This annex to EASA TCDS IM.A.636 was created to publish selected special conditions / deviations / equivalent safety findings that are part of the applicable certification basis:

CONTENTS

SUBJECT	**B-02 High Speed Characteristics**
CERTIFICATION SPECIFICATION	**CS (JAR) 23.177, 181, 251, 253, 255, 1505**
PRIMARY GROUP / PANEL	**1 (Flight)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN+AMC/IM**

23.177 Static Directional and Lateral Stability

Replace CS 23. 177 with the following:

(a) The static directional stability, as shown by the tendency to recover from a wings level sideslip with the rudder free, must be positive for any landing gear and flap position appropriate to the takeoff, climb, cruise, approach, and landing configurations. This must be shown with symmetrical power up to maximum continuous power, and at speeds from 1.2 V_{S1} up to V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate). The angle of sideslip for these tests must be appropriate to the type of aeroplane. At larger angles of sideslip, up to that at which full rudder is used or a control force limit in CS 23.143 is reached, whichever occurs first, and at speeds from 1.2 V_{S1} to V_O, the rudder pedal force must not reverse.

(b) The static lateral stability, as shown by the tendency to raise the low wing in a sideslip, must be positive for all landing gear and flap positions. This must be shown with symmetrical power up to 75 percent of maximum continuous power at speeds above 1.2 V_{S1} in the takeoff configuration(s) and at speeds above 1.3 V_{S1} in other configurations, up to V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate) for the configuration being investigated, in the takeoff, climb, cruise, and approach configurations. For the landing configuration, the power must be that necessary to maintain a 3 degree angle of descent in coordinated flight. The static lateral stability must not be negative at 1.2 V_{S1} in the takeoff configuration, or at 1.3 V_{S1} in other configurations. The angle of sideslip for these tests must be appropriate to the type of aeroplane, but in no case may the constant heading sideslip angle be less than that obtainable with a 10 degree bank, or if less, the maximum bank angle obtainable with full rudder deflection or a control force limit in CS 23.143 is reached.

(1) (c) (reserved)

(2) (d) In straight, steady slips at 1.2 V_{S1} for any landing gear and flap positions, and for any power conditions up to 50 percent of maximum continuous power, the aileron and rudder control movements and forces must increase steadily, but not necessarily in constant proportion, as the angle of sideslip is increased up to the maximum appropriate to the type of aeroplane. At larger slip angles, up to the angle at which the full rudder or aileron control is used or a control force limit contained in CS 23.143 is reached, the aileron and rudder control movements and forces must not reverse as the angle of sideslip is increased. Rapid entry into, and recovery from, a maximum sideslip considered appropriate for the aeroplane must not result in uncontrollable flight characteristics.

(See guidance below).

23.181 Dynamic Stability

(See guidance below concerning interpretation of Dutch roll requirements).

23.251 Vibration and buffeting

Replace CS 23. 251 with the following:

(a) The aeroplane must be demonstrated in flight to be free from any vibration and buffeting that would prevent continued safe flight in any likely operating condition.

(b) Each part of the aeroplane must be demonstrated in flight to be free from excessive vibration under any appropriate speed and power conditions up to VDF/MDF. The maximum speeds shown must be used in establishing the operating limitations of the aeroplane in accordance with 23.1505 in this CRI.

(c) Except as provided in sub-paragraph (d) of this paragraph, there may be no buffeting condition, in normal flight, including configuration changes during cruise, severe enough to interfere with the control of the aeroplane, to cause excessive fatigue to the crew, or to cause structural damage. Stall warning buffeting within these limits is allowable.

(d) There may be no perceptible buffeting condition in the cruise configuration in straight flight at any speed up to VMO/MMO, except that the stall warning buffeting is allowable.

(e) For an aeroplane whose Mmo greater than 0.6 and with a maximum operating altitude greater than 7620 m (25,000 ft), the positive manoeuvring load factors at which the onset of perceptible buffeting occurs must be determined with the aeroplane in the cruise configuration for the ranges of airspeed or Mach number, weight, and altitude for which the aeroplane is to be certificated. The envelopes of load factor, speed, altitude, and weight must provide a sufficient range of speeds and load factors for normal operations. Probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions. (See guidance below)

(f) The requirement FAR Part 23 § 23.251 (and CS 23) including AC material does not address the high speed/high- manoeuvring load type of aircraft. FAA guidance AC23-8A for 14CFR 23.251 does not require high normal acceleration in combination with high Mach Number Vd/Md. According to Para 120 (b) (1) the airplane must be tested in a 1 g dive in gradual increments until Vd/Md is attained. Remain at the speed only long enough to determine the absence of excessive buffet, vibration or controllability problems.

These test are appropriate for transport type of aircraft but do not specifically cover the manoeuvring type aircraft in the aerobatic category.

For the safe operation of such an aircraft, it has to be demonstrated that the aircraft has acceptable flight handling characteristics and is free from excessive vibration and buffeting up to and beyond the lift boundary and that sufficient stall warning margin exist at all Mach numbers in the entire operational flight envelope. The operational flight envelope is considered the Maximum permissible speed and load factor envelope (combination of speed and load factor).

Within the Operational flight envelope (thus the defined altitude/speed/Mach/ load factor combination for several airplane loading conditions, there shall be no objectionable buffet, trim or stability change or other irregularities.

23.253 High-speed characteristics

Replace CS 23. 253 with the following:

(a) *Speed increase and recovery characteristics.* The following speed increase and recovery characteristics must be met:

(1) Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the aeroplane trimmed at any likely cruise speed up to VMO/MMO. These conditions and characteristics include gust upsets, inadvertent control movements, low stick force gradient in relation to control friction, levelling off from climb, and descent from Mach to air speed limit altitudes.

(2) Allowing for pilot reaction time after effective inherent or artificial speed warning occurs, it must be shown that the aeroplane can be recovered to a normal attitude and its speed reduced to VMO/MMO, without –

(i) Exceptional piloting strength or skill;

(ii) Exceeding a speed VDF/MDF that is less than or equal to the lower of:

(a) VD/MD, or

(b) The maximum speed shown under 23.251

(iii) Exceeding the structural limitations; and

(iv) Buffeting that would impair the pilot’s ability to read the instruments or control the aeroplane for recovery.

(3) With the aeroplane trimmed at any speed up to VMO/MMO, there must be no reversal of the response to control input about any axis at any speed up to VDF/MDF. Any tendency to pitch, roll, or yaw must be mild and readily controllable, using normal piloting techniques. When the aeroplane is trimmed at VMO/MMO, the slope of the elevator control force versus speed curve need not be stable at speeds greater than VFC/MFC, but there must be a push force at all speeds up to VDF/MDF and there must be no sudden or excessive reduction of elevator control force as VDF/MDF is reached.

(4) Adequate roll capability to assure a prompt recovery from a lateral upset condition must be available at any speed up to VDF/MDF. (See guidance below)

(5) *Extension of speed brakes.* [see Handling and Performance CRI]

(6) Reserved

(b) *Maximum speed for stability characteristics, VFC/MFC.* VFC/MFC is the maximum speed at which the requirements of 23.175(b)(1) in this CRI, 23.177(a) through (c) in this CRI, and 23.181 must be met with wing-flaps and landing gear retracted. Except as noted in 23.253(c) of this CRI, VFC/MFC may not be less than a speed midway between VMO/MMO and VDF/MDF, except that, for altitudes where Mach Number is the limiting factor, MFC need not exceed the Mach Number at which effective speed warning occurs.

(c) *Maximum speed for stability characteristics in icing conditions*. The maximum speed for stability characteristics with the ice accretions, at which the requirements of 23.175(b)(1) in this CRI, 23.177(a) through (c) in this CRI, and 23.181 must be met, is the lower of:

(1) 556 km/h (300 knots) CAS,

(2) VFC, or

(3) A speed at which it is demonstrated that the airframe will be free of ice accretion due to the effects of increased dynamic pressure.

(See guidance below)

23.255 Out-of-trim characteristics

Add the following:

(a) From an initial condition with the aeroplane trimmed at cruise speeds up to VMO/MMO, the aeroplane must have satisfactory manoeuvring stability and controllability with the degree of out-of-trim in both the aeroplane nose-up and nose-down directions, which results from the greater of –

(1) A three-second movement of the longitudinal trim system at its normal rate for the particular flight condition with no aerodynamic load (or an equivalent degree of trim for aeroplanes that do not have a power-operated trim system), except as limited by stops in the trim system,; or

(b) In the out-of-trim condition specified in sub-paragraph (a) of this paragraph, when the normal acceleration is varied from + 1 g to the positive and negative values specified in sub-paragraph (c) of this paragraph –

(1) The stick force vs. g curve must have a positive slope at any speed up to and including VFC/MFC; and

(2) At speeds between VFC/MFC and VDF/MDF, the direction of the primary longitudinal control force may not reverse.

(c) except as provided in sub-paragraphs (d) and (e) of this paragraph compliance with the provisions of sub-paragraph (a) of this paragraph must be demonstrated in flight over the acceleration range –

(1) –1g to 2·5 g; or

(2) 0 g to 2·0 g, and extrapolating by an acceptable method to – 1 g and 2·5 g.

(d) If the procedure set forth in sub-paragraph (c)(2) of this paragraph is used to demonstrate compliance and marginal conditions exist during flight test with regard to reversal of primary longitudinal control force, flight tests must be accomplished from the normal acceleration at which a marginal condition is found to exist to the applicable limit specified in sub-paragraph (c)(1) of this paragraph.

(e) During flight tests required by subparagraph (a) of this paragraph the limit manoeuvring load factors, and the manoeuvring load factors associated with probable inadvertent excursions beyond the boundaries of the buffet onset envelopes, need not be exceeded. In addition, the entry speeds for flight test demonstrations at normal acceleration values less than 1g must be limited to the extent necessary to accomplish a recovery without exceeding VDF/MDF.

(f) In the out-of-trim condition specified in sub-paragraph (a) of this paragraph, it must be possible from an overspeed condition at VDF/MDF, to produce at least 1·5 g for recovery by applying not more than 556 N (125 lbf) of longitudinal control force using either the primary longitudinal control alone or the primary longitudinal control and the longitudinal trim system. If the longitudinal trim is used to assist in producing the required load factor, it must be shown at VDF/MDF that the longitudinal trim can be actuated in the aeroplane nose-up direction with the primary surface loaded to correspond to the least of the following aeroplane nose-up control forces:

(1) The maximum control forces expected in service as specified in CS 23.301 and 23.397 (or their equivalent).

(2) The control force required to produce 1·5 g.

(3) The control force corresponding to buffeting or other phenomena of such intensity that it is a strong deterrent to further application of primary longitudinal control force.

(See guidance below)

23.1505 Maximum operating limit speed

Add the following:

The maximum operating limit speed (VMO/MMO, airspeed or Mach number, whichever is critical at a particular altitude) is a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorised for flight test or pilot training operations. VMO/MMO must be established so that it is not greater than the design cruising speed VC and so that it is sufficiently below VD/MD or VDF/MDF, to make it highly improbable that the latter speeds will be inadvertently exceeded in operations. The speed margin between VMO/MMO and VD/MD or VDF/MDF may not be less than that determined under CS 23.335(b) (or its equivalent) or found necessary during the flight tests conducted under 23.253 of this CRI.

ANNEX

Appendix 1	Interpretative Material / Acceptable Means of Compliance to SC-B23.0253-01

Appendix 1

INTERPRETATIVE MATERIAL / ACCEPTABLE MEANS OF COMPLIANCE

High Speed Characteristics

The following is offered as guidance in interpreting the above requirements:

23.177 Static Directional and Lateral Stability

1. Sideslip Angles Appropriate to the Operation of the Aeroplane

   1.1 Experience has shown that an acceptable method for determining the appropriate sideslip angle for the operation of a transport category aeroplane is provided by the following equation: ß = arc sin (30/V) where ß = Sideslip angle, and V = Airspeed (KCAS). Recognising that smaller sideslip angles are appropriate as speed is increased, this equation provides sideslip angle as a function of airspeed. The equation is based on the theoretical sideslip value for a 56 km/h (30-knot) crosswind, but has been shown to conservatively represent (i.e., exceed) the sideslip angles achieved in maximum crosswind take-offs and landings and minimum static and dynamic control speed testing for a variety of transport category aeroplanes. Experience has also shown that a maximum sideslip angle of 15 degrees is generally appropriate for most transport category aeroplanes even though the equation may provide a higher sideslip angle. However, limiting the maximum sideslip angle to 15 degrees may not be appropriate for aeroplanes with low approach speeds or high crosswind capability.

   1.2 A lower sideslip angle than that provided in paragraph 2.1 may be used if it is substantiated that the lower value conservatively covers all crosswind conditions, engine failure scenarios, and other conditions where sideslip may be experienced within the approved operating envelope. Conversely, a higher value should be used for aeroplanes where test evidence indicates that a higher value would be appropriate to the operation of the aeroplane.

2. For the purposes of showing compliance with the requirement out to sideslip angles associated with one half of the available rudder control input, there is no need to consider a rudder control input beyond that corresponding to full available rudder surface travel or a rudder control force of 667 N (150 lbf) . Some rudder control system designs may limit the available rudder surface deflection such that full deflection for the particular flight condition is reached before the rudder control reaches one-half of its available travel. In such cases, further rudder control input would not result in additional rudder surface deflection.

3. Steady, straight sideslips

3.1 Steady, straight sideslips should be conducted in each direction to show that the aileron and rudder control movements and forces are substantially proportional to the angle of sideslip in a stable sense, and that the factor of proportionality is within the limits found necessary for safe operation. These tests should be conducted at progressively greater sideslip angles up to the sideslip angle appropriate to the operation of the aeroplane (see paragraph 1.1) or the sideslip angle associated with one-half of the available rudder control input, whichever is greater.

3.2 When determining the rudder and aileron control forces, the controls should be relaxed at each point to find the minimum force needed to maintain the control surface deflection. If excessive friction is present, the resulting low forces will indicate the aeroplane does not have acceptable stability characteristics.

3.3 In lieu of conducting each of the separate qualitative tests required by here, the applicant may use recorded quantitative data showing aileron and rudder control force and position versus sideslip (left and right) to the appropriate limits in the steady heading sideslips conducted to show compliance with (c). If the control force and position versus sideslip indicates positive dihedral effect and positive directional stability, compliance with (a) and (b) will have been successfully demonstrated.

Item (d)

1.1 At sideslip angles greater than those appropriate for normal operation of the aeroplane, up to the sideslip angle at which full rudder control is used or a rudder control force of 667 N (150 lbf) is obtained, (d) requires that the rudder control forces may not reverse and increased rudder deflection must be needed for increased angles of sideslip. The goals of this higher-than-normal sideslip angle test are to show that at full rudder, or at maximum expected pilot effort: (1) the rudder control force does not reverse, and (2) increased rudder deflection must be needed for increased angles of sideslip, thus demonstrating freedom from rudder lock or fin stall, and adequate directional stability for manoeuvres involving large rudder inputs.

1.2 Compliance with this requirement should be shown using straight, steady sideslips. However, if full lateral control input is reached before full rudder control travel or a rudder control force of 667 N (150 lbf) is reached, the manoeuvre may be continued in a non-steady heading (i.e., rolling and yawing) manoeuvre. Care should be taken to prevent excessive bank angles that may occur during this manoeuvre.

2. *Full Rudder Sideslips*

2.1 Rudder lock is that condition where the rudder over-balances aerodynamically and either deflects fully with no additional pilot input or does not tend to return to neutral when the pilot input is released. It is indicated by a reversal in the rudder control force as sideslip angle is increased. Full rudder sideslips are conducted to determine the rudder control forces and deflections out to sideslip angles associated with full rudder control input (or as limited by a rudder control force of 667 N (150 lbf)) to investigate the potential for rudder lock and lack of directional stability.

2.2 To check for positive directional stability and for the absence of rudder lock, conduct steady heading sideslips at increasing sideslip angles until obtaining full rudder control input or a rudder control force of 667 N (150 lbf). If full lateral control is reached before reaching the rudder control limit or 667 (150 lbf) of rudder control force, continue the test to the rudder limiting condition in a non-steady heading sideslip manoeuvre.

3. The control limits approved for the aeroplane should not be exceeded when conducting the flight tests required here.

4. *Flight Test Safety Concerns.* In planning for and conducting the full rudder sideslips, items relevant to flight test safety should be considered, including:

   a. Inadvertent stalls,

   b. Effects of sideslip on stall protection systems,

   c. Actuation of stick pusher, including the effects of sideslip on angle-of-attack sensor vanes,

   d. Heavy buffet,

   e. Exceeding flap loads or other structural limits,

   f. Extreme bank angles,

   g. Propulsion system behaviour (e.g. fuel and oil supply, and inlet stability),

   h. Minimum altitude for recovery,

   i. Resulting roll rates when aileron limit is exceeded, and

   j. Position errors and effects on electronic or augmented flight control systems, especially when using the aeroplane's production airspeed system.

23.181 Dynamic Stability

1. The requirements of CS 23.181 regarding Dutch roll should be met with the aircraft in its normal configuration. Credit can be taken for artificial systems to damp oscillations (such as yaw dampers) provided they default to on, they cannot be inadvertently disengaged, they are operational regardless of autopilot engagement status, and adequate alerting is provided should they be disengaged or fail. (see CS 23.672)

2. Suitable procedures and flight limitations must be developed to allow the aircraft to continue flight and land after artificial damping system failure in flight at the most critical flight conditions.

3. An AFM limitation must prohibit continued flight on autopilot alone after artificial damping system failure at flight conditions where the basic aircraft does not meet the damping criteria without the artificial damping system.

23.251 Vibration and buffeting

1. *Probable Inadvertent Excursions beyond the Buffet Boundary*

   1.1 Paragraph (e) states that probable inadvertent excursions beyond the buffet onset boundary may not result in unsafe conditions.

   1.2 An acceptable means of compliance with this requirement is to demonstrate by means of flight tests beyond the buffet onset boundary that hazardous conditions will not be encountered within the permitted manoeuvring envelope (as defined by CS 23.337) without adequate prior warning being given by severe buffeting or high stick forces.

1.3 Buffet onset is the lowest level of buffet intensity consistently apparent to the flight crew during normal acceleration demonstrations in smooth air conditions.

1.4 In flight tests beyond the buffet onset boundary to satisfy paragraph 1.2, the load factor should be increased until either –

a. The level of buffet becomes sufficient to provide an obvious warning to the pilot which is a strong deterrent to further application of load factor; or

b. Further increase of load factor requires a stick force in excess of 445 N (100 lbf), or is impossible because of the limitations of the control system; or

c. The positive limit manoeuvring load factor established in compliance with CS 25.337 is achieved.

1.5 Within the range of load factors defined in paragraph 1.4 no hazardous conditions (such as hazardous involuntary changes of pitch or roll attitude, engine or systems malfunctioning which require urgent corrective action by the flight crew, or difficulty in reading the instruments or controlling the aeroplane) should be encountered.

23.253 High-speed characteristics

An acceptable method of demonstrating compliance with this paragraph (a)(4) is as follows:

1. Establish a steady 20° banked turn at a speed close to VDF/MDF limited to the extent necessary to accomplish the following manoeuvre and recovery without exceeding VDF/MDF. Using lateral control alone, it should be demonstrated that the aeroplane can be rolled to 20° bank angle in the other direction in not more than 8 seconds. The demonstration should be made in the most adverse direction. The manoeuvre may be unchecked.
2. For aeroplanes that exhibit an adverse effect on roll rate when rudder is used, it should also be demonstrated that use of rudder in a conventional manner will not result in a roll capability significantly below that specified above.
3. Conditions for 1 and 2:

* Wing-flaps: retracted.

* Speedbrakes: retracted and extended.

* Landing gear retracted.

* Trim: The aeroplane trimmed for straight flight at VMO/MMO. The trimming controls should not be moved during the manoeuvre.

* Power: (i) All engines operating at the power required to maintain level flight at VMO/MMO, except that maximum continuous power need not be exceeded; and (ii) if the effect of power is significant, with the throttles closed.

23.255 Out-of-trim characteristics

1. *Amount of Out-of-trim Required*

1.1 The equivalent degree of trim, specified in (a)(1) for aeroplanes which do not have a power-operated longitudinal trim system, has not been specified in quantitative terms, and the particular characteristics of each type of aeroplane must be considered. The intent of the requirement is that a reasonable amount of out-of-trim should be investigated, such as might occasionally be applied by a pilot.

1.2 In establishing the maximum mistrim that can be sustained by the autopilot the normal operation of the autopilot and associated systems should be taken into consideration. Where the autopilot is equipped with an auto-trim function the amount of mistrim which can be sustained will generally be small or zero. If there is no auto-trim function, consideration should be given to the maximum amount of out-of-trim which can be sustained by the elevator servo without causing autopilot disconnect.

2. *Datum Trim Setting*

2.1 For showing compliance with (b)(1) for speeds up to VMO/MMO, the datum trim setting should be the trim setting required for trimmed flight at the particular speed at which the demonstration is to be made.

2.2 For showing compliance with (b)(1) for speeds from VMO/MMO to VFC/MFC, and for showing compliance with (b)(2) and (f), the datum trim setting should be the trim setting required for trimmed flight at VMO/MMO.

3. R*eversal of Primary Longitudinal Control Force at Speeds greater than VFC/MFC*

3.1 paragraph (b)(2) requires that the direction of the primary longitudinal control force may not reverse when the normal acceleration is varied, for +1 g to the positive and negative values specified, at speeds above VFC/MFC. The intent of the requirement is that it is permissible that there is a value of g for which the stick force is zero, provided that the stick force versus g curve has a positive slope at that point (see Figure 1).

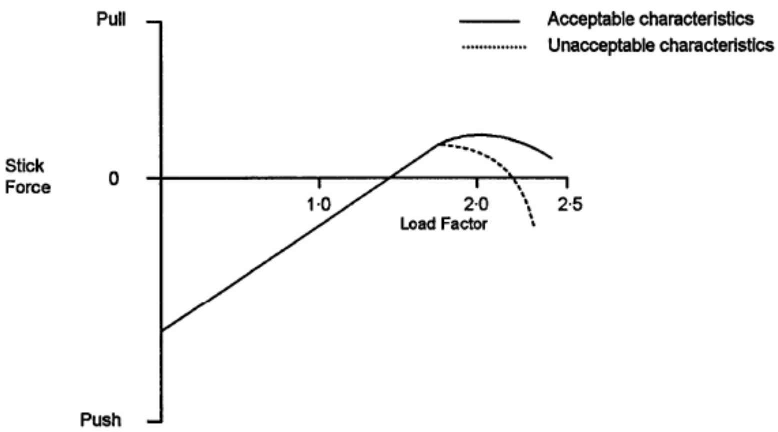


FIGURE 1

3.2 If stick force characteristics are marginally acceptable, it is desirable that there should be no reversal of normal control sensing, i.e. an aft movement of the control column should produce an aircraft motion in the nose-up direction and a change in aircraft load factor in the positive direction, and a forward movement of the control column should change the aircraft load factor in the negative direction.

3.3 It is further intended that reversals of direction of stick force with negative stick-force gradients should not be permitted in any mistrim condition within the specified range of mistrim. If test results indicate that the curves of stick force versus normal acceleration with the maximum required mistrim have a negative gradient of speeds above VFC/MFC then additional tests may be necessary. The additional tests should verify that the curves of stick force versus load factor with mistrim less than the maximum required do not unacceptably reverse, as illustrated in the upper curve of Figure 2. Control force characteristics as shown in Figure 3, may be considered acceptable, provided that the control sensing does not reverse (see paragraph 3.2)

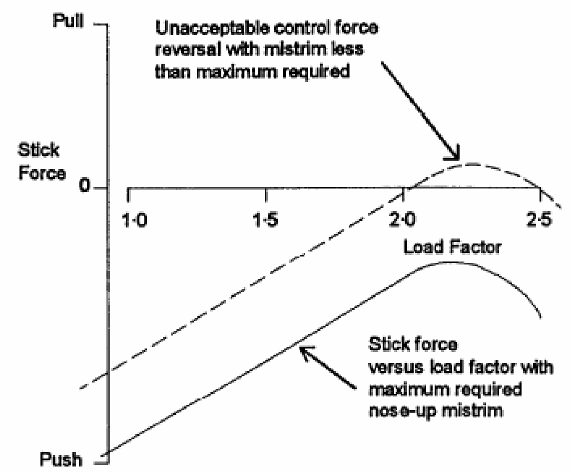


FIGURE 2

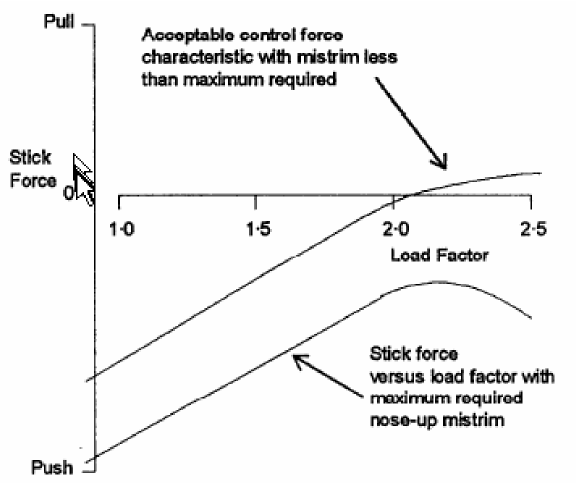


FIGURE 3

4. *Probable Inadvertent Excursions beyond the Boundaries of the Buffet Onset Envelopes.*

Paragraph (e) states that manoeuvring load factors associated with probable inadvertent excursions beyond the boundaries of the buffet onset envelopes determined under CS 23.251(e) in this CRI need not be exceeded. It is intended that test flights need not be continued beyond a level of buffet which is sufficiently severe that a pilot would be reluctant to apply any further increase in load factor.

5. *Use of the Longitudinal Trim System to Assist Recovery*

5.1 Paragraph (f) requires the ability to produce at least 1·5 g for recovery from an overspeed condition of VDF/MDF, using either the primary longitudinal control alone or the primary longitudinal control and the longitudinal trim system. Although the longitudinal trim system may be used to assist in producing the required normal acceleration, it is not acceptable for recovery to be completely dependent upon the use of this system. It should be possible to produce 1·2 g by applying not more than 556 N (125 lbf) of longitudinal control force using the primary longitudinal control alone.

5.2 Recovery capability is generally critical at altitudes where airspeed (VDF) is limiting. If at higher altitudes (on the MDF boundary) the manoeuvre capability is limited by buffeting of such an intensity that it is a strong deterrent to further increase in normal acceleration, some reduction of manoeuvre capability will be acceptable, provided that it does not reduce to below 1·3 g. The entry speed for flight test demonstrations of compliance with this requirement should be limited to the extent necessary to accomplish a recovery without exceeding VDF/MDF, and the normal acceleration should be measured as near to VDF/MDF as is practical.

SUBJECT	**B-52 Human Factor – Integrated Avionics Systems**
CERTIFICATION SPECIFICATION	**CS 23**
PRIMARY GROUP / PANEL	**1 (Flight)**
SECONDARY GROUP / PANEL	**All System Panels**
Nature	**SCN+AMC**

SC CS 23.div-01

General

a) The design of the integrated flight deck interface in particular and other systems as required, must adequately address the foreseeable performance, capability and limitations of the crew.

b) More specifically, the team must be satisfied with the following aspects of the flight deck interface design:

i. Ease of operation including automation;

ii. Effects of pilot errors in managing the aircraft systems, including the potential for error, the possible severity of the consequences, and the provision for recognition and recovery from error;

iii. Workload during normal and abnormal operation; and

iv. Adequacy of feedback, including clear and unambiguous:

- presentation of information;
- representation of system condition by display of system status;
- indication of failure cases, including aircraft status;
- indication when pilot input is not accepted or followed by the system;
- indication of prolonged or severe compensatory action by a system when such action could adversely affect aircraft safety.
- Indication of reversionary modes and back-up status

ANNEX

Appendix 1 Acceptable Means of Compliance to SC-B23.div-01

Appendix 1

ACCEPTABLE MEANS OF COMPLIANCE

Human Factors -- Integrated Avionics System

1. Demonstration of Compliance

1.1 Implementation

It is envisaged that the Flight Test Panel would manage implementation. The following is a proposal for interpretative material associated to the special condition. This will call for:

i) General Assessment: A general review of Human Factors issues arising from integrated use of the flight deck.

ii) Novel features: Careful exploration of specific Human Factors issues arising from the novel integrated avionic system in the flight deck.

1.2 It is important that the effort for consideration of human factors is focused upon any risks relevant to aircraft safety that may be raised by the novel features of the flight deck design. As clarification, some example topic areas have been suggested in italicised text beneath each of the specific criteria listed in paragraph 2.3 below. Examples are offered for illustration purposes, but evaluation against the listed criteria should not be restricted to only these examples.

1.3 The applicant should show how they have considered and applied a consistent approach across the flight deck in order to avoid confusion. This may be achieved by the use of a flight deck philosophy document that will :

a. Identify the Applicant's philosophy on design principles such as:

- Crew alerting and prioritisation of aurals
- Use of colour
- Location of controls
- Menu structures
- Crew interaction with displays
- Display reversion
- Automation principles
- System feedback to the crew

b. Identify relevant assumptions concerning use of the Flight Deck Interface, such as:

- The pilot accommodation.

- The operational environment.
- The aircraft operator [e.g., use of user modifiable checklists,
- presentation of planning data].

1.4 The applicant should prepare a dedicated plan for addressing human factors aspects in flight deck certification. This plan should include:

a. Identify items in the proposed design that are considered new or novel,

b. Identify how they will address the potential for crew related risk that may arise from these items, including their relationship to conventional features. For this purpose, they may select a format including each novel item:

- Novel Item name
- Risk Potential arising from crew interface
- Design Objectives in managing those risks
- How Foreseeable Performance of crew will be addressed
- How Ease of Use will be addressed
- How Effects of Error will be addressed
- How Task Distribution will be addressed
- How Adequacy of Feedback will be addressed
- Other foreseeable concerns
- How any special pilot training requirements will be addressed
- JAR / FAR paragraphs also relevant
- Certification credit events where the design will be exposed to the Team for formal evaluation of the item.

c. Show the planned development schedule including the manufacturer / customer internal assessments and 'proof of concept' activities, which may be observed by some Team members.

d. Describe the planned resources that will be available for development activity, in particular mock-ups, active representations and simulation.

1.5 Evaluation trials will need to include demanding scenarios representative of each flight phase (flight preparation, taxi, take-off, climb, cruise, approach, landing, go-around, and holding) with standard pilot tasks (flight path control, flight path management, communication, aircraft system management) and using all the available interface means (e.g. communication through data link if proposed). Scenarios shall include Normal, Abnormal and Emergency situations. The applicant should propose the means and methods by which these scenarios can be assessed in a realistic environment.

1.6 The applicant should identify, where appropriate, the recommended Pilot Operating Philosophy and the procedures.

1.7 A formal certification event should be designated by the applicant to permit an evaluation by the team in order that it might satisfy itself that compliance of the design with the Special Condition has been achieved.

2. Evaluation Criteria

For each feature to be evaluated, considerations may include:

2.1 Foreseeable Performance, Capabilities and Limitations of the Pilot

a. Occasional error is a normal characteristic of skilled human performance [e.g., where a single error would impact safety, the pilot should be supported by the design or, if not practicable, operating procedures or training].

b. Pilot capacity is not limitless in terms of working memory [e.g. pilot should not be expected to hold in mind long alphanumeric sequences] long term memory [e.g. without regular practice, pilots training and skill may fade over time] and attention [e.g. supplemental systems may impact safety if they are slow, distracting or difficult to use; the presentation of non-functional information should be avoided; simultaneous tasks and demands on the pilot should be minimised]

c. Established practices and conventions may influence pilot actions, especially under stressful conditions. [e.g. if a certain location on the flight deck has been associated with a particular function in many previous aircraft, it is foreseeable that some pilots may erroneously reach to that position for the function even if trained to find it elsewhere.]

d. Available pilot capacity may be reduced during failure conditions or under stress; hence the additional need to apply unfamiliar procedures at such a time should be avoided. This should be achieved within the design.

e. Expectation may bias pilots perception and thus important information that is contrary to expectation must be particularly explicit.

f. A high rate of false warnings is likely to reduce the effectiveness of genuine warnings.

g. Cultural differences may exist and could be relevant to some design expectations [e.g. on use of English alphabet for sequencing;].

2.2 Ease of Use [including Automation]:

a. Iterative involvement of test pilots and operational pilots in the development of such systems is likely to result in an improved product; this should include representations [e.g. simulation] that have a degree of realism appropriate to the level of assessment and the use of scenarios including those that are most likely to address system vulnerability and risk related situations.

b. The application of consistent philosophies may also contribute to 'ease of use'.

c. Further considerations in achieving 'ease of use' may be obtained from EN ISO 14307 on Human Centred Design Processes for Interactive Systems.

Examples: Flight Deck Philosophies that are logical and consistently applied. The design should be such that effective use by pilots is likely, giving consideration to the expected pilot training [e.g. number of VNAV modes]. CCD(Cursor control device) characteristics, including accessibility; compatibility with existing CCD conventions; resistance to inadvertent operation (e.g. by position); software control laws / gains / operating characteristics for accuracy and speed; use with right and left hand, dominant and non-dominant hand; operation under vibration / turbulent conditions;

2.3 Effects of Error:

a. The systematic evaluation of the contribution of the effects of error to safety risk in the operational environment.

b. Error in routine tasks [such as data entry or misreading digits] is a normal characteristic of human performance, and such errors are considered probable.

c. The recognition that the absence of a particular pilot error during development simulation activity does not prove that such an error can never occur in service.

Examples: To include pilot response to system failure, and also error during normal (and abnormal) operations that do not occur during a response to a failure of the system on which the error is made. It is not acceptable to assume that all errors (e.g., simple slips and lapses) can be eradicated by training.

2.4 Workload

a. The introduction of new or novel design features may potentially affect workload or awareness across time; some tasks may become more time consuming or exclusive. Such effects should be explored.

b. The quantity, similarity and function of tasks that are conducted through a single device or access point should be investigated for peaks or 'bottlenecks' at busy or critical periods.

c. The risk from task interruption [and potentially remaining incomplete] may also be related to design characteristics [such as the need to withdraw from one menu to access another in an automated system].

Examples: Time taken to access features of systems that are time critical; time taken head down during busy phases of flight (especially where lookout required); time sharing of devices for dissimilar tasks (e.g. Multi-Function Display); critical task times in comparison with previous designs; system status following interrupted tasks.

2.5 Adequacy of Feedback

a. Consistent application of feedback philosophy (Dark-Quiet, Green Light, ..).

b. Evaluation of effectiveness of method and format of feedback (look and feel).

c. Sub-categories as outlined below:

i) Presentation of information

Examples: Symbol readability in vibrating conditions; display colour philosophy.

ii) Representation of system condition by display of system status

Examples: Awareness of system status despite extensive use of MFD and large number of display choices through “Windowing”; draws attention to status change.

iii) Indication of failure cases, including aircraft status

Examples: Potential obscuration of information by pop-up menus.

iv) Indication when pilot input is not accepted or followed by the system

v) Indication of prolonged or severe compensatory action by a system when such action could adversely affect aircraft safety

Examples: Automated flight control that may be designed such that the adjustment reaches the end of its travel before the pilot is made suddenly aware of the situation.

SUBJECT	**C-03 Speed Margin**
CERTIFICATION SPECIFICATION	**CS 23.335(b)**
PRIMARY GROUP / PANEL	**3 (Structure)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN+AMC**

Instead of CS 23.335 (b)(4)(ii) the changed CS 23.335 (b)(4)(iii) is to be used:

(iii) Mach 0.07 for commuter category and all high performance aeroplanes in any category (at altitudes where M_D is established) unless a rational analysis, including the effects of automatic systems, is used to determine a lower margin. If a rational analysis is used, the minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts, and the penetration of jet streams or cold fronts), instrument errors, airframe production variations, and must not be less than Mach 0.05.

Appendix 1 Acceptable Means of Compliance to SC-C23.0335-01

Appendix 1

ACCEPTABLE MEANS OF COMPLIANCE

Speed Margins

1. PURPOSE
This AMC sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of SC-C23.0335-01 related to the minimum speed margin between design cruise speed and design dive speed.

2. REFERENCE
SC-C23.0335-01 "Speed Margins"

3. BACKGROUND
CS 23.335 requires the design dive speed, VD, of the aeroplane to be established so that the design cruise speed is no greater than 0.8 times the design dive speed, or that it be based on an upset criterion initiated at the design cruise speed, VC. At altitudes where the cruise speed is limited by compressibility effects, SC-C23.0335-01 requires the margin to be not less than 0.05 Mach. Furthermore, at any altitude, the margin must be great enough to provide for atmospheric variations (such as horizontal gusts and the penetration of jet streams), instrument errors, and production variations. This AMC provides a rational method for considering the atmospheric variations.

4. DESIGN DIVE SPEED MARGIN DUE TO ATMOSPHERIC VARIATIONS.
a. In the absence of evidence supporting alternative criteria, compliance with SC-C23.0335-01 may be shown by providing a margin between VC/MC and VD/MD sufficient to provide for the following atmospheric conditions:

(1) Encounter with a Horizontal Gust. The effect of encounters with a substantially head-on gust, assumed to act at the most adverse angle between 30 degrees above and 30 degrees below the flight path, should be considered. The gust velocity should be 15.2 m/s (50 fps) in equivalent

airspeed (EAS) at altitudes up to 6096 m (20,000 feet) . At altitudes above 6096 m (20,000 feet) the gust velocity may be reduced linearly from 15.2 m/s (50 fps) in EAS at 6096 m (20,000 feet) to 7.6 m/s (25 fps) in EAS at 15240 m (50,000 feet), above which the gust velocity is considered to be constant.

The gust velocity should be assumed to build up in not more than 2 seconds and last for 30 seconds.

(2) Entry into Jetstreams or Regions of High Windshear.

(i) Conditions of horizontal and vertical windshear should be investigated taking into account the windshear data of this paragraph which are world-wide extreme values.

(ii) Horizontal windshear is the rate of change of horizontal wind speed with horizontal distance. Encounters with horizontal windshear change the aeroplane apparent head wind in level flight as the aeroplane traverses into regions of changing wind speed. The horizontal windshear region is assumed to have no significant vertical gradient of wind speed.

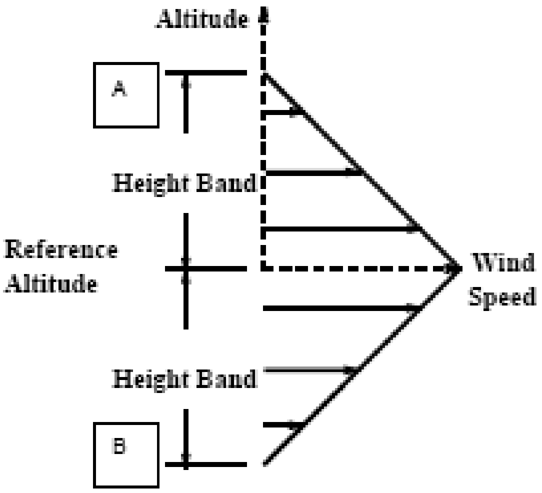
(iii) Vertical windshear is the rate of change of horizontal wind speed with altitude. Encounters with windshear change the aeroplane apparent head wind as the aeroplane climbs or descends into regions of changing wind speed. The vertical windshear region changes slowly so that temporal or spatial changes in the vertical windshear gradient are assumed to have no significant affect on an aeroplane in level flight.

(iv) With the aeroplane at VC/MC within normal rates of climb and descent, the most extreme condition of windshear that it might encounter, according to available meteorological data, can be expressed as follows:

(A) Horizontal Windshear. The jet stream is assumed to consist of a linear shear of 3.6 KTAS/NM over a distance of 25 NM or of 2.52 KTAS/NM over a distance of 50 NM or of 1.8 KTAS/NM over a distance of 100 NM, whichever is most severe.

(B) Vertical Windshear. The windshear region is assumed to have the most severe of the following characteristics and design values for windshear intensity and height band. As shown in Figure 1, the total vertical thickness of the windshear region is twice the height band so that the windshear intensity specified in Table 1 applies to a vertical distance equal to the height band above and below the reference altitude. The variation of horizontal wind speed with altitude in the windshear region is linear through the height band from zero at the edge of the region to a strength at the reference altitude determined by the windshear intensity multiplied by the height band. Windshear intensity varies linearly between the reference altitudes in Table 1.

Figure 1 - Windshear Region



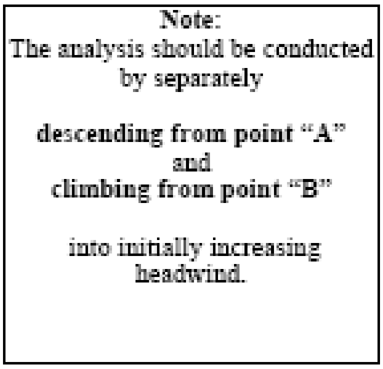


Table 1 - Vertical Windshear Intensity Characteristics

	Height Band - Ft.			
	1000	3000	5000	7000
Reference Altitude - Ft.	Vertical Windshear Units: ft./sec. per foot of height (KTAS per 1000 feet of height)			
0	0.095 (56.3)	0.05 (29.6)	0.035 (20.7)	0.03 (17.8)
40,000	0.145 (85.9)	0.075 (44.4)	0.055 (32.6)	0.04 (23.7)
45,000	0.265 (157.0)	0.135 (80.0)	0.10 (59.2)	0.075 (44.4)
Above 45,000	0.265 (157.0)	0.135 (80.0)	0.10 (59.2)	0.075 (44.4)
Windshear intensity varies linearly between specified altitudes.				

(v) The entry of the aeroplane into horizontal and vertical windshear should be treated as separate cases. Because the penetration of these large scale phenomena is fairly slow, recovery action by the pilot is usually possible. In the case of manual flight (i.e., when flight is being controlled by inputs made by the pilot), the aeroplane is assumed to maintain constant attitude until at least 3 seconds after the operation of the overspeed warning device, at which time recovery action may be started by using the primary aerodynamic controls and thrust at a normal acceleration of 1.5g, or the maximum available, whichever is lower.

b. At altitudes where speed is limited by Mach number, a speed margin of .07 Mach between MC and MD is considered sufficient without further investigation.

SUBJECT	C-04 Yawing Manoeuvre
CERTIFICATION SPECIFICATION	CS 23.441(b)
PRIMARY GROUP / PANEL	3 (Structure)
SECONDARY GROUP / PANEL	-
Nature	SCN

Instead of the original CS 23.441(b) use the following:

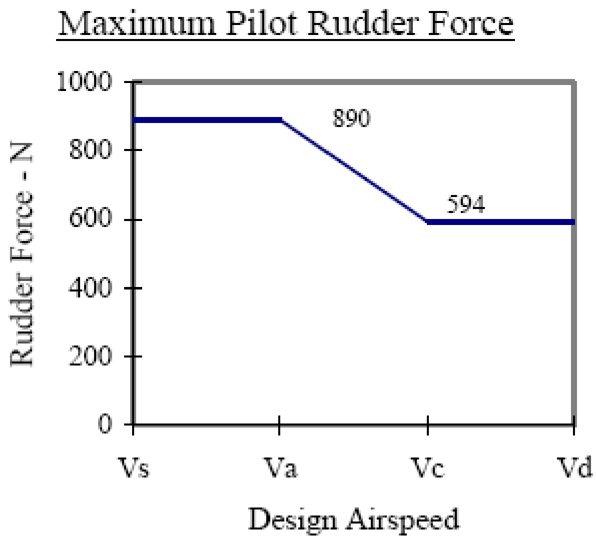
(b) For commuter category aeroplanes and high performance aeroplanes regardless of the category, the loads imposed by the following additional manoeuvre must be substantiated at speeds from V_A to V_D/M_D. When computing the tail loads:-

(1) The aeroplane must be yawed to the largest attainable steady state sideslip angle, with the rudder at maximum deflection caused by any one of the following:-

(i) Control surface stops;

(ii) Maximum available booster effort;

(iii) Pilot rudder force as shown below:-



(2) The rudder must be suddenly displaced from the maximum deflection to the neutral position.

SUBJECT	**C-106 Emergency landing dynamic conditions - HIC**
CERTIFICATION SPECIFICATION	**CS 23.562, Def Stan 00-970 section 4.16.16**
PRIMARY GROUP / PANEL	**8 (Cabin Safety)**
SECONDARY GROUP / PANEL	**-**
Nature	**ELOS**

STATEMENT OF ISSUE

CS 23.562 requires dynamic seat testing as well as compliance with the head injury criteria (HIC).

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 two ejection seats defined as primary escape means for the crew.

ELOS

If full compliance with the requirements of CS 23.562 cannot be met due the design of the seats or their installation constraints, an investigation about possible head injuries shall be conducted.

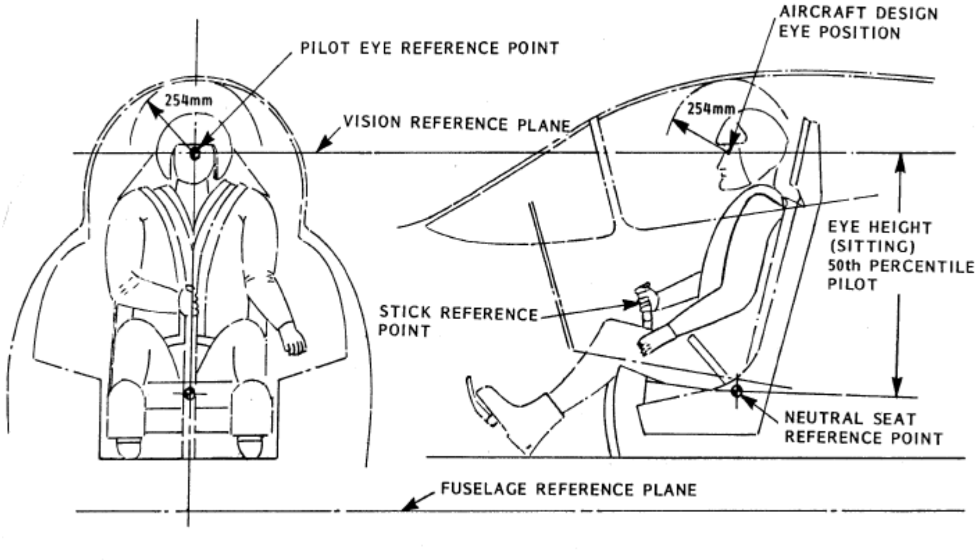
While the installation of ejection seats as primary emergency escape means already avoid occupancy of the aircraft in the majority of crash cases, occupancy of the aircraft cannot be avoided in all possible cases. The head path measured at crash tests under conditions described in CS 25.562 shall be compared with the obstruction free envelope provided at each pilot station in accordance with Def Stan 00-970 section 4.16.16.

4.16.16 Head Clearance
A minimum Spherical envelope of 254 mm shall be provided from the aircraft design eye position to ensure a minimum of 51 mm head clearance from the canopy. In aeroplanes where ejection through the canopy is possible, head clearance shall be sufficient to enable canopy breakers to penetrate the canopy and provide a clear path for the seat and crew member; where canopy break up is effected by explosive means (e.g. detonating cord) head clearance shall be sufficient to prevent injury to the pilot. When overhead actuation of ejection seat is provided, sufficient space between head gear and canopy to ensure access to and actuation of the control shall be provided.

Compliance
These clearances shall be based on the most critical size aircrew member specified wearing appropriate personal protective equipment.

Guidance

Figure 1 below for Head Clearance requirements



DEF STAN 00-970 PART 1/5
SECTION 4

FIG.1

AIRCREW STATION DEFINITION AND GEOMETRY LAYOUT FOR FIXED WING AEROPLANES

SUBJECT	**C-107 Emergency landing dynamic conditions - lumbar loads**
CERTIFICATION SPECIFICATION	**CS 23.562(c)(7) & (e)**
PRIMARY GROUP / PANEL	**8 (Cabin Safety)**
SECONDARY GROUP / PANEL	**-**
Nature	**ELOS**

STATEMENT OF ISSUE

CS 23.562 requires dynamic seat testing as well as compliance with the lumbar load criteria. The limit for the lumbar load is defined under (c)(7) *The compression load measured between the pelvis and the lumbar spine of the ATD may not exceed 680 kg (1 500 lb).*

The value is based on an ATD weight of 77 kg (170 lb).

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 two ejection seats defined as primary escape means for the crew.

Dynamic tests have been conducted with the ejection seats and ATDs dressed in pilot suits including helmets. Dummies have been uploaded to weights beyond the 77 kg value. Due to the ejection seat design and intended function vertical stroke of the seats to compensate for high lumbar loads cannot be provided and thus the results exceeded the 680 kg limit.

ELOS

If full compliance with the requirements of CS 23.562 cannot be met due the design of the seats or their installation constraints, an investigation about possible mitigation of injuries shall be conducted.

While the installation of ejection seats as primary emergency escape means already avoid occupancy of the aircraft in the majority of crash cases, occupancy of the aircraft cannot be avoided in all possible cases. The paragraph 23.562 (e) allows for:

(e) An alternate approach that achieves an equivalent, or greater, level of occupant protection to that required by this paragraph may be used if substantiated on a rational basis.

The alternate approach shall take the use of the aircraft, the primary function of the ejection seats, the availability range of the ejection seats (0/0), aircraft dispatch limitations, etc. into account.

EASA acknowledges the applicant's position to replace CS 25.562(c)(7) compliance by an alternative approach as described in CS 25.562 (e). The test criteria under which data for compliance finding is generated (CS25.562(c)(1) and CS 25.562 (d)) assumes that the aircraft, when being in a configuration for landing or after take-off, has no pitch and roll applied.

EASA is prepared to accept demonstration of occupant protection required by CS 25.562 (c)(7) by an alternative approach when the applicant can show:

- That the ejection seat(s) are usable for a flight configuration as described above for
  - Flight at and after take-off
  - Flight before and at landing

- That the use of the ejection seat(s) in TTOL flight scenario are included in the AFM section for Emergency Procedures
- By showing that the use of the ejection seats provide for an adequate level of occupant protection when compared with the conditions in a vertical crash scenario.

SUBJECT	**D-01 Take-off Warning System**
CERTIFICATION SPECIFICATION	**CS 23.703**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**SCN+IM**

SC 23.703 Take-off warning system

For high performance aeroplanes, unless it can be shown on base of a FHA and / or tests that any critical device necessary to be set to a specific position / function for take-off, that affects the take-off performance and behaviour of the aircraft would not give an unsafe take-off configuration when selected out of an approved take-off position, a take-off warning system must be installed and must meet the following requirements:

(a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the take-off roll if the aeroplane is in a configuration that would not allow a safe take-off. The warning must continue until –

(1) The configuration is changed to allow safe take-off, or

(2) Action is taken by the pilot to abandon the take-off roll.

(b) The means used to activate the system must function properly for all authorised take-off power settings and procedures and throughout the ranges of take-off weights, altitudes and temperatures for which certification are requested.

Appendix 1 Interpretative Material to SC-D23.0703-01

Appendix 1

INTERPRETATIVE MATERIAL

Take-off Warning System

IM 23.703

Examples of critical devices include, but are not limited to: high lift devices, speed brakes, longitudinal trim devices, wing spoilers or a parking brake

SUBJECT	**D-02 Extension and Retraction Systems**
CERTIFICATION SPECIFICATION	**CS 23.729**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN**

For CS 23.729, the following applies:

Subparagraphs (a), (c), (d), (f) and (g) remain unchanged.

Add to the existing CS 23.729 (b): "There must be positive means to keep the landing gear and doors in the correct retracted position in flight, unless it can be shown that lowering of the landing gear or doors, or flight with the landing gear or doors extended, at any speed, is not hazardous."

Extend existing CS 23.729 (e) with: "If the doors are not attached to the Landing Gear an independent warning must be provided."

For CS 23.729 (g), in addition refer to CRI D-51 (Wheel and Tyre Failure).

SUBJECT	**D-03 Wheels**
CERTIFICATION SPECIFICATION	**CS 23.731**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN**

SC 23.731 Wheels

Add to CS 23.731 subparagraph (c) as follows:

(c) Wheels must be approved.

SUBJECT	**D-04 Brakes and Braking System**
CERTIFICATION SPECIFICATION	**CS 23.735**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN+IM**

SC23.735 Brakes and braking systems

Instead of the requirements of CS 23.735, the following applies:

(a): deleted – text merged with SC23.735(e)

(b) The aeroplane must have a parking brake control that, when selected on, will, without further attention, prevent the aeroplane from rolling on a dry and level paved runway with take-off power on the critical engine. The control must be suitably located or be adequately protected to prevent inadvertent operation. There must be indication in the cockpit when the parking brake is not fully released.

(c) No change

(d) If anti skid devices are installed, the devices and associated systems must be designed so that they meet the reliability requirements of 23.1309.

(e) The brake kinetic capacity rating of each mainwheel brake assembly must not be less than the kinetic energy absorption requirements determined under either of the following methods:

(1) The brake kinetic energy absorption requirements must be based on a conservative rational analysis of the sequence of events expected during either

(i) a rejected take-off at the design take-off weight, or

(ii) a landing stop at the most critical combination of landing weight and speed

(2) Instead of a rational analysis, the kinetic energy absorption requirements for each mainwheel brake assembly may be derived from the following formula:

$KE = ½ MV^2/N$

where:

KE = Kinetic energy per wheel (joules)

M = EITHER Mass at design take-off weight (kg), OR Mass at design landing weight (kg)

(depending on the case being calculated)

V = EITHER Ground speed, in m/s associated with the maximum value of V1 selected in accordance with CS 23.51(c)(1).

OR Aeroplane speed in m/s. V must be not less than Vso, the power off stalling speed of the aeroplane at sea level, at the design landing weight and in the landing configuration

(depending on the case being calculated)

N = Number of main wheels with brakes

It must be substantiated by dynamometer testing that the wheel, brake and tyre assembly is capable of absorbing not less than this level of kinetic energy throughout the defined wear range of the brake.

(f) The brake system, associated systems and components must be designed and constructed so that if any electrical, pneumatic, hydraulic or mechanical connecting or transmitting element fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the aeroplane to rest with a braked roll stopping distance of not more than two times that obtained in determining the landing distance as prescribed in CS 23.75.

(g) If a stored energy system is used to show compliance with paragraph (f) of this special condition, the flight crew must be provided with an indication of the useable stored energy available.

(h) Means must be provided in each braked wheel to prevent wheel failure and tyre burst that may result from elevated brake temperatures.

(i) Means must be provided for each brake assembly to indicate when the heat sink is worn to the permissible limit. The means must be reliable and readily visible.

Appendix 1 Interpretative material for SC-D23.0735-01:

Appendix 1

Interpretative material for SC-D23.0735-01

Brakes and Braking Systems

IM SC 23.735 (f) and (g):

The available stored energy should be sufficient for:

- At least six full applications of the brakes when an anti-skid system is not operating, and

- Bringing the aeroplane to a complete stop when an anti-skid system is operating, under all runway surface conditions for which the aeroplane is certificated.

SUBJECT	**D-05 Doors / Canopy**
CERTIFICATION SPECIFICATION	**CS 23.783**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**03 (Structures), 08 (Cabin Safety)**
Nature	**SCN+IM**

SC23.783 Doors/Canopy

CS 23.783 (d), (e) and (f) are applicable to Part 23 high performance aeroplanes as defined below.

To introduce the new terminology CS 23.783 will be changed as follows:

- **CS 23.783 Doors/Canopy**
  (See AMC 23.783 (b) and IM 23.783)

(a) Each closed cabin with passenger accommodations must have at least one adequate and easily accessible external door/canopy.

(b) Passenger doors/canopy must not be located with respect to any propeller disc or any other potential hazard so as to endanger persons using that door/canopy.

(c) Each external passenger or crew door/canopy must comply with the following requirements:

(1) There must be means to latch and lock the door/canopy against inadvertent opening during flight by persons, by cargo, or as a result of mechanical failure.

(2) The door/canopy must be openable from the inside and the outside when the internal latching and locking mechanism is in the locked position.

(3) There must be a means of opening which is simple and obvious and is arranged and marked inside and outside so that the door/canopy can be readily located, unlocked, unlatched and opened, even in darkness.

(4) The door/canopy must meet the marking requirements of CS 23.811.

(5) The door/canopy must be reasonably free from jamming as a result of fuselage deformation in an emergency landing.

(6) Auxiliary security devices that are actuated externally to the aeroplane may be used but such devices must be overridden by the normal internal opening means.

(d) Not applicable

(e) Each external door on a commuter category aeroplane, each external door/canopy forward of any engine or propeller on a normal, utility, or aerobatic category aeroplane, and each door/canopy of the pressure vessel on a pressurised aeroplane must comply with the following requirements:

(1) There must be a means to latch and lock each canopy/external door, including cargo and service type doors, against inadvertent opening in flight, by persons, by cargo, or as a result of mechanical failure or failure of a single structural element, either during or after closure.

(2) There must be a provision for direct visual inspection of the locking mechanism to determine if the canopy/external door, for which the initial opening movement is not inward, is fully closed, latched and locked. The provisions must be discernible, under operating lighting conditions, by a crew member using a flashlight or an equivalent lighting source.

(3) There must be a visual warning means to signal a flight-crew member if the canopy/external door is not fully closed, latched and locked. The means must be designed so that any failure, or combination of failures, that would result in an erroneous closed, latched and locked indication is improbable for canopy/doors for which the initial opening movement is not inward.

(f) In addition, for commuter category aeroplanes, the following requirements apply:

(1) covered in CS 23.807(b)

(2) Not applicable

(g) Not applicable

Appendix 1 **Interpretative material for SC-D23.0783-02**

Appendix 1

Interpretative material IM 23.783 for SC-D23.0783-02

IM 23.783 Doors/Canopy

Inconsistent or inaccurate use of terms may lead to the installation of doors and hatches that do not fully meet the safety objectives of the regulations. To ensure that such installations fully comply with the regulations, the following definitions are used when showing compliance with **SC-D23.0783-02**:

a. *“Door”* includes all doors, canopy, hatches, openable windows, access panels, covers, etc. on the exterior of the fuselage which do not require the use of tools to open or close. This also includes each door or hatch through a pressure bulkhead including any bulkhead that is specifically designed to function as a secondary bulkhead.

b. *“Initial opening movement,”* refers to that door movement caused by operation of a handle or other door control mechanism which is required to place the door in a position free of structure that would interfere with continued opening of the door.

c. *“Inward”* means having a directional component of movement that is inward with respect to the mean (pressure) plane of the body cut-out.

d. *“Closed”* means that the door has been placed within the door frame in such a position that the latches can be operated to the “latched” condition. *“Fully closed”* means that the door is placed within the door frame in the position it will occupy when the latches are in the latched condition.

e. *“Latches”* are movable mechanical elements that, when engaged, prevent the canopy/door from opening.

f. *"Latched"* means the latches are engaged with their structural counterparts and held in position by the latch operating mechanism.

g. *"Latching system"* means the latch operating system and the latches.

h. *"Locks"* are mechanical elements in addition to the latch operating mechanism that monitor the latch positions, and when engaged, prevent latches from becoming disengaged.

i. "Locked" means the locks are engaged and held in position by the lock operating mechanism.

j. *"Locking system"* means the lock operating system and the locks.

k. *"Stops"* are fixed structural elements on the door and door frame, which when in contact, limit the directions in which the door is free to move.

l. *"Exit"* is a door designed to allow egress from the aeroplane.

m. *"Flight"* refers to that time from start of takeoff roll until the aeroplane comes to rest after landing.

n. *"Inadvertent action by persons"* means an act committed without forethought, consideration or consultation.

o. auxiliary security devices" means devices that provide a means to prevent unauthorised access to the aircraft when on the ground.

SUBJECT	**D-06 Bird Strike**
CERTIFICATION SPECIFICATION	**23.775(h)**
PRIMARY GROUP / PANEL	**3 (Structures)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN**

SC 23.631 Bird Strike

For all CS-23 high performance aeroplanes the following applies:

(1) Windshield panes directly in front of the pilot(s) in the normal conduct of their duties, and the supporting structures for these panes must withstand, without penetration, the impact of a 0·91 kg (2 lb) bird when the velocity of the aeroplane relative to the bird along the aeroplane's flight path is equal to the aeroplane's maximum approach flap speed.
(2) The windshield panels in front of the pilot(s) must be arranged so that, assuming the loss of vision through any one panel, one or more panels remain available for use by a pilot seated at a pilot station to permit continued safe flight and landing.
(3) Continued safe flight and landing is required after impact of a 0·91 kg (2 lb) bird when the velocity of the aeroplane relative to the bird along the aeroplane's flight path is equal to the aeroplane's maximum approach flap speed. This must be shown for any location prone to bird strike where a safety assessment reveals a vulnerable item of concern (e.g. cockpit, fuel tanks, empennage attachments, critical flight systems in the nose or canopy area) either through direct impact or shock wave effects.

SUBJECT	**D-102 Canopy Fracturing System**
CERTIFICATION SPECIFICATION	**CS 23.805 (b), CS 23.807 (b)(5)**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**03 (Structures), 08 (Cabin Safety)**
Nature	**SCN**

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 with 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 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. 4.23.6

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	DEF STAN 00-25 and Leaflet 63 cover anthropometric data.

	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.	

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.	

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.	

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 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.

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.	

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	The tests should be completed before the first flight.	

(b) the component can be jettisoned or fragmented with certainty and safety when the release mechanism or fragmenting device is operated.		

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 personal while operating the external means of the system.

SUBJECT	**D-103 Ejection Seats**
CERTIFICATION SPECIFICATION	**CS 23.807 (b)(5)**
PRIMARY GROUP / PANEL	**08 (Cabin Safety)**
SECONDARY GROUP / PANEL	**-**
Nature	**SCN**

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) 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.	(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. (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.	For additional strength, stiffness, and energy absorption requirements, 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.		

SUBJECT	**D-105 Emergency Evacuation Provisions**
CERTIFICATION SPECIFICATION	**CS 23.785 (d), (h), Def Stan 00-970 section 4**
PRIMARY GROUP / PANEL	**08 (Cabin Safety)**
SECONDARY GROUP / PANEL	**-**
Nature	**ELOS**

STATEMENT OF ISSUE

CS 23.785 (d) requires that each restraint system must have a single point release for occupant evacuation.

CS 23.785 (h) requires for acrobatic category aeroplane each seat to be designed to accommodate an occupant wearing a parachute.

BACKGROUND

The aircraft affected is a small two-seater aircraft for training purpose. The aircraft shall be certified in *Normal* and *Acrobatic* category. The aircraft is equipped with ejection seats which by design make literal compliance with paragraphs CS 23.785 (d)&(h) impractical. The restraint system is part of the seat and includes beside the 5-point occupant restraint other features e.g. leg restraints which are essential for ejection seat function.

The parachute is part of the seat as well and literal compliance with CS 23.785 (h) is not possible.

ELOS

While the aircraft is equipped with ejection seats and the design is such that direct compliance with the §§ CS 23.785 (d) & (h) cannot be shown EASA proposes the following equivalent level of safety requirements:

1. Establish procedures for emergency escape with the aircraft being on the ground including the un-buckling and disconnecting from the seat.
2. Demonstrate the ability to evacuate from the aircraft to the ground within 30 seconds (refer to Def Stan 00-970 section 4.22.3).
3. Due to the installation of ejection seats a placard stating as required in CS 23.785 (h) is obsolete.

SUBJECT	**D-106 Fire Extinguisher**
CERTIFICATION SPECIFICATION	**CS 23.851(a)**
PRIMARY GROUP / PANEL	**08 (Cabin Safety)**
SECONDARY GROUP / PANEL	**-**
Nature	**ELOS**

STATEMENT OF ISSUE

CS 23.851 (a) requires at least one hand fire extinguisher installed in the pilot compartment, which is within easy access of the pilot while seated. BDC requests to be exempted from that requirement for the certification of the Model 3000 (T-6C) aircraft.

BACKGROUND

The Model 3000 (T-6C) 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). If operated by one pilot only the forward seat must be used. The aircraft is equipped as a standard with two Martin Baker ejection seats. In order to comply with the requirement CS 23.851(a) two hand-held fire extinguishers are required due to the nature of aircraft usage.

The aircraft shall be certified in *Normal* and *Acrobatic* category

The aircraft is operated with a pressurized cabin, pilots wearing helmets and are supplied with breathable air from an OBOGS system. The two ejection seats are the primary escape means for the crew. They are capable of being operated at 0-speed and 0-altitude.

The space in this trainer aircraft is limited and the use of hand-held fire extinguishers will lead in a delayed ejection escape if the fire extinguishers must be stowed after an unsuccessful fire-fighting attempt or result is severe injuries to the pilots when not stowed.

The Ejection seats envelope covers nearly the entire cabin area. Therefore, an installation of the fire extinguisher is almost impossible without compromising a safe ejection.

ELOS

The applicant should analyze and demonstrate that the likelihood of a fire is improbable; and that AFM procedures are in place including clear instructions to be followed in case of a fire (this must include effects of the aircraft crashing on the ground in case the crew used the ejection seats).

SUBJECT	**D-107 Cabin Pressure Altitude Warning Indication**
CERTIFICATION SPECIFICATION	**CS 23.841(a), (b)(6)**
PRIMARY GROUP / PANEL	**08 (Cabin Safety)**
SECONDARY GROUP / PANEL	**01 (Flight)**
Nature	**ELOS**

STATEMENT OF ISSUE

CS 23.841(a) requires that "If certification for operation over 7620m (25 000 ft) is requested, the aeroplane must be able to maintain a cabin pressure altitude of not more than 4572m (15 000 ft) in event of any probable failure or malfunction in the pressurisation system"

CS 23.841(b.6) requires that there must be a "Warning indication at the pilot station to indicate when the safe or pre-set pressure differential is exceeded and when a cabin pressure altitude of (3048 m) 10.000 ft is exceeded."

The design of the Model 3000 ECS System is allowing cabin pressure altitudes up to 16.500 ft as normal operation and does not provide a warning to the pilot when exceeding 10.000ft cabin altitude.

ELOS

It is EASA position that the applicant is requested to show an equivalent level of safety to the requirements CS23.841 (a), (b)(6).

SUBJECT	**E-101 Digital Electronic engine/propeller control PMU**
CERTIFICATION SPECIFICATION	**CS 23 Subpart E**
PRIMARY GROUP / PANEL	**7 (Powerplant)**
SECONDARY GROUP / PANEL	**5 (Electronic)**
Nature	**SC**

EASA's referenced endorsement of the FAA Issue Paper P-2 "Digital Electronic Engine/Propeller Control (Power Management Unit)", which is applicable to the Model 3000, resulted in being incorporated into Special Condition 23-98-03-SC. This Special Condition is published on the FAA issued Type Certification Data Sheet A00009WI as Special Condition 23-98-03-SC which contains both Digital Electronic Engine/Propeller Control PMU (EASA CRI E-101) and Suction De-Fuel (EASA CRI E-114).

SUBJECT	**E-114 Suction Defuel**
CERTIFICATION SPECIFICATION	**CS 23 Subpart E**
PRIMARY GROUP / PANEL	**7 (Powerplant)**
SECONDARY GROUP / PANEL	**-**
Nature	**SC**

EASA's referenced endorsement of the FAA Issue Paper P-2 "Digital Electronic Engine/Propeller Control (Power Management Unit)", which is applicable to the Model 3000, resulted in being incorporated into Special Condition 23-98-03-SC. This Special Condition is published on the FAA issued Type Certification Data Sheet A00009WI as Special Condition 23-98-03-SC which contains both Digital Electronic Engine/Propeller Control PMU (EASA CRI E-101) and Suction De-Fuel (EASA CRI E-114).

SUBJECT	**E-115 Single Power Control Lever**
CERTIFICATION SPECIFICATION	**CS 23.777(d)**
PRIMARY GROUP / PANEL	**7 (Powerplant)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**ESF**

EASA's referenced endorsement of the FAA Issue Paper P-5 "Power Control Lever", which is applicable to the Model 3000, resulted in Equivalent Level of Safety ACE-97-3. This Equivalent Level of Safety is published on the FAA issued Type Certification Data Sheet A00009WI as Equivalent Safety Finding 23.777(d).

SUBJECT	**E-116 Digital Propeller Tachometer and Markings**
CERTIFICATION SPECIFICATION	**CS 23.1305(c)(5), 23.1549(b)**
PRIMARY GROUP / PANEL	**7 (Powerplant)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**ESF**

EASA's referenced endorsement of the FAA Issue Paper P-6 "Digital Propeller Tachometer and Markings", which is applicable to the Model 3000, resulted in Equivalent Level of Safety ACE-99-10. This Equivalent Level of Safety is published on the FAA issued Type Certification Data Sheet A00009WI as Equivalent Safety Findings 23.1305(c)(5) and 23.1549(b).

SUBJECT	**E-117 Digital Propeller Tachometer and Markings**
CERTIFICATION SPECIFICATION	**21A16B(a)(1), 21A17**
PRIMARY GROUP / PANEL	**7 (Powerplant)**
SECONDARY GROUP / PANEL	**5 (Electrical Systems)**
Nature	**SC**

EASA's referenced endorsement of the FAA Issue Paper P-1 "Digital Electronic Engine/Propeller Control (Power Management Unit); Protection from the Indirect Effects of Lighting", which is applicable to the Model 3000, resulted in Special Condition 23-98-03-SC. This Special Condition is published on the FAA issued Type Certification Data Sheet A00009WI as Special Condition 23-98-03-SC which contains Digital Electronic Engine/Propeller Control PMU (EASA CRI E-101), Suction De-Fuel (EASA CRI E-114), and Digital Electronic Engine/Propeller Control (Power Management Unit); Protection from the Indirect Effects of Lighting (EASA CRI E-117).

SUBJECT	**F-02 Hydraulic System**
CERTIFICATION SPECIFICATION	**CS 23.1435, AMC 23.1435(a)(6) and (b)**
PRIMARY GROUP / PANEL	**4 (Hydro-Mechanical Systems)**
SECONDARY GROUP / PANEL	**-**
Nature	**SC**

SC23.1435 Hydraulic Systems

1. In addition to the existing requirements of CS 23.1435, the following apply:

Add new to CS 23.1435:

(a)(5) Each hydraulic element must be installed and supported to prevent excessive vibration, abrasion, corrosion, and mechanical damage. If a hydraulic fluid which could be harmful to occupants when liberated in any form is used, there must be a means to prevent harmful or hazardous concentration of the fluid or vapours in the crew or passenger compartments during flight.

(a)(6) The system must be designed to avoid hazard to the aeroplane arising from the effects of abnormally high temperatures which may occur in certain parts of the system under fault conditions. (See AMC 23.1435 (a)(6))

(d) The applicant must specify the hydraulic fluid which is suitable to be used in the aeroplane.

SUBJECT	**F-52 Protection from Effects of HIRF**
CERTIFICATION SPECIFICATION	**CS-23.1309; 23.1431(a)**
PRIMARY GROUP / PANEL	**5 (Electrical Systems)**
SECONDARY GROUP / PANEL	**-**
Nature	**SC**

The aeroplane electrical and electronic systems, equipment, and installations considered separately and in relation to other systems must be designed and installed so that:

a. Electrical and electronic systems that perform a function, whose failure would prevent the continued safe flight and landing of the aeroplane must be designed and installed so that:

   i) Each function is not adversely affected during and after the time the aeroplane is exposed to the HIRF environment I defined in Appendix 1.

   ii) Each electrical and electronic system automatically recovers normal operation, in a timely manner, after the aeroplane is exposed to HIRF environment I, as defined in Appendix 1, unless the systems recovery conflicts with other operational or functional requirements of the system; and

   iii) Each electrical and electronic system is not adversely affected during and after the time the aeroplane is exposed to HIRF environment II, as described in Appendix 1.

b. Each electrical and electronic system that performs a function whose failure would significantly reduce the capability of the aeroplane or the ability of the flight crew to cope with adverse operating conditions must be designed and installed so the system is not adversely affected when the equipment providing these functions is exposed to equipment HIRF test levels (b)(i),(ii) or (iii) as described in Appendix 1.

c. Each electrical and electronic system that performs a function whose failure would reduce the capability of the aeroplane or the ability of the flight crew to cope with adverse operating conditions, must be designed and installed so that the system is not adversely affected when the equipment providing these functions is exposed to the equipment HIRF test level (c) as described in Appendix 1.

APPENDIX 1 to SC-F23.1309-02

a) HIRF environments:

Table I lists the HIRF Environment I required by SC-F23.1309-02 sub-paragraph (a)(i) & (a)(ii)

Table II lists the HIRF Environment II required by SC-F23.1309-02 sub-paragraph (a) (iii).

b) Test levels for complying with SC-F23.1309-02 sub-paragraph (b):

As a minimum, one of the following sets of equipment test levels shall be used:

1. From 10 kHz to 400 MHz, use conducted susceptibility tests with CW and 1 kHz square wave modulation of depth greater than 90 percent. The conducted susceptibility current shall start at 0.6 mA at 10 kHz, increasing 20 dB per frequency decade to 30 mA at 500 kHz. From 500 kHz to 400 MHz, the conducted susceptibility current shall be 30 mA. From 100 MHz to 400 MHz, use radiated susceptibility tests at 20 V/m peak, with CW and 1 kHz square wave modulation of depth greater than 90 percent. From 400 MHz to 8 GHz, use radiated susceptibility tests at 150 V/m peak with pulse modulation of 0.1 percent duty cycle with 1 kHz pulse repetition frequency. This signal should be switched on and off at a rate of 1 Hz with a duty cycle of 50 percent. Also, from 400 MHz to 8 GHz, use radiated susceptibility tests at 28 V/m peak with 1 kHz square wave modulation of depth greater than 90 percent. This signal should be switched on and off at a rate of 1 Hz with a duty cycle of 50 percent.
2. Or, from 10 kHz to 400 MHz, use conducted susceptibility tests with CW and 1 kHz square wave modulation of depth greater than 90 percent. The conducted susceptibility current shall start at 0.6 mA at 10 kHz, increasing 20 dB per frequency decade to 30 mA at 500 kHz. From 500 kHz to 400 MHz, the conducted susceptibility current shall be 30 mA. From 100 MHz to 400 MHz, use radiated susceptibility tests at 20 V/m peak, with CW and 1 kHz square wave modulation of depth greater than 90 percent. From 400 MHz to 8 GHz, use radiated susceptibility tests at 150 V/m peak with pulse modulation of 4 percent duty cycle with a 1 kHz pulse repetition frequency. This signal should be switched on and off at a rate of 1 Hz with a duty cycle of 50 percent with a duty cycle of 50 percent.
3. Or, the test level to be used during equipment testing may be based on the HIRF Environment II in with allowance made for aircraft attenuation using aircraft transfer function/attenuation curves. Testing must cover the frequency band of 10 kHz to 8 GHz.

c) Test levels for complying with SC-F23.1309-02 sub-paragraph (c)

As a minimum, the following equipment test level shall be used:

From 10 kHz to 400 MHz, use conducted susceptibility tests, starting at 0.15 mA at 10 kHz, increasing 20 dB per frequency decade to 7.5 mA at 500 kHz. From 500 kHz to 400 MHz, use conducted susceptibility tests at 7.5 mA. From 100 MHz to 8 GHz, use radiated susceptibility tests at 5 V/m

d) Test procedures

AC/AMJ 20.1317 Final Draft Issue (EEHWG Document WG-327 dated November 1998) and EUROCAE ED-14D/RTCA Document DO-160D, Section 20 should be referred to for the applicability of tests and test details.

TABLE I

HIRF ENVIRONMENT I

FREQUENCY FIELD STRENGTH (V/m)

FREQUENCY	FIELD STRENGTH (V/m)	
	PEAK	AVERAGE
10 kHz - 100 kHz	50	50
100 kHz - 500 kHz	50	50
500 kHz - 2 MHz	50	50
2 MHz - 30 MHz	100	100
30 MHz - 70 MHz	50	50
70 MHz - 100 MHz	50	50
100 MHz - 200 MHz	100	100
200 MHz - 400 MHz	100	100
400 MHz - 700 MHz	700	50
700 MHz - 1 GHz	700	100
1 GHz - 2 GHz	2000	200
2 GHz - 4 GHz	3000	200
4 GHz - 6 GHz	3000	200
6 GHz - 8 GHz	1000	200
8 GHz - 12 GHz	3000	300
12 GHz - 18 GHz	2000	200
18 GHz - 40 GHz	600	200

TABLE II

HIRF ENVIRONMENT II

FREQUENCY FIELD STRENGTH (V/m)

FREQUENCY	FIELD STRENGTH (V/m)	
	PEAK	AVERAGE
10 kHz - 100 kHz	20	20
100 kHz - 500 kHz	20	20
500 kHz - 2 MHz	30	30
2 MHz - 30 MHz	100	100
30 MHz - 70 MHz	10	10
70 MHz - 100 MHz	10	10
100 MHz - 200 MHz	30	10
200 MHz - 400 MHz	10	10
400 MHz - 700 MHz	700	40
700 MHz - 1 GHz	700	40
1 GHz - 2 GHz	1300	160
2 GHz - 4 GHz	3000	120
4 GHz - 6 GHz	3000	160
6 GHz - 8 GHz	400	170
8 GHz - 12 GHz	1230	230
12 GHz - 18 GHz	730	190
18 GHz - 40 GHz	600	150

SUBJECT	**F-54 Protection from Effects of Lightning Strike, Indirect Effects**
CERTIFICATION SPECIFICATION	**CS-23.867; 23.954, 23.1309**
PRIMARY GROUP / PANEL	**5 (Electrical Systems)**
SECONDARY GROUP / PANEL	**-**
Nature	**SC**

Aircraft electrical and electronic systems, equipment, and installations considered separately and in relation to other systems must be designed and installed according to the following :

(a) Each function, the failure of which would prevent the continued safe flight and landing of the aircraft

(i) Must not be adversely affected during and after exposure of the aircraft to the lightning environment; and

(ii) Each affected system that performs such a function must automatically recover normal operation following aircraft exposure to the lightning environment unless this conflicts with other operational or functional requirements of that system.

(b) Each system that performs a function, the failure of which would cause large reductions in the capability of the aircraft or the ability of the crew to cope with adverse operational conditions, may not be damaged and must be recoverable in a timely manner after exposure to the lightning environment.

(c) Each system that performs a function, the failure of which would reduce the capability of the aircraft or the ability of the crew to cope with adverse operation conditions, may not be damaged and must be recoverable in a timely manner after exposure to the lightning environment.

Interpretative material

to SC-F23.1309-03

For compliance with the above special condition, the following Interpretative Material and Acceptable Means of Compliance shall be used:

* Environment and test waveforms defined in EUROCAE document ED-84 (Aircraft Lightning Environment and Related Test Waveforms) or equivalent SAE ARP5412.
* Lightning zoning as defined in EUROCAE document ED-91 (Aircraft Lightning Zoning) or equivalent Standard SAE ARP5414.
* Acceptable Means of Compliance as defined in EUROCAE document ED-81 (Certification of Aircraft Electrical/Electronic Systems for the Indirect Effects of Lightning) or equivalent standard SAE ARP5413.This document will eventually be replaced by a new AC/AMJ 20-136A.

SUBJECT	**F-101 On Board Oxygen Generator System - OBOGS**
CERTIFICATION SPECIFICATION	**CS 23.1443(b)**
PRIMARY GROUP / PANEL	**8 (ECS)**
SECONDARY GROUP / PANEL	**-**
Nature	**SC**

SC–F23.1443-01: On-Board Oxygen Generator System

1. OBOGS shall supply oxygen to the crewmembers, with a tracheal oxygen pressure value that never drops below a minimum of 122 mmHg, in any operation up to and including a pressure altitude of 25000 ft, with the exception of brief transient following rapid decompression or change to the back-up system. It shall be possible to change to the back-up system within 5 seconds. (Figure 1).

2. Automatic switchover to 100% oxygen in the event of unintended decompression, and system to remain on 100% until either cabin pressure altitude is at a safe altitude OR the OBOGS product gas oxygen partial pressure is appropriate.

3. At and above 25,000ft cabin altitude an automatic switch over to 100% oxygen concentration is required.

4. Respiratory Demand – The performance of the oxygen system shall meet the requirements of this document at individual pulmonary ventilations (defined as flow averaged over 30 seconds) between 5 and 50 L(ATPD) min-1 and peak inspiratory and expiratory flow demands of up to 200* L(ATPD) min-1 with maximum rates of change of 10 L(ATPD) sec-2 at peak flows of 90 L(ATPD) min-1 and 20 L(ATPD) sec-2 at peak instantaneous flows of 200* L(ATPD) min-1. The oxygen system shall be capable of meeting 85% of the peak inspiratory or expiratory flows which could be demanded by the 2 crewmembers breathing exactly in phase. This represents 340 lpm (2 x 200 x 0.85).

NOTE: The 200L/min peak flow is that seen at the single mask outlet

5. At Low Engine Power Settings (OBOG systems). The impedance to respiration imposed by the breathing system is not normally to exceed the limits specified above. In certain aeroplane installations, however, the pressures at which air is supplied to the OBOG at the low engine power settings associated with engine idle on the ground may be insufficient to provide flow of product gas to an adequate pressure. In these circumstances, a deterioration of performance may be acceptable. In the worst case (idle setting of engine) the breathing system must be capable of meeting individual pulmonary ventilations of at least 25 L(ATPD) min-1 and peak inspiratory demands of at least 90 L(ATPD) min-1 with the total change of mask cavity pressure not exceeding 1.5 kPa (6.0 inwg).

6. The installation shall be compatible with and support the use of NBC protective equipment and clothing, to prevent aero-medical issues and prevent misting of the equipment's visor.

a. It is sufficient to show that the NBC masks (with filter) can be connected to the system and that the oxygen system is able to supply additional 14 lpm ATPD for one crewmember only for cabin altitudes ≤10000 ft (NBC blower failure)

7. The OBOGS shall be capable of providing oxygen enriched OBOGS product gas, as required by the effective cabin altitude conditions and the breathing demands of each crewmember. The quantity provided shall be sufficient to meet such needs under the more severe of the following conditions:

    a. The maximum endurance of the aeroplane in the most critical case in the roles specified, including any role in which the aeroplane is refuelled in flight.

    b. A return to base after loss of cabin pressure at half the maximum range of the aeroplane.

8. OBOGS shall be capable to measure oxygen partial pressure and absolute pressure to assess:

- Product gas acceptability according to 122 mmHg threshold;
- OBOGS filter and molecular sieve performance (e.g. clogging of filter, water degradation);
- Flight crew will get a good/not good performance monitoring;
- If OBOGS performance is not sufficient, automatic switchover to high pressure oxygen cylinders must take place;
- Pre-flight test can be performed to check OBOGS dispatch condition.

9. The OBOGS's product breathing gas quality shall be as detailed in Table 1, below, and as follows:

    a. If any of the contaminants have an adverse effect on the design of the unit the supplier shall state this and any proposed alternative requirement;

    b. The product gas shall be free of particles originating from the OBOGS;

    c. The OBOGS must be capable of meeting the requirements specified herein whilst being operated in the specified envelope and environmental constraints.

10. Breathing systems for aircrew shall:

    a. Meet respiratory demands without imposing excessive resistance to breathing.

    b. Prevent significant hypoxia following decompression of the pressure cabin to cabin altitudes of up to the maximum cabin altitude which can occur in flight.

    c. Prevent, when required, greater than 2% admixture of cabin air with the gas from the aircraft oxygen store or on board generation system (i.e. oxygen system, excluding the crew oxygen masks).

    d. Provide, when required, safety pressure in the mask cavity to prevent inboard leakage of environmental air.

    e. Not produce significant oscillations of pressure within the mask cavity.

    f. Prevent the pressure generated by trapped gas on rapid decompression from exceeding acceptable physiological limits.

11. Mask Cavity Pressures. The minimum and maximum pressures and the total change of pressure (pressure 'swing') during the respiratory cycle shall not exceed the following limits at any cabin altitude up to 38000 ft.

    a. Two Sets of limits, one when safety pressure is absent, and the other when Safety pressure is present, are specified:

Peak Inspiratory and Expiratory Flows - L (ATPD) per sec	Mask Cavity Pressure - kPa (inch water gauge)		
	Minimum	Maximum	Maximum Swing
Without Safety pressure			
0.5	-0.38 (-1.5)	+0.38 (+1.5)	0.5 (2.0)
1.5	-0.55 (-2.2)	+0.65 (+2.6)	0.85 (3.4)
2.5	-1.12 (-4.5)	+1.0 (+4.0)	1.75 (7.0)
3.3	-1.90 (-7.6)	+1.5 (+6.0)	3.0 (12.0)
With safety pressure			
0.5	+0.02 (+0.1)	+0.75 (+3.0)	0.5 (2.0)
1.5	-0.2 (-0.8)	+0.95(+3.8)	0.85(3.4)
2.5	-0.9 (-3.5)	+l.25(+5.0)	1.75(7.0)
3.3	-1.75 (-7.0)	+l.65(+6.6)	3.0 (12.0)

b. It is highly desirable that neither head movement (which may produce changes in volume of the flexible hose to the mask) nor the maximum rate of ascent of cabin altitude (with the pressure cabin intact) should increase by more than 0.125 kPa (0.5 inch water gauge) the pressure in the mask cavity above that which would exist under steady state conditions at that altitude.

12. Oscillatory Activity. The double amplitude of any oscillation of pressure in the mask cavity and which lasts 0.25 sec or longer shall not exceed 0.06 kPa (0.25 inch water gauge).

13. Expansion of Trapped Gas on Rapid Decompression. The pressure in the mask cavity during and immediately after rapid decompression shall not exceed that of the environment by more than 5.5 kPa (22 inch water gauge). The applicable maximum decompression rate is limited to those resulting in structural failure according to CS 23.365.

14. The back-up system for the flight deck crew shall be capable of initiation by the crew member using one hand only whilst seated in his operating position

15. Safety Pressure – Whenever oxygen regulators are used, they must be equipped with a device allowing users to always breathe at a slightly positive pressure. This device must be easy to use manually by each crew member. Positive pressure has to be sufficient to maintain a positive differential pressure inside the mask for any respiratory flow equal to or lower than 1.4 dm3 s-1.

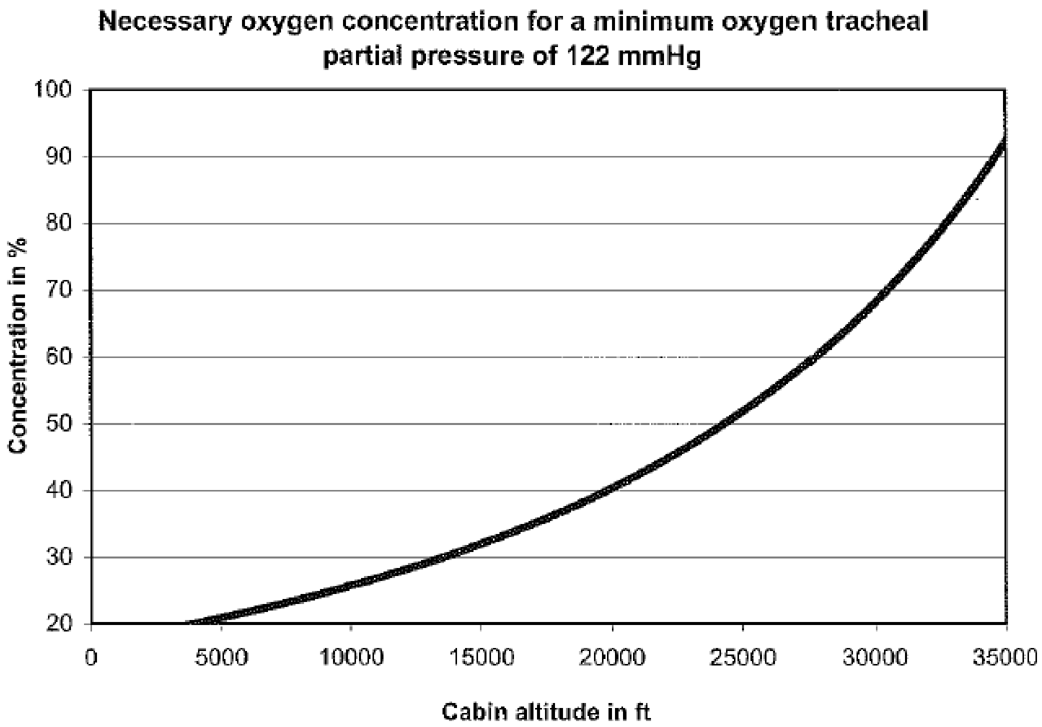


Figure 1 - Oxygen Concentration Limits with altitute

Contaminants	Limit values
Carbon Dioxide	300 ppm (v)
Carbon Monoxide	20.0 ppm (v)
Nitrous Oxide (N2O)	4.0 ppm (v)
Total Hydrocarbons :	25.0 ppm (v)
Methane (CH4)	50.0 ppm (v)
Ethane and higher hydrocarbons (as ethane) (C2H6)	6.0 ppm (v)
Unsaturated (Alkanes, Alkynes)	0.2 ppm (v)
Acetylene (C2H2)	0.1 ppm (v)
Ethylene (C2H4)	0.4 ppm (v)
Total aldehydes (out of which not more than 0.1 ppm may be Acrolein)	0.5 ppm (v)
Aromatic	0.1 ppm (v)
Refrigerants (Freon)	2.0 ppm (v)
Solvents (Halogenated)	0.2 ppm (v)
Oil	0.2 ppm (v)
Particulate Material	0.5 mg/m3
Water	5 mg/m3
Nickel	0.125 mg/m3
Cobalt	0.025 mg/m3

Table 1 – OBOGS Product breathing gas quality

SUBJECT	**F-103 Electronic Standby Direction Indicator (Compass)**
CERTIFICATION SPECIFICATION	**CS 23.1301(a)(d), 23.1303(c), 23.1309(a)(b)(c)(e), 23.1311, 23.1321, 23.1327, 23.1331, 23.1351(d)(g), 23.1353, 23.1547**
PRIMARY GROUP / PANEL	**6 (Avionic)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**ELOS**

EASA's referenced endorsement of the FAA Issue Paper SE-1 "Electronic Standby Direction Indicator" applicable to the Model 3000 resulted in Equivalent Level of Safety ACE-98-08. This Equivalent Level of Safety is published on the FAA issued Type Certification Data Sheet A00009WI as Equivalent Safety Finding 23.1303(c).
The FAA issued the new ELOS TXTAV-103850-B-SE-1 to replace the Backup Flight Instrument of the M3000.
EASA has decided to endorse the FAA ELOS TXTAV-103850-B-SE-1 applicable to the Model 3000

SUBJECT	**F-104 HUD Certification**
CERTIFICATION SPECIFICATION	**CS 23.1301, CS 23.1309, CS 23.1321**
PRIMARY GROUP / PANEL	**6 (Avionic)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**SCN**

Special Condition Head-Up Display Direction Indicator

Introductory Note:

The hereby presented Special Condition has been classified as a deviation of the applicable airworthiness codes and as such shall be subject to public consultation in accordance with EASA Management Board Decision 12/2007, dated 11 September 2007. Article 3 (2.) states:

“2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means for compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least three weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency”

Statement of Issue:
The applicant is installing a Head-Up Display (HUD) in a two-seater military trainer. The purpose of the installation of the HUD is to allow future fighter pilots to train on the use of a display that is similar to HUDs installed on fighter jets.

The HUD features a display that is depicted above the display of attitude. CS 23.1321(d)(4) requires that:

> The instrument that most effectively indicates direction of flight, other than the magnetic direction indicator required by CS 23.1303(c), must be adjacent to and directly below the instrument in the top centre position.

The instrument in the top centre position is defined as the attitude indicator in CS 23.1321(d)(1). The position of the heading information above the attitude display may be considered a non-compliance with the requirement of CS 23.1321(d)(4).

EASA Position:
In assessing the request for deviation from the strict requirements of CS 23.1321(d)(4) at Amdt. 1, EASA acted in the spirit of the new CS 23 Amdt. 5 which is much less restrictive in order to facilitate a more proportionate and risk based approach towards certification of aircraft and to better account for the intended operational use of the aircraft. In that sense, EASA considered the specific intended use of the aircraft as a trainer for future fighter pilots, recognising the benefits of training future fighter pilots using a display that is similar to the displays installed on the fighter jets in limiting the transition effort from the trainer aircraft to the fighter jet.

Considering the above, the proposed Special Condition is therefore not intended to be generically applicable to all CS 23 aircraft.

Proposed Special Condition:
The proposed special condition provides relief from the CS 23.1321(d)(4) requirement, allowing the heading information to be presented above the attitude display, by altering the requirement of CS 23.1321(b)(4) as follows:

> The instrument that most effectively indicates direction of flight, other than the magnetic direction indicator required by CS 23.1303(c), must be adjacent to ~~and directly below~~ the instrument in the top centre position.

SUBJECT	**ESF 23.841-01 Cabin rate of climb indicator removal**
CERTIFICATION SPECIFICATION	**CS 23.841(b)(5)**
PRIMARY GROUP / PANEL	**8 (ECS)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**ELOS**

The FAA issued the new ELOS TXTAV-106452-A-SM-1 for the Removal of Cabin Pressure Altitude Rate of Change Indicator of the M3000. EASA has decided to endorse the FAA ELOS TXTAV- 106452-A-SM-1 applicable to the Model 3000

SUBJECT	**ESF 23.1555 Use of Yellow and Black Emergency Markings**
CERTIFICATION SPECIFICATION	**CS 23.1555(e)(2**
PRIMARY GROUP / PANEL	**7 (Powerplant)**
SECONDARY GROUP / PANEL	**1 (Flight)**
Nature	**ELOS**

The FAA issued the new ELOS TXTAV-106452-A-SM-2 for the use of Yellow and Black Emergency Markings in Lieu of Red on the M3000. EASA has decided to endorse the FAA ELOS TXTAV-106452-A-SM-2 applicable to the Model 3000.