SUBJECT	:	**Aerobatic Operation with VLA**
CERTIFICATION SPECIFICATION	:	CS-VLA
PRIMARY GROUP / PANEL	:	All Panels
SECONDARY GROUPE / PANEL	:	---
NATURE	:	SCE

SPECIAL CONDITION

Aerobatic Operation with VLA Aeroplane

In addition to the basic code (CS-VLA) the following requirements are applicable to an VLA aeroplane certified for aerobatic operation.

A: GENERAL

A1: Applicability

This Special Condition is applicable to aeroplanes compliant to CS-VLA (or equivalent), for which aerobatic operation is anticipated.

A2: CS-VLA SC 3 Aeroplane categories

In addition to the normal category operation given in CS-VLA 3, VLA aeroplanes can be certified for aerobatic operation, if the type complies with CS-VLA and the additional requirements of this Special Condition.

For aerobatic operation there are no restrictions to manoeuvres, other than those shown to be necessary as a result of required flight tests or other compliance demonstration.

B: FLIGHT

B1: CS-VLA SC 151 Aerobatic Manoeuvres

For VLA aeroplanes certified for aerobatic operation, it must be able to perform safely the aerobatic manoeuvres for which certification is requested. Safe entry speeds, control Inputs, and exits for these manoeuvres must be determined.

B2: CS-VLA SC 177 Static Directional and Lateral Stability

add to CS-VLA 177:

(c) Sub-paragraph (a) does not apply to aerobatic category aeroplanes certificated for inverted flight.

B3: CS-VLA SC 207 Stall warning

add to CS-VLA 207:

(d) For VLA aeroplanes certified for aerobatic operation, an artificial stall warning may be mutable, provided that it is armed automatically during take-off and re-armed automatically in the approach configuration.

B4: CS-VLA SC 221 Spinning

add to CS-VLA 221:

(c) VLA aeroplanes certified for aerobatic operation must meet the requirements of sub-paragraph (a) and CS-VLA SC 807 (b) (5). In addition, the following requirements must be met in each configuration for which approval for spinning is requested –

(1) The aeroplane must recover from any point in a spin up to and including six turns, or any greater number of turns for which certification is requested, in not more than one and one-half additional turns after initiation of the first control action for recovery. However, beyond three turns, the spin may be discontinued if spiral characteristics appear;

(2) The applicable airspeed limits and limit manoeuvring load factors must not be exceeded. For flaps-extended configurations for which approval is requested, the flaps must not be retracted during the recovery;

(3) It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and (4) There must be no characteristics during the spin (such as excessive rates of rotation or extreme oscillatory motion) which might prevent a successful recovery due to disorientation or incapacitation of the pilot.

C: STRUCTURE

C1: CS-VLA SC 333 Flight Envelope

replace CS-VLA 333 (b)(3) with:

(b)(3) Factors varying linearly with speed from the specified value at V_C to -1.0 at V_D, for VLA aeroplanes certified for aerobatic operation.

C2: CS-VLA SC 335 Design airspeeds

replace CS-VLA 335 (a)(1) with:

(a) Design cruising speed, V_C. For V_C the following apply:

(1) V_C (in knots) may not be less than 36 $\sqrt{W/S}$ for VLA aeroplanes certified for aerobatic operation

where W/S = wing loading at design maximum take-off weight lb/ft2.

replace CS-VLA 335 (b)(2) with:

(b) Design dive speed, V_D. For V_D the following apply:

(2) With V_C min, the required minimum design cruising speed, V_D may not be less than 1·55 V_C min for VLA aeroplanes certified for aerobatic operation

C3: CS-VLA SC 337 Limit manoeuvring load factors

replace CS-VLA 337 with:

(a) The positive limit manoeuvring load factor n may not be less than 6.0, for VLA aeroplanes certified for aerobatic operation

(b) The negative limit manoeuvring load factor may not be less than 0.5 times the positive load factor, for VLA aeroplanes certified for aerobatic operation

C4: CS-VLA SC 347 Limit manoeuvring load factors

add to CS-VLA 347:

(b) VLA aeroplanes certified for aerobatic operation including flick manoeuvres (snap-roll) must be designed for additional asymmetric loads acting on the wing and the horizontal tail.

C5: CS-VLA SC 349 Rolling conditions

replace CS-VLA 349 (a) with:

(a) Unsymmetrical wing loads. Unless the following values result in unrealistic loads, the rolling accelerations may be obtained by modifying the symmetrical flight conditions in CS-VLA 333(d) as follows

For VLA aeroplanes certified for aerobatic operation, in conditions A and F, assume that 100% of the semi-span wing air load acts on one side of the plane of symmetry and 60% of this load acts on the other side.

C6: CS-VLA SC 371 Gyroscopic and aerodynamic loads

add new paragraph:

For VLA aeroplanes approved for aerobatic manoeuvres, each engine mount and its supporting structure must be designed for the gyroscopic, inertial and aerodynamic loads that result and to be able to withstand, with the engine and propeller, if applicable at maximum continuous rpm, the load factors expected during combined maximum yaw and pitch velocities.

C7: CS-VLA SC 561 Emergency landing conditions; General

replace CS-VLA 561 (b) with:

(b) for VLA aeroplanes certified for aerobatic operation the structure must be designed to give each occupant reasonable chances of escaping injury in a minor crash landing when

(1) Proper use is made of seats, safety belts and shoulder harnesses; and

(2) The occupant experiences the ultimate inertia forces listed below –

Upward 4.5 g

Forward 9.0 g

Sideward 1.5 g.

C8: CS-VLA SC 572 Parts of structure critical to safety

add to CS-VLA 572:

(c) For wing, empennage and associated metallic PSE (Principal Structural Element), VLA aeroplanes certified for aerobatic operation should comply with CS 23.572.

C9: CS-VLA SC 573 Damage Tolerance and fatigue evaluation of structure

Add new paragraph:

(a) For composite material fatigue, the applicant is requested to propose a certification approach to demonstrate no catastrophic failure of composite PSE structure under aerobatic operation, taking into account the following considerations:

Conditions for VLA fatigue threshold approach

(1) PSEs should be identified and design principles described, particularly bonded load paths.

(2) Material quality and stability should be ensured through sufficient process specifications (see AMC 20-29/AC 21-26). The laminates chosen should be reasonably symmetric and balanced, and the angles between adjacent plies so as not to introduce excessive interlaminar stresses.

(3) Define fatigue spectrum for the typical missions and maximum load factor, consistent with 23.1567 and 23.1583 placarding and flight manual limitations, and based on a justified load survey. Assumed spectrum reliability would be significantly supported by the installation of accelerometers in service and the establishment of an inspection program after an exceedance. Similarly, for exceedances of cockpit design temperature, the operator should be instructed not to fly.

(4) The demonstration whether a given structural detail is fatigue insensitive can be based on a comparison between damage accumulation for aerobatic operation stress spectrum, and that for VLA spectrum. Estimation of damage accumulation for a spectrum made up from different stress levels should be supported by available test data, and the comparison should conservatively account for uncertainties. In case the damage calculated is below that introduced by the VLA spectrum (with 400 MPa limit stress), the location can be considered as fatigue insensitive. If not, fatigue insensitivity should be demonstrated through sufficient fatigue testing of the relevant failure mode, spectrum and configuration.

(5) Thermal stresses, including manufacturing residual stresses, and especially for hybrid joints, need to be considered. In case the use of CS-VLA and CS-23 appendices A and B (simplified loads) leads to inconsistent, non-conservative stresses at critical details, a rational load evaluation should be used instead.

(b) Bonded load paths whose failure would critically reduce the residual strength should be assumed disbonded between arrest features, based on a disbond probability and inspectability rationale.

For bonds, adequate process specifications and enough bond overlap to allow for degradation should be established. An adaptation of the wedge test ASTM D3762 can be agreed to support a durability demonstration.

(c) If the conditions above are not met an alternative means of compliance needs to be agreed with EASA, determining the extent of CS-23 Fatigue and damage tolerance analysis and test balance, and the potential use of mitigating factors.

C10: CS-VLA SC 629 Flutter

add to CS-VLA 629:

(f) For aeroelasticity the load factors (aerodynamic loads), and v_D calculation should be evaluated according to CS-VLA SC 335.

(g) In case a bonded joint is required to be demonstrated damage tolerant as discussed in C9 (b), must be shown by analysis to be free from flutter up to v_D with the extent of damage for which residual strength is demonstrated.

D: DESIGN and CONSTRUCTION

D1: CS-VLA SC 807 (c) Emergency Exits

add to CS-VLA 807:

(c) in the case of VLA aeroplanes certified for aerobatic operation, the exit allow each occupant to abandon the aeroplane at any speed between VSO and VD.

E: POWERPLANT

E1: CS-VLA SC 975 (c) Fuel tank vents and carburettor vapour vents

add to CS-VLA 975:

(c) fuel tanks of VLA aeroplanes certified for aerobatic operation, must be vented to prevent excessive loss of fuel during aerobatic manoeuvres, including short periods of inverted flight.

E2: CS-VLA SC 1013 (d) Oil tanks

add to CS-VLA 1013:

(d) for VLA aeroplanes certified for aerobatic operation, there must be means to prevent hazardous loss of oil during aerobatic manoeuvres, including short periods of inverted flight.

E3: CS-VLA SC 1017 (b)(5) Oil lines and fittings

add to CS-VLA 1017:

(b)(5) for VLA aeroplanes certified for aerobatic operation, there is no excessive loss of oil from the breather during aerobatic manoeuvres, including short periods of inverted flight

E4: Cooling System

add to CS-VLA 1061:

(a)(4) for VLA aeroplanes certified for aerobatic operation, the liquid cooling system must be able to function properly also during all aerobatic flight manoeuvres for which the aeroplane shall be certified.

F: EQUIPMENT

F1: CS-VLA SC 1303, g-meter

add to CS-VLA 1303:

(d) g-meter

G: OPERATING LIMITATIONS AND INFORMATION

G1: CS-VLA SC 1567 Flight manoeuvre placard

For VLA aeroplanes certified for aerobatic operation there must be a placard in clear view of the pilot:

(a) listing the approved aerobatic manoeuvres and the recommended entry airspeed for each;

(b) if inverted flight manoeuvres are not approved, the placard must bear a notation to this effect;

(c) listing the control actions for recovery from spinning manoeuvres; and

(d) stating that recovery must be initiated when spiral characteristics appear, or after not more than 6 turns or not more than any greater number of turns for which the aeroplane has been certificated.

G2: CS-VLA SC 1583 (e) Operating limitations

add to CS-VLA 1583

(e) For VLA aeroplanes certified for aerobatic operation:

(e)(1) a list of approved flight manoeuvres demonstrated in the type flight tests, together with recommended entry speeds and any other associated limitations;

(e)(2) spin recovery procedure established to show compliance with CS-VLA SC 221 (c);

(e)(3) the positive and the negative limit load factors in [g].

ANNEX

Appendix 1 Acceptable Means of Compliance to SC-OVLA.div-02

Appendix 1

Acceptable methods consider to be:

AMC 23.423 (c)

AMC 23.441 (a)

AMC 23.455 (a)(2)

CS-23, Appendix A, if followed, aerobatic specifications

FTG of CS-23