**FLIGHT TEST PROGRAMME**

(Example document for LSA applicants – v1 of 17.02.16)

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# 0. Introduction

This document shows the programme of flights for certification of the aircraft ABCD. The table of section 0 contains the purposed test sequence with an overview of the main test points and certification conditions. This document demonstrates compliance to the requirements as defined in the certification basis and in the certification programme (Ref.1).

This documents does not give full details of each test points. These details can be found in the individual Flight Test Plans and Flight Test Orders.

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| --- |
| **NOTICE**  The aim of this document is to provide an example of Flight Test Programme for an aircraft type certificate application in accordance with CS-LSA.  This document is intended to assist applicants in applying for an LSA RTC/TC and therefore demonstrating compliance of the design to the requirements but it does not substitute, in any of its parts, the prescriptions of Part-21 and its amendments.  The document should not be read as a template and it should not be used as a form to fill. The final content of the document is under responsibility of the user.  The required information can be presented entirely in this document, or in additional documents appropriately identified and referred to.  Comments and notes to the user are provided throughout the document *with “blue highlighted and italic text”.*  **IMPORTANT: All the statements and/or conclusions provided in this guideline can be considered realistic and have a reasonable technical basis but the designer is solely responsible of each of the statements that he/she will provide** |

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# 1. Scope

This Flight Test Program is intended as a plan of the essential activities required to validate the flight characteristics and the performances of the aircraft model ABCD. The aim of that test program is to demonstrate compliance with CS-LSA in particular paragraphs from ASTM F2245-12d.

*NOTE: This template has been created with the assumption that the applicant is not a DOA holder thus also aspects related organization and safety of the flight are addressed. In case of a DOA holder these latter aspects are normally defined in DOA procedures)*

# 2. References

[1] Certification Programme ABCD-CP-00

[2] ABCD-CCL Compliance Check-list (Means of Compliance list)

[3] ABCD-GD-00 General Description Document

[4] ABCD-WB-08-00 Weight and Balance Report

[5] ABCD-FL-00 Flight Load Calculations

[6] AFM (POH)

[7] Flight conditions documents

# 3. Weight and Balance data and limits for flight test phases

Subparagraph 4.1.2 of ASTM F2245-12d requires the following tolerances of weight and CG:

|  |  |
| --- | --- |
| Weight | +5%, –10% |
| Weight, when critical | +5%, –1% |
| CG | ± 7% of total travel |

Datum plane: a plane through the leading edge of the wing at mean aerodynamic chord, perpendicular to the longitudinal axis of the aircraft. See [3].

*NOTE: Datum planes could be different (plane of the firewall, at the propeller cone, etc.) The CG values may be shown also in MAC%. (There is no regulation for it, it depends on practical issues.)*

Because of datum plane is at the wing leading edge at the mean aerodynamic chord, the CG limit values in centimetres could be calculated to MAC% values easily.

The MAC is 1,40 m, therefore the forward limit can be calculated with interpolation; the forward limit is 17.86% MAC, the aft limit is 27.86% MAC.

The aircraft’s centre of gravity envelope is shown on the next page:



*Calculated Weight and CG values in different conditions:*

Minimum flying weight (and CG position) (minimal useful pilot + fuel + consumable material load): 469 kg. See limitations in the table below.

Aircraft’s MTOW with maximum seat load (pilot + pax) with maximum allowed fuel load and max. baggage compartment load: 600 kg.

The forward and aft centre of gravity limit will be aft of datum plane.

The following table will describe the weight and balance limitations iaw. ASTM F2245 4.1.2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dimension** | **Limit** | **Tolerance** | **Minimum** | **Maximum** |
| **Non critical** | | | | |
| MTOW | 600 kg | +5%, –10%  +30 kg, –60 kg | 630 kg | 660 kg |
| Minimal TOW (WMIN + fuel 1h) | 421 + 28 = 449 kg  (see [4]) | +5%, –10%  +22.5 kg, –45.0kg | 404.1 kg | 471.5 kg |
| FWD CG | 25 cm AFT | ±7% total, 0.98 cm | 24.02 cm | 25.98 cm |
| AFT CG | 39 cm AFT | ±7% total, 0.98 cm | 38.02 cm | 39.98 cm |
| **Critical** | | | | |
| MTOW | 600 kg | +5%, –1%  +30 kg, –6 kg | 594 kg | 630 kg |

*NOTE: Standard values from ASTM F2245 4.1.2 are highlighted.*

Actual aircraft weight and balance is determined and noted in each test order prior flight using a scale. Weight correction for fuel and occupant loading might be applied. See [3]

**Calculated speeds of the designed flight envelope:**

*NOTE: the speeds are example speeds, the VA and VNE are calculated according to ASTM F2245-12d.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| VNE | 144 KTS | VA | 100 KTS | VS1 | 50 KTS |
| VNO | 120 KTS | VFE | 90 KTS | VS0 | 44 KTS |

The flight envelope is shown below; it shows the different limitations in different test phases. See paragraph 11.

The designed airspeeds are calibrated airspeeds (CAS), however, all the limitations and indications to the pilot are indicated airspeeds (IAS)



# 4. Flight test methods

Flight test methods are detailed in the test order. Guidelines are shown in:

– FAA AC 23-8C – Flight Test Guide for Certification of Part 23 Airplanes

– FAA AC 23-15A – Small Airplane Certification Compliance Program

– FAA AC 90-89A – Amateur-built Aircraft And Ultralight Flight Testing Handbook

– C. Edward Lan and Jan Roskam: Airplane Aerodynamics and Performance, Roskam Aviation Co.

– Russel M. Herrington et al: Flight Test Engineering Handbook, Air Force Technical Report no. 6273, NTIS No. AD 636.392 National Technical Information Service, Springfield, VA.

– NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS (TECHNICAL NOTE 2098) – The Effects Of Stability Of Spin-recovery Tail Parachutes On The Behavior Of Airplanes In Gliding Flight And In Spins. By Stanley H. Scher and John W. Draper, Langley Aeronautical Laboratory, Langley Air Force Base, Va.

– NASA Technical Memorandum 80237 – A Spin-Recovery Parachute System for Light General-Aviation Airplanes by Charles F. Bradshaw, Langley Research Center, Hampton, Virginia

– CS-23 Book 2, Flight Test Guide

– USNTPS-FTM-No. 103 U.S. NAVAL TEST PILOT SCHOOL – FLIGHT TEST MANUAL – FIXED WING STABILITY AND CONTROL, Theory and Flight Test Techniques. Naval Air Warfare Center Aircraft Division, Patuxent River, MD January 1997

– Ralph D. Kimberlin: Flight Testing of Fixed-Wing Aircraft, AIAA Education series, 2003

# 5. Configuration of the prototype

The configuration of the prototype is schematically described in the table below.

Test configuration table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Configuration variant** | **C1** | **C2** | **C3** | **C4** |
| Basic configuration | X | X | X | X |
| Pitot head boom | – | X | X | X |
| Flight Test Instrumentation | – | – | X | X |
| Spin chute | – | – | – | X |

*NOTE: AoA and slip-flags may be attached to the swivel-head pitot tube*

Details of how the Configuration management will take place are described in the appendix.

*(NOTE: configuration management procedures normally are not the part of the Flight Test Program.)*

*NOTE: The prototype, and its configuration is under the responsibility of the Design Organization iaw. 21.A.33.*

# 6. Flight test team composition

Classification of Flight Test Pilots and Engineers as well as mechanics involved in flight test campaign.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Category** | **Name** | **Licence nr.** | **Auth. nr.** | **Cat1[[1]](#footnote-1)** | **Cat2** | **Cat4** | **Notes** |
| FTP | A.I. | H/PPL/009990 | AB-01 | X | X | X | (1) |
| S.B. | 08-8591 | AB-02 | – | – | X | (2) |
| P.F. | 00-1234 | AB-03 | – | X | – | (3) |
| FTE[[2]](#footnote-2) | S.B. | 08-8591 | AB-02 | – | – | X | (2) |
| X.Y. | N/A | LFTE-001 | X | X | X | (4) |
| Ground crew | Z.X. | 66.AML.12345 | AB-04 | X | X | X | (5) |
| A.B. | 66.AML.45678 | AB-05 | – | X | X | (6) |
| C.D. | N/A | AB-06 | – | – | X | (6) |

Notes:

(1) Experience: 1600 flight hours on CS-23 aircrafts, 400 hours as instructor and 150 during flight testing, aerobatic rating

(2) Experience: 600 flight hours

(3) Experience: 800 flight hours

(4) Leading Flight Test Engineer

(5) Chief of CS

(6) Mechanic

All the members of Flight Test Team have received special egress training iaw. FAA Order 8900, Volume 3, Chapter 4, “Flight crew General Emergency Training Curriculum Segments”

Records of all the training can be found in… *NOTE: (put the reference here for the personal file; e.g. Training records are stored in computer files as well as in “hard copy”. A summary document about the trainings can be found on the company’s local network.)*

*Responsibilities of personnel can be also described here.*

*Details of available maintenance personnel (staff number, list of certifying staff) also can be described in present paragraph.*

# 7. Facilities

The airport for test flights and test airspace are described here.

*NOTE: The information may be found in AIP, or in data provided by airport operator.*

**Local Airfield (Home Base)**

|  |  |
| --- | --- |
| Airport identification (ICAO identifier) | ZZZZ |
| Location | 4 miles NW from city of XXX |
| ARP coordinates | XX°XX’XX” N YYY°YY’YY” |
| Local variation | 4.5 degs E |
| Elevation | 310 feet |
| Callsign (TWR) APP and GND if present; | ZZZZ INFO |
| Frequency | 129.9 MHz |
| NAV AID | VOR-DME (115.1 MHz) X NM SE from airport |
| Traffic pattern | 30 LH 12 RH |
| Airport category (international, domestic, private, etc.) | Domestic commercial airport |
| Operating hours | 0800-2200 (LT) |
| NVFR | Available (SALS in both directions) |
| IFR | Nil |
| MET OFFICE | H24 |
| OPS | +36 1 123 456 |
| Rescue and firefighting | CAT 5 PPR CAT 8 |
| Technical assistance | Available in AB Aviation GmbH |
| Obstacle warning | High voltage lines 1,4 km NNE from the runway |
| Populated areas | Cities of X, XX, and XXX |
| Flight restrictions (P/R/D airspaces, displaced threshold, busy international airports nearby, etc.) | XX-R6 restricted airspace can be found 8 NM NW from aerodrome (R = 3 NM from XX°XX’XX” N YYY°YY’YY” E, from GND to 2500’ AMSL) |
| Special local procedures | Avoid inhabited areas, for traffic pattern flying follow the pattern marked on VFR approach chart |

Runways:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| RWY | Dimension | Surface | TORA | LDA | Max.load (PCN) | Lights | Remarks |
| 14 | 2500 x 60 | Concrete | 2500 | 2500 | 75 | NIL |  |
| 32 | 2500 x 60 | Concrete | 2500 | 2500 | 75 | SALS | See restrictions |

**Other airfield**

Other airfield is used as an alternate airport during flight tests.

|  |  |
| --- | --- |
| Airport identification (ICAO identifier) |  |
| Location |  |
| ARP coordinates |  |
| Local variation |  |
| Elevation |  |
| Callsign (TWR) APP and GND if present; |  |
| Frequency |  |
| NAV AID |  |
| Traffic pattern |  |
| Airport category (international, domestic, private, etc.) | **Fill out with similar data of the alternate airport (see previous table). Contact airport operator and/or actual AIP.** |
| Operating hours |  |
| NVFR |  |
| IFR |  |
| MET OFFICE |  |
| OPS |  |
| Rescue and firefighting |  |
| Technical assistance |  |
| Obstacle warning |  |
| Populated areas |  |
| Flight restrictions (P/R/D airspaces, displaced threshold, busy international airports nearby, etc.) |  |
| Special local procedures |  |

Runways:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| RWY | Dimension | Surface | TORA | LDA | Max.load (PCN) | Lights | Remarks |
| 01 | 1000 x 100 | Grass | 1000 | 1000 | 3 t | NIL |  |
| 19 | 1000 x 100 | Grass | 1000 | 1000 | 3 t | NIL |  |

**Hangar**

In this paragraph, the following points will be defined:

– General description

– Layout

– Protection of the test aircraft

**Rescue and safety equipment**

This point will contain all the required safety equipment.

– Description the location of fire extinguishers, first aid kits, or other rescue and safety equipment.

– Ground personnel protection (visors, helmets, headphones)

– Description of fire station and ambulance station’s notification procedures (about the test flights).

– Classification the responsible search and rescue service.

– Permanently installed safety equipment (on-board) (seat belt, ELT, pilot parachute, crash axe, etc.)

– Specific safety provisions for the prototype (jettisonable canopy, parachutes)

– Special safety equipment (life vests, survival kit, oxygen bottle, etc.)

– Operation rules for a chase plane

**Emergency response plan**

Aims of Emergency Response Plan (ERP):

– highlight the policies and procedures to be implemented in case of a crisis,

– offer advice to the members of the crisis management team in carrying out their responsibilities,

– communicate relevant information to employees of the organization and members of the public.

*NOTE: The ERP might be designed as a separate document or part of the test program, according to the decision of the applicant.*

As opposed to other manuals of the company, the ERP manual is designed to cover crisis situations which cannot specifically or precisely be defined. An organizational framework of the actions and policies required to be implemented is presented. However, it is unlikely that an actual emergency situation will adapt to a precise framework. Adaptability and flexibility should therefore be demonstrated in the handling of such events.

The following events may result in a crisis situation and activate the Emergency Response Plan:

– Aviation accident/Serious incident

– Disaster in the premises: Fire, explosion, pollution, flood

– Loss of the working resource: workshop, offices, hangar, aircraft

– Impacts of a disaster within the vicinity of the establishment

– Climatic event: snow, storm, flood, lightning

– Natural disaster: earthquake, volcanic eruption

– Food poisoning, epidemic

– Death at the workplace

– Multiple victims connected to a disaster, illness or contagion

– Accident to the public transportation of the personnel

– Social movements: strike, blocking of the accesses

– Internal or external threat: Attack, bomb alert, sabotage, terrorism,

– Loss of energy: electricity, gas

– Loss of communication means: internet, landlines or mobile telephones

– Major media event

– Accident during missions: business trip, abroad.

Proposed parts of ERP:

1. Definitions (use ICAO Annex 13, Chapter 1 for reference)

2. Organizing emergency responses (checklists, list of managers to notify, etc.)

3. Emergency call action

4. Crisis management; roles of crisis management

5. Rules of internal and external communication

6. Egress training schedule and rules

# 8. Test instrumentation and configuration

# a. Test instrumentation

See the table below; this table will summarize the configurations during the flight test campaign.

*NOTE: “I0 – instrumentation” is the basic applied instrumentation for the flight test campaign. In the column “priority” there is a priority index for each equipment. The meaning: lower numbers-higher priority-“must have” equipment.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Priority** | **Designation** | **Description** | **Items** |
| 1 | Basic | Basic instrumentation | Basic instrumentation like the production aircraft |
| 1 | I0 | Basic instrumentation + installed electronic CO meter | Electronic CO meter |
| 3 | I1 | Swivel head pitot tube | Installed swivel head pitot tube for test flight record as well as altitude and airspeed calibration (see C3 of chapter 7.) |
| 5 | I2 | Accelerometers | Installed accelerometers |
| 2 | I3 | Stopwatch | Installed stopwatches |
| 4 | I4 | Cameras + voice recorders | Installed cameras pointed to the instrument panel, to the horizon, to the left and right wings. Time-stamp function are used on the cameras. |
| 4 | I5 | Strain gauges | Strain gauges are installed to the specific points of the aircraft. |
| 5 | I6 | Temperature sensors | Temperature sensors are installed to specific positions (OAT, fuel temperature, etc.) |
| 2 | I7 | GPS | Installed GPS logger(s) |
| 4 | I8 | Potentiometers | Potentiometers installed to control rods to measure stick deflections |

*NOTE: if the aircraft is designed with “glass-cockpit”, and the system has the capability to log to an SD card, it can be acceptable for use as long as its suitability is assessed.*

# b. Test aircraft configuration

Test aircraft configuration is like the production aircraft; exceptions are noted in chapter 7.

# 9. Test airspace

Flight tests will be executed in a separated airspace 10 NM from ZZZZ airport. The area is unpopulated, the next inhabited area is XXX, in the direction of N/S/W/E in a distance of YY NM. (Or defined by the responsible ATS unit.) Temporary airspace limitations might be requested from the national aeronautical navigation company, and issued in NOTAMs.

# 10. Timeline of the flight test

# a. The planned steps of the flight tests are the following:

Phase 3;

Opening the whole flight envelope

Phase 2;

Performances

Phase 1;

Handling qualities check;

Calibration of instruments

*NOTE: the phases are the following:*

 *Phase1: first flights; preliminary performances, handling qualities,*

*If necessary, a “Phase 1b” also could be added between Phase 1 and 2. This phase has the same limitations as “Phase 1”, except the wider CG range.*

 *Phase2: performances in various flight phases*

 *Phase3: assessing the limitations, extend the flight envelope to its limits.*

**Between each steps, there are breakpoints; each breakpoints will include an assessment about the continuation of the program. If the airplane fails any of the pass/fail criteria; the part of the test program should be repeated.**

For each part of the flight test campaign, different flight conditions may be applicable. An example for that is shown below:

**Phase 1:**

**Limitations** (design value are shown in brackets for comparison)

– Never exceed speed VNE: 130 kts (160 kts)

– Manoeuvring speed VA: 90 kts (100 kts)

– VNO: 110 kts (120 kts)

– Crosswind component limit: 5 kts

– Max. manoeuvring load factors: +1.5 / –1 (+4/–2)

– Max. operating altitude: 5000 feet (13000 feet)

– MTOM: 520 kg (600 kg)

– Flight centre of gravity limits: 29.7–34.9 centimetres aft of datum (24–39 cm aft of datum)

– Air crew: 1 pilot (1+1)

– Airspace: 10 NM radius of ZZZZ airfield, avoiding inhabited areas

**Phase 1b:**

**Limitations** (design value are shown in brackets for comparison)

– Never exceed speed VNE: 130 kts (160 kts)

– Manoeuvring speed VA: 90 kts (100 kts)

– VNO: 110 kts (120 kts)

– Crosswind component limit: 5 kts (15 kts)

– Max. manoeuvring load factors: +2 / –1 (+4/–2)

– Max. operating altitude: 5000 feet (13000 feet)

– MTOM: 520 kg (600 kg)

– Flight centre of gravity limits: 24–39 centimetres aft of datum

– Air crew: 1 pilot (1+1)

– Airspace: 10 NM radius of ZZZZ airfield, avoiding inhabited areas

**Phase 2:**

**Limitations** (design value are shown in brackets for comparison)

– Never exceed speed VNE: 145 kts (160 kts)

– Manoeuvring speed VA: 100 kts

– VNO: 120 kts

– Crosswind component limit: 5 kts (15 kts)

– Max. manoeuvring load factors: +2 / –1.5 (+4/–2)

– Max. operating altitude: 8000 feet (13000 feet)

– MTOM: 600 kg

– Flight centre of gravity limits: 24–39 centimetres aft of datum (different value can be used, see flight test order)

– Air crew: 1 pilot+1engineer (if needed)

– Airspace: 10 NM radius of ZZZZ airfield, avoiding inhabited areas

**Phase 3**

**Limitations** (design value are shown in brackets for comparison)

– Never exceed speed VNE: 160 kts

– Manoeuvring speed VA: 100 kts

– VNO: 120 kts

– Crosswind component limit: 15 kts

– Max. manoeuvring load factors: +4 / 2

– Max. operating altitude: 13000 feet

– MTOM: 600 kg

– Flight centre of gravity limits: 24–39 centimetres aft of datum

– Air crew: 1 pilot+1 engineer (if needed)

– Airspace: 10 NM radius of ZZZZ airfield, avoiding inhabited areas

# b. Preconditions of flight tests

Flight tests can be conducted, when:

– static tests of wing, fuselage, empennages are done *(within the initial limited flight envelope, it may acceptable that some static tests are not completed. A proposal, supported by an engineering rationale, should be agreed with the Agency. Supporting analysis, similarity with previously approved design, simplicity of the design can be used to support the rationale. Service experience is not normally, alone, a valid argument)*

– Control system static and operation tests are done;

– An analysis at least of the Landing gear strength and absorption capability

– Flutter analysis supported by GVT (a preliminary analysis can be acceptable within the limited envelope, but before full opening of the envelope, the full analysis shall be agreed by the agency);

– Before first flight, a maintenance check must be carried out. After engine ground run, all the operational fluids (fuel, oil, coolant) must be drained, and inspected for contamination, particles, etc.

– Ground tests of the powerplant systems are completed;

– Ground tests of the avionic systems are completed;

– Test aircraft configuration properly documented;

*(the above set of tests/analyses can vary significantly from project to project. A proposal shall be agreed in advance with the Agency. For this reason it is important that this document is drafted in a fairly early phase of the project).*

# c. Schedule of flights

*NOTE: The following test schedule contains only the minimum number of flights necessary for certification and development of the aircraft. The actual set of flights may be different.*

*IMPORTANT: The test campaign contains breakpoints. The number of breakpoints are not consistent with the flight test phases.*

*NOTE: A compliance matrix has been attached to the Flight Test Program. The matrix itself will contain all the certification flights.*

| **Seq.** | **Reference ASTM or CS-LSA** | **Subject of test** | **Test point** | **Number of flights** | **Configuration  (see point 7 and 11.)** | **Flight test plan reference** |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | F2245-12d 4.7.1, 4.7.2 | Ground stability and control tests | Checking brakes, taxi to head,  tail and crosswind. High-speed  taxi with nose up and crosswind conditions | – | C1, MID CG, MIN WT | Ground test plan |
| 2 | N/A | Engine check | Checking the engine with flight conditions (operation with TO for ~5 min, MCP for ~15 min, cruise settings for 20 min.) taxies up to VR, checking engine RPM limits and static power (with dynamometer)  After that, a maintenance check should be carried out. See 11.b. | – | C1, MID CG, MIN WT, I0 | Ground test plan |
| ***Breakpoint – test campaign can be continued, when the aircraft passes all the items above. Consider 11.b.*** | | | | | | |
| 3 | N/A | High speed taxi | High speed taxi tests up to VR | – | C1, MID CG, MIN WT, I0 | Flight#1 |
| 4 | N/A | First flight | Take-off, climb, general handling characteristics | 1 | C1, MID CG, MIN WT | Flight #1 |
| 5 | N/A | Acceleration tests | Aircraft’s stability, and yawing/pitching characteristics during accelerating/decelerating, initial effects of power and flight controls | 1 | C1, MID CG, MIN WT | Flight #1 |
| 6 | N/A | Engine cooling & behavior test | Engine characteristics within flight | 1 | C1, MID CG, MIN WT | Flight #1 |
| 7 | F2245-12d 6.11.1, 6.11.2, 8.2.1, 8.2.2 | Airspeed indicator, Altitude indicator and AOA indicator initial calibration flights | Flying at altitude 6000’ with the reference airspeed system | 4–5 | C2, MID CG, MIN WT, I1, I7 | Flight#2 |
| 8 | N/A | General flight control characteristics | Longitudinal, lateral, directional control characteristics. Sideslips for assessing static directional and lateral stability characteristics. Trimmability | 7 | C2, MID CG, MIN WT | Flight#2 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Seq.** | **Reference ASTM or CS-LSA** | **Subject of test** | **Test point** | **Number of flights** | **Configuration  (see point 7 and 11.)** | **Flight test plan reference** |
| 9 | N/A | *Low speed handling characteristics (with mid CG) Vmin: 1.1 VS* | Slow deceleration, (1 kt/sec) to stall warning, checking aircraft’s controllability | 1 | C2, MID CG, MIN WT | Flight#2 |
| 10 | N/A | Stall (At limited CG position) | Stall characteristics | 2 | C2, MID CG, MIN WT | Flight #2 |
| 11 | F2245-12d  4.5.5 | Static directional and lateral stability | Sideslips | 2–3 | C2, MID CG, MIN WT | Flight#2 |
| 12 | F2245-12d  4.5.2.1, 4.5.2.2, 4.5.2.3 | Longitudinal control  (not in the full cg envelope) | Checking elevator, | 2 | C2, MID CG, MIN WT | Flight #3 and 4 (flights with aft and fwd CG) |
| 13 | F2245-12d  4.5.4 | Trim (in the limited speed envelope) | Trim check and its sensitivity at forward CG limit | 1 | C2, FWD CG, MIN WT | Flight #3 (flights with fwd CG) |
| 13/A | F2245-12d  4.5.4 | Trim (in the limited speed envelope) | Trim check and its sensitivity at  aft CG limit | 1 | C2 AFT CG, MIN WT | Flight #4 (flights with aft CG) |
| 14 | F2245-12d 4.5.3. | Directional and lateral control  (not in the full cg envelope) | Controllability in slips, lateral and directional controls must not reverse | 2 | C2, FWD CG, I2, MTOW | Flight #3 and 4 (flights with aft and fwd CG) |
| 15 | F2245-12d  4.5.3.1 | Rate of roll | Handling of ailerons | 1 | C2, FWD CG, I3, I4, I7, MTOW | Flight #4 (flights with fwd CG) |
| 16 | F2245-12d  4 .5.4.1, 4.5.4.2, 4.5.4.3, 4.5.4.4. | Static longitudinal stability | Checking a/c’s characteristics above 1.1Vs1, checking neutral point, checking longitudinal non-linearities. (Differential ratio of function of longitudinal stability changes – if it becomes 0, or slightly positive, the aircraft is unstable) | 3 | C2, AFT CG, I3 MTOW | Flight #3 and 4 (flights with aft and fwd CG) |
| 17 | F2245-12d 4.5.6 | Dynamic stability | Dutch roll tendency, longer period (phugoid) oscillations | 2 | C3, AFT CG, I3,  MTOW | Flight #3 (flights with aft CG) |
| 18 | N/A | Pre-stall assessment with wider CG envelope | Same as point 9, but within the whole envelope | 2 | C3, AFT CG, FWD CG, I3 MTOW |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Seq.** | **Reference ASTM or CS-LSA** | **Subject of test** | **Test point** | **Number of flights** | | **Configuration  (see point 7 and 11.)** | **Flight test plan reference** |
| 19 | CS-LSA 4.5.7.1 4.5.7.2, 4.5.7.3  4.5.8 | Stall, wings level and turning flight (accelerated turning stalls), stall warning – wider envelope | Stall cases (with or without engine, with or without flaps, banked, unbanked, etc.), stall warning operation  Stall performances – fwd CG position | 3 | | C3, FWD CG I3, I4, MTOW, FLAPS UP, T/O, LDG CONF. | Flight #3 (flights with fwd CG) |
| 19/A | CS-LSA 4.5.7.1 4.5.7.2, 4.5.7.3  4.5.8 | Stall, wings level and turning flight (accelerated turning stalls), stall warning – wider envelope | Stall cases (with or without engine, with or without flaps, banked, unbanked, etc.), stall warning operation  Stall characteristics – aft CG position, checking stability | 3 | | C3, AFT CG, I3, I4, MTOW, FLAPS UP, T/O, LDG CONF. | Flight #4 (flights with aft CG) |
| ***Breakpoint – end of phase 1*** | | | | | | | |
| 20 | N/A | Envelope expansion flight and airspeed indicator calibration |  | | 1–2 | C3, MTOW, MID CG, I7 |  |
| 21 | N/A | Gliding characteristics with running and stopped engine | Measuring L/D ratio and respective speed, measuring the points of V/w | | 4 | C3, FWD CG, MTOW | Flight #5 Gliding characteristics with various configurations |
| 22 | F2245-12d 4.4.2.1, 4.4.2.2. | Take-off distance and ground roll | Ground roll and TOD measurements to 50 feet | | 3 | C3, FWD CG, MTOW | Flight #6 Performance |
| 23 | F2245-12d 4.4.3.1, 4.4.3.2 | Climb | Rate of climb and climb gradient measurements, finding VX and VY speeds, in different configurations | | 3 | C3, FWD CG, MTOW | Flight #6 Performance |
| 24 | F2245-12d 4.4.4.1, 4.4.4.2 | Landing distance and ground roll | Ground roll and landing distance measurements from 50 feet to full stop | | 3 | C3, FWD CG, MTOW | Flight #6 Performance |
| 25 | 4.4.5 | Go-around and balked landing | Climb gradient with landing configuration | | 3 | C3, FWD CG, MTOW | Flight #6 Performance |
| 26 | F2245-12d 7.3.1 | Unusable fuel | Considering FTP #11, when first signs of fuel starvation occurs; stop the engine and land | | 2 | C2, MID CG, MIN WT | Flight #7 Fuel calibration flights; prerequisites: Flight #5 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Seq.** | **Reference ASTM or CS-LSA** | **Subject of test** | **Test point** | **Number of flights** | **Configuration  (see point 7 and 11.)** | **Flight test plan reference** |
| 27 | CS-LSA  7.1.5. | Engine cooling test in a wider envelope | Engine cooling characteristics at higher speeds | 2 | C2, MID CG, MIN WT | Flight #8 |
| 28 | N/A | Max. operating altitude | Determining max. ceiling | 2 | C3, MID CG, MTOW | Flight #8 |
| ***Breakpoint – end of phase 2*** | | | | | | |
| 29 | N/A | Envelope expansion flight and airspeed indicator calibration |  | 1–2 | C2, MID CG, MIN WT |  |
| 30 | F2245-12d 4.5.3. | Directional and lateral control in the whole envelope | Controllability in slips, lateral and directional controls must not reverse | 2 | C3, FWD CG, MTOW, T/O FLAPS, LDG FLAPS | Flight #3 and 4 (flights with aft and fwd CG) |
| 31 | F2245-12d 4.5.9.1, 4.5.9.2, 4.5.9.3, 4.5.9.4 | Spinning (1 turn/ 3 sec. spinning, what lasts more) | Spin recovery characteristics in various configurations | 6 | C3, AFT CG, MIN WT, (LATER MTOW), | Flight #9 Spinning |
| 32 | F2245-12d 4.3 | Propeller speed and pitch limitation | Verification of the propeller limits, the propeller must not reach the RPM limit given by the propeller manufacturer, even in high speed dive at VNE | 2 | C1, I4, MIN WT, MID CG | Flight #10 Propeller limits |
| 33 | F2245-12d 4.5.6 | Dynamic stability at higher speeds | Dutch roll tendency, longer period (phugoid) oscillations | 2 | C3, MTOW, CG AFT AND CG FWD, I1, I3 | Flight #3 and 4 (flights with aft and fwd CG) |
| 34 | F2245-12d 4.6 | Flutter tests, vibrations, buffeting (speeds to VD, completing the envelope) | Looking vibrations on the whole envelope, flutter can occur only above VNE | 4 | C1, MTOW, CG VARIOUS, I2 | Flight #11 Flutter flights |
| 35 | F2245-12d 6.11.1, 6.11.2, 8.2.1, 8.2.2 | Airspeed calibration | Airspeed calibration flights on the whole flight envelope (from VS0 to VH ) | 1–2 | C2, MTOW, CG VARIOUS | Flight #11 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Seq.** | **Reference ASTM or CS-LSA** | **Subject of test** | **Test point** | **Number of flights** | **Configuration  (see point 7 and 11.)** | **Flight test plan reference** |
| 36 | F2245-12d  4.5.4 | Trim | Trim check and its sensitivity at higher speeds (with FWD CG) | 2 | C3, MTOW, FWD CG | Flight #3 (flights with fwd CG) |
| 36/A | F2245-12d  4.5.4 | Trim | Trim check and its sensitivity at higher speeds (with AFT CG) | 2 | C3, MTOW, AFT CG | Flight #4 (flights with aft CG) |
| 37 | CS-LSA 7.1.5 | Engine qualification test | Engine characteristics throughout the whole envelope | 3 | C3, MTOW, MID CG | Flight #11 |
| 38 | CS-LSA 7.1.3 | Engine-airframe interaction test | 100 hr flight operation test | See NOTE2 | C1, MTOW, CG VARIOUS | Flight #12 (Engine qualification plan) |
| ***Breakpoint – end of phase 3*** | | | | | | |

N/A – the test point is not directly performed for certification (development flight) (for example: Flights aimed to go through a stepped approach to the compliance test point are also considered development flight: stalls at mid CG, ceiling flights, general flight characteristics, etc.)

|  |  |
| --- | --- |
| *NOTES:* | *1. The development flights are also included to the test schedule.* |
|  | *2. Additional development flights might be planned by the applicant.* |
|  | *3. There is no requirement for the number of flights. However, the ASTM F2245-12d 7.1.3 requires a 100 flight hours engine-airframe test (as an endurance test).* |

Some paragraph from the requirements are not covered with particular flight tasks, these parameters will be observed throughout the complete flight test program. Observations and reports are reported into a document named “Qualitative pilot statements” (example: assessment of the cockpit accessibility and visibility).

|  |  |
| --- | --- |
| **Reference** | **Requirement** |
| F2245-12d 4.5.1 | Controllability and manoeuvrability (general) |
| F2245-12d 6.10 | Pilot’s comfort, accessibility, ability to reach all the controls |
|  | Engine operations and handling characteristics |
|  | Equipment functions |
|  | Cockpit controls location and movements |
|  | Heat, and ventilation |
| F2245-12d 5.3.6 | Control System Stiffness and Stretch |
| CS-LSA 7.8 | Exhaust – carbon monoxide contamination |
| 7.1.3 | Engine-airframe qualification test |

# 11. Flight test orders

Normally, the test plan must contain the flight test orders (for each flight), each flight test order must contain the flight test cards (for each test points).

Each test order will contain the following parts:

– Sequence of planning of flights

– If the flights are certification flights, a reference to the applicable requirements

– Method of test flight

– Weight and balance settings

– Required weather conditions (and log for the actual)

– Required facilities and airspace

– Designated crew (pilot, engineer)

– Communication rules (frequencies)

– Aircraft configuration and instrumentation

– Specific limitations for the flights

– Emergency procedures, risk mitigation

– Test points, limits, and assessments

– Flight profile

– Test cards for each flight

For a test card example; see part 14 of Appendix. For risk mitigation example, see part 10. of the Appendix.

# Appendix 1 – Organisational aspects

This appendix is intended to provide guidance for applicants without a Flight Test Organization (and a DOA). In fact, the aspects treated here are normally treated in the FTOM[[3]](#footnote-3). In case a Flight test organization is not in place, the content of this appendix can be used to complement the flight test program. This appendix can be seen as a “small” FTOM.

# 1. Special tools and equipment – Data source summary

The table shown below list all special / measurement equipment typically used and its purpose. All measurement equipment shall be calibrated (see 21.A.33 2.).

|  |  |
| --- | --- |
| 1. Scale  Description of scale used for CG measurement  Weight limit, increment, dimension, design features  Calibration standards | (1) |
| 2. Swivel head pitot-static tube  iaw. AC-23-8C § 23.49 static port 1 chord length in front of the wing | (1), (2) |
| 3. A/D converter for the computers  Type of the device  Type of inputs (pressure, voltage from strain gauges) | (1) |
| 4. Strain gauges  Type  Amplifier type  Power source  Placement | (1) |
| 5. G sensor  Device type  Connection | (1) |
| 6. Temperature  Device type  Placement | (1) |
| 7. GPS | (1) |
| 8. Video cameras / recorders | (1) |
| 9. CO meter  Type of device  Metering limits | (1) |
| 10. Other devices | (1) |

(1) Picture could be inserted there

(2) Picture, or engineering drawing could be inserted there

# 2. Airfield assessment

It is recommended, that for the first flights the airport must be obstacle-free. Aspects like obstacles and suitability of the areas for emergency landing (Congested areas, lakes, uncultivated lands, pits, etc.) shall be assessed and noted on a VFR chart (or even a google map picture!!). An example below.

|  |
| --- |
|  |
| Airfield assessment. Possible risks are marked with red, available emergency landing sites within the airport area are marked with white, the recommended emergency landing trajectories are marked with yellow. |
|  |
|  | |
|  | |
|  | |
| Most significant obstacles: high voltage electrical wires and pylons 1400 m away from the runway. | |

# 3. Requirement of Flight Test Team

Below 2000 kg of MTOW, there is no specific requirement in qualifications and/or flight hours. Although, the applicant should establish its rules about selection of crewmembers. E.g. Flight hours, previous experience, aerobatic rating (iaw. FCL.800), etc.

# 4. Phases of the flight tests

This section defines how the Flight Test Campaign phases are organized and the general criteria for the opening of the envelope. Since, these aspects have been already addressed in the core part of the document, they will not be treated in this appendix.

# 5. Strategy for extension of the flight envelope

The extension of the envelope will be done step by step.

– Familiarization: In this phase the flight test crew familiarizes themselves with the aircraft, its controls, and the evacuation procedures

– Ground tests: In this phase, necessary ground tests before the first flight will be performed (wing static test, control system test, etc.)

– First flight: The demonstration of the aircraft is capable for flight

– Stability, handling. First with limited CG range, and limited weight

– Extending the stability and handling tests to the whole CG range

– Performances (take-off, landing, go-around, climbing, gliding characteristics)

– Extending the flight envelope (flutter assessment, stalls, spins, flights around – and beyond-VNE)

# 6. Briefing rules

A flight test order will be filled for each flight. This order contains data about:

– the flight test team

– their medical fitness for the particular task

– the predefined sequence of tasks (and referring flight test cards)

– the flight profile

– weight and balance information

– limitations applicable to that flight

– emergency procedures

– aircraft’s status and maintenance release for the test

– test points and test methods, assessment methods (See the Cooper-Harper handling scale for reference)

After filling the flight test order, a daily briefing will be commenced. It will cover:

– the points of the flight test order

– establishing the flight test cards

– the meteorological situation

– the proposed actions in an emergency

– check-up of necessary documents (aircraft, personnel)

# 7. Handling qualities assessment example



Figure 1 – Cooper-Harper handling scale

Example:

Ground stability and control tests to see compliance against 4.7.1 and 4.7.2 of ASTM F2245. The aim of the test: evaluate the aircraft’s controllability on ground and show, that the pilot is able to maintain the direction of taxiing.

The pilot should assess these questions on the left side of the diagram:

– Is it controllable? Is the pilot able to maintain the centreline of the runway? If yes, move to the next question;

– Is adequate performance attainable with a tolerable pilot workload? Does the aircraft run in the direction, are there any tendency to steer left or right? Does the pilot need to correct the movements? If the aircraft could maintain the direction, move to the next;

– Is it satisfactory without improvement? If yes, see, how many pilot compensations is needed to maintain the centreline. Scale it between 1–3

|  |  |  |  |
| --- | --- | --- | --- |
| Handling scale – 4.7.1 and 4.7.2 |  | | Rating: |
| Is it controllable? Is the aircraft maintaining the direction during taxiing? Is centreline tolerance is within 2 meters with conventional pilot inputs? | Yes | No |  |
| Is adequate performance attainable with a tolerable pilot workload? Is centreline tolerance is within 1 meters with conventional pilot inputs? | Yes | No |  |
| Is it satisfactory without improvement? Is it acceptable? Is centreline tolerance is within 50 centimetres with conventional pilot inputs? | Yes | No |  |
| If the aircraft passes all the criteria, note the rating from the upper part of the scale | | |  |

# 8. Workload assessment (if necessary)

Normally, workload assessment is not a part of the certification of a Light Sport Airplane. Although, when the applicant intends to use special conditions (e.g. Night VFR) or intends to use special equipment, the pilot workload should be assessed.

Assessment methods: There are many workload assessment techniques, a few example is shown.

A. NASA Task Load Index (TLX) : <http://humansystems.arc.nasa.gov/groups/tlx/>

B. Bedford rating scale:

|  |
| --- |
| Figure 2 – Bedford workload scale |

See para 0 for “best practices”

C. Heart-rate variability examination; see articles and papers about it:

[1] M. H. Asyali, Discrimination Power of Long-Term Heart Rate Variability Measures, Proceedings of the 25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, pp. 200–203, Cancún, México, September 17–21, 2003.

[2] Bansevicius D, Westgaard RH, Jensen C, Mental Stress of Long Duration: EMG Activity, Perceived Tension, Fatigue, and Pain Development in Pain-Free Subjects, Medline, Headache, Volume 37, Issue 8, pp. 499–510, 1997.

[3] L. Izsó, Developing Evaluation Methodologies for Human-Computer Interaction (INTERFACE), Delft University Press, 2001.

NOTE: for method “C”, proper crew (aviation psychologist) and equipment (ECG) is essential.

# 9. Post flight data processing

This section should define how the data are post processed. For examples:

– Airspeed correction method *(for errors)*

– Engine power corrections to ISA *(for performance calculations – air temperature affects density what affects power – a brief method how to do it)*

– Temperature and altitude graph (for density altitude and ISA calculations)

# 10. Safety management / risk assessment

This section should explain how the safety of the flight is managed. In this case, the Appendices C and D of [FAA Order 4040.26B](http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1019824) have been followed. Further information on Risk Management can also be found in various sources, for example, in the [EHEST SMS Toolkit](http://easa.europa.eu/essi/ehest/main-page/ehest-safety-management-toolkit/).

**Identify a person responsible of the safety:** it is advised to identify a “safety manager”, that will be responsible over the “safe” execution of the whole flight test campaign through the proper implementation of the established procedures.

**Identify the test technique involved:** Generally, the risk associated with a specific flight test, is dependent, among others, on the specific flying test techniques.

However, there may be risks associated with flying a test airplane that result strictly from the airplane’s configuration or the environment into which it is flown and these sources of risk must also be considered.

**Identify the hazard(s) associated with the test technique:** Ask “What adverse events might happen when accomplishing this test technique?” Note that one test technique may have several hazards and each should be addressed (e.g., another hazard with this test technique would be engine failure caused by inlet distortion, or fuel starvation, or the aircraft may enter into spin during a stall characteristic test).

**List the cause of each hazard:** Ask “Why might the hazard happen?”

**List the effect of each hazard:** Ask “What will be the effect?” These should be related to either injury/loss of life or damage to aircraft/property.

**Perform a subjective risk assessment by:**

(1) Estimating the probability of each hazard occurring. Defined as improbable, remote, occasional, probable, or frequent.

(2) Estimating the severity of each hazard, if it occurs. Defined as no safety effect, minor, major, hazardous, or catastrophic.

(3) Defining the risk of each hazard as a combination of the probability and severity. Defined as low, medium, high, or avoid.

**Describe the steps for Mitigation of causes for each hazard:** Develop controls that mitigate all risks to an acceptable level. Mitigations are actions to minimize, understand, prepare or respond to causes of the hazards. They can be in the form of actions from the flight test crew or information developed by the design engineers (e.g., lab testing, simulator evaluations). Mitigations will reduce either the probability of the event, or the severity of the effect, or both. Mitigations should be detailed and specific in nature.

**Describe any Emergency Procedures to accomplish if the hazard occurs, despite mitigation steps.**

**Document and verify the risk assessment:** The risk level after mitigation shall be highlighted and classified iaw. the table below and it shall be independently verified.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Risk** | | | | | **Management** | | | | |
| **Hazard** | **Cause** | **Effect** | **Probability** | S**everity** | | **Risk** | **Mitigation** | **Emerg. Proc.** | **Risk** |
| Describe “what might happen?” | Describe the “why might it happen?” | Describe the effect | Use Table 3 | Use Table 4 | | State the overall risk category, eg. 3B, use Table 1 and 2 | Describe the method how the risk is minimized | Describe what will be done if the hazard occurs | State the overall risk after mitigation e.g. 3D |

Table app. 1 – Summary table for risk assessment

Example:

Stall characteristics test iaw. ASTM F2245-12d 4.5.7. Because the envelope is not yet fully opened, and the flight characteristics are still not completely determined, the aircraft could enter into spin and could not be able to recover. The effect of the risk could be fatal. The severity is class “A”, which means “Destruction of equipment, Fatalities”.

The probability of that effect is very low, because the aircraft’s behaviour can be modelled, and if the spin occurs, the autorotation could be stopped with proper pilot technique (reducing power, using rudder in opposite direction, and pushing the elevator to decrease AoA). Although, the probability is low, the only action is that the pilot abandons the aircraft. If the pilot cannot bail out before a certain altitude, he/she would not have enough time to jump out and open the parachute. So it’s improbable, but may occur, it’s classification is “3” according to Table app. 3.

The overall risk classification is 3A. The colour of the 3A risk is red, what means unacceptable. (See Table app. 4)

Because the kind of risk is unacceptable, it must be mitigated.

– The stall test would be performed at a minimal safe altitude (to get enough time to bailout, if the spin is unrecoverable) for example at least at 6000 feet (1800 m) above ground level

– To make the bailout easier, a canopy or door jettison system may be installed.

– Ultimately also the aeroplane can be modified, adding a test spin-chute or a BRS (for such flights the crew must anyway wear parachutes).

– Emergency procedures shall be established, e.g. in this case, if recovery attempts are unsuccessful until a certain altitude (e.g. 1500 feet AGL), the aircraft must be abandoned.

After the risk management, the situation is the following:

– The aircraft still could enter into an inadvertent and unrecoverable spin. The possibility remains 3

– The risk for the flight crew is lower, because they have chance to save their lives (wearing parachutes, abandoning the aircraft is easier with the jettisonable canopy), therefore the only outcome of a spin accident would be the loss of the aircraft (the flights were planned in uninhabited areas – see point 11 – therefore the only endangered people are the crew on board). The severity will be D (loss of the aircraft, injuries during bailout – applying emergency procedures)

– The overall risk decreases to 3D, which is yellow-coloured. It will be acceptable after the review of the operations

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Risk** | | | | | **Management** | | | | |
| **Hazard** | **Cause** | **Effect** | **Probability** | S**everity** | | **Risk** | **Mitigation** | **Emerg. Proc.** | **Risk** |
| The aircraft enters unrecover-able spin during stall test | The unknown flight charac-teristics above | Crash, and fatal injuries to the flight crew | 3; Improbable, but may occur | A; Destruction of equipment, fatalities | | 3A | Parachute wearing; Minimal safe altitude to 6000’ AGL; Canopy jettison system installation | If the spin is unreco-verable before 1500’ the aircraft must be abandoned. | 3D |

Table app. 2 – Example of use of risk mitigation table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Probability of occurrence** | | **Severity of occurrence** | | | | |
| **Catastrophic** | **Hazardous** | **Major** | **Minor** | **Negligible** |
| **A** | **B** | **C** | **D** | **E** |
| **5** | **Frequent** | **5A** | **5B** | **5C** | **5D** | **5E** |
| **4** | **Probable** | **4A** | **4B** | **4C** | **4D** | **4E** |
| **3** | **Occasional** | **3A** | **3B** | **3C** | **3D** | **3E** |
| **2** | **Remote** | **2A** | **2B** | **2C** | **2D** | **2E** |
| **1** | **Improbable** | **1A** | **1B** | **1C** | **1D** | **1E** |

Table app. 3 – Risk classification table

Risk management process

Overall risk after mitigation

Overall risk before mitigation

Legend of risk (and colouring):

|  |  |
| --- | --- |
| **Avoid** | Unacceptable; |
| **High** | Handling of risk demands decision; |
| **Medium** | Acceptable after review of operation; |
| **Low** | Acceptable; |

Table app. 4 – Acceptability of risks

In the probability table, you can assign a value from 1 to 5 to the probability of each hazard.

|  |  |  |
| --- | --- | --- |
| **Probability table** | | |
| **Type** | **Meaning** | **Value** |
| Frequent | Probably occurs frequently; | **5** |
| Probable | Probable sometimes occurs; | **4** |
| Occasional | Improbable, but may occur; | **3** |
| Remote | Very improbable to occur; | **2** |
| Improbable | Almost unimaginable to occur; | **1** |

Table app. 5 – Probability

Severities could be classified in the table below:

|  |  |  |
| --- | --- | --- |
| **Severity classification** | | |
| **Definition** | **Meaning** | **Value** |
| **Catastrophic** | Destruction of equipment | **A** |
| Fatalities |
| **Hazardous** | Very substantial degradation of aviation safety measurements;  Physical danger or workload, when the operators might be unable to complete their tasks;  Serious injuries occurring with multiple personnel;  Major damage of equipment; | **B** |
| **Major** | Substantial degradation of aviation safety measurements;  Degradation of operators’ abilities to complete their tasks in an increasing workload environment  Serious accident;  Injuries; | **C** |
| **Minor** | Damage of equipment | **D** |
| Operational limitations |
| Applying emergency procedures |
| Minor accidents |
| **No safety effect** | Minor consequences | **E** |

Table app. 6 – Severity classification

# 11. Configuration management

The prototype will have to be released with a statement of conformity to the design configuration identified by the design organisation. The conformity statement will be (normally) provided by the Production Organisation. After this step, the airplane will be fully managed by the Design Organization.

The Maintenance and calibration of the equipment will be performed by Maintenance personnel identified and accepted by the design organisation*.*

The Design organization is responsible to maintain a current list of scheduled maintenance tasks and calibration planning for each test equipment and to arrange for timely performance of those tasks.

Each modification in the aircraft configuration shall be assessed against:

– The safety of the flights

– The validity of the approved flight conditions;

– The already executed Flight tests (example: installation of vertical fin might give results which cannot be compared with already executed flights);

– The already executed certification activities (example: reduction of the size a control surface might invalid the flutter analysis)

Each modification in the aircraft configuration shall be logged into the technical log, and each test card must be signed by the personnel. An example for the flight test card layout can be found in the paragraph 14 of this appendix.

At the moment of issuing of this document, the prototype aircraft is conforming to the type design and the equipment corresponds to the designated equipment list items, except:

– A spare set of backup instrumentation for the EFIS

– Separate transponder instead of the remote-controlled one

– The baggage compartment is modified to accommodate the specific test instrumentation. (Installed instrument racks, removed carpets, etc)

# 12. Maintenance procedures (arrangements with maintenance organizations)

Throughout the whole flight test campaign the aircraft’s maintenance tasks will be performed in accordance with the provisional version of the AMM (iaw. CS-LSA.30 – ASTM F2483-12). Additional inspections will be carried out according to the flight test pilot’s observations and remarks noted into each flight report.

Any maintenance task[[4]](#footnote-4) on the prototype will be performed by qualified personnel, holding a proper authorization. Certifying Staff member must held a Part-66 (Annex III. Of 1321/2014 EC) licence. The aircraft’s technical log will be kept and updated as soon as any kind of maintenance are carried out.

Modifications in configuration will be recorded the regarding section of the following flight test order, and the responsible person for the design must declare the aircraft is airworthy before each flight during the pre-flight briefing by signing the appropriate field on a given Flight Test Order.

The maintenance staff preparing the aircraft for test is responsible to check the calibration status of each installed test equipment / test instrumentation and record the respective calibration expiry date in the referring technical log. The earliest expiry date of all installed test equipment shall be referred to in the aircraft’s conformity statement (“Calibration status of all FTE/FTI has been checked and will not expire before [date]”).

# 13. Technical log example

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | XXXX Air Ltd. – Technical Department | | | | | | | | | | | | |  | | | |  |  | |
|  |  |  |  | |  |  | | | | | | | | |  | | | |  |  | |
|  |  |  | **AIRCRAFT TECHNICAL REPORT** | | | | | | | | | | | | | | | |  |  | |
|  |  |  |  | |  |  | | | | | | | | |  | | | |  |  | |
| **BASIC DATA** | | | | | | | | | | | | | | | | | | | | | |
| **DATE** | |  | | | | | | **REG NR.** | | |  | | | | | | | | | | |
| **FLT TIME** | |  | | | | | | **BLK TIME** | | |  | | | | | | | | | | |
| **WO** | |  | | | | | | **TYPE** | | |  | | | | | | | | | | |
| **TIME** | |  | | | | | | **S/N** | | |  | | | | | | | | | | |
| **LOCATION** | |  | | | | | | **CREW** | | |  | | | | |  | | | | | |
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| **DESCRIPTION OF DEFECTS** | | | | | | | | | | | | **ATA** |  | | | | | | | | |
| (Attach multiple pages and/or photos, if necessary.) | | | | | | | | | | | | | | |  | | | |  |  | |
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| **ENGINE READINGS (IF APPLICABLE)** | | | | | | | | | | | | | | | | | | | | | |
|  | **MP** | **RPM** | | **EGT** | | | **CHT** | | **FP** | **OT / OIL PRES.** | | | | **COOLANT** | | | | | **VOLTS / AMPS** | | |
| **1** |  |  | |  | | |  | |  |  | | | |  | | | | |  | | |
| **2** |  |  | |  | | |  | |  |  | | | |  | | | | |  | | |
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| **CORRECTIVE ACTION TAKEN** | | | | | | | | | | | | | | | | | | | | | |
| (Specify the appropriate maintenance action, and/or attach the work order number.) | | | | | | | | | | | | | | | | | | |  |  | |
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|  | Two (2) copies. White: retained by Technical Department, Colored: remaining on A/C | | | | | | | | | | | | | | | | | | | | |
|  | NOTE: Detach this page ONLY AFTER the corrective action has been noted on the | | | | | | | | | | | | | | | | | | | | |
|  | appropriate cell. | |  | |  |  | | | | | | | | |  | | | FORM\_TECHREP\_001 | | | |

# 14. Example for flight test card preparation

This card should be designed in a DIN A5 size, to get it fit to the knee block.

The test point in this example, the para. 4.5.3.1 “Directional and Lateral Control” from ASTM F2245-12d 4.5.3.1.

Requirement:

*4.5.3.1 It must be possible to reverse a steady 30° banked coordinated turn through an angle of 60°, from both directions:*

*(1) within 5 s from initiation of roll reversal, with the airplane trimmed as closely as possible to 1.3 VS1, flaps in the take-off position, and maximum take-off power; and*

*(2) within 4 s from initiation of roll reversal, with the airplane trimmed as closely as possible to 1.3 VSO, flaps fully extended, and engine at idle.*

One flight will be performed, with two tests for each points.

The aircraft’s stall speeds are the following:

|  |  |  |  |
| --- | --- | --- | --- |
| **Stall speeds** | | **Set speeds** | |
| VS0: | 44 KT | 1.3 x VS0: | 57.2~58 KT |
| VS1: | 50 KT | 1.3 x VS1: | 65~65–66 KT |

**Instrumentation and configuration:** see #15 of flight test sequence.

**CG setting:** controllability must be examined at forward CG position, therefore the CG will be at FWD end.

**Configuration:** a stopwatch must be on board to measure reversal time, in this case I3 was used.

**Instrumentation:** Conventional instrumentation, the pitot-boom is not necessary due to the low airspeeds VMAX 90–100 knots, and the flight envelope has been already opened until 130 knots.

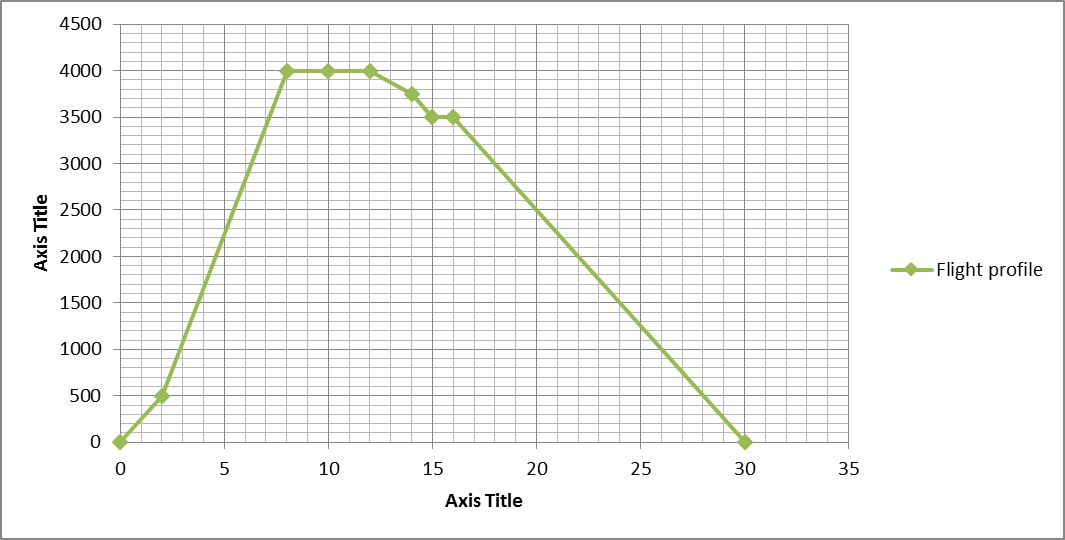
**Limitations:** as per “Phase 1b”. See para 11.a.

For risk assessment, follow the method from para. 10 from Appendix.

**Flight profile:**

The altitude was shown in QFE. The airfield’s elevation is 310 feet (see para. 8 “Facilities”)

Estimated time of test task: 30 minutes.



Description:

– In the first two minutes, until 500 feet there is a climb with small gradient, and performing the after take-off checklist.

– Climbing to 4000 feet will last around 6 minutes (estimated)

– Between 8–12 minutes from take-off, steps 6–13 can be performed (estimated)

– Between 12–15 minutes from take-off, steps 14–22 can be performed (estimated)

– In the remaining time: descent with avg. 250 feet/min and perform normal landing.

The test cards can be used to prepare the flight test order. The test order will define the sequence of test points. After the flight, the filled test cards can be used for establishing the test report.

NOTE: The level of explication should be as detailed as practical. An example is shown here,

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| Directional and Lateral Control – roll performance (para 4.5.3.1. of ASTM F2245-12d) | | | | | | | | | | |
| **Test points and conditions** | | | | | **Test plan no.** | | Flight #4 / 15 | | | |
| Initial conditions | |  | | | Safety procedures | | Limitations | | | |
| ALT: 4000’ (QFE)  Speed range: VS1-100 KTS  Trim: straight and level flight | |  | | | Overall risk: 2B; after mitigation: 2C  Safety equipment: personal parachutes, crash axe in the baggage bay. | | VS0: 44 KT  VS1: 50 KT  VFE: 90 KT  VMAX: 100 KT | | RPM: 2550  MP: 30 HgIn | |
| Limit | Steps | | Time | Comment | Limit | Steps | | Time | | Comment |
| VFE 90 KT  VS1: 50 KT | 1. Extend takeoff flaps  2. Trim the aircraft to 59 KT  with full power (TOGA)  3. Establish a coordinated turn with 30° bank angle to the left  4. Start timing  5. Reverse to 30° turn in the opposite direction  6. Record time of 60° bank change achievement  7. Repeat step 3-6 for both directions | |  |  | VFE: 90 KT  VS0: 44 KT | 8. After step 7 was done, set altitude to 4000 feet  9. Set idle power  10. Extend landing flaps (below VFE)  11. Trim the aircraft to 50 KT  12. Establish a coordinated turn with 30° bank angle to the left  13. Start timing  14. Reverse to 30° turn in the opposite direction  15. Record time of 60° bank change achievement  16. Repeat step 12-15 for both directions | |  | |  |
| Test data report | | | | | | | | | | |
| |  |  |  | | --- | --- | --- | | Seq1. | Test #1 | Test #2 | | Left |  |  | | Right |  |  |  |  |  |  | | --- | --- | --- | | Seq.2 | Test #3 | Test #4 | | Left |  |  | | Right |  |  |  |  |  | | --- | --- | | Initials | | |  |  | | FTP | FTE | | | | | | | | | | | |

**NOTE:** This task is planned as an individual flight. However, the applicant may choose to combine flights. (If fuel allows it.)

For example, the task nr. 13–14–15 from the test timeline (see para. c ) may be combined. In this case, all the instrumentation for the other tasks should be installed to the aircraft. Task nr. 13 and 13/A could be interchanged, because these flights can be performed with the same way, although the CG position is not the same.

**IMPORTANT:** each test point from the test order must have separate test card, to avoid confusion.

# Appendix 2 – Flight Conditions and Permit to Fly

A valid Permit to Fly shall be held in accordance with Subpart P of EU 748/2012

Application for associated Flight Conditions (shall be submitted to EASA).

The application for Permit to Fly shall be submitted to the Competent Authority after the Flight Conditions are approved by EASA.

See: <http://easa.europa.eu/easa-and-you/aviation-domain/aircraft-products/permit-fly>

<http://easa.europa.eu/document-library/application-forms/focert00037>

Application form direct link:

<http://easa.europa.eu/system/files/dfu/FO.CERT_.00037-002%20Application%20for%20AFC%20for%20a%20permit%20to%20fly.docx>

Application should include the Flight Test Program, the proposed flight conditions, and a declaration that the aircraft is capable for safe flight under the restrictions iaw. 21.A.708 (b).

# Appendix 3 – Best Practices

 Flight Test Safety Committee : <http://flighttestsafety.org/best-practices>: NOTE: The Flight Test Safety Committee (FTSC) is an international non-profit organization formed jointly in November 1994 by members of the Society of Experimental Test Pilots (SETP), the Society of Flight Test Engineers (SFTE) and the American Institute of Aeronautics and Astronautics (AIAA).

 FAA Order 4040.26B (as amended) Aircraft Certification Service Flight Test Risk Management Program: <http://www.faa.gov/documentLibrary/media/Order/4040.26B.pdf>

 Peter W. Merlin, Gregg A. Bendrick, and Dwight A. Holland: Breaking the Mishap Chain (NASA eBook) <http://www.nasa.gov/connect/ebooks/break_mishap_chain_detail.html>

NOTE: This linked eBook contains a collection of case studies of mishaps involving experimental aircraft, aerospace vehicles, and spacecraft in which human factors played a significant role. In all cases the engineers involved, the leaders and managers, and the operators (i.e., pilots and astronauts) were supremely qualified and by all accounts superior performers. Such accidents and incidents rarely resulted from a single cause but were the outcome of a chain of events in which altering at least one element might have prevented disaster. As such, this work is most certainly not an anthology of blame. It is offered as a learning tool so that future organizations, programs, and projects may not be destined to repeat the mistakes of the past. These lessons were learned at high material and personal costs and should not be lost to the pages of history.

 Bedford Workload Scale (FAA):

<http://www.hf.faa.gov/workbenchtools/default.aspx?rPage=Tooldetails&subCatId=11&toolID=316>

 Bedford Workload Scale (eurocontrol):

<https://www.eurocontrol.int/ehp/?q=node/1643>

1. For flight test categories, see NPA 2008-20 [↑](#footnote-ref-1)
2. FTE qualifications iaw. Opinion 07/2013 and NPA 2013-16 [↑](#footnote-ref-2)
3. Flight Test Organization Manual. [↑](#footnote-ref-3)
4. Maintenance task in this case means: routine and non-routine maintenance tasks, CG adjustment (ballast installation or removal), installation or removal a flight test instrumentation (strain gauges, air data computers, recorders, etc.) [↑](#footnote-ref-4)