Testing Agreement MS 001-01-2012

between the LBA recognized testing centers and the PMA

In accordance with LTF 23/05 part 4.3 " Operating characteristics of canopies for powered paragliders and trikes", the glider must be tested for airworthiness by a testing center.

Problematic: the exact procedure for determining and judging glider airworthiness is not defined in the LTF. This may lead to differing results from different testing centers.

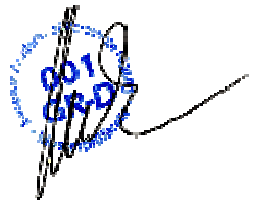
Goals: To clearly define procedures and guidelines for the testing and judging of glider airworthiness according to the LTF.

Agreement: The undersigned representatives of the LBA recognized testing centers for motorized paragliders and the PMA agree to test and judge the airworthiness of motorized paraglider glider operation in accordance with the guidelines and procedures detailed below.

Note: Recognition of this agreement from the LBA is not mandatory.

Validity: the agreement begins on the signing of this document.

Bad Grönenbach, 20.02.2012



EAPR – Guido Reusch

Flight Test program

Scope: This document details requirements and procedures to verify relevant safety requirements of motorized paragliders and trikes.

Definitions: the following definitions are used throughout the document:

Brakes: primary controls designed by the manufacturer for directional and velocity control.

Additional controls: secondary controls for directional control alternatives at higher speed such as stabilizer line or outer brake-line controls.

Trimmers: adjustable pitch control system which remains set until the pilot releases it.

Speed system: secondary pitch control system usually operated per foot, which returns to initial position once pilot input is ended.

Pilot action: any action such as weight shifting, braking, applying speed, trimmers or changing the motor output.

Normal flight: position at which a completely opened canopy is flying straight ahead with no pilot action. A small number of the canopy cells may remain collapsed.

Automatic recovery: recovery to normal flight occurs without the need for pilot action.

Frontal collapse: a frontal collapse is defined as when the pilot is able to see the upper surface of the canopy while suspended below it. Deformed leading edges are not to be seen as frontal collapses.

Cascade: a cascade occurs when one abnormal flight state leads to another or to a series of further abnormal flight states.

Minimum speed: the minimum speed at which the canopy flies without entering a deep stall or full stall.

Low speed: the speed at which the canopy flies when 50% brake is applied (100% brake range is from zero brake to the point where a stall occurs).

Trimspeed: the speed at which the canopy flies when zero brake is applied, no use of speed system is made and trimmers are set closed or at neutral without motor input.

Maximum speed: the speed at which the canopy flies with zero brake input, trimmers off, maximum use of the speed system and zero motor input. The definition maximum speed will only be used for gliders fitted with trimmers and / or speed systems.

Start mass: the mass of the pilot and all flying equipment ready for launching, rounded to the next full kilogram.

1. Flight tests

1.1. General

The flight test program as detailed in 4. is to be demonstrated to a test center test pilot by a manufacturers test pilot. The Test center test pilot is to conduct flight tests on the glider once satisfied with the demonstration.

1.2. Equipment

1.2.1 Test pilot equipment: the test pilot must have the following equipment:
• Radio for contacting ground crew
• Speedometer,
• Variometer,
• Ballast system for regulation of start mass according to manufacturers specifications,
• Type-tested reserve parachute,
• Helmet
Should a tandem glider be tested then the co-pilot must have:
• Ballast system for regulation of start mass according to manufacturers specifications.

1.2.2. Ground crew equipment (not necessary if onboard-documentation is performed) The ground crew must have the following equipment:
• Video camera to film the actions and movements of the pilot, and reactions of the glider,
• Radio for contact to the test pilot and commentary recording on the video data carrier

1.3. Test example

1.3.1. A glider and operating manual identical in all points to the test example defined in the test application are to be supplied for test flights.
1.3.2. Should it not be possible to perform test manoeuvres specified in the test flight procedure due to canopy line geometries, the manufacturer may fit folding lines to the canopy to accomplish this. The use of folding lines is to be documented in the test protocol and operating manual of the glider.

1.4. Testing conditions: Weather:

• Wind speed under 20 km/h at the test site,
• no thermal activity which may disturb test manoeuvres is permitted.

1.5. Test procedure

1.5.1. General: A tolerance of ± 5 kg is permitted for all masses. A tolerance of ± 2 km/h is permitted for all speeds. A manoeuvre which has not been performed precisely as detailed in section 4 (e.g. due to pilot error or weather conditions) must be repeated.

1.5.2. Trimmers: test manoeuvres are to be conducted at both maximum settings for gliders fitted with trimmers, in addition to use of the speed system. Specifics are given in the individual test manoeuvres.

1.5.3. Other adjustable or removable controls: should a glider be fitted with other adjustable or removable controls which are not explicitly handled in this document, then the glider is to be tested in the least favorable geometrically symmetric configuration possible. Torque compensators are to be set that the glider flies on a straight course with no pilot input during normal flight.

1.5.4. Video documentation

• The flight test program is to be recorded per video camera. Recordings from onboard cameras showing the entire canopy are permitted.

1.5.6. Harness measurements: should the motor be fitted with thrust bars, then tests are to be conducted with no changes to the separation between these bars. Should a horizontal adjustment be possible then this should be set at the minimum possible, but not less than 46cm.

2. Flight test program und grading scheme

2.1. **Test manoeuvres and results**: The flight test program is to be recorded per video camera and documented in test protocols. The results are also to be documented. Test pilots may comment on every test manoeuvre. Trimmer settings are not to be changed during manoeuvres. Should the speed system be applied for a manoeuvre then the test pilot should release it after initiating the manoeuvre unless otherwise detailed. Should the permitted start mass range not exceed 25% of the minimum start mass then it is permitted to test the glider in the mid- to top end of this range. Should manoeuvres under power be borderline, then they must be repeated at the minimum start mass. Should the manufacturer exclude certain test manoeuvres due to constructional limitations then these must be clearly defined and explained on the glider and in the operating manual. Non-optional manoeuvres are mandatory.

2.1.1. Launch tests

Inflation must occur on level ground, with or without running motor. Should a glider require a specific technique to launch then this must be described in the operating manual and used by the test pilot. Should no comment to trimmers be made in the operating manual then launch testing is to be conducted at minimum and maximum setting.

Evaluation

Measurement	Result	Classification
Special launch technique required	No	Positive
	Yes	Positive: special note in flight-test-report
Height gain after 300m flight	>15 meters	Positive
	<15 meters	Negative

2.1.2. Landing tests: The pilot must perform a normal (straight final approach, no running motor) landing in less than 8 km/h headwind (measured at 1.5 meters over ground) on level ground. Landing is to be performed using only the brakes. Should a glider require a specific technique for landing then this must be described in the operating manual and used by the test pilot. Should no comment to trimmers be made in the operating manual then landing testing is to be conducted at minimum and maximum setting.

Evaluation

Measurement	Result	Classification
Soft Landing possible running / rolling	Yes / continual braking	Positive
	Yes / Special technigue required (flaring, trimmers etc)	Positive: Operating manual description
	No	Negative

2.1.3. Trimspeed testing

The true airspeed (TAS) is to be measured with a suitable instrument. Trimspeed must be minimum 30 km/h with closed trimmers. The motor must not run during this test.

Evaluation

Measurement	Result	Classification
Trimspeed >=30 km/h	Yes	Positive
	No	Negative

2.1.4. Braking characteristics in accelerated flight without running motor
The glider is to be flown with fully opened trimmers and a fully applied speed system at maximum speed as described in the operating manual. The test pilot should apply symmetric brake over a period of 2 seconds to 25% of brake travel. This brake position is to be held for a further 2 seconds, and then released to allow the glider to dive forward. The glider should not collapse or recover automatically from a collapse.

Evaluation

Measurement	**Result**	**Classification**
Collapse on brake release in accelerated flight	No	Positive
	Yes / automatic recovery	Positive: special note in flight-test-report
	Yes / pilot action required	Negative

2.1.3 5. Pitch stability testing. Pitching is to be induced from normal flight by applying motor thrust two times to produce maximum amplitude pitching. The manoeuvre is to be flown with trimmers set at minimum and maximum.

Evaluation

Measurement	**Result**	**Classification**
Course change > 15°per motor thrust	No	Positive
	Yes / course correction possible	Positive: special note in flight-test-report
	Yes / course correction not possible or twist	Negative
Collapse	No	Positive
	Yes / automatic recovery	Positive: special note in flight-test-report
	Yes / pilot action required	Negative
Pitch damping	Oscillations reduced	Positive
	Oscillations do not reduced, or increased	Negative

2.1.6. Turning characteristics with motor thrust. A “straight 8” manoeuvre is to be performed – the test pilot should fly a figure of eight and apply motor thrust to compensate for the increased sink during turning to maintain constant height. Entry and exit to the manoeuvre should occur parallel to each other. The first circle should be flown in the torque direction given by the motor. Glider handling must be sufficient to allow the manoeuvre to be completed harmonically within 30 seconds through brake input. Times are to be measured from the first brake input through to regaining normal flight after the second turn.

Evaluation

Measurement	**Result**	**Classification**
“Straight 8” in <30 seconds	Yes	Positive
	Yes / with secondary controls as described in operating manual	Positive: special note in flight-test-report
	No	Negative

Spin tendency	No	Positive
	Yes	Negative
Unstable flight: twisting at turn change	No	Positive
	Yes	Negative

2.1.7. Roll stability testing.
Rolling is to be induced from normal flight without motor thrust by applying brake two times on opposite sides to produce maximum amplitude rolling. A short brake input to prevent the outer edge of the canopy collapsing on rolling is permitted; this input must be kept to a minimum. Roll angles should be between 45° and 60°. Observations on further cha racteristics are to be made.
The manoeuvre is to be flown with trimmers set at minimum and maximum.

Evaluation

Measurement	**Result**	**Classification**
Rolling and roll damping	Oscillations reduced rapidly	Positive
	Oscillations reduced slowly (>10 seconds) or increased	Negative

2.1.8. Roll stability testing in normal flight. The glider is to be flown with no brake input under normal straight flight conditions.

Evaluation

Measurement	Result	Classification
Roll stability under normal flight	Rolling <10°	Pos itive
	Rolling >10°<15° which can be dampened with brake input	Positive: special note in flight-test-report
	Rolling >15° which cannot or is difficult to dampen with brake inputs	Negative

2.1.9. Spin testing under minimal brake input. The glider should be flown at full motor thrust and 25% brake be symmetrically applied. This position should be held, and the glider should then be turned against the motor torque direction. A directional change of 180° within 10 seconds must be possible without the glider entering a spin.

Evaluation

Measurement	Result	Classification
Turning with 25% brake applied against motor torque direction	Yes, 180° in 10 seconds possible	Positive
	No, glider enters a spin	Negative

2.1.10. Stall testing at maximum motor thrust. The glider should be flown normally at full motor thrust. Brake should be applied to induce a deep stall, and held at this position. Brakes should then be slowly released over a period of 3 seconds. A full stall should not be performed. Motor thrust should remain constant to the point of self-recovery. And only reduced if the glider does not recover automatically. Brake travel length must be >40cm to the point where the glider enters a stall. Brake tension must be marked and constant or increasing up to the stall point. Brake travel length is to be measured from the point where the trailing edge of the canopy is deformed onwards. Should brake travel lengths or tensions be so large that they are not able to be applied by a test pilot using normal techniques to do so, then the manoeuvre will be rated as unflyable and the maximum reached values are to be recorded in the protocol. The manoeuvre is to be flown with fully closed trimmers and no speed system applied.

Evaluation

Measurement	Result	Classification
Brake travel length in cm, brake tension	>40cm, constant or increasing	Positive
	<40cm, decreasing	Negative
Tendency to enter a deep stall	No	Positive
	Yes, automatic recovery on motor thrust reduction	Positive: special note in flight-test-report
	Yes, pilot action required to recover	Negative
Yawing	<10°	Positive
	>10 - <30°	Positive: special note in flight-test-report
	>=30° or twist	Negative

2.1.11. Recovery to normal flight from large back-pitching manoeuvres

The glider is to be flown at the steepest descent path possible (deep stall) with minimum canopy deformation (usually possible by shortening the B-risers with a minimum amount) and with no use of brakes or speed system. This condition should be held for 3 seconds, before symmetrically and continually releasing the risers over a period of a further 3 seconds. If it is not clear whether the glider has regained normal flight, then this must be verified after a further period of 3 to 5 seconds by applying 50% brake on one side. The manoeuvre is to be flown with closed trimmers at maximum motor thrust.

Evaluation

Measurement	Result	Classification
Recovery	Automatic in <3 seconds	Positive
	Automatic after motor thrust reduction	Positive: special note in flight-test-report
	Recovery with pilot action after a further 3 seconds	Negative
Cascade occurs	No	Positive
	Yes	Negative

2.1.12. Asymmetric collapse testing under normal flight with closed trimmers and no use of speed system

The glider is to be flown without motor thrust and 55-65% of the leading edge is to be collapsed at a folding lime of 40-45°(see graphic). Lines pulled to induce the collapse are to be immediately released again, and the reactions of the glider are to be observed. Should a cravat be imminent or the glider pitch forward to a degree that slack lines are to be expected, then the test pilot should act to prevent this. The test must be repeated or the result is negative then.

Evaluation

Measurement	Result	Classification
Glider reaction	Automatic recovery, pitch forward <45°, course change <90°	Positive
	Automatic recovery, pitch forward <60°, course change 90°-180°	Positive: special note in flight-test-report
	Pilot action required to recover or prevent cravat, twist or falling with slack lines. Extreme course change or pitch forward. Cascades occur	Negative
	Maneuver not possible	Positive: special note in flight-test-report

2.1.13. Asymmetric collapse testing under accelerated flight with opened trimmers and full use of speed system

This manoeuvre is to be performed in all glider configurations permitted by the manufacturer. If particular glider configurations are not excluded by the manufacturer in the operating manual then the glider is to be tested with trimmers closed and speed system fully applied, and with trimmers opened and speed system fully applied. (It is not sufficient to just test the most extreme combination, as the use trimmers and speed systems together may result in severely different canopy profiles.) The glider is to be flown without motor thrust and 55-65% of the leading edge is to be collapsed at a folding line of 40-45°. Lines pulled to induce the collapse are to be immediately released again, the speed system is to be released, and trimmers should remain at their setting. The reactions of the glider are to be observed. Should a cravat be imminent or the glider pitch forward to a degree that slack lines are to be expected, then the test pilot should act to prevent this. The test must be repeated, or the result is then negative.

Evaluation

Measurement	Result	Classification
Glider reaction	Automatic recovery, pitch forward <60°, course change <180°	Positive
	Automatic recovery, pitch forward <90°, course change <360°	Positive: special note in flight-test-report
	Pilot action required to recover or prevent cravat, twist or falling with slack lines. Extreme course change or pitch forward. Cascades occur	Negative
	Manoeuvre not possible	Positive: special note in flight-test-report

2.1.14. Symmetric collapse testing with closed trimmers

The glider should be flown at trim speed with no motor thrust. Brakes should be fully released and attached to the risers (for safety reasons the brakes may remain in the hands of the test pilot when collapses may be performed without deforming the trailing edge). A symmetrical front collapse over the entire leading edge should be performed by abruptly pulling down on the A lines or risers. The collapse should be as small as possible but at least deform 40% of the profile depth at the middle of the glider. Risers or lines should be immediately released after the collapse has been induced. Should the glider not automatically return to normal flight within 3 seconds or within a course change of 180° (whichever occurs first), then the test pilot should actively recover from the manoeuvre using brake but not by stalling the glider. If it is not clear whether the glider has regained normal flight, then this must be verified after a further period of 3 to 5 seconds by applying 50% brake on one side.

Evaluation

Measurement	**Result**	**Classification**
Glider reaction to front collapse (min. 40%) with closed trimmers	Automatic recovery, pitch forward <45°, course change <30°	Positive
	Automatic recovery, pitch forward <60°, course change <60°, short deep-stall phase (<3sec)	Positive: note in protocol
	Glider can be stabilised in <3 seconds with pilot action	Positive: note in protocol
	Glider needs severe pilot action >3 seconds, permanent deep stall or cascade	Negative
	Manoeuvre not possible	Positive: note in protocol

2.1.15 Symmetric collapse testing with open trimmers and speed system

The glider should be flown normally at maximum speed. Brakes should be fully released and attached to the risers (for safety reasons the brakes may remain in the hands of the test pilot when collapses may be performed without deforming the trailing edge). A symmetrical front collapse over the entire leading edge should be performed by abruptly pulling down on the A lines or risers. Risers or lines should be immediately released after the collapse has been induced. Should the glider not automatically return to normal flight within 3 seconds or within a course change of 180° (whichever occurs first), then the test pilot should actively recover from the manoeuvre using brake but not by stalling the glider. If it is not clear whether the glider has regained normal flight, then this must be verified after a further period of 3 to 5 seconds by applying 50% brake on one side.

Evaluation

Measurement	**Result**	**Classification**
Glider reaction to front collapse (min. 40%) with opened trimmers and fully applied speed system	Automatic recovery, pitch forward <45°, course change <30°	Positive
	Automatic recovery, pitch forward <60°, course change <60°, short deep-stall phase	Positive: note in protocol
	Glider can be stabilised in <3 seconds with pilot action	Positive: note in protocol
	Glider needs severe pilot action >3 seconds, permanent deep stall or cascade	Negative
	Manoeuvre not possible	Positive: note in protocol

2.1.16 Spiral dive testing

The glider should be flown at trim speed with no motor thrust. Through the use of only one brake a spiral dive should be induced **in the propeller torque direction** (opposite to the motor torque direction). Should torque compensators be present, then these should be set such that the glider flies straight ahead during normal flight. Using both brakes, the glider should be accelerated to a sink velocity of 14 m/s. Should this not be possible, then the maximum sink velocity is to be recorded. Brakes should then be released over a period of 2 seconds. Should the glider continue to accelerate into a tighter turn, then the test pilot should actively recover from the manoeuvre. If not, then the test pilot should wait for 3 turns to grade the manoeuvre. Test pilots should not act against G-forces at any time of the test manoeuvre. Aggressive reactions to this manoeuvre must be noted in the test protocol.

Evaluation

Measurement	Result	Classification
Glider reaction on spiral dive entry	Turn steepens and sink velocities increase continually with increased brake input	Positive
	Glider accelerates automatically to 14 m/s sink velocity and must be supported by test pilot	Positive: note in protocol
	Glider accelerates rapidly to >14 m/s sink velocity and must be restrained by test pilot	Negative
Glider reaction to exit from spiral dive	Turns <720°, automatic recovery	Positive
	Remains in spiral at constant sink velocity, requires some pilot action to recover (apply gentle brake to outer side of wing)	Positive: note in protocol
	Severe Pilot action required to recover	Negative
Glider reaction on spiral dive exit	On brake release the glider recovers automatically. No pilot action required to recover from pitching	Positive
	Energy from the spiral dive must be continually bled off, otherwise large pitching and collapses result	Positive: note in protocol
	Recovery requires expert pilot action	Negative

2.1.17 Testing of all other manoeuvres in the glider manual

Rapid descent methods such as B-stalls, C-stalls or big-ears are not standard for motor gliders. Should the manufacturer wish for these manoeuvres to be tested, or describe the manoeuvres in the manual, then they are to be tested and the results recorded in the test protocol.
Results may be commented on as necessary.

2.2 Compatibility testing

Should type-test certification for a motor or glider already have been attained in accordance with the airworthiness requirements in this document, then the flight test program for compatibility testing under existing certification can be reduced as follows:

2.1.1	**Launch tests**
2.1.2	**Landing tests**
2.1.3	**Pitch stability testing under changing motor thrust**
2.1.6	**Turning characteristics under partial motor thrust**
2.1.7	**Roll stability testing**
2.1.10	**Stall testing under maximum motor thrust**
2.1.16	**Spiral dive testing**
2.1.17	**Testing of all other manoeuvres in the glider manual should they be relevant for compatibility**

2.2.1 Testing is to be conducted with a certified harness/motor and an certified reserve parachute. Testing is to be conducted at the maximum start mass.

3. Test grading

A motor glider will not have passed the test procedure if,
either, as a result of one of the tests 2.1.1 to 2.1.17 a part or component should suffer a failure
or, one of the results form tests 2.1.1 to 2.1.17 should be negative.

3.1 Testing restrictions due to glider design

Gliders tested according to 2.1.4, 2.1.12, 2.1.13, 2.1.14 and / or 2.1.15
which cannot achieve reproducible results, must not necessarily be graded negative. Such gliders must be clearly marked and declared “unsuitable to be used for students training”. The restricted certification must be clearly identifiable on the glider label and in the manual.
Folding line usage must be clearly noted in the test protocol and glider manual. Should it not be possible to perform collapses, then this must be clearly marked and emphasized in the glider manual. The manufacturer must inform pilots that the glider may collapse with unknown consequences, even though it was not possible to test the manoeuvre.

3.2 Folding lines

Should it not be possible to collapse a glider by applying normal force on the A-lines or risers, then the manufacturer may attach folding lines to the canopy to aid this. Folding line geometry should follow that of the A-lines. Folding lines should have at least 10cm of slack. Attachment points on the canopy are between the A-Lines and the leading edge. Should collapses still not be possible with the addition of folding lines, then further testing of these manoeuvres may be omitted.

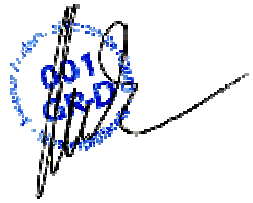
4. Test protocol

Test protocols must contain the following information:

a) Name and address of the manufacturer
b) Name and address of the person or company applying for testing and certification (should this differ from the manufacturer)
c) Name and further information on the equipment to be tested
d) Class of tested paramotor glider
e) Results of all test manoeuvres 2.1.1 to 2.1.17
f) Name and address of testing center
g) Certification number issued by the testing center
h) Name of the test pilot

The following must be archived (or handled according to the test center regulations) in addition to the test protocol by the testing center:

l) Test protocols for all tests according to section 4
j) Video protocols for all tests according to section 4
k) Manual
l) Construction or photo documentation of the tested specimen



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