SUBJECT	**:**	**RPAS Subpart B - Flight**
CERTIFICATION SPECIFICATION	**:**	CS VLA - Subpart B
PRIMARY GROUP / PANEL	**:**	1 (Flight Test and Human Factors) 4 (Hydromechanical Systems)
SECONDARY GROUPE / PANEL	**:**	-
NATURE	**:**	Special Condition

PROPOSED SPECIAL CONDITION

RPAS Subpart B – Flight

SC-RPAS.SubpartB-01, **RPAS Subpart B – Flight**

This Special Condition and the related AMC are applicable to any RPAS:

- for which a type certification is requested,
- for which the kinetic energy assessment in accordance with section 6 of the EASA policy E.Y013-01 results in an initial certification basis according to CS-VLA, and
- with no occupant on board.

GENERAL

B.15 RPA system ancillary elements

Where an RPA System (RPAS) includes any ancillary elements necessary to enable safe flight (such as, for instance, launch and landing elements), Special Conditions must be established and agreed with the Certifying Authority to ensure safe operations.

B.21 Proof of compliance

(a) Each requirement of this subpart must be met at each appropriate combination of weight and centre of gravity within the range of loading conditions for which certification is requested. This must be shown –

(1) By tests upon an aeroplane of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and

(2) By systematic investigation of each probable combination of weight and centre of gravity, if compliance cannot be reasonably inferred upon combinations investigated.

(b) The following general tolerances are allowed during flight testing. However, greater tolerances may be allowed in particular tests.

Item	Tolerance
Weight	+5% ,-10%
Critical items affected by weight	+5%, -1%
C.G.	±7% total travel.

(c) Substantiation of the data and characteristics to be determined according to this subpart may not require exceptional RPAS piloting skill, alertness or exceptionally favourable conditions. (AMC B.21 (c))

(d) Consideration must be given to significant variations of performance and inflight characteristics caused by rain and the accumulation of insects. (AMC B.21 (d))

B.23 Load distribution limits

Ranges of weight and centres of gravity within which the aeroplane may be safely operated must be established and must include the range of lateral centres of gravity if possible loading conditions can result in significant variation of their positions.

B.25 Weight limits

(a) Maximum weight. The maximum weight is the highest weight at which compliance with each applicable requirement of this Special Condition is shown. The maximum weight must be established so that it is not more than –

(i) The highest weight selected by the applicant;

(ii) The design maximum weight, which is the highest weight at which compliance with each applicable structural loading condition of the certification basis is shown; or

(iii) The highest weight at which compliance with each applicable flight requirement of this Special Condition is shown.

(b) Minimum weight. The minimum weight (the lowest weight at which compliance with each applicable requirement of the certification basis is shown) must be established so that it is not more than the sum of –

(1) The empty weight determined under B.29;

(2) The fuel necessary for one half hour of operation at maximum continuous power.

B.29 Empty weight and corresponding centre of gravity

(a) The empty weight and corresponding centre of gravity must be determined by weighing the aeroplane with –

(1) Fixed ballast;

(2) Unusable fuel determined under CS-VLA 959; and

(3) Full operating fluids, including -

(i) Oil;

(ii) Hydraulic fluid; and

(iii) Other fluids required for operation of aeroplane systems,

(b) The condition of the aeroplane at the time of determining empty weight must be one that is well defined and can be easily repeated.

B.33 Propeller speed and pitch limits

(a) Propeller speed and pitch must be limited to values that ensure safe operation under normal operating conditions.

(b) Propellers that cannot be controlled in flight must meet the following requirements:

(1) During take-off and initial climb at VY, the propeller must limit the engine rotational speed at full throttle to a value not greater than the maximum allowable take-off rotational speed, and

(2) During a glide at VNE with throttle closed or the engine inoperative, provided this has no detrimental effect on the engine, the propeller must not permit the engine to achieve a rotational speed greater than 110% of the maximum continuous speed.

(c) A propeller that can be controlled in flight but does not have constant speed controls must be so designed that –

(1) Sub-paragraph (b)(1) is met with the lowest possible pitch selected, and

(2) Sub-paragraph (b)(2) is met with the highest possible pitch selected.

(d) A controllable pitch propeller with constant speed controls must comply with the following requirements:

(1) With the governor in operation, there must be a means to limit the maximum engine rotational speed to the maximum allowable take-off speed, and

(2) With the governor inoperative, there must be a means to limit the maximum engine rotational speed to 103% of the maximum allowable take-off speed with the propeller blades at the lowest possible pitch and the aeroplane stationary with no wind at full throttle position.

PERFORMANCE

B.45 General

(a) Unless otherwise prescribed, the performance requirements of this Special Condition must be met for still air and a standard atmosphere (at sea-level).

(b) The available power must correspond to engine power, not exceeding the approved power less installation losses on power absorbed by accessories.

B.49 Stalling speed

(a) VS0 is the stalling speed, if obtainable, or the minimum steady speed, in km/h (knots) (CAS), at which the RPA is controllable, with the –

(1) Power condition set forth in subparagraph (c);

(2) Propeller in the take-off position;

(3) Landing gear extended;

(4) Wing flaps in the landing position;

(5) Cowl flaps closed;

(6) Centre of gravity in the most unfavourable position within the allowable range; and

(7) Maximum weight

(b) VS1 is the stalling speed, if obtainable, or the minimum steady speed, in km/h (knots) (CAS), at which the RPA is controllable, with the –

(1) Engine idling, throttle closed;

(2) Propeller in the take-off position;

(3) RPA in the condition existing in the test in which VS1 is being used; and

(4) Maximum weight.

(c) VS0 and VS1 must be determined by flight tests, using the procedure specified in B.201, unless Minimum Demonstration speed according B.50 is used.

B.50 Minimum demonstration speed

If the stalling speed is not demonstrated by flight tests, a “minimum demonstration speed” will be considered.

(a) The minimum demonstration speed Vmin DEMO for any specific configuration is the minimum speed demonstrated by flight test in that configuration, using the procedure and meeting the flight characteristics specified in B.201 (a).

(b) For each configuration specified in B.201 (a) the minimum demonstration speed Vmin DEMO must be less than r times the minimum steady flight speed in this configuration. The ratio shall not be above 0.95 and shall be agreed with the Certifying Authority.

B.51 Take-off Speeds

Except for catapult assisted or rocket assisted take-off, the following applies:

(a) The rotation speed VR (if applicable), is the speed at which the flight control system makes a control input with the intention of lifting the RPA out of contact with the runway.

(b) VR must not be less than VS1.

(c) The speed at 15 m (50 ft) must not be less than the greater of

(i) A speed that is shown to be safe under all reasonably expected conditions, including turbulence and compliant with the requirement established in B.63; and

(ii) 1.20 VS1.

B.53 Take-off Performance

Except for catapult assisted or rocket assisted take-off RPA, the following applies:

(a) The take-off distance must be determined in accordance with sub-paragraph (b), using speeds determined in accordance with B.51.

(b) The distance required to take-off and climb to a height of 15 m (50 ft) above the take-off surface must be determined for each weight, altitude and temperature within the operational limits established for take-off with

(1) Take-off power on the engine;

(2) Wing flaps in the take-off position(s); and

(3) Landing gear extended in the take-off position

(c) Take-off performance as required by B.53 (a) must be determined with the operating engine within approved operating limitations.

(d) Maximum rotation rate (if applicable) is to be determined such that resulting dynamic effects do not lead to unsafe conditions or reduction in loading or manoeuvers safety margins.

B.55 Aborted take-off

For RPAS not equipped with traditional brakes, arresting means to a complete stop (i.e. cables) must be provided for any aborted take-off before VR.

B.63 Climb: General

(a) Compliance with the requirements of B.65, B.69 and B.77 must be shown

(1) Out of ground effect; and

(2) At speeds which are not less than those at which compliance with the powerplant cooling requirements of CS-VLA.1041 to CS-VLA.1047 have been demonstrated.

(3) Unless otherwise specified, at a bank angle not exceeding 5 degrees.

(b) Compliance must be shown with B.65, where appropriate and B.77 at maximum take-off or landing weight, as appropriate in a standard atmosphere, or

(c) At weights, as a function of airfield site altitude and ambient temperature, within the operational limits established for take-off and landing respectively.

B.65 Climb Performance

The RPA must have a steady rate of climb at least 2m/s with:

(1) Not more than take-off power;

(2) Landing gear retracted

(3) Wing flaps in take-off position, and

(4) Cowl flaps in the position used in the cooling test

(5) A climb speed not less than 1.3 VS1

B.69 En-route Climb

The steady gradient and rate of climb must be determined at each weight, altitude and ambient temperature within the operational limits established by the Applicant with:

(1) Not more than power required to reach the maximum continuous power or thrust on the engine;

(2) The landing gear retracted;

(3) The wing flaps retracted; and

(4) A climb speed not less than 1.3 VS1.

B.71 Glide

The maximum horizontal distance travelled in still air, in km per 1000 m (nautical miles per 1000 ft) of altitude lost in a glide, and the speed necessary to achieve this, must be determined with the engine inoperative and its propeller (if applicable) in the minimum drag position, and landing gear and wing flaps in the most favorable position.

B.75 Landing Distance

The horizontal distance necessary to land and come to a complete stop, from a point 15 m above the landing surface must be determined as follows:

a) A steady gliding approach with a calibrated airspeed of at least 1.3 Vs1 must be maintained down to the 15m height, except if it is demonstrated that a lower speed does not affect safe landing due to RPAS system performance whatever the combination of environmental conditions.

(b) The landing must be made without excessive vertical acceleration or tendency to bounce, nose over, ground loop, porpoise, or water loop.

(c) It must be shown that a safe transition to the balked landing conditions of B.77 can be made from the conditions that exist at the 15 m height.

(d) For RPAS equipped with arresting means other than wheel brakes (i.e. cable), landing distance should be established with and without using the arresting means.

B.77 Balked Landing

(a) The steady angle of climb at sea level must not be less than 1:30 with:

(1) Take-off power;

(2) Landing gear extended, and

(3) Wing flaps in the landing position

(4) A climb speed equal to 1.3VS1

(b) Minimum balked landing height shall be determined. This is defined as the minimum height above the ground where a successful balked landing could be performed safely.

FLIGHT CHARACTERISTICS

B.141 General

(a) The RPA must meet the requirements of B.143 to B.255 without requiring exceptional skill or alertness from the RPA crew.

(b) The RPA must demonstrate the fulfilment of the requirements (a) under any critical loading condition within the range of weights and centre of gravity for which certification is requested and all operating altitudes.

CONTROLLABILITY AND MANOEUVRABILITY

B.143 General

(a) The RPA must be safely controllable and manoeuvrable during all flight phases including:

(1) Take-off;

(2) Climb;

(3) Level flight, including mission relevant special manoeuvres;

(4) Descent;

(5) Go-around;

(6) Landing (power on and power off);

(7) The Emergency Recovery capability if it relies on the controllability and manoeuvrability of the RPA.

(b) It must be possible to make transition from one flight phase and/or condition to another without danger of exceeding the limit load factor, under any probable operating condition.

(c) The RPA must be able to follow standard ATC instructions and to perform collision avoidance manoeuvers during all flight phases except in datalink loss scenarios.

B.157 Rate of roll

(a) Adequate roll capability shall be demonstrated during take-off climb. It must be possible to roll the aeroplane from a steady 30 degree banked turn through an angle of 60 degrees, so as to reverse the direction of the turn within 5 seconds from initiation of roll with:

(1) Maximum take-off power, and

(2) Aeroplane selected speed of 1.2 Vs

(b) Adequate roll capability shall be demonstrated during approach. It must be possible to roll the aeroplane from a steady 30 degree banked turn through an angle of 60 degrees, so as to reverse the direction of the turn within 5 seconds from initiation of roll with:

(1) Engine operating at idle power; and

(2) Aeroplane selected speed of 1.3 Vs

TRIM

B.161 Trim

The Flight Control System (FCS) must trim the RPA in such a manner that enough control remains available to ensure that dynamic characteristics and safety margins are not compromised.

STABILITY

B.171 General

(See AMC B.171)

(a) The RPA, augmented by the FCS including all degraded modes, must be longitudinally, directionally and laterally stable in any condition normally encountered in service, at any combination of weight and centre of gravity for which certification is requested.

(b) Transient response in all axes during transition between different flight conditions and flight modes must be smooth, convergent, and exhibit damping characteristics with minimal overshoot of the intended flight path.

(c) In addition to data obtained by computation or modelling, stability analysis must be supported by the results of relevant flight tests.

STALLS

B.201 Wings level stall

(a) Flight tests must be conducted by starting with wings levelled and in steady flight for each relevant RPA configuration, for the most appropriate combination of weight and centre of gravity, and the required power for 1kt/s deceleration, then reducing the speed at a decelerating rate of approximately 1 kt/s.

a) Up to the time the RPA stalls, or

b) until intended Vmin DEMO, if the stalling speed is not to be demonstrated in compliance with B.50, and,

i. no stall tendency shall occur down to Vmin DEMO

ii. Vmin DEMO shall be lower by the margin established under B.50 than the minimum steady flight speed (except take-off and landing) allowed by the flight envelope protection maintained by the flight control system.

(b) The flight test may require to adjust or inhibit the flight control protection features.

B.203 Stall protection in wing level and turning flight with flight envelope protection

(a) Flight tests must be conducted in straight flight and in the maximum bank angle allowed by the flight control protection features for the most unfavourable combination of weight, centre of gravity and engine setting while abruptly reducing speed command as per relevant flight control mode.

(b) During these tests, it must be shown that

(1) The steady speed achieved should remain greater than or equal to the minimum steady flight speed (except take-off and landing) allowed by the flight envelope protection maintained by the flight control system.

(2) No unsafe characteristics occur.

B.205 Low speed warning

(a) There must be a clear and distinctive low speed warning in the GCS, with the flaps and landing gear in any normal position in straight and turning flight, in accordance with the following

(1) It should not be possible to command from the GCS speed values lower than the minimum steady flight speed (except take-off and landing) allowed by the flight envelope protection maintained by the flight control system..

(2) Adequate low speed cues and warning should be provided in the GCS when approaching the stalling speed or Vmin DEMO if the stalling is not to be demonstrated.

(3) During the tests required by B.201 the low speed warning must begin at a speed exceeding the stalling speed or Vmin DEMO (if the stalling is not to be demonstrated) by a margin of not less than 5 knots and must continue as long as the condition is true.

(4) When following the procedures of CS-VLA.1585, the low speed warning must not occur during a take-off with all engines operating, a take-off continued with one engine inoperative or during an approach to landing.

(b) The low speed warning must be furnished by a device that will give clearly distinguishable indication. A visual low speed warning device that requires the attention of the RPAS crew within the GCS is not acceptable by itself.

SPINNING

B.221 Spinning and tumbling

The RPA must be designed characteristically incapable of intentional spinning/tumbling (all spin and tumbling modes) due to the flight envelope protection maintained by the flight control system or other means to be substantiated by the Applicant unless in defined circumstances agreed to by the Certifying Authority (i.e. used as an emergency recovery capability).

GROUND HANDLING CHARACTERISTICS

B.231 Longitudinal stability and control

RPAS may have no uncontrollable tendency to nose over in any reasonably expected operating condition, including rebound during landing or take-off. Wheel brakes, when fitted, must operate smoothly and may not induce any undue tendency to nose over.

B.233 Directional stability and controllability

(a) A 90° cross-component of wind velocity, demonstrated to be safe for take-off and landing, must be established and must not be less than 18.5 km/h (10 knots).

(b) The RPA must have adequate directional control during take-off.

(c) The RPA must be able to maintain a straight path during landing until full stop

(d) Except for RPA not designed for taxi, the RPA must have adequate directional control during taxi.

B.235 Ground Operation

RPA shock-absorbing mechanism must not damage the structure of the RPA when the RPA is operated on the roughest ground that may reasonably be expected in normal operation.

MISCELLANEOUS FLIGHT REQUIREMENTS

B.251 Vibration and Buffeting

(a) There must be no vibration or buffeting severe enough to result in structural damage and each part of the RPA must be free from excessive vibration, under any appropriate speed and power or thrust conditions up to at least the minimum value of V_D allowed in CS-VLA.335.

(b) There must be no vibration or buffeting in any normal flight condition severe enough to interfere with the satisfactory control of the RPA.

ANNEX

Appendix 1 Acceptable Means of Compliance to SC-RPAS.SubpartB-01

Appendix 1

ACCEPTABLE MEANS OF COMPLIANCE

TO SC-RPAS.SubpartB-01

AMC B21 (c)
Proof of Compliance (Interpretative Material)

Whenever used, the sentence 'may not require exceptional piloting skill' should be interpreted to mean that it is no more than the skill expected from an average pilot.

AMC B21 (d)
Proof of Compliance (Acceptable Means of Compliance)

1. Performance and flight characteristics related to stalling speed, take-off , and climb should be investigated with a wet profile.
2. Although the performance may exceed the limits specified in B45, B51, B65, (dry conditions), the variations from those achieved in dry conditions should not exceed 9.3 km/h (5 kt) for VS0, 50 m for take-off distance, 0.5 m/s (100 ft per min.) for rate of climb.
3. The test conditions should be such that the profile must remain wet throughout all of the test.

AMC B.171 General

(a) Control loops stability analysis shall be performed including the effect of sensors, and computational errors and delays.

(b) The control loops must exhibit enough robustness as to cover variation of operational and functional conditions. The robustness will be measured in terms of stability margins in each control loop. The stability margins considered for certification purposes are (Gain margin: 4.5dB; Phase margin: 30 degrees); these limits apply both in normal and degraded modes of the flight control system in the approved flight envelope. Some degradation is allowed outside the approved flight envelope during unintended non-steady flight associated to system failure transients or overshoots due to atmospheric perturbations.

(c) In case of no fulfilment of paragraph (b) requirements, alternative safety evidences of enough control robustness will be provided.