

Advisory Pamphlet

עלון מידע

RPAS flight manual
ספר טיסה למערכת כטב"ם

AP 1.4.506A



ספר טיסה למערכת כטב"ם

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1. מטרה

1.1. מטרת עלון מידע זה להגדיר את הפרקים והסעיפים הנדרשים כחלק מתוכנו של ספר טיסה למערכת כטב"ם.

2. חומר עזר

2.1. דרישות החוק:

2.1.1. חוק הטיס, תשע"א – 2011, סעיף 63.

2.1.2. תקנות הטיס(נהלי תיעוד כלי טיס וחלקיהם), תשל"ז-1977, תקנה 67,

תקנה 87.

2.2. רקע ודיון כללי –

2.2.1. חומר רקע –

2.2.1.1. Annex 8 to the Convention on International Civil Aviation

– Airworthiness of Aircraft.

2.2.1.2. STANAG 4671 ED1 – UAV System flight manual

2.2.1.3. STANAG 4703 – UAV System flight manual

2.2.1.4. נוהל רישוי, תיעוד ושינויים במערכות כטב"ם

2.3. הגדרות וראשי תיבות –

2.3.1. הגדרות:

Airplane Flight Manual (AFM). A CAAI - approved document that contains information (operating limitations, operating procedures, performance information, etc.) necessary to operate the airplane at the level of safety Established by the airplane's certification basis.

Flightcrew Operating Manual (FCOM). A document developed by a manufacturer that describes, in detail, the characteristics and operation of the airplane or its systems.

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2.3.2. ראשי תיבות:

UAV - Unmanned Aerial Vehicle
UCS – Unmanned control station
 $V_{MO/MMO}$ - Maximum Operating Limit Speed.
 V_{MC} - Control Speed with Critical Engine Inoperative
 V_{MCG} - Minimum Control Speed on the Ground
 V_{NE} - Never Exceed Speed
 V_{NO} - maximum structural cruising speed
 V_R - Rotation Speed
 V_{REF} - Reference Landing Approach Speed
 V_{Rf} - Refusal Speed
 V_S - Stalling Speed
 V_{S0} - Stalling Speed or Minimum Steady Flight Speed in Landing Configuration
 V_{S1} - Stalling Speed or Minimum Steady Flight Speed in Take-off Configuration
 V_{SF} - Computed Stalling Speed with Flaps fully extended at the Design Weight
 V_{SSE} - Minimum safe speed with one Engine inoperative

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3. הנחיות ותהליכים

- 3.1. המבקש הרשאה מיוחדת קבועה לטיסה למערכת כטב"ם יגיש במסגרת המסמכים הנדרשים בנוהל רישום, רישוי, תיעוד ושינויים, ספר טיסה (Flight Manual) למערכת הכטב"ם.
- 3.2. תכולת ספר הטיסה תהיה על פי סעיף 4 למסמך זה.

טיסות

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4. תכולת ספר טיסה (Flight Manual) למערכת כטב"ם:

1. General

(a) A UAV System Flight Manual must be submitted to the Certifying Authority and it must contain the following:

(1) Information required by Paragraph 2 to 5.

(2) Other information that is necessary for safe operation because of design, operating or handling characteristics. In particular, any information associated with the UCS, such as:

- Command and control data link
- Communication system.

Any other ancillary elements necessary to enable flight such as launch and landing elements must be stated in specific subpart of the UAV System Flight Manual with emphasis on deployment and operation limitations.

(3) Further information necessary to comply with the relevant operating rules.

(b) Approved information

(1) Each part of the UAV System Flight Manual containing information prescribed in Paragraph 2 to 5 must be approved by the Certifying Authority, segregated, identified and clearly distinguished from each unapproved part of that UAV System Flight Manual.

(c) The units used in the UAV System Flight Manual must be the same as those marked on the appropriate indicators, data display and placards both on the UAV and in the UCS.

(d) All UAV System Flight Manual operational airspeeds must, unless otherwise specified, be presented as indicated Airspeeds.

(e) The UAV system flight manual must be readily accessible to the UAV crew in the UCS.

(f) Revisions and/or amendments. Each UAV System Flight Manual must contain a means for recording the incorporation of revisions and/or amendments.

(g) If the UCS is capable of operating more than one UAV, the maximum number of UAVs that can be safely controlled from the UCS must be stated in the UAV System Flight Manual. In addition, the UAV System Flight Manual must contain procedures for UAV handover within a same UCS, where this capability exists.

(h) Hazardous effects of radiation emitted from the UAV on fuel, ordinance, and personnel must be stated in the UAV System Flight Manual, and appropriate stand-off distances provided if the UAV is emitting radiation.

(i) For UAVs with a battery, environmental limitations and potential hazards associated with the battery must be stated in the UAV System Flight Manual.

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2. Operating limitations

The UAV System Flight Manual must contain operating limitations determined, including the following:

(a) Airspeed limitations

- (1) Information necessary for the marking of the airspeed limits on the indicator and the significance of each of those limits and of the colour coding used on the indicator.
- (2) The speeds VMC, VO, VLE and VLO and their significance.

(b) Powerplant limitations

- (1) General. The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines or propellers are approved by the Certifying Authority.
- (2) Take-off operation. The powerplant take-off operation must be limited by
 - (a) The maximum engine rotational speed (rpm);
 - (b) The maximum allowable manifold pressure where the UAV is equipped with reciprocating engine with a controllable propeller or a turbocharger ;
 - (c) The maximum allowable gas temperature (for turbine engines);
 - (d) The time limit for the use of the power or thrust corresponding to the limitations established in sub-paragraphs (a) to (c); and
 - (e) The maximum allowable cylinder head (as applicable), liquid coolant and oil temperatures.
 - (f) The minimum oil pressure, minimum gas temperature, minimum coolant temperature, and minimum oil temperature.
 - (g) For electrical engine applications, a minimum voltage and current required threshold.

(3) Continuous operation. The continuous operation must be limited by

- (a) The maximum engine rotational speed;
- (b) The maximum allowable manifold pressure where the UAV is equipped with reciprocating engine with a controllable propeller or a turbocharger ;
- (c) The maximum allowable gas temperature (for turbine engines); and
- (d) The maximum allowable cylinder head, oil and liquid coolant temperatures.
- (f) The minimum oil pressure, minimum gas temperature, minimum coolant temperature, and minimum oil temperature.

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(g) For electrical engine applications, a minimum voltage and current required threshold.

(4) Fuel grade / designation. The minimum fuel grade (for reciprocating engines), or fuel designation (for turbine engines), must be established so that it is not less than that required for the operation of the engines within the limitations in sub-paragraphs (2) and (3).

(5) Ambient temperature. For all UAV, ambient temperature limitations must be established as the maximum ambient atmospheric temperature.

(6) Explanation of the limitations, when appropriate.

(7) Information necessary for marking the data displayed in the UCS

(8) Fuel and oil designation and limitation

(a) For two-stroke engine, the fuel/oil ratio.

(c) Weight

(1) The maximum weight; and

(2) The maximum landing weight, if the design landing weight selected by the Applicant is less than the maximum weight.

(3) UAV performance operating limitations as follows:

(i) The maximum take-off weight for each airfield or take-off area altitude and ambient temperature within the range selected by the Applicant.

(ii) The maximum landing weight for each airfield or landing area altitude and ambient temperature within the range selected by the Applicant.

(4) The maximum take-off weight for each airfield altitude and ambient temperature within the ranges selected by the Applicant at which the critical field length determined is equal to the available runway length plus the length of any stopway, if utilised.

(5) The maximum zero fuel weight where relevant as established.

(d) Center of gravity. The established center of gravity limits.

(e) Authorised manoeuvres.

(f) Load factor. The positive and negative limit load factors in g's,

(g) Minimum UAV crew and maximum ground station capacity. The number and functions of the minimum UAV crew determined. In addition, the maximum number of non-crew persons allowed to occupy the UCS must be stated in the UAV System Flight Manual.

(h) Kinds of operation. A list of the kinds of operation to which the UAV System is limited or from which it is prohibited, and also a list of installed equipment that affects any operating limitation and identification as to the equipment's required operational status for the kinds of operation for which

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approval has been granted.

(i) Maximum operating altitude.

(j) Allowable lateral fuel loading. The maximum allowable lateral fuel loading differential, if less than the maximum possible.

(k) Payload loading. The following information for each payload compartment or zone:

(1) The maximum allowable load; and

(2) The maximum intensity of loading.

(l) Systems. Any limitations on the use of UAV systems and equipment.

(m) Ambient temperatures. Where appropriate maximum and minimum ambient air temperatures for operation.

(n) Smoking. Any restrictions on smoking in the UCS and in the vicinity of any UAV System elements.

(o) Types of surface. A statement of the types of surface on which operation may be conducted.

(p) Deployment limitations : all limitations induced by the deployment of the UCS, the command and control data link, the launch and landing elements and any ancillary systems must be stated in the UAV System Flight Manual.

(q) Communication system and command and control data link limitations: the limitations and performances of the communication system and of the command and control data link must be stated in the UAV System Flight Manual and also the effect of link loss on performance limitation. The requested operating frequencies must be stated in the UAV System Flight Manual.

(r) Automatic take-off and landing system (if applicable). The UAV System Flight Manual must state

(1) Limitations (wind, turbulence, ...) and performance for which the automatic take-off and landing system is certificated

(2) Permitted configurations (e.g. flap setting, number of engines operating, ...)

(3) Normal and emergency procedures

(4) Minimum required equipment that must be serviceable before engaging the automatic take-off and landing system.

(s) Information concerning battery storage, operation, handling, maintenance, safety limitations and battery health conditions must be provided

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3. Operating procedures

(a) Information concerning normal, degraded (if applicable) and emergency procedures and other pertinent information necessary for safe operation and the achievement of the scheduled performance must be furnished, including

- (1) An explanation of significant or unusual flight or ground handling characteristics;
- (2) The maximum demonstrated values of crosswind for take-off and landing and procedures and information pertinent to operations in crosswinds;
- (3) A recommended speed for flight in rough air. This speed must be chosen to protect against the occurrence, as a result of gusts, of structural damage to the UAV and loss of control;
- (4) If applicable, procedures for restarting any engine in flight, including the effects of altitude;
- (5) Procedures, speeds and configuration(s) for making a normal approach and landing and a transition to the balked landing condition.

(b) In addition to sub-paragraph (a), for a single-engined UAV (where emergency recovery includes a glide), the procedures, speeds and configuration(s) for a glide following engine failure and the subsequent forced landing, must be furnished.

(c) In addition to sub-paragraph (a), for all multi-engined UAV, the following information must be furnished:

- (1) Procedures, speeds and configuration(s) for making an approach and landing with one or more engine(s) inoperative;
- (2) Procedures, speeds and configuration(s) for making a go-around with one or more engine(s) inoperative and the conditions under which a go-around can be performed safely, or a warning against attempting a go-around.
- (3) The V_{MC} determined In addition to sub-paragraphs (a) and (b) or (c) as appropriate, the following information must be furnished.
 - (i) Procedures, speeds and configuration(s) for making a normal take-off and the subsequent climb;
 - (ii) Procedures for abandoning a take-off due to engine failure or other cause.

(d) In addition to sub-paragraphs (a), (c) and (d) for multi-engined UAV, the information must include

- (1) Procedures and speeds for continuing a take-off following engine failure and the conditions under which take-off can safely be continued, or a warning against attempting to continue the take-off;
- (2) Procedures, speeds and configurations for continuing a climb following engine failure, after take-off, or en-route.

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(e) In addition to sub-paragraphs (a) and (c), the information must include

- (1) Procedures, speeds and configuration(s) for making a normal take-off;
- (2) Procedures and speeds for carrying out an accelerate-stop;
- (3) Procedures and speeds for continuing a take-off following engine failure,

(f) Fuel and Energy

- (1) For multi-engine UAV, information identifying each operating condition in which the fuel system independence is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.
- (2) The UAV System flight manual shall describe how maximum capacity refuelling is to be accomplished with the requested mission loads.

(g) For each UAV, the operating procedures for disconnecting the battery from its charging source must be furnished.

(h) Information on the total quantity of usable fuel for each fuel tank and the effect on the usable fuel quantity as a result of a failure of any pump must be furnished.

(i) Procedures for the safe operation of the UAV's systems and equipment, both in normal use and in the event of malfunction, must be furnished. In particular, emergency recovery capability procedures and data link loss strategy must be stated in the UAV System Flight Manual.

4. Performance information

Unless otherwise presented, performance information must be provided over the altitude and temperature ranges required and for intended UAV configuration, engine configuration and weight ranges required. All performance shall base on a minimum engine performance. If other engine performance is used, the flight manual shall state such.

(a) The following information must be furnished:

- (1) The stalling speeds V_{SO} , and V_{S1} with the landing gear and wing flaps retracted, defined for the weight ranges required and the effect on these stalling speeds at maximum bank angles allowed by the flight control system ;
- (2) The steady rate and gradient of climb with all engines operating;
- (3) The landing distance for each airfield altitude and standard temperature and the type of surface for which it is valid;
- (4) The effect on landing distance of operation on other than smooth hard surfaces, when dry and when wet; and
- (5) The effect on landing distance of runway slope and 50% of the headwind component and 150% of the tailwind component.

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- (6) The limitations on the flight performance imposed by the flight envelope protection.
- (b) In addition to sub-paragraph (a), the steady angle of climb/descent must be furnished.
- (c) In addition to sub-paragraph (a) and paragraph (b) the following information must be furnished:
- (1) The take-off distance and the type of surface for which it is valid;
 - (2) The effect on take-off distance of operation on other than smooth hard surfaces, when dry and when wet;
 - (3) The effect on take-off distance of runway slope and 50% of the headwind component and 150% of the tailwind component;
 - (4) For multi-engine powered UAV, the one or more engine(s) inoperative take-off climb/descent gradient;
 - (5) For multi-engine UAV, the en-route rate and gradient of climb/descent with one or more engine(s) inoperative; and
 - (6) For single-engine UAV, the glide performance.
- (d) In addition to paragraph (a), the following information must be furnished:
- (1) The accelerate-stop distance;
 - (2) The effect on accelerate-stop distance, take-off distance and, if determined, take-off run, of operation on other than smooth hard surfaces, when dry and when wet;
 - (3) The effect on accelerate-stop distance, take-off distance and, if determined, take-off run, of runway slope and 50% of the headwind component and 150% of the tailwind component;
 - (4) The en-route gradient of climb/descent with one engine inoperative;
 - (5) The effect, on the en-route gradient of climb/descent with one or more engine(s) inoperative, of 50% of the headwind component and 150% of the tailwind component;
 - (6) The relationship between IAS and CAS; and
 - (7) The altimeter system calibration required.
- (e) Engine performance data shall be provided and maximum power performance data for take-off shall be specifically stated.
- (f) Flight Planning Performance data shall be provided.
- (g) For navigation systems that utilize an external reference source (such as GPS) as the primary means of ensuring navigation performance, the UAV system flight manual must contain information on
- (1) Navigation sensor accuracy (to include both normal and degraded modes),

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(2) Areas of navigator susceptibility that can result in the degraded mode (such as the navigation system's ability to compensate for constellation instabilities, clock timing errors, etc), and

(3) Any operational procedures that must be performed by the operator to compensate for the degraded navigation.

5. Loading information

The following loading information must be furnished:

- (a) The weight and location of each item of equipment that can easily be removed, relocated, or replaced and that is installed when the UAV was weighed.
- (b) Appropriate loading instructions for each possible loading condition between the maximum and minimum weights, to facilitate the centre of gravity remaining within the limits.

6. The data link information

- (a) Time delays in the command and control data link (namely 'latency') shall be specified in the UAV System Flight Manual as a function of all relevant conditions.
- (b) A command and control data link loss strategy must be established, approved and presented in the UAV System Flight Manual taking into account the emergency recovery capability.
- (c) Command and control data link antenna masking must be stated in the UAV System Flight Manual.