Notice of Airworthiness Requirements for Remote Controlled Model Helicopters[1]

LTF-FM-H

of

26.2.2025

Below are the German Federal Aviation Office

Airworthiness Requirements

for

Remote Controlled Model Helicopters with a maximum take-off mass greater than 25 kg but less than or equal to 150 kg.

Braunschweig, 26.2.2025

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

Federal Aviation Office

pp.

[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 Model Helicopters of 2.3.2011 (NfL II-22/11), in addition to editorial changes, the following amendments have been made:

Former numbering	New numbering	Amendment
1.1	1.1	Addition of definition of model helicopters
2.4.2	2.5.2	Determination of the evidentiary value by the competent authority
2.4.3	2.4.3	Elimination of range test
2.5.8	2.6.7	Moved
3.1.2	3.1.2	Elimination of manufacturer’s certificate
3.1.3	3.1.3	Definition of flight records with data recording
3.1.6	3.1.6	Specification of the type of test
3.1.7	-	Eliminated
3.1.11	3.1.11	Definition of static test load
4.3	4.3	Addition of electric propulsion
4.9	4.9	Addition of ‘at any time’
4.12	4.12	Identification and definition of safe flight time
5.3	5.3	Addition of clamping force instead of securing
5.4	5.4	Addition of capacity and load capacity of batteries
5.5	-	Eliminated
5.7	5.6	Addition of protection against chafing and kinking
6.1	6.1	Addition of redundancy
6.3	6.3	Specification
6.4	-	Eliminated
-	6.6	Reliability of the radio connection
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 model helicopters (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 helicopter shall be safely controllable and sufficiently manoeuvrable

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

2.1.2 Evidentiary methods

Evidence that the model helicopter complies with the requirements set out in this section shall be provided by ground test runs and appropriate 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 positions within the range of loading conditions for which the approval is requested. Evidence shall be provided for all conditions (e.g. camera equipment, load transport, etc.) in which the model helicopter is to be operated.

2.2 Limits of load distribution

The weight and centre of gravity ranges within which the model helicopter 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 model helicopter 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 Ground tests

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 helicopter can be retrimmed at any time.

2.4.2 Flexibility of control

The flexibility of control of the main rotor and tail rotor shall be kept as low as possible. If the pitch of a main rotor blade is blocked, the pitch of the free rotor blade shall not change by more than 2°. Inspections shall be carried out in accordance with the requirements of the competent authority by manually rotating a main rotor blade at minimum and maximum swashplate deflection and at rotor blade positions of 90°, 180°, 270° and 360°.

2.4.3 Functional tests

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

2.5 Main and tail rotor blades

2.5.1 General information

Rotor blades must not have design features that are dangerous or unreliable.

2.5.2 Suitability

a) The suitability of the materials used in manufacture shall be demonstrated by stress analysis of the material used.
b) To prevent flutter, the profile centre of gravity should always be in front of the thrust centre (torsion) of the rotor blade. The neutral point should be behind or on the axis of rotation of the rotor blade.
c) The rotor blades shall be balanced and have the same centre of gravity.

2.5.3 Operating behaviour

The applicant shall demonstrate in a functional run in accordance with 2.4.3 that the rotors and their accessories are working properly.

2.5.4 Securing

All fixed and movable connecting elements of the rotor head, the rotors and their steering shall be sufficiently secured (e.g. by self-locking screws, securing varnish, etc.).

2.5.5 Vibrations

a) The magnitude of the vibration load on the rotor blades under normal operating conditions shall not jeopardise the continuous operation of the model helicopter.
b) All components of the helicopter shall be solid and rigid enough to withstand the effects of induced vibrations.

2.5.6 Critical loads

Critical loads shall be demonstrated for all functional components of the main and tail rotor and their power transmission (in particular transmission to the tail rotor).

Compliance with these requirements shall be checked at the maximum achievable speeds.

The rotors shall be checked for their deflection magnitude and direction. The appropriate allocation of the control sweeps to the control levers of the remote control system shall be ensured.

2.5.7 Permissible blade speed

Compliance with the permissible blade tip speed shall be checked by a speed measurement at maximum speed, taking into account the maximum forward speed to be achieved. This must not be exceeded in any flight condition and shall be documented in the operating documentation. The blade tip speed must not exceed the manufacturer's specifications.

$$d_{R0} \times \pi \times \frac{(n_{RO} + 20\,\%)}{60}$$

(To this must be added the air speed in m/s)

2.5.8 Collision safety of main rotor

After reaching the end deflection of the head damping, there shall be sufficient distance between the main rotor blade tips and adjacent components of the structure (e.g. tail boom) to prevent a collision of the main rotor blades with the structure.

2.5.9 Other operating equipment

All other operating equipment shall be checked and demonstrated to be in proper working order.

2.6 Flight tests

2.6.1 Climbing performance

The load capacity achieved in hover flight should include a sufficient safety reserve at maximum take-off mass. To do this, the model helicopter shall be brought to a stationary hovering altitude of at least twice the rotor diameter (outside the ground effect). From this stationary state, the model helicopter should quickly transition to climb-out. During this manoeuvre, the maximum angle of incidence (max. pitch) must not be reached.

2.6.2 Vertical descent and recovery

From a safe hovering altitude outside of ground effect, the helicopter shall descend quickly vertically to a safe recovery altitude and be recovered there. The maximum angle of incidence (max. pitch) should not be reached.

2.6.3 Manoeuvrability

It shall be possible to make the sufficiently necessary course changes in all directions and axes. The tail rotor shall be able to compensate for the maximum achievable torque. The functionality of the tail rotor control shall be clearly visible, contrary to the torque, at the maximum climb-out rate.

In the event of failure of the propulsion system or tail rotor, the helicopter shall be safely controllable (e.g. autorotation)

2.6.4 High-speed flight

At 60–80 % of the maximum pitch position (depending on the type of helicopter), the helicopter shall have stable flight behaviour and sufficient manoeuvrability in horizontal flight.

2.6.5 Flutter

Rotor flutter must not occur in any approved operating range.

2.6.6 Recovery from horizontal flight

After reaching the maximum horizontal flight speed, the model helicopter should be braked strongly by a counter-tilt. The model helicopter should not climb or descend until it comes to a horizontal standstill. Immediately after braking, the model helicopter should be straightened and climbed without delay or interference.

2.6.7 Landing

The operator shall conduct several landing approaches until all points of the airworthiness requirement are met. The number shall be determined by the examiner. In doing so, care shall be taken to continuously reduce speed and height. The landing approaches shall be completed at hovering altitude and continued to ground level. The touchdown point is determined in advance by the operator.

3 Strength

3.1 Loads

The strength requirements are specified through the indication of safe loads (the maximum loads to be expected in operation) and breaking loads (the safe loads multiplied by the safety factors specified under 3.1.1). Unless otherwise stated, the loads stated are 'safe loads'.

3.1.1 Safety factors

The safety factor j shall be 1.5 unless another value is specified.

By way of derogation, the safety factors to be taken into account shall be:

a) Rotor blade connections j = 3
b) Impact and swivel joints j = 3
c) Blade retention bolts j = 3
d) All gear trains of main and tail rotors j = 4.5

3.1.2 Proof of strength

It shall be demonstrated that the strength structure is capable of safely withstanding the loads expected during operation.
The applicant shall carry out a centrifugal force calculation to determine the tensile forces on the blade mounts, pivot bearings and, if applicable, impact and swivel joints.

Centrifugal force $[N]$:

$$F_{zF} = \frac{1}{2} \times m \times d_{ROM} \left(\frac{\pi \times n_{Ro\,max}}{30} \right)^2$$

F_{zF} = centrifugal force $[N]$

m = mass of rotor blade $[kg]$

d_{ROM} = rotor diameter centre of mass $[m]$

$n_{Ro\,max}$ = max. rotor speed $[rpm]$ incl. 20 % allowance for AR speed increase

3.1.3 Flight tests

The evidence of sufficient strength is to be recorded or provided by means of three flight tests using electronic data recording (data logger).

The following shall be recorded:

a) Load factors of the three axles
   - Longitudinal axis (roll)
   - Vertical axis (yaw)
   - Transverse axis (pitch)

b) Maximum air speed

At least the following safe recovery load factors shall be achieved: n = +3 g and -1.5 g

3.1.4 Component tests

If evidence of sufficient strength is not be provided by calculation or certification, or if there is no or insufficient experience for the chosen design, component tests shall be carried out.

3.1.5 Steering

Gear trains, their connection elements and the fastening of steering elements (servos and the like) shall be designed in such a way that the moments/forces that occur, e.g. from the servos, can be absorbed with the safety factor stated in 3.1.1. Servo types with actuating forces shall be used that are appropriate to the expected actuating forces, taking into account the model helicopter size and type of deflection.

3.1.6 Rotor head deflection

The deflection shall be able to safely withstand the actuating force of all servos involved, without push rods etc. coming out or settings becoming permanently changed. The test shall be carried out by blocking the pitch of two rotor blades.

3.1.7 Control paths

When all functions are at full deflection, including roll, pitch and yaw simultaneously, the mechanism must not run to the stop.

3.1.8 Strength and elasticity of the main rotor (blade holder and blades)

The suitability of the rotor blade, the structure, the material used and the critical loads (tensile load on the rotor blade eye) shall be demonstrated by means of a calculation.

3.1.9 Engine mount

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

3.1.10 Strength of landing gear / undercarriage

The strength of the landing gear / undercarriage shall be demonstrated for a safe load factor of 3 of the maximum take-off mass. Evidence may be provided by:

a) Calculation with safety factor j = 1.5
b) Component test with safety factor j = 1
c) Experience with technically identical designs (e.g. with kits or existing identical model helicopters)

3.1.11 Other installations (e.g. fuel tanks and 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 3.1.3.

4 Engine system

4.1 Dimensioning

The engine system shall be sufficiently dimensioned in terms of performance.
The speed must not collapse even at the maximum angle of incidence of the rotor blades.

The clutch and/or free-wheel used shall be suitable and sufficiently dimensioned for the maximum expected speeds and torques.

4.1.1 Electric propulsion

Electric motors shall be carefully shielded against interference. The power cables to the motors shall have a sufficient cross-section to avoid excessive heating.

4.1.2 Engine

Only engines with good running characteristics may be used. Once installed, the engines shall be easily accessible for maintenance.

4.1.3 Cooling

In all cases, sufficient attention shall be paid to cooling. When using timing-controlled engines, sufficient cooling shall be ensured by efficient fan wheels. Electronic controls shall not exceed the maximum permissible operating temperature of the propulsion system throughout the operating range.

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 entire 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 cell (e.g. use of vibrating metals).

The occurrence of resonances at certain speeds shall be prevented by suitable means (elasticity of the suspension, speed control, etc.). Corresponding evidence shall be provided as part of the ground tests.

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 Lubrication system

If a lubrication system is fitted, it shall be constructed and designed in such a way that it can operate correctly in the normal operating range and under the expected operating conditions.

4.7 Operating behaviour

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

4.8 Exhaust system

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

4.9 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.

4.10 Mutual influence of the motors

Motors shall be arranged and separated from each other in such a way that the failure or defective operation of any motor or any system that is likely to affect the motor does not impair the continuous, safe operation of the other motors. Several electric motors shall be controlled in at least two separate units.

4.11 Fuel system

The fuel system shall be designed in such a way that it is capable of safely and adequately supplying fuel to the engine in the normal operating range and under the expected operating conditions.

4.12 Fuel tank 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)

4.13 Fuel tanks

a) 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 special use.
b) In the case of flexible fuel tanks, it shall be demonstrated that they are suitable for the particular use.

4.14 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.

4.15 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 Electrical system

5.1 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.

5.2 Load capacity

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

5.3 Connections

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

5.4 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.

5.5 Additional functions

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

5.6 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.

5.7 Power switchgroup

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

6 Remote control system

6.1 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 helicopter, the operator or any third party. If necessary, individual components or functions shall be implemented redundantly. The receiving system shall in any case be designed redundantly.

6.2 Vibrations

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

6.3 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.

6.4 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).

6.5 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.

6.6 Failure of the radio connection

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

7 Design and construction

7.1 General information

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

7.2 Manufacturing process

The manufacturing process used shall consistently produce perfect strength bonds.

7.3 Electrical bridging

In order to avoid 'cracking pulses', metal parts that rub against each other must be electrically bridged.

7.4 Arrangements for checks

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

8 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.

9 Minimum equipment

Charging control display for transmitter and receiving system.

10 Operating and maintenance instructions

10.1 Flight manual

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

The flight manual must include at least the following information:

- Three-view drawing with dimensions
- Short description of the model helicopter
- Maximum take-off mass
- Unladen mass
- Permissible loading conditions, weight and centre of gravity ranges
- Maximum forward speed

- Minimum space allowing safe take-off, flight and landing
- Information on the engine system (type of engine, power, speed)
- If applicable, information on the electric propulsion
- Speeds of all rotors (and their limits / max. speeds)
- Information on the fuel tank contents and operating time until the reserve quantity is reached
- Fuel
- Check before start of flight
- Range test
- Take-off
- Flight operations and authorised manoeuvres
- Landing
- Check after end of flight

10.2 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 operator.