

CAP 482

British Civil Airworthiness Requirements

Section S - Small Light Aeroplanes

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Issue 7

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Foreword

1 General

[This BCAR Section S (CAP 482) is published in support of the powers of the Civil Aviation Authority contained in Article 9 of the Air Navigation Order 2005 as amended.]

- 1.1 This BCAR Section S contains requirements for Small Light Aeroplanes which have been developed by considerably simplifying the existing requirements for Sailplanes and Powered Sailplanes from JAR-22.
- 1.2 Aeroplanes which have been shown to comply with BCAR Section S will only be eligible for a Permit to Fly.
- 1.3 The level of airworthiness implied by these requirements is not appropriate to the use of microlight aeroplanes for the purpose of public transport or aerial work (other than aerial work consisting solely of the giving of instruction in flying), nor is it appropriate to the issue of UK Certificates of Airworthiness.

2 Recognition

Recognition will be accorded to small light aeroplanes designed, manufactured and tested in accordance with technical standards or regulations of other [] states [], which ensure an equivalent level of safety. The results of checks and tests carried out by suitably qualified and approved bodies and laboratories of other [] states [] will be taken into consideration where such results provide a level of accuracy, fitness and suitability for purpose equivalent to the results of tests carried out in the United Kingdom and where such bodies and laboratories offer a suitable and satisfactory guarantee of technical and professional competence and understanding.

3 Interpretation

- 3.1 These requirements, with or without explanatory material, should not be regarded as constituting a textbook of current aeronautical knowledge; interpretation of the requirements against a background of such knowledge is essential.
- 3.2 Where necessary, the mandatory requirements have been supplemented by [interpretative material], which give acceptable interpretation of requirements, state recommended practices or give supplementary information.
- 3.3 Mandatory clauses are invariably denoted by the use of 'shall' or 'must', 'should' or 'may' are used in the text to indicate permissive or recommended clauses.
- 3.4 It is implicit in requirements expressed qualitatively (e.g. 'readily visible', 'adequately tested') that the CAA will adjudicate in cases where doubt exists.

[]

4 Presentation

4.1 Arrangement of Requirements

This BCAR Section S is divided into 2 Parts []. Part 1 is further divided into 11 sub-sections and Part 2 is Acceptable Means of Compliance (AMC). Where there is AMC material that relates to the whole paragraph, reference to it will appear after the main paragraph title. If there is AMC material that only relates to a certain sub-paragraph(s) reference to it will appear after the affected paragraph(s).

4.2 Editorial

As far as possible, BCAR Section S paragraphs carry the same number as the equivalent paragraph in FAR/[CS-23].

4.3 S.I. units

S.I. units have been used in these requirements.

NOTE: Strict observance of the S.I. system is not compatible with current aeronautical practice, in which performance data are scheduled. Consequently, some variations from S.I. units will be found in Sub-Section B.

5 Amendment and Issue

- 5.1 The printed version of the Section, which is identified by an Issue No. and date will be deemed to be amended by each BCAR Amendment, appropriate to the Section, which is issued subsequent to the date of issue of the printed version.

[]

- 5.2 Material differences from the previous issue of each page are indicated with [bold square brackets].

- 5.3 The issue or revision date is indicated at the foot of each page. The significance of the wording is as follows:

[a) (Date) – Date of first issue of that page.]

b) Revised (Date) – Revisions, indicated by bold square brackets, have been introduced at the revision date.

c) Reissued (Date) – The text on the page has not changed from the previous issue or amendment, but the page has been reissued because of movement of text on the page [].

6 Effective Date

New requirements and amendments promulgated in BCAR Amendments are effective from the date printed on them. Thus for any application made on or after the date of issue of a printed version of the Section, the effective requirements will be made up of those in the printed version of the Section together with those in any appropriate BCAR Amendments incorporated at the time the application is made.

7 Application and Enquiries

[] For further copies of this Section [please contact TSO (see reverse of Title page for details)]. Applications for permission to reproduce any part of the requirements and any enquiries regarding their technical content should be addressed to the Civil Aviation Authority, Safety Regulation Group, Aviation House, Gatwick Airport South, West Sussex RH6 0YR.

Preambles

Section S

4 April 1995

BCAR Section S is the basis for the issue of Permits to Fly for new types of small light aeroplanes, application for approval of which is received after the above date. The basis for the issue of Certificates of Airworthiness for small light aeroplanes will continue to be JAR-VLA.

Issue 1 of BCAR Section S presents the technical intent of the advance issue, which was published in March 1983. In addition, Working Draft Papers S854, S856, S857, S861, S863 and S867 have been consolidated into the text, together with some additional material which has been taken from Working Draft Papers S855, S865 and S866.

BCAR Section S Issue 1 is made effective upon acceptance of the advice of the Airworthiness Requirements Board.

Issue 2

31 August 1999

Issue 2 consolidates Working Draft Papers S848, S880, S885, S887, S896 and S901 into the text.

These regulations were notified in draft to the European Commission in accordance with Directive 98/34/EC (formerly 83/189/EEC 19834 O.J. L109/8), (as amended).

Issue 3

15 August 2003

Issue 3 contains **no new technical changes** from those incorporated in Issue 2. The publication has however been restructured to mirror the layout of Joint Aviation Requirements (JAR) codes and European Aviation Safety Agency (EASA) Certification Specifications. Marginal lines have been replaced with bold square brackets. The AMC material has been moved to a separate section and references to any AMC material inserted against the relevant paragraph/s. The pages have been re-dated to show the applicability date of any technical material contained in them.

Issue 4

21 December 2007

Issue 4 consolidates Working Draft Papers S930 and S934 into the text.

These regulations were notified in draft to the European Commission in accordance with Directive 98/34/EC (formerly 83/189/EEC 19834 O.J. L109/8, as amended).

Issue 4 corrected

31 January 2008

A correction to the occupant weight published in Issue 4, AMC S785 a) was made.

Issue 5

21 October 2009

Issue 5 incorporates Working Draft Paper S 937 into the text.

These regulations were notified in draft to the European Commission in accordance with Directive 98/34/EC (formerly 83/189/EEC 19834 O.J. L109/8, as amended).

[Issue 6

31 May 2013

Issue 6 of BCAR S, dated 31 May 2013 incorporates Working Draft Papers S 963, S 965 and S 966 into the text.

Paper S 963 introduces changes to BCAR Section S following an accident to a foreign registered aircraft. AAIB analysis of the aircraft, its installed equipment and potential hazards led to a recommendation to agree a common standard warning placard for ballistic recovery parachutes.

Papers S 965 and S 966 introduce changes applicable to BCAR Section S, that followed the review of Paper T 957 incorporated into BCAR Section T at issue 4, dated 29 July 2011.

Some editorial changes convenient to be made at this time, have also been incorporated.】

Abbreviations and Definitions

Abbreviations

C_{m0} The zero lift pitching moment coefficient.

[EAS Equivalent airspeed. True airspeed $\times (\frac{\rho}{\rho_0})^{1/2}$ where ρ is the air density and ρ_0 is the air density in standard sea level conditions.

IAS Indicated airspeed. The readings of the pitot-static airspeed indicator as installed in the aeroplane, corrected only for instrument error.]

V_A The Design Manoeuvre Speed, EAS.

V_C The Design Cruising Speed, EAS.

V_D The Design Diving Speed, EAS.

V_{DF} The maximum speed attainable up to V_D that can be demonstrated in flight.

V_F The Design Flaps-Extended Speed, EAS.

V_{FE} The Wing Flaps Extended Speed. A maximum speed IAS with wing flaps in a prescribed extended position.

V_H The maximum level speed at maximum continuous power.

V_{LO} The Landing Gear Operating Speed. A maximum speed IAS at which it is safe to extend or retract the landing gear.

V_{NE} The Never Exceed Speed.

V_{S1} A stalling speed (or if no stalling speed is obtainable, a minimum steady flight speed), EAS, with the aeroplane in the configuration appropriate to the case under consideration.

V_{S0} A stalling speed (or if no stalling speed is obtainable, a minimum steady flight speed), EAS, with the wing flaps in the landing setting.

Definitions

Fireproof

'Fireproof' with respect to materials, components and equipment means the capability to withstand the application of heat by a flame, for a period of 15 minutes without any failure that would create a hazard to the aircraft.

Compliance with the criteria for fireproof materials or components should be shown as follows:

- 1) The flame to which the materials or components are subjected should be $1100^{\circ}\text{C} \pm 80^{\circ}\text{C}$.
- 2) Sheet materials approximately 64 cm^2 should be subjected to the flame from a suitable burner.

- 3) The flame must be large enough to maintain the required test temperature over an area approximately 13 mm².

For example, materials which are considered fireproof without being subjected to fire tests include:

- a) stainless steel sheet 0.4 mm (0.016 in) thick;
- b) mild steel sheet protected against corrosion 0.45 mm (0.018 in) thick; and
- c) titanium sheet 0.45 mm (0.018 in) thick.

Fire-resistant

'Fire-resistant' with respect to materials, components and equipment means the capability to withstand the application of heat by a flame, as defined for 'Fireproof', for a period of 5 minutes without any failure that would create a hazard to the aircraft.

For materials this may be considered to be equivalent to the capability of withstanding a fire at least as well as aluminium alloy, in dimensions appropriate for the purposes for which they are used.

Part 1 Requirements

Sub-Section A General

S 2 Applicability

a) This Section S states requirements applicable to aeroplanes:

- 1) having a maximum total weight authorised (MTWA) not exceeding 300 kg for single seat aeroplanes [(315 kg if fitted with an airframe mounted emergency parachute recovery system)], or 450 kg for two seat aeroplanes [(472.5 kg if fitted with an airframe mounted emergency parachute recovery system)];
- 2) designed to carry not more than two persons; and
- 3) with either:
 - i) a wing loading at the MTWA not exceeding 25 kg per square metre; or
 - ii) a stalling speed V_{SO} , of not greater than 65 kph (35 kt) CAS for wing loadings greater than 25 kg/square metre.

For the purpose of UK airworthiness requirements such aeroplanes are referred to as 'microlight' aeroplanes. The requirements are applicable to all microlight aeroplanes whether they have 'rigid' or 'flexible' flying surfaces and whether their means of flight control is by conventional control surfaces or any other means.

b) Where the requirements of Section S are inappropriate to particular design and construction features it will be necessary to reconsider the validity of the requirements for each particular case, and the CAA must be consulted as to the applicable requirements.

c) Permitted Operations

A microlight aeroplane granted a Permit to Fly will be permitted only non-aerobatic operation. Non-aerobatic operation is intended to include:

- 1) Any manoeuvre necessary for normal flying.
 - 2) Stalls.
 - 3) Steep turns in which the angle of bank does not exceed 60°.
- d) In the absence of any indication to the contrary, requirements and recommendations are applicable to all aeroplanes.
- e) The method of indicating that a requirement is applicable only to aeroplanes of a specific weight range, to special conditions of certification or to aeroplanes having specified technical features, is an appropriate reference in the paragraph title or text.

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Sub-Section B Flight

General

S 21 **Proof of compliance** (See AMC S 21).

- a) Each requirement of this Sub-Section must be met by test upon an aeroplane of the type for which a Permit to Fly is requested at the most adverse combination of weight and centre of gravity (c.g.) within the range of loading conditions for which certification is requested. If control is effected by weight shift, it must be shown that the handling qualities meet the requirements at the maximum and minimum weights established under S 23. (See AMC S 21 a).)
- b) Compliance must be established for all configurations at which the aeroplane will be operated except as otherwise stated.

NOTE: Flight tests required in this Sub-Section B do not constitute all the flight testing necessary to show compliance.

S 23 **Load distribution limits**

- a) The ranges of weight and c.g. within which the aeroplane is to be safely operated must be selected by the applicant.
- b) The c.g. range must not be less than that which corresponds to the weight of each occupant, varying between a minimum of 55 kg for the pilot alone up to the maximum placarded weight with a pilot and passenger, together with a variation in fuel contents from zero to full fuel. The placarded maximum [occupant] weight must be not less than [86 kg] per person. (See AMC S 23 b).)

S 25 **Weight limits**

Maximum weight. The maximum weight must be established so that it is:

- a) not more than:
 - 1) the highest weight selected by the applicant;
 - 2) the design maximum weight, which is the highest weight at which compliance with each applicable structural loading condition and each applicable flight requirement is shown.
 - b) not less than the weight which results from the empty weight of the aeroplane, plus a weight of occupant(s) of [86] kg for a single-seat aeroplane, or [172] kg for a two-seat aeroplane, plus the required minimum equipment, plus [] fuel [for at least 60 minutes flight at maximum continuous power.]
- []
- c) [not less than the weight which results with one (86 kg pilot) occupant, required minimum equipment and maximum fuel. (See AMC S 25 c).]

S 29 **Empty weight and corresponding c.g.**

- a) The empty weight and corresponding c.g. must be determined by weighing each aeroplane:
 - 1) with:
 - i) fixed ballast;
 - ii) required minimum equipment;

- iii) unusable fuel, maximum oil and, where appropriate, engine coolant and hydraulic fluid;
- 2) excluding the weight of the occupant(s).
- b) The condition of the aeroplane at the time of determining empty weight must be one that is well defined and easily repeated, [and must be specified in the weighing report which demonstrates compliance with these requirements.]

Performance

S 45 General

Compliance with performance requirements of this Sub-Section must be shown at maximum weight for still-air in standard atmosphere at sea-level conditions using engine power not in excess of the maximum declared for the engine type.

S 49 Stalling speed

- a) V_{S0} is the stalling speed (CAS), if obtainable, or the minimum steady speed at which the aeroplane is controllable, with the engine idling (throttle closed) or engine off, whichever gives the higher value of V_{S0} , and:
 - 1) the aeroplane in the landing configuration; and
 - 2) maximum weight.
- b) V_{S1} is the stalling speed (CAS), if obtainable, or the minimum steady speed at which the aeroplane is controllable with the engine idling (throttle closed), or engine off, and:
 - 1) in the configuration existing in the test in which V_{S1} is being used; and
 - 2) at maximum weight.
- c) V_{S0} and V_{S1} must be determined by flight tests using the procedure specified in S 201.

S 51 Take-off

The take-off distance at maximum weight and in zero wind, from rest to attaining a height of 15 metres at a speed not less than $1.3 V_{S1}$ or $V_{S1} + 10$ knots, whichever is the greater, must be determined when taking off from a dry, level, short-grass surface. (See AMC S 51).

S 65 Climb

The time for climb from leaving the ground up to 1000 ft above the field must be determined and, when corrected at sea level, must not exceed four minutes with:

- a) not more than take-off power;
- b) landing gear retracted;

and without exceeding any temperature limits established under S 1041.

S 71 Rate of descent

The rate of descent in power-off en-route configuration at maximum weight must be determined.

S 75 Landing

The landing distance on a dry level short-grass surface at maximum weight and in zero wind from a height of 15 metres must be determined. The speed at 15 metres should

be the recommended approach speed, but not less than $1.3 V_{S0}$ or $V_{S0} + 10$ knots, whichever is the greater, at a power setting to be stated in the Pilot's Handbook.

Controllability and Manoeuvrability

S 143 General

- a) The aeroplane must be safely controllable and manoeuvrable during;
 - 1) take-off at maximum take-off power;
 - 2) [any steady] climb [condition];
 - 3) level flight;
 - 4) descent;
 - 5) landing, power on and off; and
 - 6) with sudden engine failure.
- b) It must be possible to make a smooth transition from one flight condition to another (including turns, reversal of turns and slips) with no more than average piloting skill, alertness or strength, and without danger of exceeding the limit load factor, under any probable operating condition, with the engine running at all allowable power settings, including the effect of power changes and sudden engine failure. Modest departures from any recommended techniques must not cause unsafe flight conditions. (See AMC S 143 b.)
- c) Any unusual flying characteristics observed during the flight tests required to determine compliance with the flight requirements and any significant variations in flight characteristics caused by rain must be determined with the engine running at all allowable powers.
- d) If marginal conditions exist with regard to pilot effort the 'pilot effort' limits must be shown by quantitative tests [for a minimum weight pilot]. In no case may the limits exceed those prescribed in the following table []. This requirement must be met with the engine running at all allowable powers. (See AMC S 143 d.)

[

For 3-axis control systems	Pitch daN	Roll daN	Yaw daN	Wing-flaps, air-brakes, landing gear – daN
a) Temporary application				
Joystick	20	10	-	20
Wheel (applied to rim)	25	20	-	
Rudder pedal	-	-	40	
b) Prolonged application	2	1.5	10	
For weight-shift control systems	Pitch daN	Roll daN	Yaw daN	Wing-flaps, air-brakes, landing gear – daN
a) Temporary application				
Control frame (using both arms)	25	20	-	20
Foot steering pedal	-	-	40	
b) Prolonged application	2	1.5	10	

]

S 145 Longitudinal Control

- a) It must be possible at any speed below $1.3 V_{S1}$ to pitch the nose downwards so that a speed equal to $1.3 V_{S1}$ can be reached promptly.
 - 1) **Test conditions.** All possible configurations and engine powers when trimmed at $1.3 V_{S1}$ (where trim control is fitted).
- b) It must be possible throughout the appropriate flight envelope to change the configuration (landing gear, wing flaps etc.) without exceptional piloting skill and without exceeding the control forces defined in S 143 d).
- c) It must be possible to raise the nose at V_{DF} at all permitted c.g. positions and engine powers.
- [d) For weight-shift pitch control systems, it must be demonstrated that the wing generates a positive (nose-up) aerodynamic pitching moment at wing incidences over the range from +10 to -10 degrees about the zero lift angle of incidence, at a speed of V_{S0} . (See AMC S 145 d).)]

S 147 Lateral and directional control

- a) Using an appropriate combination of controls, it must be possible to roll the aeroplane from a steady 30° banked turn through an angle of 60° , so as to reverse the direction of the turn within 5 seconds when the turns are made at speeds of $1.3 V_{S1}$ and at V_{NE} .
- b) (Applicable only if control is effected by weight shift). When a steady 60° banked turn is reversed by using maximum roll control at a speed between $1.6 V_{S1}$ and V_A , it must not be necessary to apply anti-roll control before reaching wings-level in order to avoid exceeding 60° of bank in the reversed direction.
- c) The tests required by a) and b) must be performed:
 - 1) where applicable, with the landing gear and wing-flaps retracted and with the landing gear and wing-flaps extended;
 - 2) without encountering uncontrollable rolling tendencies or uncommanded high roll rates; and
 - 3) with any uncommanded pitching during the manoeuvre being readily controllable.

S 155 Pitch control force in manoeuvres

The pitch control force during turns or when recovering from manoeuvres must be such that at a constant speed an increase in load factor is associated with an increase in control force. In addition:

- a) For conventional control systems the minimum value of this force to apply to the aeroplane a normal acceleration which would impose [limit] load on the structure must not be less than 7 daN [from a trimmed 1 g condition] at all speeds [up to V_{NE}] at which the required normal acceleration can be achieved without stalling, with wing-flaps and, where applicable, landing gear retracted.
- b) For weight shift/flexwing control aeroplanes:
 - 1) The control force to achieve proof load must be agreed with the CAA;
 - 2) There must be no sudden change of the pitch control force at achievable load factors within the limits established under S 337 at any speed [between V_{S1} and] V_{NE} ;

- 3) The static longitudinal stability requirements of S 173 a) must also be met under the conditions of b) 2) above.

S 161 Trim

The speeds to achieve lateral, longitudinal and directional trim must lie within $1.3 V_{S1}$ and $2.0 V_{S1}$ at all engine powers and the extreme c.g. positions.

Stability

S 171 General

The aeroplane must meet the conditions of S 173 to S 181 inclusive. In addition the aeroplane must show suitable stability and control 'feel' in any condition normally encountered in service.

S 173 Static longitudinal stability

- a) Under the conditions and throughout the speed range specified in S 175 the slope of the curve, control force versus speed, must be positive and have a value such that any significant speed change will cause a variation in control force plainly perceptible to the pilot.
- b) 1) Where the aeroplane can be trimmed longitudinally the airspeed must return to within 10% of the original trim speed when the aeroplane is disturbed from the trimmed condition.
- 2) Where the aeroplane has no longitudinal trimmer the airspeed must return to within 10% of the trim speed required by S 161 in each configuration, when the aeroplane is disturbed from the trimmed condition.

S 175 Demonstration of static longitudinal stability

The control force/speed curve must have a stable slope in the following conditions:

- a) Climb:
- 1) At $1.4 V_{S1}$;
 - 2) Landing gear retracted;
 - 3) Wing-flaps in the position for climb; and
 - 4) Maximum power.
- b) Cruise:
- 1) At maximum level flight speed and $[V_{DF}]$;
 - 2) Landing gear retracted;
 - 3) Wing-flaps retracted.
- c) Approach:
- 1) At the recommended approach speed;
 - 2) Wing-flaps in the landing position;
 - 3) Landing gear extended; and
 - 4) Engine at normal approach power and with engine off.

S 177 Lateral and directional stability

- a) With the aeroplane in straight steady flight, and when the roll and yaw controls are gradually applied in opposite directions, any increase in sideslip angle must correspond to an increased deflection of the lateral control. This behaviour need not follow a linear law.
- b) In a sideslip any control force must increase progressively with sideslip; it need not be linear but must not reverse.

S 181 Dynamic stability

- a) Any short period oscillations not including combined lateral-directional oscillations occurring between the stalling speed and V_{DF} must be heavily damped with the primary controls:
 - 1) Free;
 - 2) Fixed.
- b) Any combined lateral-directional oscillations occurring between the stalling speed and V_{DF} must be damped with the primary controls:
 - 1) Free;
 - 2) Fixed.
- [c) Any long period oscillation of the flight path (phugoid) must not be so unstable as to cause an unacceptable increase in pilot workload or otherwise endanger the aeroplane. When, in the conditions of S 175, the longitudinal control force required to maintain speeds differing from the trimmed speed by at least $\pm 15\%$ is suddenly released, the response of the aeroplane must not exhibit any dangerous characteristics nor be excessive in relation to the magnitude of the control force released. (See AMC S 181 c).)]

These requirements must be met with the engine running at all allowable powers.

Stalls**S 201 Wings level stall**

Stalling behaviour must be investigated at forward and aft c.g. limits and at the maximum and minimum weights established under S 23.

- a) Stall demonstrations must be conducted by reducing the speed by approximately 1 kt per second from straight and level flight until either a stall results as evidenced by a downward pitching motion or downward pitching and rolling motion not immediately controllable or until the longitudinal control reaches the stop. It must be possible to produce and correct roll and yaw by unreversed use of the controls until the stall occurs.
- b) It must be possible to prevent more than 20° of roll by normal use of the controls during recovery. There must be no tendency to spin.
- c) The loss of altitude from the beginning of the stall until regaining level flight by applying normal procedures and the maximum pitch attitude below the horizon must be determined. (See AMC S 201 c).)
- d) Compliance with the requirements of sub-paragraphs a) to c) of this paragraph must be shown under the following conditions:
 - 1) Wing-flaps in any position;
 - 2) Landing gear retracted and extended;

- 3) Trimmed to $1.4 V_{S1}$ (if fitted with a trimmer);
- 4) Power [(See AMC S 201 d) 4)]:
 - i) Engine idling; and
 - ii) Maximum continuous power[, or, if the power-to-weight ratio at maximum continuous power results in extreme nose-up attitudes, demonstration may be carried out with the power not less than that required for level flight in the landing configuration at maximum landing weight and a speed of $1.4 V_{S0}$, except that the power may not be less than 75% maximum continuous power].

S 203 **Turning flight stalls**

- a) When stalled during a co-ordinated 30° banked turn, it must be possible to regain normal level flight without encountering uncontrollable rolling or spinning tendencies. (See AMC S 203 a).)
- b) The loss of altitude from beginning of the stall until regaining level flight by applying normal procedures must be determined. This requirement must be met with the engine running in the conditions prescribed in S 201(d)(4) and the wing-flaps in any position.

S 207 **Recovery from the stall**

- a) An aeroplane which does not give warning of the approach of the stall may be acceptable provided that when a stall occurs from straight flight:
 - 1) it is possible to produce and correct roll by using the roll control, the yaw control being held neutral; and
 - 2) no appreciable wing-dropping occurs when both the roll and yaw controls are held neutral.
- b) An aeroplane which does not meet the conditions of a) must give clear and distinctive stall warning with the wing-flaps and landing gear in any normal position, both in straight and turning flight. The stall warning must not occur at normal operating speeds, but must occur sufficiently before the stall to allow the pilot to recover safely. The stall warning may be furnished either through the inherent aerodynamic qualities (e.g. buffeting) or by a device that will give clearly distinguishable indications.
- c) Aeroplanes with flexible lifting surfaces shall be designed to ensure that:
 - 1) if the surface deforms owing to a gust or any manoeuvre, the surface shall re-establish its profile quickly so as not significantly to delay recovery to normal level flight.
 - 2) application of full sustained control deflection(s), will not cause any control difficulties or, in the case of powered parachutes, cause canopy collapse.

Spinning

S 221 **General**

For any aeroplane that is not controlled by weight shift:

- a) the aeroplane must be able to recover from a one-turn erect spin or a 3 second erect spin, whichever takes longer, in not more than one additional turn, with the controls used in the manner normally used for recovery. The recovery must be demonstrated with flaps, airbrakes and undercarriage in any allowable position and

without exceeding the pilot effort limits for temporary application under S 143 and the applicable airspeed and positive manoeuvring load factor limitations.

b) it must be impossible to obtain unrecoverable spins with any use of the controls.

For the flaps and airbrakes extended condition, the flaps and airbrakes may be retracted during the recovery.

c) If clearance for intentional spinning is desired, the CAA must be consulted.

Ground Handling Characteristics

S 233 Directional stability and control

There must be no uncontrollable ground-loop tendency at any speed at which the aeroplane may be expected to be operated on the ground, and it must have adequate directional control during taxiing.

S 235 Take-off and landing in crosswinds

The ability to take-off and land safely in crosswinds shall be investigated. Based on the results of these tests, advice on operation in crosswinds shall be given in the Pilot's Handbook.

Miscellaneous Flight Requirements

S 251 Vibration and buffeting

Each part of the aeroplane must be free from excessive vibration at all speeds up to at least V_{DF} . In addition, there must be no buffeting, in any normal flight conditions, severe enough to interfere with the satisfactory control of the aeroplane, cause excessive fatigue to the crew, or result in structural damage. Stall warning buffeting within these limits is allowable. This requirement must be met with the engine running at all allowable powers [including start-up and shutdown].

Sub-Section C Structure

General

S 301 Loads

- a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.
- b) Unless otherwise provided, the air and ground loads must be placed in equilibrium with inertia forces, considering each major item of mass in the aeroplane. These loads must be distributed so as to represent actual conditions or a conservative approximation to them.
- c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.
- d) The structural integrity criteria in Sub-Sections C and D for flight conditions are applicable to aeroplanes with a design maximum speed V_D not exceeding 140 kt EAS. For aeroplanes with a design maximum speed in excess of this, then subparts C, D and paragraphs 1505, 1511, 1545 and 1583 a) of CS VLA may be used as the appropriate structural integrity criteria. The Authority must be consulted if an alternative code is to be used.

S 303 Factor of safety

- a) Unless otherwise provided, a factor of safety of 1.5 must be used.
- b) For the textile fabric elements of powered parachute wings, a factor of safety of at least 5 must be used. A reduced factor of safety of at least 2 may be used if it is shown that the stated factor will preclude failure due to creep and provide adequate protection against tear propagation.

S 305 Strength and deformation

- a) The structure must be able to support limit loads without [detrimental] permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation. This applies in particular to the control system.
- b) The structure must be able to support ultimate loads without failure for at least three seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.

S 307 Proof of structure

- a) Compliance with the strength and deformation requirements of S 305 must be shown for each critical load condition. Theoretical structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. In other cases, substantiating load tests must be made. (See AMC S 307 a).)
- b) Certain parts of the structure must be tested as specified in Sub-Section D of these requirements.

NOTE: Structural requirements contained in Sub-Section C do not constitute all of the structural requirements necessary to show compliance

Flight Loads

S 321 General [(see AMC S 321)]

- a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the flight path of the aeroplane) to the weight of the aeroplane. A positive flight load factor is one in which the aerodynamic force acts upward, with respect to the aeroplane.
- b) Compliance with the flight load requirements must be shown:
 - 1) at each critical altitude within the range in which the aeroplane may be expected to operate; and
 - 2) at each practicable combination of weight and disposable load [within the operating limitations specified in the Flight Manual]. (See AMC S 321 b).)

S 331 Symmetrical flight conditions

- a) The appropriate balancing loads on horizontal stabilising surfaces must be accounted for in a rational or conservative manner when determining the wing loads and linear inertia loads corresponding to any of the symmetrical flight conditions specified in S 333 to S 345.
- b) The incremental loads on horizontal stabilising surfaces due to manoeuvring must be reacted by the angular inertia of the aeroplane in a rational or conservative manner.
- c) In computing the loads arising in the prescribed conditions, the angle of attack is assumed to be changed suddenly without loss of flight speed until the prescribed load factor is attained. Angular accelerations may be disregarded.
- d) Aerodynamic data required for the establishment of the loading conditions must be verified by tests, calculations or by conservative estimation.
 - 1) In the absence of better information the maximum negative lift coefficient for rigid lifting surfaces in the normal configuration may be taken as -0.8 . For flexible lifting surfaces the CAA must be consulted.
 - 2) If the [zero lift] pitching moment coefficient C_{m0} is less than ± 0.025 , a coefficient of at least ± 0.025 must be used for the wing and horizontal stabilising surfaces.
 - [3) At Condition A and Condition G of the flight envelope, in lieu of a lower value justified by rational analysis, a load equalling 25% of the lift force acting on the wing must be applied to the wing in the forward direction, parallel to the wing chord line in a suitable span-wise distribution (see AMC S 337 a) 1) and b) 1) for suitable distributions).]

S 333 Flight envelope

- a) **General.** Compliance with the strength requirements must be shown at any combination of air speed and load factor on and within the boundaries of the flight envelope specified by manoeuvring criteria of sub-paragraph b) of this paragraph.
- b) **Manoeuvring envelope.** Wing-flaps in the en-route setting (see Figure 1).

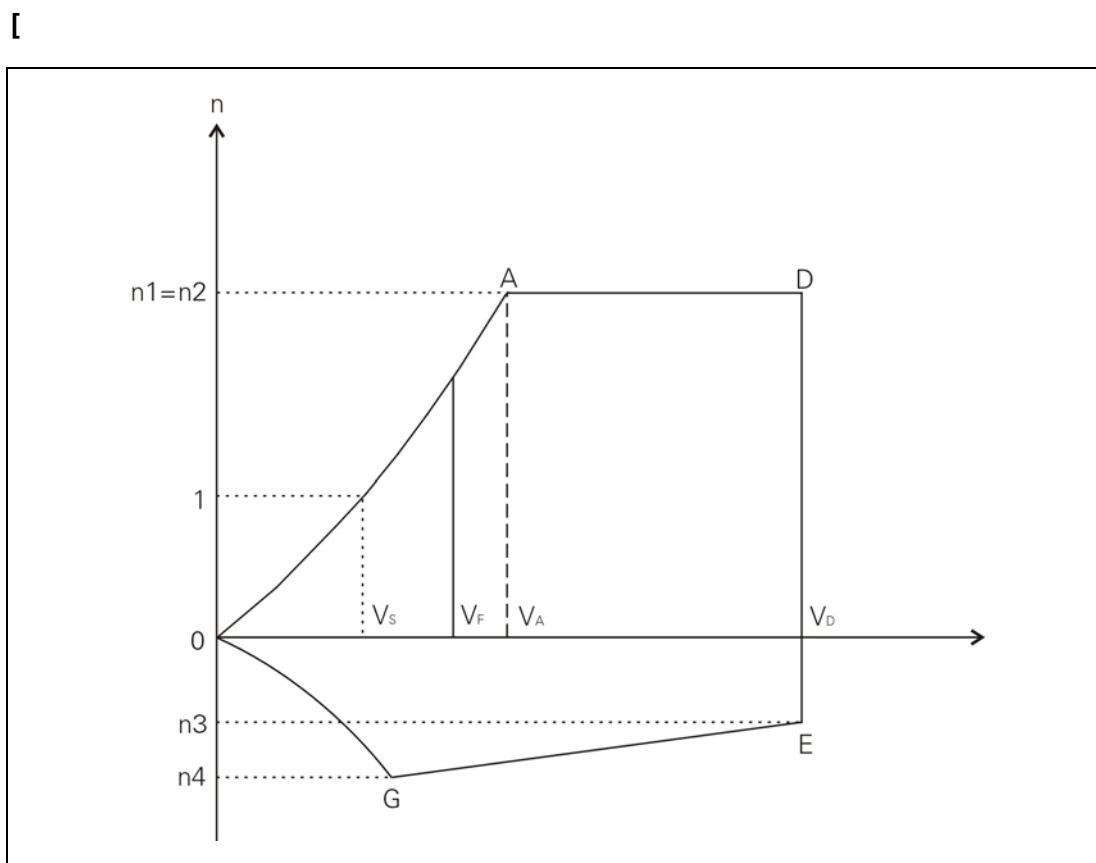


Figure 1

S 335 **Design air speeds**

The selected design air speeds are equivalent air speeds (EAS):

a) Design manoeuvring speed V_A

$$V_A = V_{S1} \sqrt{n1}$$

where:

V_{S1} = estimated stalling speed at design maximum weight with wing-flaps retracted and engine idling.

b) Design flap speed, V_F

1) For each landing setting, V_F must not be less than the greater of:

- i) $1.4 V_S$, where V_S is the computed stalling speed with wing-flaps retracted at the maximum weight;
- ii) $2.0 V_{SF}$, where V_{SF} is the computed stalling speed with wing-flaps fully extended at the maximum weight.

c) Design diving speed V_D . The design maximum speed may be chosen by the applicant but must not be lower than: $1.4 V_H$ where V_H is the maximum level speed at maximum continuous power.

S 337 Limit manoeuvring load factors (See AMC S 337).

The limit manoeuvring load factors on the V-n diagram (see Figure 1) must have at least the following values:

Category	Non-aerobatic
n 1	+4.0
n 2	+4.0
n 3	-1.5
n 4	-2.0

The negative manoeuvring load factors for flexible lifting surface aeroplanes which have limited ability to sustain negative accelerations in flight must be agreed with the CAA.

S 345 Loads with wing-flaps extended

If wing-flaps are installed, the aeroplane must be assumed to be subjected to manoeuvres up to a positive limit load factor of 4.0 with wing-flap positions from retracted to the maximum setting, at speeds up to V_F .

S 347 Unsymmetrical flight conditions (See AMC S 347).

The aeroplane is assumed to be subjected to the unsymmetrical flight conditions of S 349 and S 351. Unbalanced aerodynamic moments about the c.g. must be reacted in a rational or conservative manner, considering the principal masses furnishing the reacting inertia forces.

S 349 Rolling conditions (See AMC S 349)

The aeroplane must be designed for the rolling loads resulting from the roll control deflections and speeds specified in S 455 in combination with a load factor of at least two-thirds of the positive manoeuvring load factors prescribed in S 337.

S 351 Yawing conditions

The aeroplane must be designed for yawing loads on the vertical tail surface specified in S 441.

S 361 Engine torque

- a) The engine mount and its supporting structure must be designed for the effects of:
- 1) The limit torque corresponding to take-off power and propeller speed, acting simultaneously with 75% of the limit loads from flight condition A of S 333 b) [and including the effects of engine thrust where this is critical];
 - 2) The limit torque corresponding to the maximum continuous power and propeller speed, acting simultaneously with the limit loads from flight condition A of S 333 b) [and including the effects of engine thrust where this is critical].