# Notice of Airworthiness Requirements for Remote Controlled Winged Model Aircraft [1]

## LTF-FM-F

of

26.2.2025

Below are the German Federal Aviation Office
Airworthiness Requirements
for
Remote Controlled Winged Model Aircraft with a maximum take-off mass greater than 25 kg but less than or equal to 150 kg.

Braunschweig, 26 February 2025

Ref.: T323-050801-LTF-FM-F-2025

Federal Aviation Office

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[1] Notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services (OJ L 241, 17.9.2015, p. 1)

# Table of contents

# 0 Register of amendments

Compared to the previous edition of the airworthiness requirements for remote controlled winged model aircraft of 2 March 2011 (NfL II-21/11), in addition to editorial changes, the following amendments have been made:

| Old numbering | New numbering | Amendment |
|---|---|---|
| 1.1 | 1.1 | Addition of definition of model aircraft |
| 2.1.3 | 2.1.3 | Deletion, second sentence |
| 2.4.2 | 2.4.2 | Amendment of burden of proof |
| 2.4.3 | 2.4.3 | Range test moved to 7.4 |
| 2.5 | 2.5 | Determination of ground roll distances and flightpath angles |
| 2.6 | 2.6 | Deletion, evidence of engine failure on one side |
| 2.7 | 2.7 | Determination of engine power by competent authority |
| 2.8 | - | Deleted |
| 3.2 | 3.2 | Addition of consideration of experience |
| 3.3 | 3.3 | Deletion of Annex 1 |
| 3.4 | 3.4 | Definition of flight records with data recording |
| 3.4.5 | - | Deleted |
| 3.4.8 | 3.4.7 | Amendment of burden of proof |
| 4.3 | 4.3 | Addition of electric propulsion |
| 4.9 | - | Deleted |
| 4.10 | 4.9 | Identification and definition of safe flight time |
| 6.3 | 6.3 | Addition of clamping force instead of securing |
| 6.5 | - | Deleted |
| 6.7 | 6.6 | Addition of kink protection |
| 7.1 | 7.1 | Addition of redundancy |
| 7.3 | 7.3 | Specification |
| - | 7.4 | Addition of range test |
| - | 7.5 | Addition of gyro systems |

| | | |
|---|---|---|
| - | 7.6 | Addition of reliability of the radio connection |
| 8.5 | - | Deleted |
| 8.6.2 | 8.6.2 | Deletion of mass balancing |
| 9 | 9 | Dynamic reference to current noise regulations |

# 1 Scope

## 1.1 General information

These airworthiness requirements apply to model aircraft pursuant to § 1(1)(8) LuftVZO (German Air Traffic Licensing Regulation) category of winged model aircraft (unmanned aircraft operated in sight of the operator exclusively for the purpose of sport or recreation) with a maximum take-off mass greater than 25 kg but less than or equal to 150 kg.

# 2 Operating behaviour

## 2.1 General information

### 2.1.1 Manoeuvrability

The model aircraft shall be safely controllable and sufficiently manoeuvrable

a) at take-off,
b) in flight (including climb-out, horizontal flight and let-down),
c) at landing and
d) when taxiing.

The corresponding wing flap position shall be indicated in the evidence.

### 2.1.2 Evidentiary methods

Evidence that the model aircraft complies with the requirements set out in this section shall be provided by suitable flight tests.

### 2.1.3 Evidentiary scope

Unless otherwise specified, the individual requirements of this section shall be demonstrated with all critical combinations of weight and centre of gravity within the range of loading conditions for which the approval is requested.

## 2.2 Limits of load distribution

The weight and centre of gravity ranges within which the model aircraft can be safely operated shall be specified in the operating documentation.

## 2.3 Mass limits

### 2.3.1 Maximum take-off mass

The maximum take-off mass shall be such that it is not greater than the maximum take-off mass demonstrated by the applicant for all points of these guidelines.

### 2.3.2 Unladen mass

The unladen mass is the weight of the aircraft model with permanently installed ballast and specified equipment. This unladen mass shall be defined in such a way that it can be recovered and used at any time to determine the centre of gravity. Fuel is considered a disposable load.

## 2.4 Evidence

### 2.4.1 Centre of gravity position

The associated unladen mass centre of gravity position shall be determined using the unladen mass defined in 2.3.2. The unladen mass centre of gravity shall be marked accordingly (e.g. by red-marked screws, circles, centre of gravity marks), so that the model aircraft can be retrimmed at any time.

### 2.4.2 Flexibility of control

The flexibility of control shall be kept as low as possible in order to minimise flutter. The flexibility (including play) must not exceed 20 % of the full steering gear travel under the load determined in 3.4.4.

### 2.4.3 Functional tests

All ground functional tests shall be completed before the start of test flights.

## 2.5 Take-off and landing distance

The following values shall be determined:

a) Take-off roll distance from standstill to lift-off; and
b) Landing roll distance from touchdown to standstill.

After lift-off and before touchdown, a stationary flightpath angle of at least 10° shall be achieved.

## 2.6 Manoeuvrability

It shall be possible to change course rapidly in all directions and axes. This shall be demonstrated under the following conditions:

a) Landing gear extended
b) Wing flaps and air brakes in landing position

## 2.7 Stalling behaviour

a) The stalling behaviour shall be examined during straight flight.
b) In case of stalling when cornering with bank angle of approximately 45°, it shall be possible to restore normal horizontal flight without an uncontrollable tendency to spin.

The engine power for the evidence shall be determined by the competent authority.

## 2.8 Flutter

Flutter must not occur in any of the approved operational areas.

# 3 Mechanical strength

## 3.1 Loads

The strength requirements are specified through the indication of safe loads (the greatest loads to be expected in operation) and breaking loads (the safe loads multiplied by the safety figures given under 3.2). Unless otherwise stated, the loads stated are ‘safe loads’.

## 3.2 Proof of strength

It shall be demonstrated that the strength structure is capable of withstanding the loads expected during operation, i.e. the safety figure
j = 1.0. In the case of computational evidence, the safety figure is j = 1.5.

As an alternative to component tests in accordance with paragraphs 3.4.1 to 3.4.3, experience with technically identical structures (e.g. in the case of kits or existing identical model aircraft) may be taken into account.

## 3.3 Load factors

The following shall be used as safe recovery load factors:

a) n = +3 g and -1.5 g for model aircraft not suitable for aerobatics
b) n = +6 g and -3 g for basic aerobatic flight (rolling, looping, turning, etc., no snapped or flicked manoeuvres, etc.)
c) n = + and -8 g at least for unlimited use

## 3.4 Flight tests

Evidence of sufficient strength shall be provided by means of three flight tests using electronic data recording (data loggers). All authorised manoeuvres must be covered.

At least the following shall be recorded:

a) Load factor of the three axes
   - Longitudinal axis (roll)
   - Vertical axis (yaw)
   - Transverse axis (pitch)
b) Maximum air speed
c) GPS position with altitude information, which can also be determined barometrically

### 3.4.1 Load-bearing structure

If the component test is carried out only with the load-bearing structure or one wing half, the attachment of the wing to the fuselage shall be as close to reality as possible.

The load determined according to 3.3 shall be carried out on the basis of an elliptical lift distribution by applying individual weights arranged in a stair shape.

### 3.4.2 Tail units and their attachment

Stress tests with tail units are required.

### 3.4.3 Fuselage

For the fuselage, a critical case component test shall be carried out consisting of

a) the maximum horizontal tail unit load,
b) the maximum lateral tail unit load; and
c) the critical load from landings.

### 3.4.4 Control

By placing defined weights on the control surfaces, it is possible to understand the forces involved. The respective hinge moment shall be determined by means of a function that takes into account the lift coefficient and wing geometry.

Control linkages, their connecting links and the attachment of control elements (servos and the like) shall be designed in such a way that the calculated moments and forces can be absorbed at the control surfaces.

### 3.4.5 Engine mount

The engine mount and its suspension shall be designed to withstand all loads resulting from flight operations. Evidence of this shall be provided by flight tests.

### 3.4.6 Landing gear

In the case of retractable landing gear, care must be taken to ensure smooth running, and cables and hoses in the landing gear bays must be securely fastened. In addition, attention must be paid to the proper function of the remaining covers, if present.

### 3.4.7 Structural strength of tow release (if present)

The tow release attachment shall be dimensioned for the following safe loads:

a) 75 % of the maximum weight of the tow aircraft or towed sailplane forwards or rearwards in the horizontal direction,
b) 75 % of the maximum weight forwards or rearwards 30° sideways and upwards and downwards; and
c) 50 % of the maximum weight 90° sideways

The thrust measurements shall be carried out using a suitable measuring device (e.g. thrust scale)

The fuselage must not have any abnormalities such as deformations, cracks and the like during and after the test. The tow release shall hold the towline securely and release it securely when releasing under load

### 3.4.8 Other installations (e.g. batteries)

The mountings for other installations shall be dimensioned in such a way that they can absorb, without failure, the accelerations occurring in accordance with 3.3.

# 4 Engine system

## 4.1 Dimensioning

The engine system must be sufficiently dimensioned in terms of performance.
Only engines with good running characteristics may be used.
Once installed, the engines shall be easily accessible for maintenance. Good cooling shall be ensured.

## 4.2 Design

The propulsion system must not have any design features that are dangerous or unreliable.

## 4.3 Fire prevention

The appropriate design and construction of the propulsion system and the supply lines, as well as the choice of suitable materials, shall keep the probability of fire as low as possible (thick-walled fuel hoses and cut-off valves). The same applies to electrically loaded cables, especially in the case of electric propulsion.

## 4.4 Vibrations

The propulsion system must not generate critical vibrations in the normal operating range that put excessive strain on the propulsion system and the model aircraft (e.g. use of vibrating metals).

## 4.5 Ignition system

The ignition system shall provide sufficient operational safety and shall not lead to malfunctions that affect the functioning of the remote control system.

## 4.6 Operating behaviour

The operating behaviour test shall include all tests necessary to demonstrate the behaviour of the propulsion system during starting, at idling speed, at partial load and at maximum speed.

## 4.7 Exhaust system

Heat radiation shall be taken into account when installing the exhaust system.

## 4.8 Switching off the engine system

It shall be ensured that the engine system can be switched off at any time by means of the remote control system.

## 4.9 Fuel system content / Propulsion batteries / Flight time

The safe flight time shall be calculated from the fuel tank contents and the fuel consumption of the propulsion system at full load. For safety reasons, a reserve of 20 % of the calculated safe flight time shall be deducted.

(calculated safe flight time – 20 % reserve = flight time to be specified)

In the case of electric propulsion, the safe flight time shall be calculated from the battery capacity and the maximum current consumption of the propulsion system. For safety reasons, a reserve of 20 % of the calculated safe flight time shall be deducted.

(calculated safe flight time – 20 % reserve = flight time to be specified)

## 4.10 Fuel tanks

Fuel tanks shall be able to withstand, without failure, the vibrations/inertia/liquid loads and the accelerations to which they may be subjected during operation and shall be suitable for the particular use.

## 4.11 Screens and filters

A screen/filter shall be provided between the fuel tank and the engine at a suitable accessible location on the fuel line.

## 4.12 Lines and hoses

Fuel lines or hoses shall be suitable for the intended task. They shall be installed and secured in such a way as to prevent excessive vibrations and to withstand the loads resulting from fuel pressure and accelerated flight conditions.

# 5 Propellers

## 5.1 General information

Propellers must not have any design features that are dangerous or unreliable.

## 5.2 Suitability

a) The suitability of the materials used in manufacture must be demonstrated on the basis of experience or tests.
b) Propellers shall be suitable for operation and balanced, taking into account the information contained in the engine manufacturer's operating instructions.

## 5.3 Operating behaviour

The applicant shall demonstrate in a functional run that the propeller and its accessories are operating without any signs of damage.

## 5.4 Securing

Spinners and propellers shall be firmly connected and secured.

## 5.5 Vibrations

a) The magnitude of the vibration load on the propeller blades under normal operating conditions shall not jeopardise the continuous operation of the model aircraft.
b) Parts of the model aircraft in the vicinity of the propeller tips shall be solid and rigid enough to withstand the effects of induced vibrations.

# 6 Electrical system

## 6.1 Documents

A system overview with a parts list shall be created for the entire model-side electrical system, specifying, for example, the type and cross-section of the cables and wires used. These documents shall be included in the operating manual.

## 6.2 Load capacity

The maximum load capacity of the cables and wires must not be exceeded.

## 6.3 Connections

Due to possible vibrations, only plug-in and clamp connections are permitted as cable links or connections. Sufficient clamping force shall be ensured.

## 6.4 Power supply

The type of batteries used shall be suitable for the intended use. Particular attention shall be paid to the current-carrying capacity and power capacity of the batteries. The receiving system shall be operated by two independent batteries. Safe operation shall be ensured by means of an appropriate device.

## 6.5 Additional functions

Additional functions, such as lighting, etc., shall be connected to a separate power supply.

## 6.6 Wires and cables

The electrical cables shall consist of flexible wires, be suitable for the particular purpose, and be laid in bundles.
The fastenings shall be designed in such a way that the cables neither sag nor rub against other components. It is important to ensure that suitable kink protection is used.

## 6.7 Power switchgroup

A power switchgroup shall be provided for the model-side system.

# 7 Remote control system

## 7.1 General information

Only radio equipment that complies with the applicable regulations of the German Federal Network Agency may be used. Such radio equipment shall be operated in accordance with the applicable rules of the Federal Network Agency.

When selecting and installing the remote control, there shall be no known characteristics that affect safe operation. The entire remote control system and other associated equipment shall be designed in such a way that any failure, whether due to technical defects, wear or ageing, of the whole system or parts thereof, which cannot be considered improbable from the outset, cannot endanger the model aircraft, the operator or any third party. If necessary, individual components or functions shall be designed redundantly. The receiving system shall in any case be designed redundantly.

## 7.2 Vibrations

Receivers and steering gear shall be installed in a vibration-proof manner.

## 7.3 Antenna

Special attention shall be paid to the installation of the antennas.
As receiving systems evolve, particularly with regard to the required redundancy, several antennas are used.

In the case of shielding materials such as carbon fibre composites, aluminium-coated covering materials, etc., the antennas shall be directed to the outside.

## 7.4 Range test

The range test shall be carried out according to the instructions of the remote control manufacturer. Due to the interference suppression (hold), a defined steering action should be repeated continuously during the range test.
If any of the equipment has one of the following devices:

- Radio transmitter (telemetry, video, etc.)
- Other radio receivers (data uplink)
- GPS receiver

the range test carried out shall be executed a second time with all devices running (and, where applicable, with the propulsion system running simultaneously).

## 7.5 Electronic stabilisation (gyro systems)

Only devices that correspond to the state of the art and intended for model aircraft construction are permitted. The gyro-sensitivity of the individual axes,

- Longitudinal axis (roll)
- Vertical axis (yaw)
- Transverse axis (pitch)

shall be adjustable and capable of being switched off from the transmitter.

The gyro system shall be securely fastened.

## 7.6 Failure of the radio connection

In the event of a failure of the radio connection, the model aircraft shall automatically adopt a configuration agreed with the competent authority. This shall be documented in the operating documentation.

# 8 Design and construction

## 8.1 General information

Model aircraft shall be marked at an appropriate location (outside or inside) with an EU registration (e-ID) and the approval mark.

## 8.2 Manufacturing process

The manufacturing processes used shall consistently produce perfect strength bonds.

## 8.3 Electrical bridging

In order to avoid ‘cracking pulses’, metal parts that rub against each other shall be electrically bridged.

## 8.4 Arrangements for checks

Arrangements shall be made to ensure that the parts of the model aircraft that need to be checked, re-calibrated or lubricated as part of regular inspections and maintenance work are accessible.

## 8.5 Tail units

### 8.5.1 Installation

Movable control surfaces shall be arranged in such a way that they cannot be obstructed by each other or by other fixed construction parts if one of the surfaces is held in its outermost position and the other is moved over its full area of impact. This requirement shall also be met under a safe load (positive and negative) for all impacts over the full area of impact. Deformations of the strength bond supporting the control surfaces shall be taken into account under a safe load.

### 8.5.2 Control surfaces

Each control surface should be actuated by its own servo with sufficient power reserve (if necessary, multiple servos may be required).

### 8.6 Control

All controls and control systems shall operate with the ease, speed, force and freedom of play appropriate to their function, so that they can perform their tasks properly.

## 9 Noise

The applicant shall submit a noise measurement report drawn up under the measurement conditions of the latest published noise regulation for aircraft (LVL) published by the Federal Aviation Office.

## 10 Minimum equipment

Charging control display for transmitter and receiving system.

## 11 Operating and maintenance instructions

### 11.1 Flight manual

The operating limits, as well as any other information that identifies the flight model and that is necessary for the safe operation of the model aircraft, shall be listed in the flight manual.

The flight manual shall include at least the following information:

- Three-view drawing with dimensions
- Short description of the model aircraft
- Maximum take-off mass
- Unladen mass
- Take-off and landing distances
- Information on the engine system (type of engine, power, speed)
- Information on the fuel tank contents and operating time until the reserve quantity is reached
- Fuel
- Type and size of propellers used
- Check before start of flight
- Range test
- Taxiing
- Take-off
- Aerobatic flight (manoeuvres with descriptions for entry and exit, as far as permitted)
- Landing
- Check after end of flight

### 11.2 Operational records

The flights shall be documented by means of an on-board log commonly used in general aviation.

The correctness of the information shall be confirmed by the tax payer.