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Crop protection equipment — Test methods for the evaluation of cleaning systems —

Part 2: External cleaning of sprayers

Matériel de protection des cultures — Méthodes d'essai pour l'évaluation des systèmes de nettoyage —

Partie 2: Nettoyage externe des pulvérisateurs

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22368-2 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*.

ISO 22368 consists of the following parts, under the general title *Crop protection equipment — Test methods for the evaluation of cleaning systems*:

— *Part 1: Internal cleaning of complete sprayers*

— *Part 2: External cleaning of sprayers*

— *Part 3: Internal cleaning of tank*

Introduction

The cleaning of sprayers used in crop protection is becoming increasingly important, especially for the following reasons:

— to avoid contamination of the environment and the operator;

— because of the possibility of accidental release of agrochemicals that could cause crop damage, raise residue fears or lead to the mixing of incompatible crop protection products.

Moreover, it is likely that the relevant sections of the industry are in need of guidance in developing cleaning systems, so that the state of the art and a basis for future specifications can be evaluated.

ISO 22368-1 and ISO 22368-2 specify test methods related to the internal and external cleaning of sprayers, offering the user the means to evaluate the general performance of both inside and outside cleaning systems and a possible basis for defining performance specifications in the future. The standard also offers individual sections for key sprayer components (see ISO 22368-3).

This part of ISO 22368 enables the cleaning system to be evaluated for specific components and provides the means for obtaining detailed results that can be used for its improvement. Its main purpose is to specify a standardized procedure for simulating the contamination of the sprayer by spray liquid under normal operating conditions. Depending on the intended use, either or both of two different test methods may be used: Test A is especially intended for the development or adjustment of the sprayer to minimize external contamination of the sprayer; Test B allows comparison of the cleaning systems of different sprayers and checking of the performance of the cleaning devices in respect of possible future requirements.

Crop protection equipment — Test methods for the evaluation of cleaning systems —

Part 2:
External cleaning of sprayers

WARNING — Users of this part of ISO 22368 should be familiar with normal laboratory practice. This part of ISO 22368 does not address all possible safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and ensure compliance with any national regulatory conditions related to safety and environmental issues.

1 Scope

This part of ISO 22368 specifies two test methods for evaluating the performance of cleaning systems fitted onto sprayers used in crop protection for the removal of deposits on the external surfaces of the sprayer. The purpose of the tests is to provide sprayer designers with information on contamination of the sprayer and permit comparison of different attachments or adjustments in relation to external cleaning (Test A), and to allow the performance of different cleaning devices to be determined (Test B). It is applicable to mounted, trailed and self-propelled agricultural sprayers used for crop protection and liquid fertilizer applications.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
cleaning device
attached component to the sprayer for cleaning the external surface of the sprayer

3 Test liquid and conditions

3.1 General

The tests shall be performed using the test liquids specified in 3.2, and under the conditions given in 3.3. Other traced liquids may be used if the same level of measuring performance can be demonstrated. For this purpose, accuracy of measurements — for example — should be at least 0,01 % of the original tank concentration.

NOTE One test liquid is specified for Test A and another for Test B. A soluble dye is used for Test A, as an easy cleaning of the deposit is sufficient, whereas, for Test B, the stickier test liquid is needed to make a clearer difference between the performance of the different cleaning devices.

3.2 Test liquid

3.2.1 Test A

Testing shall be performed using a 0,1 % solution of yellow Tartrazine 85 % E 102 test liquid.

3.2.2 Test B

Testing shall be performed using the 0,1 % suspension of copper oxychloride test liquid according to Annex A.

3.3 Test conditions

Testing shall be performed under the following conditions.

Temperature of the test liquid: 5 °C to 25 °C.

Ground conditions: without dust and leaves (e.g. grassland).

During replications

— range of air temperature: 5 °C max.

— range of relative humidity of air: 20 % max.

— maximum wind speed: 5,0 m/s (measured at a fixed position on the test area at a height of 2 m).

4 Test A — Production of a defined, reproducible external contamination

SAFETY PRECAUTIONS — Because of possible environmental hazards inherent in this method, recognized precautions shall be observed to eliminate accidental release of test liquids outside the test site. All operations should preferably be carried out such that the test liquids and the water used to clean the sprayer can be collected. If this is not the case, care shall be taken that the spread liquids do not cause any environmental damage. During the contamination of the sprayer, as well as during cleaning, precautions shall be taken to minimize drift of test liquids.

IMPORTANT — This test may be modified (e.g. cleaning of sprayer parts separately, contamination shown by photographs) in order to get more detailed information. Alternative methods aimed at assessing the contamination of separate parts of the sprayer (e.g. using removable artificial collectors made of the same materials as the sprayer) are allowed, provided the same level of measuring performance can be demonstrated.

4.1 The external surface shall be dry and clean at the start of the test. Fill up the tank with test liquid (see 3.2.1) to the volume needed according to 4.2. Take three representative samples from the sprayer tank in order to check the concentration of the reference test liquid. Each of these samples shall have a volume of at least 50 ml and shall not deviate by more than 5 % from the concentration of the reference test liquid.

4.2 Operate the sprayer under the intended conditions (speed, pressure, etc.). Drive in circles for a duration of 10 min, ensuring that the number of right and left turns is identical. The circle radius for boom sprayers (field crop and bush crops) shall be equal to the boom width, while that for mist blowers shall be 10 m. Measure and report the volume of test liquid sprayed.

4.3 Wind speed, air temperature and humidity, and field conditions during the test shall be recorded.

4.4 Put the sprayer in a catchment pool of an appropriate size to collect the total amount of rinsing liquid. In the case of trailed sprayers, exclude the tyres of the sprayer by cleaning them outside the catchment pool. In the case of mounted sprayers, it could be necessary to drive the tractor partially into the catchment pool, but ensure that contamination of the tractor is not included, by, for example, partially washing or covering the tractor outside the catchment pool.

4.5 Clean the sprayer using a spray gun at 1 MPa (10 bar) pressure. Measure and report the volume of water used for total cleaning. Take three representative samples out of the collected rinsing liquid. Clean the catchment pool completely.

4.6 Add a second cleaning process similar to that specified in 4.5.

4.7 Determine the concentration of the yellow dye of the rinsing liquid (see 4.5 and 4.6) using appropriate means such as spectrophotometric analysis. Calculate the mean values of the samples taken according to 4.5 and 4.6.

4.8 Report the mass of yellow dye (4.5 and 4.6) found as a deposit on the sprayer as a percentage of the mass of the yellow dye sprayed.

4.9 Add a third cleaning process if the mass of yellow dye found after the second cleaning process amounts to more than 10 % of the mass of the yellow dye found after the first.

4.10 Under the conditions given in 3.3, perform at least three replications. If the CV value is higher than 15 %, repeat the test. Calculate the CV as a mass fraction.

4.11 Report all data and additional information, e.g. contamination shown by photographs (for an example test report, see Annex B).

5 Test B — Determining the performance of external-surface cleaning devices

SAFETY PRECAUTIONS — Because of possible environmental hazards inherent in this method, recognized precautions shall be observed to eliminate accidental release of test liquids outside the test site. All operations should preferably be carried out such that the test liquids and the water used to clean the sprayer can be collected. If this is not the case, care shall be taken that the spread liquids do not cause any environmental damage. During the contamination of the sprayer, as well as during cleaning, precautions shall be taken to minimize drift of test liquids.

IMPORTANT — With regard to the surface adhesion parameters of the test liquid, special attention should be paid when taking the samples in order to ensure their true representativeness.

5.1 The external surface shall be dry and clean at the start of the test. Fill up the tank with test liquid (see 3.2.2) to the volume needed according to 5.2. Take three representative samples from the sprayer tank in order to check the concentration of the reference test liquid. Each of these samples shall have a volume of at least 50 ml and shall not deviate by more than 5 % from the concentration of the reference test liquid.

5.2 Drive in circles for a duration of 10 min, as specified in 4.2. The forward speed should be 5,0 km/h. Using a boom sprayer, the pressure should amount to 0,3 MPa (3,0 bar) for flat fan nozzles and 0,5 MPa (5,0 bar) for air injection nozzles, and that when using a mist blower should amount to 1 MPa (10,0 bar).

5.3 Wind speed, air temperature and humidity, and field conditions during the test shall be recorded.

5.4 Put the sprayer in a catchment pool of an appropriate size to collect the total amount of rinsing liquid. In the case of trailed sprayers, exclude the tyres of the sprayer by cleaning them outside the catchment pool. In the case of mounted sprayers, it could be necessary to drive the tractor partially into the catchment pool, but ensure that contamination of the tractor is not included, by, for example, partially washing or covering the tractor outside the catchment pool.

5.5 Clean the sprayer by the attached cleaning device according to the operator's manual. Clean the catchment pool and measure the volume of water used. Take 10 representative samples out of the collected rinsing liquid. Clean the catchment pool completely.

5.6 Clean the sprayer complete using a spray gun at a minimum pressure of 1 MPa (10,0 bar). Measure the volume of water used for total cleaning. Take 10 representative samples out of the collected rinsing liquid.

5.7 Determine the concentration of the copper of the rinsing liquid (see 5.5 and 5.6) using appropriate means such as atomic-absorption-spectrometry analysis. Calculate the mean values of the samples taken according to 5.5 and 5.6.

5.8 Report the mass of copper cleaned by the attached cleaning device (5.5) as a percentage of the total mass of copper cleaned by both cleaning procedures (5.5 and 5.6).

5.9 Under the conditions given in 3.3, perform at least three replications. If the CV value is higher than 15 %, the test shall be repeated. Calculate the CV as a mass fraction.

5.10 Report all data (for an example test report, see Annex C).

Annex A
(normative)

Composition of test powder

A.1 Composition

Copper shall be used in the form of copper oxychloride trihydrate [the test powder is also known under the name Cupravit[1)]], as follows:

Compound	Content
($3CuO \cdot CuCl_2 \cdot 3H_2O$)	45 %
Lignosulfonate	5 %
Calcium carbonate ($CaCO_3$)	8 %
Sodium sulfate decahydrate ($Na_2SO_4 \cdot 10H_2O$)	11 %

A.2 Size and distribution of particles

The size and volume distribution of the particles used shall be as follows:

Size	Volume distribution
< 20 µm	98 % min.
< 10 µm	90 % min.
< 5 µm	70 % min.

A.3 Impurities in the technically active material

Impurities shall be limited to the following.

Total impurities: 3,5 % max.

Water: 2 % max.

Ash: 1,5 % max. (in addition to copper).

A.4 Solubility

The test powder shall be slowly soluble in water and organic solvents, soluble in strong mineral acids, and soluble in solutions of ammonia and amines through the formation of complexes.

1) Cupravit is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 22368 and does not constitute an endorsement by ISO of this product.

Annex B
(informative)

Example test report — Test method A

Sprayer data

Type of sprayer: .....

Nominal tank capacity: l

Boom width (boom sprayers): ..... m

Number of nozzles (mist blowers): .....

Type of nozzle: .....

Nozzle spacing: ..... cm

Spray pressure: ..... MPa (….. bar)

Test conditions

Field conditions: .....

Diameter of track circle: ..... m

Measurement data

Replication		**Yellow dye sprayed**	**Yellow dye on sprayer 1st cleaning** (see 4.5)	**Yellow dye on sprayer 2nd cleaning** (see 4.6)	**Yellow dye on sprayer 3rd cleaning** (see 4.9), **if needed**
1	Volume				
	Concentration				
2	Volume				
	Concentration				
3	Volume				
	Concentration				

Test results

Replication	Mass of yellow dye sprayed mg	Mass of yellow dye on sprayer 1st cleaning (see 4.5) mg	Mass of yellow dye on sprayer 2nd cleaning (see 4.6) mg	Percentage 2nd to 1st cleaning	Mass of yellow dye on sprayer 3rd cleaning (see 4.9), if needed mg	Deposit on the sprayer total amount mg	Mass of yellow dye on sprayer/mass of yellow dye sprayed %	Air temperature °C	Humidity %	Maximum wind speed m/s
1										
2										
3										
Mean										
CV %	—	—	—	—	—	—		—	—	—

Annex C
(informative)

Example test report — Test method B

Sprayer data

Type of sprayer: .....

Nominal tank capacity: l

Clean water tank capacity: l

Boom width (boom sprayers): ..... m

Boom height: ..... cm

Number of nozzles (mist blowers): .....

Type of nozzle: .....

Nozzle spacing: ..... cm

Spray pressure: .....MPa (..... bar)

Type of cleaning device: .....

Test conditions

Field conditions: .....

Diameter of track circle: ..... m

Measurement data

Replication		Copper on sprayer 1st cleaning (see 5.5)	Copper on sprayer 2nd cleaning (see 5.6)
1	Volume		
	Concentration		
2	Volume		
	Concentration		
3	Volume		
	Concentration		

Test results

Replication	**Mass of copper on sprayer 1st cleaning** (see 5.5) mg	**Mass of copper on sprayer 2nd cleaning** (see 5.6) mg	**Mass of copper on sprayer Total amount** mg	**Mass of copper cleaned by device as % of total mass of copper cleaned by both procedures** (see 5.5 and 5.6)	**Air temperature** °C	**Humidity** %	**Max. wind speed** m/s
1							
2							
3							
Mean							
CV %	—	—	—		—	—	—

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