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Agroscope

Sprayer drones: Testing and approval of sprayers, 2020

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1 EXPLANATION OF TERMS

This Directive applies to **remotely steered devices weighing no more than 150 kg which are used for spraying plant protection products during flight. The devices are referred to hereafter as ‘sprayer drones’.**

Approval, which is granted only once for sprayer drones of identical construction, is required for their authorisation. Unlike the sprayer test, approval also includes determination of potential drift.

Sprayer drones must pass the sprayer test before they are first put into service and once every three years thereafter.

2 POINTS TO BE CHECKED FOR SPRAYER TESTING AND APPROVAL

Tests are carried out only on rinsed, cleaned and serviceable appliances.

The test includes checking the sprayer drone and its spray mixture droneport. The entire installation must be such that the spray mixture can be correctly fed into the drone and that the drone can be emptied without endangering humans or the environment.

	Requirements for sprayer drones & droneport (sprayer testing and approval)	Checks to be performed
Pump and tubes	<p>The entire sprayer system must be leak-proof at the maximum achievable system pressure. No pressure regulation is required. Hoses must be arranged so that no kinks or frictions occur.</p> <p>The filling level of the container must be clearly visible during the filling process.</p>	Visual inspection and operational test
Agitation system	Circulation of the spray mixture to agitate it and rinse the spray tank must be possible. Agitation does not have to take place at the same time as spraying. It must also be possible to switch the system off (e.g. using a three-way valve).	Visual inspection and operational test
Nozzles	The pressure generated by the pump must be such that the working range of the nozzles is within the approved range according to the Julius Kühn Institute nozzle tables. The droplet size can be freely selected from within the authorised range. The flow rate of the individual nozzles compared with the ISO nozzle table is +/- 15%. Deviations from the mean output: +/- 10%. No dripping of the	Visual inspection and operational test, pressure measurement, nozzle flow measurement

	nozzles for more than 5 seconds after spraying has stopped (e.g. using a droplet filter). No anti-drip diaphragms are prescribed.	
Lateral distribution	Testing on a groove patternator, similar to that of agricultural sprayers, with a width of at least 3 m, length 6 m and at least 1.5 times the length of the application width of the drones. The coefficient of variation (standard deviation of the different values/average value) of the quantities of spray mixture collected by the grooves is max. 15% (average value of the coefficient of variation of three measurements).	Measurement on a groove patternator
Spray mixture tank	The tank must be leak-proof and its level should be easy to read. It must be easy to empty the tank (e.g. via a drainage valve). The technical residual quantity may not exceed 4%.	Visual inspection/measurement
Pressure gauge	A pressure gauge is to be carried as an accessory. It should be coupled directly into the spray circuit for control and not alter the flow of the system. The scale must have gradations of at most 0.1 bar for working pressures up to 5 bar. The accuracy of the manometer must be at least +/- 0.1 bar of the real value.	Measurement
Strainers	No separate strainer is necessary on the drone: nozzle filters are sufficient.	Visual inspection and operational test
Droneport	The sprayer drone must be able to land on a droneport for filling and emptying. The content must be at least 100% of the sprayer tank volume of the drone. The droneport must be at least as wide and as long as the drone so that the drone can be rinsed without loss.	Visual inspection and operational test
Autonomous navigation	The drone must be equipped with a precise air navigation system. The drift from a predefined flight path may not exceed ± 50 cm. The reference point is the middle of the drone, where the nozzles are located. The flight path is planned prior to the flight. The drone then operates autonomously, without	Visual inspection of the marked flight path

	<p>human intervention, and sprays within the predefined perimeter. The spraying process is activated and deactivated automatically. Take-off and landing may be carried out manually. If repeat flights are undertaken (e.g. after the tank becomes empty), the drone must autonomously resume spraying within 50 cm of the location where it stopped at the end of the previous flight.</p> <p>Manual disactivation of spraying and manual drone control must be possible at all times.</p>	
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3 APPROVAL OF SPRAYER DRONES

(NOT REQUIRED FOR SPRAYING TESTS)

3.1 Approval procedure

Unlike agricultural sprayers and turbo-sprayers, there are currently no standards for sprayer drones used for applying plant protection products (PPP). For this reason, sprayer drones are subject to specific approval in Switzerland.

- Authorisation by the Federal Civil Aviation Office (OFAC) is required for all drones used for spraying PPP. OFAC issues this authorisation only if the corresponding type has been approved by Agroscope and the Federal Environment Office (OFEV).
- Each model is approved once only. The approval is valid for all drones of the same manufacture.
- A new approval must be obtained if modifications are made to the apparatus which may change the spraying process (engines, propellers, aerodynamics, spraying system, etc.)
- Agroscope, based in Tänikon, is responsible for technical approval tests and may either delegate that task or carry it out in collaboration with other technical inspection centres.
- In common with all other devices used for applying PPP, drones which have entered into service must pass a test once every three years.

3.2 Components and characteristics requiring approval

The following are checked for the purpose of approval:

- complete sprayer drone with spray mixture tank, pump and nozzles. Approval of the spraying process and quality of the lateral distribution;
- droneport;
- potential drift;
- flight path planning and automatic navigation system;
- the mixing tank (independent of the drone) and the transfer device are **not** tested: they are tested only as part of the triennial sprayer test.

3.3 Measuring potential drift as a function of wind speed

In order for the drone to be approved, its potential drift must be checked. This is done above a flat surface, which may be grassed or metalled. The flight altitude is 2 m.

In the case of multicopters, the measured wind speeds must be within the following limits:

Distance from drone	Height above ground	Wind speed m/s
10 m	1 m	5 m/s
	2 m	3 m/s
20 m	1 m	3 m/s
	2 m	2 m/s

The measurement is taken three times.

For other aircraft, an appropriate procedure must first be developed. The drift values relative to the ground according to ISO 22369 for standard sprayers provide the benchmark for approval.

3.4 Flight-path planning and automatic navigation system

- The flight path is determined as a function of the drone spray widths. The trajectory must be programmable in three dimensions. It may be programmed in two dimensions if the flight altitude is controlled by a sensor (e.g. radar).
- The flight path is planned prior to the flight.
- The flight path may deviate by no more than ± 50 cm from the programmed trajectory. This deviation is determined using a GPS RTK or a comparable measuring device.
- Only straight flight paths are verified.
- Manual control is permitted for take-off and landing.
- The total distance is travelled automatically and the spraying process starts and stops automatically.
- The spraying process must be activated and deactivated to within an accuracy of ± 50 cm without human intervention. If the tank is empty, spraying is restarted for the next flight within an accuracy of ± 50 cm at the location where the previous flight was interrupted.

4 SCHEDULE OF FEES FOR 2020

Type approval (only for drones of identical construction) with assessment of drift measurement data, approval report and notification to OFAC: CHF 800.00

Sprayer test (every three years): CHF 250.00.

These prices include all administrative work and tests listed above. A precondition is that all the tests are passed at the first try. Additional work is invoiced as a function of the time taken and equipment used.