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Flight test requirements for autonomous capability of civil large and medium-sized fixed-wing unmanned aircraft system

民用大中型固定翼无人机系统自主能力飞行试验要求

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1 Scope

The document specifies the general requirements, flight capability, operational risk factor identification and response capability, manual intervention capability and test flight report requirements for flight testing the autonomous capability of civil large and medium-sized fixed-wing unmanned aircraft systems, referred to below as unmanned aircraft systems.

It applies to flight testing the autonomous capability of civil large and medium-sized fixed-wing unmanned aircraft systems; unmanned aircraft systems of other types may follow it for reference.

2 Normative references

GB/T 35018 Classification and grading of civil unmanned aircraft systems; GB/T 38152 Unmanned aircraft system terminology.

Dated references apply in the edition cited; undated references apply in their latest edition, including any amendments.

3 Terms and definitions

The terms and definitions of GB/T 35018 and GB/T 38152 apply, together with the following.

3.1 autonomous capability: the capability of an unmanned aircraft system to carry out flight and to identify and respond to operational risk factors within the design operating range, in autonomous mode or in automatic mode. Note 1 states that in autonomous mode the pilot of the unmanned aircraft system does not intervene in the flight and decisions rest on the judgement of the system. Note 2 states that automatic mode follows a pre-set program, that important decisions rest on human judgement and that the pilot has to send commands.

3.2 unmanned aircraft system pilot: the operating personnel taking part in the flight of the unmanned aircraft system.

3.3 operational risk identification and response: the identification of variable factors liable to lower the level of operational safety, and the making of a suitable response.

4 General requirements

4.1 Test flight conditions. The site conditions of the test flight, such as elevation and runway, and the environmental conditions, such as air temperature, atmospheric pressure, humidity, wind speed, wind direction, visibility and the electromagnetic environment, are to comply with the technical requirements of the unmanned aircraft system. Test flight subjects for operational risk identification and response capability are to be carried out first as a ground test, and the corresponding flight test is to be started only after the validity of the ground test result has been assessed.

4.2 Test flight object. The object of the test flight is the unmanned aircraft system, comprising the unmanned aircraft, the control console or station, the control link and the mission payload. The technical condition of the system is to comply with its technical requirements.

4.3 Test flight items. The test flight items are to include: a) the autonomous flight capability of the unmanned aircraft system; b) the operational risk factor identification and response capability; c) the manual intervention capability.

4.4 Documents. The following documents are to be provided: a) the flight test programme;

b) the technical manual of the unmanned aircraft system; c) the pilot's manual and the flight manual of the unmanned aircraft system; d) other necessary material and calculation results relating to the test flight.

4.5 Personnel requirements. The personnel taking part are to satisfy the following: a) the unmanned aircraft system pilot is qualified to operate the system under test; b) the other personnel taking part meet the requirements for their post.

4.6 Instrumentation and modification. Instrumentation and modification are to satisfy the following: a) they do not alter the aerodynamic characteristics of the system, do not affect its normal working and do not endanger the safety of personnel on the ground; b) the instrumentation and modification are designed according to the measurement needs of the autonomous capability test flight, covering but not limited to the type, number, measuring range and accuracy of the measuring equipment; c) the measuring equipment has passed verification by a verification body and is within its period of validity.

4.7 Data processing. Data processing is to satisfy the following: a) the validity of the test flight data is analysed according to the test method, invalid data are discarded and usable data are obtained; b) for unmanned aircraft systems that use an air data system, the position error of the pressure altitude and of the airspeed is corrected through the test flight.

5 Flight capability

5.1.1 Route planning, test purpose: to check the automatic route planning capability of the unmanned aircraft system, and to check its autonomous route planning capability.

5.1.2 Test method. Check of the automatic route planning capability: before take-off, the position information of the airspace available for flight, the no-fly zones and the target working area, together with the height and position information of the take-off and landing points and other route planning constraint information, are loaded into the route planning system; the pilot sends the planning command, the route planning system carries out the route planning automatically, and the response of the system in carrying out the pre-planned route is checked. Check of the autonomous route planning capability: during flight the system receives, in real time, air traffic control information, operational risk factor information and other route planning constraint information not entered in advance by the pilot; the route planning system carries out the route planning autonomously and the response of the system in carrying out the real time route planning is checked.

5.1.3 Test result: the route information planned by the unmanned aircraft system is given.

5.2.1 Autonomous taxi-in and taxi-out. Test purpose: to check the automatic taxi-in and taxi-out capability of the system and its autonomous taxi-in and taxi-out capability. Test method: the pilot issues the taxi-in or taxi-out command and the response of the aircraft is checked; after the system has completed route planning, the aircraft carries out taxi-in or taxi-out autonomously and the response is checked. Test result: the control mode of the

aircraft from the sending of the command to the end of the taxi-in or taxi-out is given, and a time history curve is plotted that includes the taxi-in or taxi-out command and the coordinate values in the runway coordinate system or the latitude and longitude.

5.2.2 Take-off, including take-off in the reverse direction. Test purpose: to check the automatic take-off capability of the system and its autonomous take-off capability. Test method: the pilot issues the take-off command and the response of the aircraft is checked; after the system has completed route planning, the aircraft carries out the take-off autonomously and the response is checked. Test result: the control mode of the aircraft from the sending of the command to the end of the take-off is given. For wheeled aircraft, the take-off run distance, the lift-off speed, the take-off run time and the energy consumed during the take-off run are given for a given airfield environment and a given take-off weight. For aircraft that take off or launch by rocket assistance, air launch or another method, the end-of-launch or end-of-release speed at a given weight is given.

5.2.3 Route holding. Test purpose: to check the capability of the system to carry out route holding automatically and to carry it out autonomously. Test method: flight tests are carried out under combinations of different aircraft configuration, weight, speed and altitude. In one case the aircraft takes off after route planning and the pilot issues the route holding command, and the response is checked; in the other the aircraft takes off after route planning and flies autonomously along the planned route, and the response is checked. Test result: the control mode of the aircraft from the sending of the command to the end of route holding is given; time history curves are given for the speed, altitude, angle of attack, pitch angle, roll angle, heading angle and lateral deviation; and data are given for the route holding accuracy, attitude angle holding accuracy, heading angle holding accuracy, altitude holding accuracy and speed holding accuracy during route holding.

5.2.3.4 Manoeuvre. Test purpose: to check the capability of the system to carry out manoeuvres automatically and to carry them out autonomously. Test method: flight tests are carried out under combinations of different aircraft configuration, weight, speed and altitude; in one case the aircraft takes off after route planning and the pilot issues the manoeuvre command, and the response is checked; in the other the aircraft takes off after route planning and carries out the manoeuvre autonomously according to the pre-set manoeuvre command, and the response is checked. Test result: the control mode from the sending of the command to the end of the manoeuvre is given; curves of turn load factor and turn radius against speed are given, together with a time history curve of the turn including pressure altitude, calibrated airspeed or Mach number, roll angle, yaw angle, longitudinal load factor and normal load factor; the horizontal acceleration and deceleration distance, time, energy consumption and longitudinal load factor are given as curves and data against speed; and a time history curve of the climb or descent is given, including pressure altitude, calibrated airspeed, true airspeed, rate of climb, angle of attack, pitch angle and roll angle.

5.2.4 Landing, including landing in the reverse direction. Test purpose: to check the