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Electrostatic Sprayer – Technical Requirements

静电喷雾器 技术要求

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Electrostatic Sprayer – Technical Requirements

1 Scope

This Standard specifies the model marking, basic parameters, technical requirements, test methods, inspection rules, packaging, transportation and storage of electrostatic sprayer.

This Standard applies to battery-powered electrostatic sprayer with rated working pressure not exceeding 1.0MPa, such as backpack, shoulder, and portable electrostatic sprayers operated by a single person.

2 Normative References

The following documents are essential to the application of this Document. For the dated documents, only the versions with the dates indicated are applicable to this Document; for the undated documents, only the latest version (including all the amendments) is applicable to this Document.

GB/T 191 Packaging – Pictorial marking for handling of goods

GB 4706.18 Household and similar electrical appliances-Safety-Particular requirements for battery chargers

GB/T 9480 Tractors machinery for agriculture and forestry, powered lawn and garden equipment - Operators manuals - Content and presentation

GB 10396 Tractors, machinery for agriculture and forestry, powered lawn and garden equipment - Safety signs and hazard pictorials - General principles

GB/T 19639.1-2014 General purpose valve-regulated lead-acid batteries - Part 1: Technical conditions

GB/T 20085 Equipment for crop protection - Vocabulary

JB/T 9781-2011 Sprayer - Spray parts

JB/T 9782-2014 Equipment for Crop Protection - General Test Methods

5 Technical Requirements

5.1 Safety requirements

5.1.1 Sealing performance

Sealing performance requirements are as follows:

a) Fill the liquid tank with clean water of rated capacity; cover the lid of the liquid tank; and tilt the liquid tank forward, backward, left, and right to a position of 45° with the plumb line. There shall be no leakage at any joint.

b) When the electrostatic sprayer sprays at the highest working pressure that can be achieved, and when the liquid pump is running and the shut-off valve is in the closed position, all components and their connections shall be sealed reliably and without leakage.

5.1.2 Liquid pump overload protection device

The liquid pump of the electrostatic sprayer shall take overload protection measures. When the electrostatic sprayer is working under working pressure, close the water outlet shut-off valve and the pressure in the liquid pump shall be no higher than 1.2 times the maximum working pressure.

5.1.3 Pressure resistance performance of spray parts

The spray parts of the electrostatic sprayer shall comply with the provisions of 4.1.3 in JB/T 9781-2011.

5.1.4 Electrical system

The electrical system requirements are as follows:

a) The electrical system of the electrostatic sprayer shall have good insulation properties and take waterproof measures. The liquid overflowing from the liquid tank shall not flow into or drip onto the electrical components. All wiring shall not be exposed, and insulating conduits shall be installed when wires pass through holes. The insulation resistance value between the battery terminal and the metal parts of the machine shall be no less than 2MΩ.

b) The wiring specifications of the electrical system shall be adapted to the current size; switches and buttons shall be easy to operate and shall not be turned on or off by themselves due to vibration.

c) Electrical components shall be installed firmly, have correct polarity, and be marked with clear polarity symbols. They shall not be loose, damaged, short-circuited or open-circuited due to vibration or other reasons.

d) The electrical system shall have undervoltage, overload and short-circuit protection functions.

e) Effective protective measures shall be taken to prevent high-voltage static electricity from causing harm to the operator.

5.2 Requirements of overall machine performance

5.2.1 Total mass of electrostatic sprayer

After adding the rated capacity of clean water into the liquid tank, the total mass of the electrostatic sprayer shall not exceed 25kg.

5.2.2 Spray performance

The spray performance requirements are as follows:

a) When the DC motor operates at rated voltage, the spray pressure of the electrostatic sprayer shall reach the working pressure value specified in the instruction manual;

b) When the electrostatic sprayer sprays at working pressure, the mist flow shall be uniform and continuous, with a complete mist shape; the atomization shall be good;

c) The droplet volume median diameter (VMD) of the electrostatic sprayer when spraying at working pressure shall be no greater than 150μm.

5.2.3 Nozzle spray volume deviation

When the electrostatic sprayer sprays at working pressure, the deviation of the actual spray volume of the nozzle from the manufacturer's expressly rated spray volume shall not exceed ±8%.

5.2.4 Charging performance of electrostatic devices

The electrostatic device of the electrostatic sprayer shall have good charging performance. When spraying at working pressure, the charge-to-mass ratio of the mist flow shall be no less than 0.4mC/kg.

5.2.5 Amount of mist droplets deposited on the back of the target

When the electrostatic sprayer sprays at rated voltage and working pressure, the ratio of the coverage rate of the mist flow deposited on the back of the target to the coverage rate of the mist flow on the front of the target shall be no less than 0.1.

5.2.6 Continuous working time

The continuous normal spray working time of the standard electrostatic sprayer battery after one saturated charge shall be no less than 4 h.

a) There shall be a clear liquid level line indicating the rated capacity on the outer surface of the liquid tank. The deviation of the actual capacity at the liquid level line from the rated capacity of the liquid tank shall not exceed ±5%;

b) The total capacity of the liquid tank shall be at least 5% larger than the rated capacity;

c) The diameter of the liquid filling port of the liquid tank shall be no less than 100mm;

d) The liquid tank lid shall be reliably connected to the mouth of the liquid tank to ensure that it does not become loose or open accidentally during use.

5.3.3 Liquid pump

The requirements of liquid pump are as follows:

a) When the liquid pump operates at rated speed and maximum working pressure, there shall be no abnormal vibration, noise, loose fasteners, etc.

b) The pump body shall have good pressure resistance. When the pressure test is performed at 2 times the maximum working pressure, there shall be no rupture, leakage, etc.

5.3.4 Electrostatic generator

The requirements of electrostatic generator are as follows:

a) When a DC power supply is used to input the nominal voltage of the battery into the electrostatic generator, the deviation of the electrostatic voltage output value from the manufacturer's expressed output value shall not exceed ±10%;

b) Use a DC power supply to input the nominal voltage of the battery into the electrostatic generator. After 4 h of continuous operation, the deviation of the electrostatic voltage output value from the initial electrostatic voltage shall not exceed ±10%;

c) The surface packaging of the electrostatic generator shall be complete and without cracks, and the leads shall be firm and free of looseness.

5.3.5 Battery

The battery of the electrostatic sprayer shall meet the requirements specified in GB/T 19639.1-2014 or other battery standard expressed by the manufacturer.

5.3.6 Charger

The charger of the electrostatic sprayer shall meet the requirements of GB 4706.18.

5.3.7 Control device

The switches of electrical appliances and fluid flow systems shall be located within easy reach

of the operator, and shall have confirmed and clear "on" and "off" signs nearby.

The adjustment of the electrostatic sprayer equipped with a liquid flow regulating valve shall be convenient and accurate.

5.3.8 Pressure hose

The requirements of pressure-bearing hoses are as follows:

a) The surface of the hose shall be permanently marked directly or indirectly indicating the manufacturer and the maximum allowable working pressure.

b) Flexible hoses shall be used that shall not form dead bends in all normal working positions.

5.3.9 Straps

The strap requirements are as follows:

a) Backpack electrostatic sprayers shall be equipped with at least one strap with a hooking device. When the operator carries the work on his back, the hooking device shall be able to hook or disconnect easily and reliably. The strap shall not loosen by itself due to gravity or during movement.

b) The length of the strap that can be adjusted shall be easily adjusted while being carried; the length of the strap shall be securely locked in the adjusted position.

c) The strap shall be made of non-absorbent material; the length of the shoulder load-bearing part shall be no less than 100 mm, and the width shall be no less than 50 mm.

5.4 Assembly and appearance quality

5.4.1 Assembly quality

The requirements of assembly quality are as follows:

a) The parts of the electrostatic sprayer shall be intact and complete; the connection of each part and fasteners shall be firm and reliable; and the parts that are easy to automatically loosen shall be equipped with anti-loosening devices;

b) The moving parts shall be flexible in operation and shall not be stuck or bumped;

c) The non-moving parts shall have no obvious deviation, warping, deformation, etc.

5.4.2 Appearance quality

The appearance of the electrostatic sprayer shall be neat and clean, without oil stains, rust, obvious scars, damage and other defects.

product number, manufacturer or supplier name.

5.6.2 Safety warning signs

There shall be safety signs at conspicuous locations on the electrostatic sprayer to warn operators of precautions for safe operation. The type and content of safety signs shall comply with the provisions of GB 10396.

6 Test Methods

6.1 Test conditions

During the test, all measuring instruments and meters shall be within the validity period of verification (or calibration). Appendix A gives examples of test equipment and measuring tools.

Unless otherwise specified, the performance test shall be conducted under the rated working conditions specified in the product technical conditions or instruction manual. The test medium is water at normal temperature, and the density of water is calculated by 1.0kg/L.

6.2 Spray performance test

Connect a pressure gauge to the water outlet pipe of the electrostatic sprayer; and start the electrostatic sprayer to spray according to the usage instructions specified in the instruction manual. Carry out the following inspections:

a) When the DC motor is operating at rated voltage, whether the spray pressure of the electrostatic sprayer reaches the working pressure value specified in the instruction manual;

b) When spraying at working pressure, whether the atomization is good, whether the mist shape is complete, and whether the mist flow is continuous and uniform;

c) Measure the droplet volume median diameter during spraying at working pressure according to the method specified in 4.1.2 of JB/T 9782-2014.

The observation time is 1 min. One adjustment of the machine is allowed during the test, but replacement of parts is not allowed.

6.3 Sealing performance test

The sealing performance test is as follows:

a) Install the electrostatic sprayer into use state; add the rated capacity of clean water into the liquid tank; cover the lid of the liquid tank; tilt the liquid tank forward, backward, left and right at 45°; and keep it in each position for 10s; observe the leakage.

b) During the test procedures of 6.2a) and 6.2b), visually inspect whether the components and their connections leak, when the electrostatic sprayer is spraying at the highest working pressure that can be achieved, and when the liquid pump is running and the shutoff valve is in the closed position. For electrostatic sprayers equipped with multiple (kinds) of nozzles with different spray volumes or adjustable nozzles, the minimum spray volume nozzle shall be used or at the minimum spray volume to carry out the test.

c) Inspect the connection reliability between the liquid tank lid and the liquid tank mouth.

6.4 Inspection of liquid pump overload protection device

Install a pressure gauge between the water outlet of the pump and the shut-off valve of the spray component of the electrostatic sprayer. During normal operation, read the pressure value displayed by the pressure gauge; place the shut-off valve in the "closed" position and read the pressure value displayed by the pressure gauge again.

6.5 Pressure resistance test of spray parts

The pressure resistance performance of the spray parts shall be determined according to the method specified in 5.1 of JB/T 9781-2011.

6.6 Inspection of electrical system

The inspection of electrical system is as follows:

a) Use a megger to measure the insulation resistance value between the battery terminals and the metal parts of the electrostatic sprayer;

b) Measure the current value of the electrostatic sprayer when it is working normally; and inspect whether the wire specifications meet the current value requirements;

c) Use a DC power supply to input the nominal voltage of the battery into the electrostatic generator; and use a high-voltage electrostatic tester to measure the electrostatic voltage output value of the electrostatic generator;

d) Inspect the waterproofing measures of the electrical system and the tightness of the connections of the electrical components;

e) Inspect whether effective measures have been taken to prevent high-voltage static electricity from causing injury to the operator.

6.7 Measurement of total mass of the electrostatic sprayer, actual capacity deviation at the liquid level line of the liquid tank and total capacity

The measurement of total mass of the electrostatic sprayer, the actual capacity deviation at the liquid level line of the liquid tank, and the total capacity are determined as follows:

6.9 Inspection of liquid pump

The inspection of liquid pump is as follows:

a) Inspect whether there are any abnormal vibrations, noises, loose fasteners, etc. when the liquid pump is operating at rated speed and maximum working pressure.

b) Install the pump body on the pressure test bench; conduct a pressure test at 2 times the maximum working pressure, hold for 1 min; and check whether the pump body is cracked, leaked, etc.

6.10 Inspection of electrostatic generator

The inspection of electrostatic generator is as follows:

a) Use a DC power supply to input the nominal voltage of the battery at the input end of the electrostatic generator; use a high-voltage electrostatic tester to measure the electrostatic voltage value of the electrostatic output; and calculate the deviation from the manufacturer's stated output value; as well as deviation of the electrostatic voltage from the initial electrostatic voltage after 4 h of continuous operation;

b) Visually inspect the surface packaging quality of the electrostatic generator.

6.11 Inspection of battery

Batteries are inspected according to relevant battery standards.

6.12 Determination of charge-to-mass ratio of mist flow

The electrostatic sprayer sprays at rated voltage and working pressure; and the measurement is carried out according to the method specified in 4.1.7 of JB/T 9782-2014.

6.13 Determination of mist flow coverage

The test is conducted by the paper card method. The paper card can be water-sensitive paper, white paper with a small diffusion rate, or other suitable droplet test cards. The size of the paper card is 52mm × 74mm or other similar sizes.

NOTE 1: The diffusion of white paper can be judged by visual inspection. Immediately after spraying, remove the paper card and observe whether the mist droplets on the paper have diffusion adhesion. As long as diffusion adhesion does not occur, it can be used.

NOTE 2: The paper card size of 52mm×74mm is equivalent to sixteen equal parts of A4 copy paper.

The test liquid uses a carmine aqueous solution or other red dye aqueous solution with a mass fraction (i.e., concentration) of 1‰~5‰ (or other concentrations suitable for test needs).

Arrange the sampling paper cards as shown in Figure 1: Arrange 3 rows of paper cards evenly

--- Production that have been discontinued for more than 1 year are resumed;

--- There are major changes in the structure, process, materials, etc. of the product;

--- The product is in normal production and it has been 3 years since the last type test.

The type test items shall include all the requirements of this Standard, and the number of type test shall be no less than 2 sets.

8 Packaging, Transportation and Storage

8.1 Packaging

8.1.1 When the electrostatic sprayer leaves the factory, the product certificate, instruction manual, packing list and spare parts (consumable parts), accessories and random tools shall be included in the packaging box.

8.1.2 The outside of the packaging box shall at least indicate the following:

a) Product name and model;

b) Quantity;

c) Packing box volume: length × width × height, in mm × mm × mm;

d) Exit-factory date;

e) Name of manufacturer or supplier;

f) The total mass of the packaging, in kg;

g) "Handle with care", "Upward", "Moisture-proof", "Stacking layers" and other storage and transportation signs that comply with the provisions of GB/T 191.

8.1.3 The packaging box shall be firm and reliable, easy to transport, and have moisture-proof and pressure-proof measures.

8.1.4 The spray hose shall be in its natural state when packed into the box. If it must be bent, the inner diameter of the bending should be no less than 15 times the diameter of the hose. At the same time, the phenomena of puncturing and flattening shall be avoided.

8.2 Transportation and storage

8.2.1 During transportation, products shall be protected from being beaten, impacted, and dampened.

8.2.2 Products shall be stored in dry and ventilated warehouses and shall not be stacked in the

Appendix B

(Informative)

Example of Calculation Method of Mist Flow Coverage

B.1 Image acquisition

B.1.1 Image acquisition device selection: Use a spiral-arm microscope equipped with a CCD camera.

B.1.2 Determine the measurement area of the image screenshot: Use a blank paper card made of the same material as the spray paper card; use a black pen to draw a 10mm × 10mm square in the center of the paper card; and place the paper card on the object stage on the microscope; so that the square area is located in the center of the microscope light aperture; adjust the focus and shoot; and obtain an image containing a square. Then use image processing software to read the number of pixels corresponding to the horizontal and vertical directions between the four corners of the square image, which are recorded as *M* and *N* respectively (since the CCD camera is not necessarily isotropic when shooting the image, *M* and *N* corresponding number of pixels may not be the same).

B.1.3 Mist droplet image acquisition: Place the sampling paper cards obtained in the 6.13 test one by one on the object stage on the microscope to capture images. The shooting method is: visually observe the paper card; adjust the focus and then shoot. Since there are mist droplets deposited on both the front and back sides of the paper card, it is necessary to collect images of the front and back sides of the paper card, respectively. Therefore, each spray paper card can obtain a front image and a reverse image.

B.1.4 Determine the mist droplet image counting and analyzing area: According to the number of pixels *M* and *N* in the horizontal and vertical directions obtained during the determination process of image screenshot measurement area, take a screenshot of the paper card image so that the number of pixels in the horizontal direction of the captured area is *M*, the number of pixels in the vertical direction is *N*. And this area is the mist droplet image counting and analyzing area. The gray value corresponding to the pixels outside the mist droplet image counting and analyzing area is forcibly set to 0 by the image processing software.

B.2 Binarization processing of mist droplet image counting and analyzing area

The image binarization processing uses the maximum inter-class variance method (other binarization methods can also be selected) to determine the binarization threshold *T*. After binarization processing, the gray value of each pixel in the mist droplet image counting and analyzing area has only two values of 0 and 1, specifically:

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