STATEMENT OF ISSUE

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 ejection seats for the both crew member to evacuate the cockpit in case of emergency.

In order to comply with 23.807 (b)(5) the aircraft is equipped with ejection seats and a control to select the ejection sequence /mode. There are three modes available: single, dual and command.

Special Condition

While the CS 23 requirements do not specifically address the installation of ejection seats Special Conditions are issued. They are derived from the Def Stan 00-970 section 4.

In the absence of detailed requirements for the installation of ejection seats 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 conditions of 4.23.1(a), (b),	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.	

3. **4.23.8 (b)&(c)**

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: (b) a single control, operated by a pull of between 111 N and 289 N to initiate the entire escape sequence, so arranged that the trajectory of the occupant, his seat and all personal equipment is automatically cleared of dangerous obstructions, (c) a single control, to enable the occupant to separate himself from the seat after ejection with parachute and personal survival pack intact should automatic separation fail to occur, and to permit manual escape should this be necessary,	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.	

4. 4.23.17

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.	

5. 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.	

6. 4.23.19

ESCAPE IN FLIGHT		
ASSISTED ESCAPE		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**

When upward ejection seats are provided, the design of the escape system as a whole shall be such that the following standard escape drill will be both appropriate and sufficient: (a) operation of the control specified in 4.23.8 (b) after which the escape system shall function automatically until full parachute deployment is attained, but should the seat automatic separation device fail, separation shall be achieved manually by: (b) operation of the single control specified in 4.23.8 (c).		

7. 4.23.23

ESCAPE IN FLIGHT		
JETTISONING IN FLIGHT		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
Escape by means of an ejection seat shall require no separate effort from the aircrew to dispose of the canopies or hatches. However, separate controls for the disposal of the canopies or hatches shall be provided for circumstances which do not involve an ejection, including outside rescue.	The control for outside rescue should be accessible for safe operation (this may involve more than one outside rescue handle being provided)	

8. 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 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		See ASCC Air Standard 61/102/04A. Escape Path and Escape Path Clearance are defined in Part0.

9. 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.		

10. 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.	

11. 4.23.35

STRENGTH REQUIREMENTS		
EJECTION SEAT INSTALLATIONS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
When ejection seats are chosen as the method of compliance with 4.23.16, the seats and all parts of their installation, and adjacent parts of the aeroplane structure which might by failing:	(a) A number of positions of the seat or seats during ejection shall be considered. Compliance with the proof condition is necessary to the extent that distortion shall not be sufficient to prevent the first or subsequent ejections.	For additional strength, stiffness, and energy absorption requirements,

(a) prevent the proper completion of the ejection, or in the case of multi-seat aeroplanes, (b) prejudice the escape of the crew members, or (c) adversely affect the flying characteristics of the aeroplane, shall have a proof factor not less than 1.0 on the combination of the most critical flight loads of 4.23.1 and the ejection gun thrust.	(b) The value of the unfactored ejection gun thrust shall be assumed to be equal to the force produced by an average set of cartridges at the appropriate maximum temperature specified in 7.1, with an ejected weight equal to the weight of a large man (93kg) plus equipment and seat. The appropriate value of the thrust will be supplied by the seat designer.	see 4.22

12. 4.23.36

COMMAND EJECTION		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
	The aim of a command ejection system shall be to enhance survival of all crew members by minimizing the time required for safe escape, reducing the risk of collision or entanglement and ensuring escape when one or more crew members are incapacitated.	Command ejection occurs when one crew member is ejected from an aircraft as a result of an action of another crew member.

13. 4.23.37

COMMAND EJECTION		
DESIGN REQUIREMENTS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
Command ejection shall provide positive escape path clearance (see 4.23.32 - 4.23.34).		

14. 4.23.38

COMMAND EJECTION		
DESIGN REQUIREMENTS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
The system shall be capable of initiation by all crew members.	As determined by the Integrated Project Team Leader it shall be possible for crew member(s) to 'opt out' of the system by positive individual action, permitting the remaining crew to escape individually.	Note: 'Opt out' means that a crew member can decide whether or not to be command ejected by another crew member.

15. 4.23.39

COMMAND EJECTION		
TESTING		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
Full sequence tests shall be performed to demonstrate the safety of the system and that the requirements of 4.23.37 and 4.23.38 are met.		

16. 4.23.43

TESTS		
JETTISONABLE OR FRANGIBLE HOODS, HATCHES AND DOORS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
For aeroplanes fitted with ejection seats, demonstration of satisfactory canopy disposal shall be part of the test programme for the complete escape system (see Leaflet 82).		

17. 4.23.45

TESTS		
ESCAPE IN FLIGHT - UNASSISTED		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
For single and dual seat aeroplanes, safe egress under flight conditions shall be demonstrated on the ground using a blower tunnel.		

18. 4.23.46

TESTS		
EJECTION SEAT INSTALLATIONS - PULL-UP TESTS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
Tests shall be made to demonstrate that the ejection path required by 4.23.18 has been provided.	(a) The tests shall consist of hauling the ejection seat up the ejection rails (with canopy ejection rams in representative position) and measuring the clearances. The seat shall be loaded with a man or dummy, having 98 percentile mass and dimensions, wearing the clothing and personal equipment specified in the Aircraft Equipment Assembly for the aeroplane so that the back and seat are properly compressed. (b) The tests shall be made at the Mock-up stage and shall be repeated on an actual aeroplane before test flying starts. Repeat tests shall be carried out whenever changes are made to the Aircrew Equipment Assembly, the aeroplane or its equipment	

	which are likely to alter the clearance.	

19. 4.23.47

TESTS		
EJECTION SEAT INSTALLATIONS EJECTION TESTS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
It shall be demonstrated that a safe ejection can be made without injury to the occupants or damage to any personal equipment necessary for survival.	(a) Unless otherwise agreed by the Integrated Project Team Leader, the test for in-flight ejection shall include at least one ejection through the hood, even if this is not the normal method of escape, except where technical evidence shows that safe penetration of the hood is impossible. (b) The tests shall cover the full range of aircrew, with respect to height and weight, as defined in Leaflet 63, together with the full Aircraft Equipment Assembly appropriate to the aeroplane. (c) A test schedule, based on the principles stated in Leaflet 82 shall be discussed and agreed with the Integrated Project Team Leader during the initial design and planning of the aeroplane.	

20. 4.23.48

TESTS		
EJECTION SEAT INSTALLATION PROOF STRENGTH TESTS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
A static test shall be made with the object of demonstrating compliance with the requirement of 4.23.35 as applied to the seat attachments and adjacent parts of the aeroplane structure. The tests shall be carried out on a specimen which adequately represents the stiffness of the complete airframe, and all parts which might be distorted or damaged shall be included	The test cases and loads shall be discussed and agreed with the Integrated Project Team Leader at an early stage in the design. Any tests considered necessary shall represent, as accurately as practicable, the critical proof loading conditions, including the ejection gun thrust, air blast and inertia loads, derived from the requirements of 4.23.35.	

21. 4.23.49

TESTS		
COMMAND FIRING TESTS		
REQUIREMENT	**COMPLIANCE**	**GUIDANCE**
Command firing tests shall include confirmation of the sequential timing of events with design tolerances and the operation of all actuation/signal lines including redundant lines.		