Civil Aviation Authority – The Netherlands

Assessment Specifications for Remotely Piloted Aircraft Systems, Class 1

AS-RPAS1

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AS–RPAS1

REMOTELY PILOTED AIRCRAFT SYSTEMS, CLASS 1

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SUBPART A – GENERAL

RPA.G.0 Introduction

This assessment specification will be used for the assessment of RPAS with a maximum take-off mass between 0 and 150 kg and operate only within 'class 1 operations'. This class of operations will restrict the risks for third parties on the ground and in the air.
The assessment will be used for the consideration of requests for an exemption of the prohibition to use an RPAS without a valid certificate of airworthiness.
The assessment is NOT part of a certification programme, so there is no approved design organisation and no approved production organisation related to the assessed RPAS.

Though the assessment is applicable for RPAS up to a MTOM of 150 kg it is written with practical experience in CAA-NL, EuroUSC and NLR mainly with RPAS with a MTOM between 0 and 25 kg. So additional or other assessment items may be expected for an exemption for an RPAS with a MTOM between 25 and 150 kg.

RPA.G.1 Applicability

This assessment is applicable to class 1 RPAS defined as aircraft:

(a) witha maximum take-off mass of 150 kg;
(b) operating with a maximum speed of 70 knots;
(c) flown only in uncontrolled airspace;
(d) flown in Visual Line of Sight (VLOS) or Extended Visual Line of Sight (E-VLOS);
(e) flown below 120m (400ft);
(f) flown no further than 500m from the Pilot In Command (PIC) or in case of E-VLOS no further than 750m from the PIC, but within 500m maximum distance of the observer;
(g) operating at a minimum distance (horizontal) of 150m from public and buildings.
(h) flown in visual meteorological conditions (VMC) within the daylight period.

Note 1. Flights are always flown by a team of at least 2 persons: Pilot In Command (PIC) and Observer.

Note 2. The horizontal distance to a building incl. industrial ‘object’ under control of the RPAS operator can be less than 150 m. If that object can have electromagnetic radiating influences, flights are allowed only if DL.5 is assessed positive.

RPA.G.2 Mass

The manufacturer shall specify empty and maximum take off mass of the aircraft. These masses shall be verified by test.

RPA.G.3 Dimensions

The manufacturer shall specify outboard dimensions of the aircraft. These dimensions shall be verified by test and.

RPA.G.4 Centre of gravity

The manufacturer shall specify the centre of gravity of the aircraft. The centre of gravity shall be located within the limits specified by the manufacturer.

RPA.G.5 Emergency descent

The time to descent from maximum height to 20 m (60ft) height AGL shall not exceed 36 seconds.

RPA.G.6 Minimum manoeuvrability

The aircraft shall be capable to take off, fly at cruise speed and land within a maximum radius of 500m from the Pilot In Command (PIC).
In case of an E-VLOS accepted aircraft, the aircraft shall make a turn within 750m from the PIC, but within 500m maximum distance of the observer. The manual shall give information about adequate communication procedures

between the PIC and observer. They shall be trained explicitly for this communication to be able to give way to other aircraft and enable a safe operation of the aircraft.

RPA.G.7 Environmental conditions Water resistance

The manufacturer shall specify environmental capabilities: operating temperature range, humidity and wet weather capability.
If wet weather capabilitiesare specified in the Flight Manual, the RPAS shall be able to withstand water spray up to that specified level.

RPA.G.8 Landing

Unless otherwise specified in the Flight Manual, the aircraft shall be able to land with no excessive vertical acceleration, no tendency to bounce, nose over, ground loop and without exceptional Piloting skills.
{Flight Mnaual – Technical Specification}

RPA.G.9 Manufacturer change notifications

The actual and historic hardware and software versions shall be tested and documented. Changes shall be documented and tested to ensure continuous airworthiness.

RPA.G.10 One engine inoperative

In case the aircraft specification mentions a one engine inoperative capability, the aircraft shall perform as mentioned in the Flight Manual.

RPA.G.11 System cooling

The design of the RPAS and its components shall not be subject to overheating.

RPA.G.12 Line colours

Fuel, oil and air lines shall have a different colour code.

RPA.G.13 Idle motor/engine conditions

The aircraft shall hold its position on the ground while motor/engine is running at idle.

RPA.G.14 Identification plate

A fireproof identification plate containing at least the aircraft registration and operator or owner contact details shall be secured to the aircraft in a prominent position.

RPA.G.15 System check

All flight systems shall be functioning as indicated in the Flight Manual.

RPA.G.16 Markings and placards

The RPA and RPS shall have all placards and switch markings in place on all operator accessible system components.

RPA.G.17 Safety devices check

All safety devices shall be functioning as indicated in the Flight Manual.

SUBPART B – STRUCTURE

RPA.S.1 Propellers

All propellers and/or rotors shall be undamaged, without sharp edges and with the tips clearly marked.

RPA.S.2 Airframe

The airframe structure shall be able to withstand flight limit loads without failure, malfunction or permanent deformation.

RPA.S.3 Fasteners

Each removable bolt, screw, nut, pin, or other fastener whose loss could jeopardize the safe operation of the RPAS, shall incorporate a locking device. No self-locking nut shall be used on any bolt subject to rotation in operation unless:

(a) A non-friction locking device is used in addition to the self-locking device, or
(b) The nut is tightened to the specified torque and its position is marked with sealing varnish.

RPA.S.4 Cracks

The aircraft shall not fly with visible cracks.

RPA.S.5 Vibrations

The aircraft shall be free of excessive vibrations under any operational speed and power condition.

RPA.S.6 Doors and panels

All doors, hatches and panels shall be properly secured.

RPA.S.7 Propeller blade clearance

Propeller blade clearance should be sufficient from structures and/or components.

SUBPART C – CONTROL

RPA.C.1 Flight phase transition

It shall be possible to make a smooth transition from one flight condition to another without exceptional pilot skills.

RPA.C.2 Control response

Control system forces and free play may not inhibit smooth and direct response to control system input. All controls shall be free from excessive deflection.

RPA.C.4 Stability control

The aircraft shall be able to maintain a stable flight without pilot input.

RPA.C.5 Pilot controllability

The pilot shall be able to control the aircraft without exceptional skills.

RPA.C.6 Pilot intervention

At any moment in flight, the pilot shall be able to deviate the aircraft as necessary from an automatic flight trajectory.

SUBPART D – ELECTRONICS

RPA.E.1 Primary electronics

All primary electronics shall be on board of the aircraft. . All electronic parts shall be properly mounted on the aircraft.

RPA.E.2 Wiring

The wiring lay out of the aircraft shall be according to the wiring diagram. +voltage and -voltage shall have clear colour coding, different from signal wires. Unless specified in the wiring diagram, the colour code shall be as follows: +voltage = red, -voltage = black, signal wire = other colour.

RPA.E.3 Cable routing

All wires shall be strain relieved while having minimum slack. Cable routing shall not be along sharp edges.

RPA.E.4 Cable connections

Soldering connections between cables is not allowed.

RPA.E.5 Connections

All electronics shall be connected with adequately secured connections to prevent loosening during vibrations. No unnecessary connections shall be present.

RPA.E.6 Location sensor

A location sensor shall on board and send its location to the ground station with an accuracy as specified by the manufacturer, but at least within an inaccuracy of 10 m.

RPA.E.7 Wiring

All wiring shall be suitable for the current and voltage going through; no kinks in the wiring are allowed.

RPA.E.8 Battery mounting

Battery shall be properly mounted.

RPA.E.9 Battery monitoring system

Battery used for primary electronics shall be suitable. For battery check a monitoring system shall be used.

SUBPART E – EQUIPMENT, SYSTEMS, AND INSTALLATIONS

RPA.EQ.1 Safety

All documented modes and functions of operation shall not adversely affect the safety of the RPAS, the RPAS crew, and third parties.

RPA.EQ.2 Power supply

The power supply of secondary electronics shall be separated from the primary functions power supply.

SUBPART F – AEROPLANE

RPA.A.1 Stall speed

The minimum specified operating speed of the aircraft shall be at least 10% above the actual stall speed.

SUBPART G – HELICOPTER

RPA.H.1 Yaw speed

The aircraft shall be able to rotate about the z-axis as specified in the technical specification.

RPA.H.2 Rotor track and balance

Rotor blades shall be statically balanced per set of blades and rotor track and balance shall be verified.

SUBPART H – POWERPLANT

ELECTRICAL MOTOR

RPA.EM.1 Motor controller

The motor controller shall have an overcurrent/overheating protection.

COMBUSTION ENGINE

RPA.CE.1 Exhaust

Exhaust shall be firmly mounted to the aircraft frame and free of any obstructions.

RPA.CE.2 Engine maintenance

Engine shall be lubricated and maintained according to instruction of supplier.

RPA.CE.3 Fuel system

The fuel system shall be leak free and qualified for the used fuel type and pressure.

RPA.CE.4 Location engine start-up battery

Engine start-up battery shall not interfere with the proper operation of the data link and/or control receiver.

RPA.CE.5 Engine start safe mode

Engine start on the ground shall be inhibited when data link is unavailable.

RPA.CE.6 Fuel level

A fuel level check shall be possible on the aircraft and the actual fuel level shall be transmitted to the RPS.

TURBINE ENGINE

RPA.TE.1 Fuel system

The fuel system shall be leak free and qualified for the used fuel type and pressure.

RPA.TE.3 Air intake

Air intake of the turbine engine shall be sufficient to operate at all possible flight conditions.

RPA.TE.4 Engine start safe mode

Engine start on the ground shall be inhibited when data link is unavailable.

RPA.TE.6 Fuel level

A fuel level check shall be possible on the aircraft and the actual fuel level shall be transmitted to the RPS.

SUBPART I – REMOTE PILOT STATION

RPS.1 Aircraft status information

The following information shall be displayed on the Remote Pilot Station:

(a) Aircraft altitude (AGL or AMSL)
(b) Aircraft position or horizontal distance to remote pilot or equivalent information that ensures that the aircraft shall stay within the maximum distance
(c) Aircraft ground speed
(d) Level of fuel and/or battery
(e) Aircraft GPS satellite fix indication

RPS.2 Aircraft airspeed indication

If the aircraft maximum airspeed exceeds 70 knots, an airspeed indication shall be present at the RPS. If no airspeed indication is available, but ground speed indication is available on the RPS, then the max ground speed shall not exceed 70 knots minus the maximum allowable wind speed in knots as specified in the Flight Manual.

SUBPART J – DATA LINK

DL.1 Frequency

Used data link frequency and transmitting power shall be approved by the radio communications agency.

DL.2 Range

Communication range shall be sufficient to have a permanent connection with the aircraft.

DL.3 Payload

Flight control shall not be affected by payload operations.

DL.4 Safe mode

When data link is lost or in other contingencies, the aircraft shall follow a predefined procedure to ensure a safe end of flight within the required area restrictions.

DL.5 Electromagnetic compatibility

Electronic equipment and installations shall be free from hazards and capable of functioning properly when exposed to expected external electromagnetic (EM) influences. This requirement is applicable for RPAS operating within 150 m of EM radiating sources (for example power lines and transmitter antenna's).

DL.6 Lost link warning

The Pilot In Command (PIC) shall be informed when the data link is lost by means of a warning signal.

BOOK 2 – ACCEPTABLE MEANS OF COMPLIANCE (AMC)

SUBPART A – GENERAL

AMC.RPA.G.4 Centre of gravity

The centre of gravity will be measured for the main (known/maximum) payloads and the measured limits will be verified with the limits presented in the Flight Manual, which shall not be exceeded. If the Flight Manual does not provide the limits, they shall be specified by manufacturer.

AMC.RPA.G.5 Emergency descent

Demonstrate in the test flight that the RPA is able to descent from maximum specified operating height to 20 m AGL within 36 seconds.

AMC.RPA.G.7 Water resistance

When the aircraft is stated to be capable to operate in rain, snow or highly damp (fog) conditions, the manufacturer shall provide test results to proof that the RPAS is at least IP55 qualified.

AMC.RPA.G.10 One engine inoperative

Continued flight with one engine inoperative until a landing as soon as particle is possible will be verified, unless the aircraft behaviour with one engine inoperative has been explicitly described otherwise in the Flight Manual. A safe end of flight will be essential.

AMC.RPA.G.11 Propulsion system cooling

The propulsion system and cooling design will be evaluated from a cooling point of view. If maximum temperatures are specified, these specifications will be verified.

AMC.RPA.G.15 System check

The functioning of all systems required for safe flight will be verified against the Flight Manual. Verification includes a check that other systems shall not negatively influence systems required for safe flight. This verification may be included in the flight test under PRA.EQ.1 if this cannot be performed during a ground check.

AMC.RPA.G.16 Markings and placards

The failsafe switch shall be a one function switch and marked red.

AMC.RPA.G.17 Safety devices check

The functioning of all safety devices will be verified against the Flight Manual during ground or flight test.

SUBPART B – STRUCTURE

AMC.RPA.S.2 Propulsion system

The verification includes:

1) a static test to limit load (based on MTOM);
2) a visual check on the engine mounting and structure on ground and after a test flight.

AMC.RPA.S.3 Fasteners

Verification includes:
1) All critical bolts of the main load carrying structures are tightened using a locknut.
2) All bolts are locked using thread locking compound.
3) Every bolt has at least two threads sticking out of the nut.
4) No self-locking nut is used on any bolt subject to rotation in operation unless:
   (a) A non-friction locking device is used in addition to the self-locking device, or
   (b) The nut is tightened to the specified torque and its position is marked with sealing varnish.

AMC.RPA.S.4 Cracks

Before and after flight it will be verified that no cracks are present. If cracks have been found, the components with cracks shall be replaced before flight.

AMC.RPA.S.7 Propeller blade clearance

Sufficient propeller blade clearance of all blades from structures and/or components under expected maximum load will be verified.

SUBPART C – CONTROL

AMC.RPA.C.1 Flight phase transition

The transitions from steady to turning flight, climbing and descending without exceptional pilot skills will be verified during flight.

AMC.RPA.C.2 Control response

The verification includes:
1) excessive free play and/or friction on all actuators and control surfaces that could inhibit smooth and direct response;
2) the maximum deflection of all flight controls.

AMC.RPA.C.3 Controllability

The verification includes:
1) documentation in the Flight Manual of the control mechanism;
2) demonstration of yaw, pitch and roll motions in the test flight.

AMC.RPA.C.4 Stability

The verification includes a test flight, in most manual mode, in which the aircraft shall maintain a stable flight for at least 1 second when the pilot let's go of the controls (throttle may be an exception). A fully manual mode without stability augmentation is excluded for helicopter configurations.

AMC.RPA.C.5 Pilot controllability

The verification includes demonstration during flight that the pilot can perform take-off, cruise and landing manoeuvres without exceptional skills.

AMC.RPA.C.6 Pilot intervention

Pilot flight path intervention will be verified by demonstration in flight.

SUBPART D – ELECTRONICS

AMC.RPA.E.1 Primary electronics

Primary electronics are: actuators, engine/motor control, data link, location sensor, and board computer

The verification includes:
1) primary electronics are on board the aircraft;
2) proper mounting of the electronic parts.

If verification is not possible, due to inaccessibility, document substantiation with signed manufacturer statement shall be provided.

AMC.RPA.E.2 Wiring

The verification includes that:
1) cables are connected according to the diagram;
2) colour coded are according to the diagram;
3) the wires are properly mounted.

If verification is not possible, due to inaccessibility, document substantiation with signed manufacturer statement shall be provided.

AMC.RPA.E.3 Cable routing

Strain, slack, and cable routing not over sharp edges will be verified for all wires.
If verification is not possible, due to inaccessibility, document substantiation with signed manufacturer statement shall be provided.

AMC.RPA.E.4 Cable connections

All cables will be verified on correct connections (no soldering in between).
If verification is not possible, due to inaccessibility, document substantiation with signed manufacturer statement shall be provided.

AMC.RPA.E.5 Connections

Adequately secured connection of electronic devices and no unnecessary connections are verified.
If verification is not possible, due to inaccessibility, document substantiation with signed manufacturer statement shall be provided.

AMC.RPA.E.7 Wiring

Wiring diameter in accordance with electrical load and wiring without kinks are verified.
If verification is not possible, due to inaccessibility, document substantiation with signed manufacturer statement shall be provided.

AMC.RPA.E.8 Battery mounting

Properly battery mounting in such a way that the battery cannot move during flight is verified.

AMC.RPA.E.9 Battery monitoring system

The verification includes:
1) suitability of the specified battery (specifications) for the primary electronics;
2) availability of a sufficient battery monitoring system.

SUBPART E – EQUIPMENT, SYSTEMS, AND INSTALLATIONS

AMC.RPA.EQ.1 Safety

All documented modes and functions of operation (such as “waypoint navigation”, “assisted mode” and “manual mode”) will be verified during ground and flight test to perform as documented and in a safe manner.

SUBPART F – AEROPLANE

AMC.RPA.A.1 Stall speed

The airplane specified minimum operating speed or actual minimum speed will be verified to be at least 10% above the provided stall speed. This requirement shall be tested in all available flight modes.

SUBPART G – HELICOPTER

AMC.RPA.H.1 Yaw speed

The sufficient rotation about the z-axis will be verified in test flight for both yaw directions.

SUBPART H – POWERPLANT

ELECTRICAL MOTOR

AMC.RPA.EM.1 Motor controller

The verification includes:
1) availability and capability of a motor controller;
2) appropriate operating temperatures.

COMBUSTION ENGINE

AMC.RPA.CE.3 Fuel system

Verification includes:
1) suitability for the used fuel type and pressure;
2) no fuel leaks in the system under pressure during the operational test on the ground.

TURBINE ENGINE

AMC.RPA.TE.1 Fuel system

Verification includes:
1) suitability for the used fuel type and pressure;
2) no fuel leaks in the system under pressure during the operational test on the ground.

AMC.RPA.TE.2 Fuel pump

Fuel pump qualification for the used fuel type will be verified using the fuel pump data sheet.

AMC.RPA.TE.3 Air intake

The engine will be verified for the appropriate operating temperatures.

SUBPART J – DATA LINK

AMC.DL.2 Range

Fully functioning communication is verified during a distance communication test from all possible azimuth angles at a distance of 1.2 times the maximum operating distance for the RPA.

AMC.DL.3 Flight control

Communication with controls is verified not to be effected by payload data link operations.

AMC.DL.4 Safe mode

The verification includes the existence and proper functioning of the system with procedures for the following circumstances (if applicable):

1. control failure due to failure of servo
2. fatal autopilot error;
3. loss of engine power;
4. low battery voltage;
5. loss of GPS signal;
6. radio control link failure;
7. RPS communication failure;

Proper functioning shall be tested:

(a) on the ground;

(b) during normal cruise flight.

AMC.DL.5 Electromagnetic compatibility

The RPAS will be verified to be functioning properly during a EMI check, focusing on to be expected interfering frequencies (application dependent).