCE	GUIDANCE

On aeroplanes with ejection seats, the following controls, which shall be so shaped and positioned to avoid any possible chance of confusion in their operation, shall be provided: (a) a control for jettisoning or fragmenting the hood or hatch conforming to 4.23.7. Where Miniature Detonating Cord (MDC) is used to fragment the hood the separate firing control shall permit the firing of the MDC independently of the seat for both internal and external operation and provision shall be made to reduce the likelihood of injury to an outside rescuer from hood debris, eg by pulling a long lanyard,	All emergency controls shall be operable with the man strapped into the seat with the harness retracted and locked; this should also apply when upper limb restraint is installed on the seat.	
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6. 4.23.9

PRECAUTIONS AGAINST INADVERTENT OPERATION		
REQUIREMENT	COMPLIANCE	GUIDANCE
Inadvertent release or jettison of hoods, hatches or doors shall not be possible from any cause including: (a) accidental operation by crew or passengers, (b) vibration or buffeting, (c) structural deformation or flexing due to loads within the fully factored flight envelope, including pressurisation loads, (d) mechanical failure of locks and linkage, and (e) the effect of temperature variations on the airframe, etc.		

7. 4.23.11

PRECAUTIONS AGAINST INADVERTENT OPERATION		
REQUIREMENT	COMPLIANCE	GUIDANCE
Where assisted escape systems are used, a mechanical device shall be provided to prevent inadvertent operation of the system or of individual components whilst the aeroplane is parked on the ground or undergoing maintenance.	The number of devices should not exceed one for the seat and one for each canopy system. An aeroplane cockpit stowage shall be provided. The state of the system and of the devices shall be readily apparent to both aircrew and groundcrew.	

8. 4.23.17

If the Canopy Fracturing System is designed to allow initiation of a single loop only, this shall not influence the remaining system provisions nor injure remaining crew member.

ESCAPE IN FLIGHT		
ASSISTED ESCAPE		
REQUIREMENT	COMPLIANCE	GUIDANCE

Operation of his escape system by any one crew member shall not result in injury to any other occupants nor prejudice their chances of safe escape.	Where a command ejection facility is fitted, each crew member shall still have the ability to eject individually and the command control should be selectable in accordance with the Aeroplane Specification.	
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9. 4.23.18

ESCAPE IN FLIGHT		
ASSISTED ESCAPE		
REQUIREMENT	COMPLIANCE	GUIDANCE
No rigid object shall be located in the ejection path and any movable objects which can enter the path shall be so arranged that they are moved clear when the seat is fired by automatic means or on impact with the seat without damage to personnel or their equipment.	Fixed but frangible objects are permitted in the ejection path provided they cause no damage to personnel or their equipment during an ejection. Consideration shall be given to the possible need for shielding of objects above shoulder height (eg canopy rails) to minimise injuries which may be caused on ejecting under lateral "g" conditions.	

10. 4.23.20 (e)

ESCAPE IN FLIGHT		
EXIT COVERS		
REQUIREMENT	COMPLIANCE	GUIDANCE
The doors of parachute exits, hoods and hatches provided for emergency escape shall either: (e) be fragmented or cut by initiation of miniature detonating cord (MDC) or other means.	When the door or hatch is hinged, means shall be provided to open it against all aerodynamic and inertia loads which may occur and to lock it in an open position in a manner which does not reduce the size of the exit. There shall be adequate standing space about each parachute exit in the floor.	

11. 4.23.22

ESCAPE IN FLIGHT		
JETTISONING IN FLIGHT		
REQUIREMENT	COMPLIANCE	GUIDANCE

Parachute exit doors, hatches and cockpit hoods when jettisoned or fragmented in flight under the conditions of 4.23.1 (a) to provide means of escape for the crew shall not cause:		
(a) irrecoverable loss of control,		
(b) inability to fly the aeroplane,		
(c) injury to any occupant, or		
(d) inability to operate any service essential to the safe flying of the aeroplane.		

12. 4.23.25

ESCAPE IN FLIGHT		
FRAGMENTATION BY MINIATURE DETONATING CORD		
REQUIREMENT	COMPLIANCE	GUIDANCE
In addition to the separate firing control called for in 4.23.8 (a) the MDC shall be fired when the ejection seat is initiated either directly by the initiating charge or by movement of the seat itself against a separate firing unit.	(a) Where MDC is used as the means of fragmenting or cutting a hood it shall be arranged over the surface of the transparency to produce effective escape path clearance for the minimum length of cord and the minimum explosive charge. (b) MDC systems should be tested in accordance with the provision of 4.23.37 - 4.23.38 and Leaflet 82. In addition, special attention shall be given to hazards from debris.	The life of the MDC should be the same as or longer than that of the hood, or a means shall be provided to replace the MDC on life expiry.

13. 4.23.28

EMERGENCY ALIGHTING		
JETTISONABLE OR FRANGIBLE HOODS OR HATCHES		
REQUIREMENT	COMPLIANCE	GUIDANCE
No action shall be required of the appropriate crew member other than that necessary to operate the jettison control or fragmenting device.		

14. 4.23.32

ESCAPE PATH CLEARANCE		
DESIGN REQUIREMENTS		
REQUIREMENT	COMPLIANCE	GUIDANCE
The following human factors criteria shall be applied during the design and evaluation of escape path clearance mechanisms: (a) The escape path shall permit the safe egress of the most critical combination of aircrew and equipment specified for use		See ASCC Air Standard 61/102/04A. Escape Path and Escape Path Clearance

with that escape system. (b) The escape path clearance mechanisms should minimize the risk to aircrew and their equipment. (c) The various potential environmental hazards to which the aircrew might be exposed on the escape path or due to the clearance mechanisms, shall be controlled to be compatible with established human exposure limits. Depending upon the method used , these potential hazards may include overpressure, acoustic noise, flame, fragmentation and others. (d) Failure of the escape path clearance system shall not prevent escape nor expose the crew to undue risk of unacceptable injury. (e) The method of escape path clearance should produce minimal interference with the crew tasks		are defined in Part0.
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15. 4.23.33

ESCAPE PATH CLEARANCE		
TESTING		
REQUIREMENT	COMPLIANCE	GUIDANCE
The escape path clearance sub-systems in an aeroplane shall be proved capable of functioning adequately throughout the flight profile and range of environmental conditions applicable to that aeroplane.		

16. 4.23.34

ESCAPE PATH CLEARANCE		
TESTING		
REQUIREMENT	COMPLIANCE	GUIDANCE
The escape path clearance mechanisms constitute one sub-system of the aeroplane escape system. Testing of the clearance mechanisms shall be completed in conjunction with functional testing of the total escape system.	The escape path clearance mechanisms constitute one sub-system of the aeroplane escape system. Testing of the clearance mechanisms shall be completed in conjunction with functional testing of the total escape system. Test results shall cover the following points: (a) reliability of system, (b) effects of partial failure, (c) effects of aeroplane speed on system performance, (d) effects of aeroplane attitude and altitude on system performance, (e) effects of aeroplane pressurization on system performance, (f) effects of acceleration on system performance, (g) range of environmental variables acceptable for	

	system performance, (h) data on hazardous environments to which crew members might be exposed.	
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17. 4.23.40

TESTS		
JETTISONABLE OR FRANGIBLE HOODS, HATCHES AND DOORS		
REQUIREMENT	COMPLIANCE	GUIDANCE
Prototype installations or new designs of jettisonable or frangible hoods, hatches and doors and their associated locking and jettisoning mechanisms or fragmenting devices shall be subjected to a comprehensive series of functional, wind tunnel and blower tunnel tests on the general lines given in Leaflet 79 to ensure that: (a) the strength of the component and its adjacent structure and the design of the locking mechanism are adequate to prevent inadvertent release under the most adverse combination of the conditions of 4.23.9, and (b) the component can be jettisoned or fragmented with certainty and safety when the release mechanism or fragmenting device is operated.	The tests should be completed before the first flight.	

- 18.** The activation of the Canopy Fracturing System shall not inhibit the function of the canopy locking provisions in case of an ordinary emergency evacuation from the aircraft on ground.

When the Canopy Fracturing System (CFS) is initiated, the activation is not stoppable (entire sequence takes only milliseconds) and at the end the canopy is totally fragmented. After fragmentation, there exists no obstruction over the canopy to be able to perform an ordinary emergency evacuation.

- 19.** The activation of the Canopy Fracturing System shall not endanger external rescue personnel while operating the external means of the system.