

SPECIAL CONDITION
Remote Pilot Station

Doc. No. : **SC-RPAS.RPS-01**

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SUBJECT : **Remote pilot station**

CERTIFICATION SPECIFICATION : CS VLA

PRIMARY GROUP / PANEL : Panel 6 (Avionic Systems)

SECONDARY GROUPE / PANEL : Panel 1 (Flight & Human Factors)
Panel 4 (Hydromech.)
Panel 5 (Electrical)
Panel 7 (Powerplant)
Panel 10 (Software)
Panel 12 (Development Assurance and Safety Assessment)

NATURE : Special Condition

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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.
- with no handover of one RPA between different RPS
- with RPS that remain in a fixed location for the duration of the RPA flight. When the RPS is to be used on a moving platform, the Certifying Authority may require an additional special conditions.

SC-RPAS.RPS-01 General

(a) The RPAS remote pilot station must be adequate to support the command and control of the RPA by the RPAS crew for the kind of operations to be approved by the Certifying Authority.

(b) The remote pilot station and its installed equipment must be designed to withstand the environmental conditions stated in the RPAS Flight manual.

SC-RPAS.RPS-02 Infrastructure and work place

(a) The physical parameters (e.g. size, temperature, power supply, earth bonding, maximum capacity ...) deemed as essential for operation and that define the infrastructure suitable for the control station must be stated in the RPAS Flight Manual.

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(b) The crew work place conditions (temperature, humidity, air quality, ventilation, vibration, noise, heat emissions ...) must be adequate to allow the safe execution of the flights.

(c) The crew work place lights, if available must:

(1) make each indicator, data display, information, markings, placard and control easily readable and discernible.

(2) be installed so that their direct rays, and rays reflected from any surface, are shielded from the crew's eyes.

(d) The remote pilot station must provide an unimpeded and rapid escape to the crew.

SC-RPAS.RPS-03 Function and installation of remote pilot station equipment

Each item of equipment installed in the control station must comply with CS-VLA.1301

SC-RPAS.RPS-04 Minimum flight crew

(a) The minimum flight crew is established so that it is sufficient for safe operation, considering the workload on each individual crew member and kinds of operation to which the RPA is certified

(b) Each crew member workload and role are determined considering the following:

(1) Flight path control

(2) Separation and collision avoidance with ground obstacle or air traffic

(3) Navigation

(4) Communications

(5) Operation and monitoring of all RPAS systems required for continued safe flight and landing

(6) Tasks not related to piloting (e.g. payload operation)

(7) Pre-flight activities

SC-RPAS.RPS-05 Systems and equipment used by the crew

This paragraph applies to equipment intended for crew members' use in the operation of the RPA at the control station. Installed equipment must be shown, individually and in combination with other such equipment, to be designed so that qualified crew members trained in its use can safely perform their tasks associated with its intended function by meeting the following requirements:

(a) Controls must be installed to allow accomplishment of these tasks and any information necessary to accomplish these tasks must be provided.

(b) Controls and information intended for crew use must:

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- (1) Be presented in a clear and unambiguous form, at resolution and precision appropriate to the task.
- (2) Be accessible and usable by the crew in a manner consistent with the urgency, frequency, and duration of their tasks, in compliance with SC-RPAS.RPS-09
- (3) Be plainly marked as to its function and method of operation, except these controls whose function is obvious, and
- (4) Enable crew awareness, if awareness is required for safe operation, of the effects on the RPA or systems resulting from crew actions.

(c) Operationally-relevant behaviour of the installed equipment must be:

- (1) Predictable and unambiguous, and
- (2) Designed to enable the crew to intervene in a manner appropriate to the task.

(d) To the extent practicable, installed equipment must enable the crew to manage errors resulting from the kinds of crew interactions with the equipment that can be reasonably expected in service.

(e) The remote pilot station and its equipment must allow the crew to perform their duties without unreasonable concentration or fatigue.

SC-RPAS.RPS-06 Remote pilot station electrical systems

(a) Remote pilot station Electrical Systems

1) Each electrical system in the remote pilot station must be:

- a) Free from hazards in itself, in its method of operation, and in its effects on other parts of the remote pilot station (RPS)
- b) So designed that the risk of electrical shock to RPA crew in the RPS and other ground personnel is reduced to a minimum.
- c) Designed to be protected against Electrostatic, Lightning and HIRF hazards.

2) The global electrical heat emission must be taken into account in the design of the RPS.

(b) Remote pilot station Power Supply

- 1) The RPS power supply must be designed such that the operations in normal and failure conditions shall not lead to an unsafe condition; the corresponding minimum RPS power required must be stated in the RPAS Flight Manual.
- 2) The parameters (e.g. size, temperature, power supply, earth bonding, ...) deemed as essential for flight safety and defining the infrastructure convenient for the remote pilot station must be stated in the RPAS Flight Manual.

(c) Electrical Systems Warning and Indication

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- 1) A means must exist in the control station to indicate to the crew the electric power supply quantities in RPS essential for safe operation
- 2) A warning which is unambiguous and clearly distinguishable to the RPAS Ground crew shall be immediately provided for any GCS power supply failure which could result in an unsafe condition in any phase of RPAS flight, including landing and take-off.

SC-RPAS.RPS-07 Remote pilot station controls

(a) General requirements: Controls must be designed to:

- (1) Prevent the inadvertent entry of foreign objects into places where they would jam the system.
- (2) Maintain any set position without-
 - (i) Constant attention; or
 - (ii) Tendency to creep due to control loads or vibration.

(b) Fuel shutoff means:

- (1) There must be a means in the control station to rapidly shutoff the fuel required by the RPA for propulsion.
- (2) There must be means to guard against inadvertent operation of each shutoff,

(c) Engine control:

There must be a means in the control station to separate the power or thrust control for each engine and a separate control for each supercharger that requires a control, unless it can be shown that multiple engines, operated by a single control will not prohibit the isolation of a failed motor and the control of the remaining motors to insure safe flight and landing

SC-RPAS.RPS-08 Indication general

- (a) Each indication of a valve or switch required for safety shall indicate the effect of the operation of the valve or switch.
- (b) In case the effect of the operation of the valve or switch does not correspond with the commanded position, a warning needs to be announced to the crew.
- (c) There must be an indication of which RPA is paired to the RPS

SC-RPAS.RPS-9 Indication markings

(a) For each required instrument, that indicates a range of operation:

- (1) Maximum, and if applicable minimum, safe operating limit is indicated;
- (2) Normal operating range, if indicated, is green not extending beyond the maximum and minimum safe limits;

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(3) Each precautionary range is indicated in yellow; and

(4) Each system operating range that is restricted is indicated in red.

(b) When an airspeed indicator is provided, it must be marked as specified in subparagraph (a) of this paragraph, with the marks located at the corresponding indicated airspeed.

(1) For the never-exceed speed VNE, a red line.

(2) For the caution range, a yellow range; extending from the red line specified in subparagraph (b)(1) of this paragraph to the upper limit of the normal operating range or line specified in subparagraph (b)(3) of this paragraph.

(3) For the normal operating range, a green range with the lower limit at VS1 with maximum weight and with landing gear and wing flaps retracted, and the upper limit at the maximum structural cruising speed VNO established under CS-VLA.1505(b)

(4) For the flap operating range, a white range with the lower limit at VSO at the maximum weight and the upper limit at the flaps- extended speed VFE established under CS-VLA.1511.

SC-RPAS.RPS-10 Arrangement and visibility

(a) Each flight, navigation, powerplant instrument and datalink status information provided, must be clearly arranged and plainly visible to the pilot.

(b) Instrument panel vibration may not damage or impair the readability or accuracy of any instrument.

SC-RPAS.RPS-11 Warning, caution, and advisory lights

If warning, caution or advisory lights are installed in the control station, they must, unless otherwise approved by the Agency, be:

(a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);

(b) Amber, for caution lights (lights indicating the possible need for future corrective action);

(c) Green, for safe operation lights; and

(d) Any other colour, including white, for lights not described in sub-paragraphs (a) through (c), provided the colour differs sufficiently from the colours prescribed in sub-paragraphs (a) to (c) to avoid possible confusion.

SC-RPAS.RPS-12 Flight and navigation instruments

(a) The following are the minimum required flight and navigational data that must be displayed at all times in the remote pilot station at an update rate consistent with safe operation:

- (1) Indicated airspeed;
- (2) Pressure altitude and related altimeter setting;
- (3) Heading or track;
- (4) RPA position on a map at a scale selectable by the operator, together with the deviation between the planned ground track and the actual RPA flight path;

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- (5) Where automatic or semi-automatic flight control modes (e.g. altitude hold, heading hold, airspeed hold) are activated, the commanded flight or navigation parameters sent to the RPA must be displayed
- (b) The following are the minimum required flight and navigational data that shall be selectable or available when queried by the RPA pilot for display in the remote pilot station at an update rate consistent with safe operation:
- (1) Ground speed;
 - (2) RPA position relative to the LOS data link transmitter/receiver displayed in terms of range, bearing and altitude;
 - (3) Airspeed minimum and maximum limitations and corresponding speed warnings;
 - (4) RPA attitude;
 - (5) Vertical speed;
 - (6) Navigation system status;
 - (7) G-meter, if applicable;
 - (8) The strength and status of the Command and Control (i.e. frame/bit error rate) uplink and downlink should be provided and continuously monitored.
- (c) The applicant must demonstrate that sufficient information is provided to the pilot to safely operate the RPA.

SC-RPAS.RPS-13 Fuel capacity instruments for propulsion

- (a) There must be an indication in the control station of the total usable fuel storage capacity.
- (b) There must be an indication of the usable fuel quantity for the propulsion provided to the remote crew.
- (c) There must be a warning and indication to the remote crew to:
- (1) Indicate the system minimum fuel capacity required for safe operation;
 - (2) Indicate a failure in the fuel supplying or storage system

SC-RPAS.RPS-14 Powerplant instruments

The following shall be provided:

- (a) All instrumentation required to assure operation of the engine within established limitations, in any normal mode of operation; and
- (b) Crew alerts of any failures that require crew awareness and intervention.

SC- RPAS. RPS-15 Marking and placards.

- (a) The remote pilot station must contain –
- (1) The markings and placards specified in CS-VLA 1545 to 1567; and
 - (2) Any additional information, instrument markings, and placards required for the safe operation if it has unusual design, operating, or handling characteristics

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(b) Each marking and placard prescribed in sub-paragraph (a) of this paragraph –

- (1) Must be displayed in a conspicuous place; and
- (2) May not be easily erased, disfigured, or obscured.

(c) The units of measurement used on placards must be the same as those used on the indicators.

SC-RPAS.RPS-16 Limitations placard

There must be an indication in clear view of the crew stating in the control station that the RPA must be operated in accordance with the RPAS Flight Manual.

SC-RPAS.RPS-17 RPS Information Security

(a) RPS is designed ensuring security protection of systems and networks from access by unauthorized sources, both internal and external, if their corruption (including hardware, software, data) by an inadvertent or intentional attack would impair safety

(b) RPS is designed so that security threats to the RPA (including those possibly caused by maintenance activity or any unprotected connecting equipment/devices), are identified, assessed and risk mitigation strategies are implemented to protect the RPAS from all adverse impacts on safety

ANNEX**Appendix 1**

Acceptable Means of Compliance to SC-RPAS.RPS-01

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ACCEPTABLE MEANS OF COMPLIANCE
AMC to SC-RPAS.RPS-01**AMC.SC-RPAS.RPS-01 General**

The RPAS remote pilot station includes all the ground equipment needed for the command and control of the RPA (i.e. antennas, electrical equipment ...).

AMC.SC-RPAS.RPS-04.1 Minimum flight crew

In determining the minimum flight crew, the usability of the control station interface by the crew and associated workload should be measured under a full spectrum of conditions using a methodology such as that found in FAA Advisory Circular 27-1523. The crew workload associated with actions necessary for collision avoidance should be considered.

If the operations involve crew different than the ones in the control station, the applicant shall identify all the ground crew involved in the operations, their role and communication between different crew. This could be applicable for instance to all ground operations such as engine start, taxi, loading of flight plan, pairing, engine run up, take off, landing, final taxi and engine shut down. The applicant shall identify who is in control for each phase of operation and how the control is switched over.

AMC.SC-RPAS.RPS-04.2 Minimum flight crew communications

When RPA operation is supported by more than 1 person, workload assessment should take into account crew communications.

When operational or airspace requirements are such that crew should communicate with Air Traffic Services (either by voice or by datalink), workload assessment should take into account such communications.

AMC.SC-RPAS.RPS-05 Systems and equipment used by the crew

Environmental conditions and system operation in a RPAS differ from manned aircrafts. The information is provided to the pilot in displays similar to the display of integrated flight decks. The RPAS operation could be based on high level commands following the concept of autopilot commands in manned aviation. Any specific Human Factors potential issue that may be related to non-conventional crew distribution shall be identified and scrutinized (e.g. CRM issues, task sharing, communication, crew coordination, etc.)

- a) The design of the RPAS remote pilot station (RPS), must adequately address the foreseeable performance, capability and limitations of the crew.
- b) Due to the separation between aircraft and pilot, the pilot is deprived of a range of sensory cues available to a manned aircraft pilot. For this reason, adequate information and alerts shall be provided to the pilot for the kind of operation for which certification is requested.
- c) The workload during normal and abnormal situations shall remain within an acceptable level for the kind of operation for which certification is requested.

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- d) The following aspects of the human-machine interface design shall be assessed as adequate by the Agency:
- 1) Ease of operation including automation;
 - 2) Effects of pilot errors, including the potential for error, the possible severity of the consequences, and the provision for recognition and recovery from error;
 - 3) Clear and unambiguous:
 - presentation of controls and information;
 - feedback following crew or automation actions
 - 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
 - 4) Adequacy of flight crew alerting:
 - flight crew alerts must provide the flight crew with the information needed to:
 - (i) identify non-normal operation or aeroplane system conditions, and
 - (ii) determine the appropriate actions, if any;
 - flight crew alerts must be readily and easily detectable, intuitive and intelligible by the flight crew under all foreseeable operating conditions, including conditions where multiple alerts are provided;
 - satisfactory alerts must be provided to avoid unintended excursions outside the permitted flight area;
 - the alerts must be removed when the alerting condition no longer exists;
 - warning and caution alerts must be prioritised based on the urgency of flight crew awareness and response:
 - warning and caution alerts must provide timely attention-getting cues through at least two different senses by a combination of aural, visual, or tactile indications;
 - warning and caution alerts must permit each occurrence of the attention-getting cues to be acknowledged and suppressed, unless they are required to be continuous;
 - the alert function must be designed to minimise the effects of false and nuisance alerts, preventing the presentation of an alert when it is inappropriate or unnecessary.

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AMC.SC-RPAS.RPS-07 Control Station Controls

(d) Engine controls:

(1) The power or supercharger control should give a positive and immediate responsive means of controlling its engine or supercharger.

(2) If a power control incorporates a fuel shut-off feature, the control should have a means to prevent the inadvertent movement of the control into the shut-off position. The means should:

- (i) Have a positive lock or stop at the idle position; and
- (ii) Require a separate and distinct operation to place the control in the shut-off position.

(3) Ignition switches:

- (i) Each ignition circuit should be independently switched, and should not require the operation of any other switch for it to be made operative.
- (ii) The ignition switch should not be used as the master switch for other circuits.

(4) Mixture control:

The control should require a separate and distinct operation to move the control toward lean or shut-off position.

(5) Propeller speed and pitch controls:

- (i) If there are propeller speed or pitch controls, they should be grouped and arranged to allow:
 - ☐ Separate control of each propeller; and
 - ☐ Simultaneous control of all propellers.
- (ii) The controls should allow ready synchronisation of all propellers on twin-engine aeroplanes.

(6) Propeller feathering controls:

If there are propeller feathering controls installed, it should be possible to feather each propeller separately. Each control should have means to prevent inadvertent operation

(7) Carburettor air temperature controls:

There should be a separate carburettor air temperature control for each engine.

AMC.SC-RPAS.RPS-10 Arrangement and visibility

The instruments under this requirement should:

(1) Be easily legible under all lighting condition encountered in the control station, including direct sunlight during the entire useful life.

(2) Incorporate sensory cues for the pilot that are equivalent to those in the instrument being replaced by the electronic display indicators.

(3) Incorporate visual displays of instrument markings, required by SC-RPAS.RPS-09, or visual displays that alert the pilot to abnormal operational values or approaches to established limitation values, for each parameter required to be displayed by this CS.

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AMC to CS-23.1322 can be used as guidance.

AMC-RPAS.RPS-12.1 Flight and navigation instruments

In addition to the minimum required displayed flight and navigational data, it is recommended to also display the following data if applicable:

- "Manual abort function" status and command (especially for auto take-off and autoland functions)
- Flight modes (i.e. automatic, semiautomatic, manual)
- Status of C2 Link
- Ground obstacles (in order to allow ground separation, if applicable)
- Other traffic (in order to allow separation, if applicable)
- Flight plan (when applicable)
- RPA position relatively to RPS

AMC.SC-RPAS.RPS-12.2 Flight and navigation instruments

A warning should be provided in case of a degradation of a flight and navigation instrument required by this paragraph.

(a)(1) Airspeed Indication:

The airspeed indicating system must indicate true airspeed at sea-level in standard atmosphere with a maximum error not exceeding ± 8 km/h or $\pm 5\%$ whichever is greater, through the following speed range:

- (i) 1.3 VS1 to VNE, with wing-flaps retracted.
- (ii) 1.3 VS1 to VFE, with wing-flaps extended.

The airspeed indicating system must be suitable for speeds between VS0 and at least 1.05 times VNE.

(a)(2) Altitude Indication:

The type of altitude information to be displayed should be determined by the operating context.

(a)(3) Magnetic Direction Indication:

Where magnetic heading or track is displayed in the remote pilot station, it should be automatically compensated for deviation.

(7) G meter should be provided in order to avoid structural limit exceedances in manual direct piloting conditions, where there are no other alternative means to avoid g exceedances);

AMC.SC-RPAS.RPS-13 Energy capacity instruments for propulsion

(a) Fuel quantity indicator. Each fuel quantity indicator should be installed to clearly indicate to the crew the quantity of fuel in each tank in flight. In addition:

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- (1) Each fuel quantity indicator should be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under CS-VLA.959;
- (2) When two or more tanks are closely interconnected by a gravity feed system and vented, and when it is impossible to feed from each tank separately, at least one fuel quantity indicator should be installed

AMC.SC-RPAS.RPS-13 Fuel instruments for propulsion

- a) The remote pilot station should have a fuel quantity indicator for each fuel tank.
- (1) Each fuel quantity indicator must be calibrated to read 'zero' during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under CS-VLA 959;
- b) The remote pilot station should have a fuel pressure indicator or a low fuel pressure warning for pump-fed engines.

AMC.SC-RPAS.RPS-14 Powerplant instruments

The remote pilot station should have the following powerplant instruments for RPA with reciprocating engines:

- a) A tachometer for each engine
- b) A coolant temperature indicator for liquid-cooled engines.
- c) An oil pressure indicator for each engine or a low oil pressure warning for the engine except for engines with no oil pressure systems and for the super charger oil system if it is separate from other oil systems
- d) An oil temperature indicator for each engine except for two-stroke engines