

# In-farm self-inspection and calibration of sprayers

## SPISE ADVICE manuals and quick guides

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## SPISE ADVICE manuals – 14 published documents (8 regarding the inspection of PAE)

- developed by SPISE Working Group upon proposals of several Technical Working Groups
- provide technical instructions describing procedures for inspection and calibration of PAE
- tackled by SUD but not yet by the existing ISO/CEN standards
- applicable on voluntary basis



- SPRAYING TRAINS AND OTHER EQUIPMENT FOR HERBICIDE APPLICATION ON RAILWAYS AND PUBLIC ROADS (2016)



- SEED TREATMENT EQUIPMENT (2019)



- POSTHARVEST APPLICATION EQUIPMENT (2019)



- DUSTERS (2019)



- GRANULATE APPLICATION EQUIPMENT (2021)



- ROTARY ATOMISERS FOR BAND APPLICATION (2022)



- PLOT SPRAYERS (2022)



- WIPER APPLICATORS (2022)

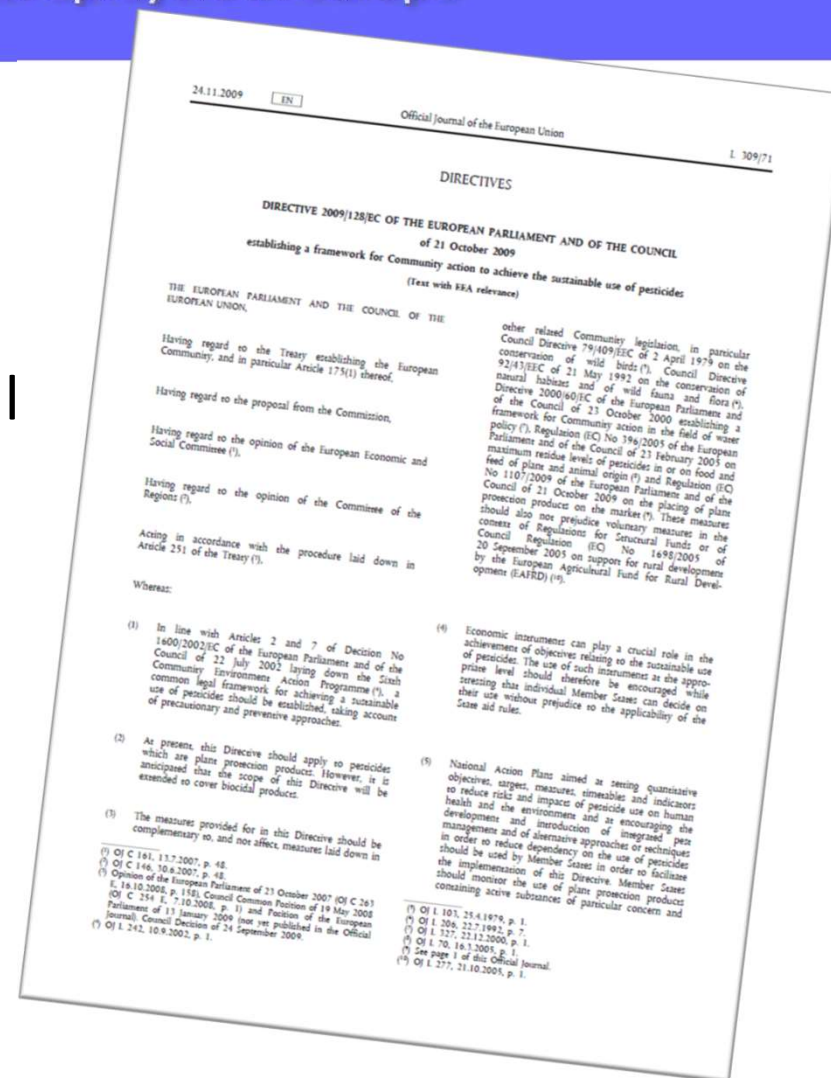
## DIRECTIVE 2009/128/EC

### Article 8

1. Member States shall ensure that pesticide application equipment in professional use shall be subject to inspections at regular intervals.

(...)

5. Professional users shall conduct regular **calibrations and technical checks** of the pesticide application equipment in accordance with the appropriate training.



## SPISE ADVICE manuals on in-farm self-inspection, maintenance and calibration

SELF-INSPECTION



MAINTENANCE



CALIBRATION



# SPISE

Standardized Procedure for the Inspection of Sprayers in Europe

# ADVICE

- Knapsack sprayers
- Field crop sprayers
- Fruit crop sprayers

## Knapsack sprayers

- very popular (several millions sold yearly)
- used for majority of agrochemicals applied world wide
- posing high risk for the operator  
(direct exposure to spray plume and possible leaks)
- often of poor design and quality
- seldom used with proper operator protection



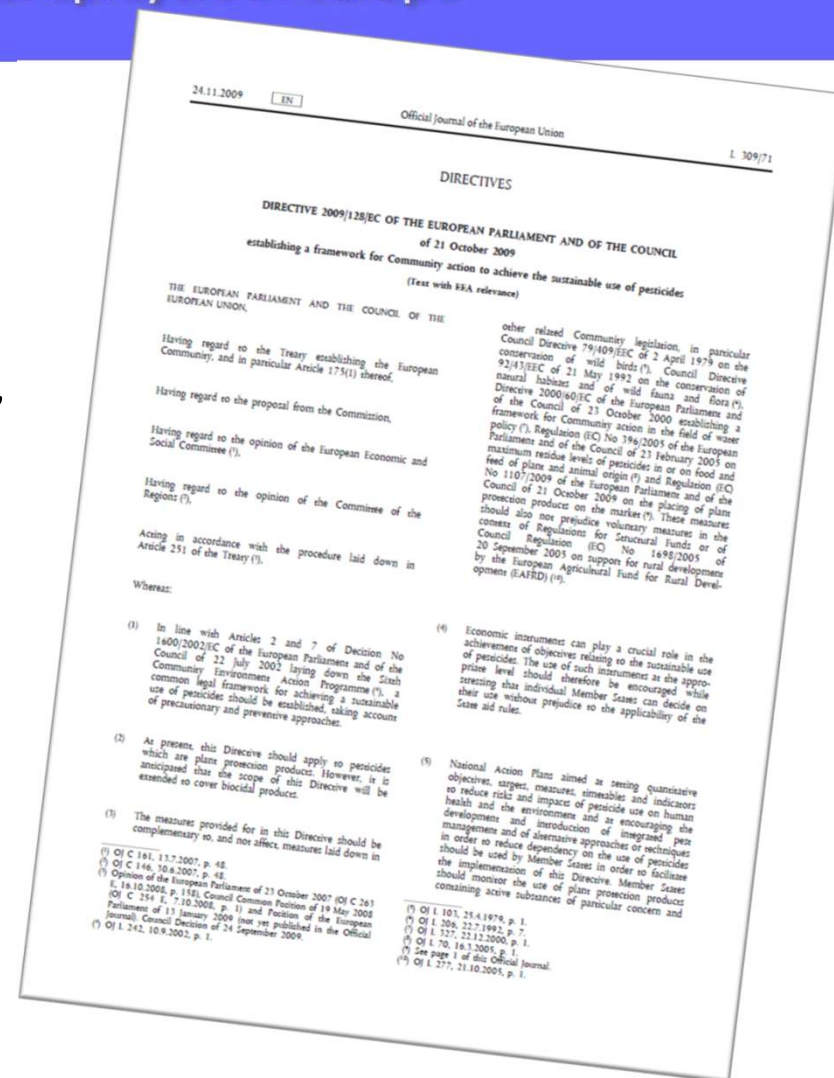
## DIRECTIVE 2009/128/EC

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(...)

3. By way of derogation from *mandatory PAE inspections*, on the basis of a risk assessment and considering the scale of use Member States may exempt from inspection handheld pesticide application equipment or knapsack sprayers.

In this case the Member States shall ensure that operators have been informed of the need to change regularly the accessories, of the specific risks linked to that equipment, and that operators are trained for the proper use of that application equipment.



## Knapsack sprayers

### Main sources of risk for the operator and environment

- difficult or careless filling
- leakage
- improper dosing
- spray drift
- cleaning



## Knaspack sprayers

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- difficult or careless filling
- leakage
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can be minimized with  
**technically fit sprayer**

- correctly self-inspected
- well maintained
- properly calibrated





## SPISE ADVICE for self-inspection, maintenance and calibration of knapsack sprayers

TWG 18



- Lever operated
  - diaphragm
  - piston
- Compression



## **SPISE ADVICE** for self-inspection, maintenance and calibration of knapsack sprayers

### CONTENTS

#### **1. Introduction**

- **Rationale**

- requirement of SUD
- exemption from mandatory inspections

- **Target audience**

- users of knapsack sprayers
- farm managers,
- advisors,
- plant protection service supervisors
- providers of training

- **Reference to EN ISO standards**

- requirements for new sprayers (19932-1)
- verification methods (19932-2)
- Inspection (19932-3)

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#### 2. Typical defects

- **Troubleshooting table**

Problems that defects may cause:

- leakage of spray liquid (PS)
- risk of spray drift (DS)
- reduced application quality

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- **Regular cleaning**
- **Parts wear**
- **Parts replacement**



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#### 4. Operator safety

- **Personal protection**
- **Sprayer cleaning**

## SPISE ADVICE for self-inspection, maintenance and calibration of knapsack sprayers

### CONTENTS

#### 5. Self-inspection (*inspection items put in form of questions*)

- **Before filling** (visual assessment)

- 1) Harness
- 2) Tank
- 3) Strainer
- 4) Filter
- 5) Hose



**Recommendation:**

*to be considered to modify or upgrade the sprayer by easy replacement of parts that may improve the work comfort and safety.*

- **After filling with water** (visual assessment + functional test)

- |                                |                               |
|--------------------------------|-------------------------------|
| 6) Readability of liquid level |                               |
| 7) Tightness                   |                               |
| 8) Pressure generation         | <u>Lever operated sprayer</u> |
| 9) Pressure regulator          | 14) Pump functionality        |
| 10) Pressure gauge             | 15) Vent valve                |
| 11) Shut-off valve             | <u>Compression sprayer</u>    |
| 12) Shut-off valve lock        | 16) Pump operation            |
| 13) Spray jet correctness      | 17) Relief valve              |

## SPISE ADVICE for self-inspection, maintenance and calibration of knapsack sprayers

### CONTENTS

#### 5. Self-inspection (*inspection items put in form of questions*) - EXAMPLE

##### ***(4) Is the in-line filter on the pressure side clean and in good condition to prevent the nozzle from clogging?***

Remove the filter insert from the housing installed between the device creating pressure and the shut-off valve controlling the flow of spray liquid to the nozzle (in most cases it is installed in the handle of spray lance) and closely examine it for cleanliness and damage caused by cracks, corrosion or deformation. Clean the filter if necessary.

##### ***Recommendation:***


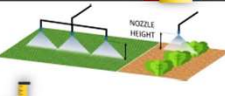
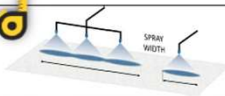
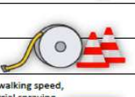
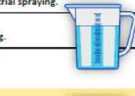




*The mesh width of the pressure filter should correspond with the size of orifice in the nozzle fitted on the spray lance.*

## SPISE ADVICE for self-inspection, maintenance and calibration of knapsack sprayers

### CONTENTS

#### 6. Calibration



CALIBRATION OF KNAPSACK SPRAYER							
1		Fit the sprayer with nozzle(s) best appropriate for the intended application and fill the sprayer tank to about half full with clean water.					
2		Prime the sprayer and carry out a trial spraying in order to determine walking speed and distance between the nozzle(s) and the target to be kept during a comfortable and effective spraying. For solid field and low crops use a measuring tape to determine the nozzle height (preferably about 50 cm).					
3		A. For solid field crops determine the spray width of the nozzle(s). Spray on the dry surface (e.g. concrete, soil) while keeping the nozzle(s) at the height as used during the trial spraying, and measure the width of the wetted area. B. For row crops determine the row spacing.					
4		Put the sprayer on an even surface and add clean water into the tank until a recognizable level (up to recognizable mark).					
5		Set a certain, measured test distance in the crop (e.g. 25 m). Use a long measuring tape and mark the beginning and the end points.					
6		Spray on the ground/crop at the set test distance trying to keep a constant walking speed, nozzle distance (height) and liquid pressure (pumping action) as during the trial spraying.					
7		Check the volume of water used for spraying. Use a measuring jug to refill the tank up to the same level as before spraying.					
8		Calculate the applied spray volume for either solid field crops or row crops. A. Solid field crops (e.g. lawns): $\text{Spray volume } \mu \text{ [L/ha]} = \frac{\text{Volume of water used [L]}}{\text{Test distance [m]} \times \text{Spray width [m]}} \times 10\,000$ B. Row crops (e.g. strawberries, vegetables, vines, bushes, trees): $\text{Spray volume } \kappa \text{ [L/ha]} = \frac{\text{Volume of water used [L]}}{\text{Test distance [m]} \times \text{Row spacing [m]}} \times 10\,000$					
9		Calculate the amount of the plant protection product (PPP) per tank. $\text{PPP per tank [kg or L]} = \frac{\text{Tank volume [L]} \times \text{Pesticide dose rate [kg or L/ha]}}{\text{Spray volume [L/ha]}}$					
TANK VOLUME	NOZZLE DISTANCE	TEST DISTANCE	VOLUME OF WATER USED	SPRAY WIDTH/ ROW SPACING	SPRAY VOLUME	PESTICIDE DOSE RATE	PPP per TANK
[L]	[m]	[m]	[L]	[m]	[L/ha]	[kg or L/ha]	[kg or L]

- Filling with **clean water**
- Trial application on **defined distance**
- Measuring **spray width**
- Measuring **water volume used**
- Calculating **spray volume rate**
- Calculating amount of **PPP per tank**





## SPISE ADVICE for self-inspection, maintenance and calibration of knapsack sprayers

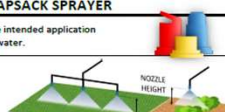
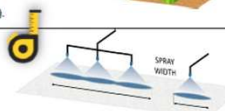
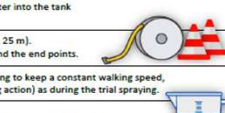
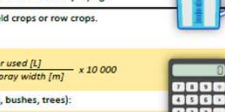
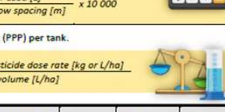
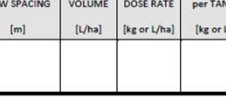


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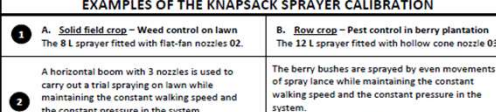
EXAMPLE: for solid field and row crops

Table of Nozzle Flow Rate

## 6. Calibration



CALIBRATION OF KNAPSACK SPRAYER							
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<p><b>2</b> Prime the sprayer and carry out a trial spraying in order to determine walking speed and distance between the nozzle(s) and the target to be kept during a comfortable and effective spraying.</p> <p>For solid field and low crops use a measuring tape to determine the nozzle height (preferably about 50 cm).</p>							
<p><b>3</b> A. For solid field crops determine the spray width of the nozzle(s). Spray on the dry surface (e.g. concrete, soil) while keeping the nozzle(s) at the height as used during the trial spraying, and measure the width of the wetted area.</p> <p>B. For row crops determine the row spacing.</p>							
<p><b>4</b> Put the sprayer on an even surface and add clean water into the tank until a recognizable level (up to recognizable mark).</p>							
<p><b>5</b> Set a certain, measured test distance in the crop (e.g. 25 m). Use a long measuring tape and mark the beginning and the end points.</p>							
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<p><b>7</b> Check the volume of water used for spraying. Use a measuring jug to refill the tank up to the same level as before spraying.</p>							
<p><b>8</b> Calculate the applied spray volume for either solid field crops or row crops.</p> <p>A. Solid field crops (e.g. lawns):</p> $\text{Spray volume } \mu \text{ [L/ha]} = \frac{\text{Volume of water used [L]}}{\text{Test distance [m]} \times \text{Spray width [m]}} \times 10\,000$ <p>B. Row crops (e.g. strawberries, vegetables, vines, bushes, trees):</p> $\text{Spray volume } \kappa \text{ [L/ha]} = \frac{\text{Volume of water used [L]}}{\text{Test distance [m]} \times \text{Row spacing [m]}} \times 10\,000$							
<p><b>9</b> Calculate the amount of the plant protection product (PPP) per tank.</p> $\text{PPP per tank [kg or L]} = \frac{\text{Tank volume [L]} \times \text{Pesticide dose rate [kg or L/ha]}}{\text{Spray volume [L/ha]}}$							
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[L]	[m]	[m]	[L]	[m]	[L/ha]	[kg or L/ha]	[kg or L]

EXAMPLES OF THE KNAPSACK SPRAYER CALIBRATION							
<p><b>1</b> A. Solid field crop – Weed control on lawn The 8 L sprayer fitted with flat-fan nozzles 02.</p> <p>B. Row crop – Pest control in berry plantation The 12 L sprayer fitted with hollow cone nozzle 03.</p>							
<p><b>2</b> A horizontal boom with 3 nozzles is used to carry out a trial spraying on lawn while maintaining the constant walking speed and the constant pressure in the system.</p> <p>The measured NOZZLE HEIGHT is 50 cm.</p>		<p>The berry bushes are sprayed by even movements of spray lance while maintaining the constant walking speed and the constant pressure in the system.</p> <p>The distance between the nozzle and the bush is kept to evenly cover the target by spray.</p>					
<p><b>3</b> The measured SPRAY WIDTH is 1,50 m.</p>		<p>The measured ROW SPACING is 3 m.</p>					
<p><b>4</b> The sprayer tank is filled with water precisely up to the mark of nominal volume, 8 L.</p>		<p>The sprayer tank is filled with water precisely up to the mark indicating the volume 10 L.</p>					
<p><b>5</b> The TEST DISTANCE on the lawn is 25 m.</p>		<p>The TEST DISTANCE on the bush row is 10 m.</p>					
<p><b>6</b> The lawn is sprayed at the test distance 25 m.</p>		<p>The 10 m of bush row is sprayed on both sides.</p>					
<p><b>7</b> The measured VOLUME of WATER USED is 0,75 L.</p>		<p>The measured VOLUME of WATER USED is 1,80 L.</p>					
<p><b>8</b> The applied SPRAY VOLUME is calculated as follows:</p> <p>A. for lawn:</p> $\text{SPRAY VOLUME} = \frac{0,75 \text{ L}}{25 \text{ m} \times 1,50 \text{ m}} \times 10\,000 = 200 \text{ L/ha}$ <p>B. for berry plantation:</p> $\text{SPRAY VOLUME} = \frac{1,80 \text{ L}}{10 \text{ m} \times 3 \text{ m}} \times 10\,000 = 600 \text{ L/ha}$							
<p><b>9</b> The amount of the PLANT PROTECTION PRODUCT (PPP) per TANK is calculated as follows:</p> <p>A. herbicide DOSE RATE = 0,8 L/ha</p> $\text{PPP per TANK} = \frac{8 \text{ L} \times 0,8 \text{ L/ha}}{200 \text{ L/ha}} = 0,032 \text{ L}$ <p>B. insecticide DOSE RATE = 0,4 L/ha</p> $\text{PPP per TANK} = \frac{12 \text{ L} \times 0,4 \text{ L/ha}}{600 \text{ L/ha}} = 0,008 \text{ L}$							
TANK VOLUME	NOZZLE DISTANCE	TEST DISTANCE	VOLUME OF WATER USED	SPRAY WIDTH/ ROW SPACING	SPRAY VOLUME	PESTICIDE DOSE RATE	PPP per TANK
[L]	[m]	[m]	[L]	[m]	[L/ha]	[kg or L/ha]	[kg or L]
A. 8	0,5	25	0,75	1,50	200	0,8	0,032
B. 12	0,5	10	1,80	2,0	600	0,4	0,008

### 7. Nominal nozzle flow table

Nominal flow rates of the most commonly used sizes of nozzles. More details about the nozzles, including information on the recommended pressure ranges and size of generated droplets, can be found in nozzle catalogues offered by the nozzle manufacturers or available on their websites.

Pressure bar	Nozzle size							
	01	015	02	025	03	04	05	06
1,5	0,28	0,42	0,57	0,70	0,85	1,13	1,41	1,70
2,0	0,33	0,49	0,65	0,81	0,98	1,31	1,63	1,96
2,5	0,37	0,55	0,73	0,91	1,10	1,46	1,83	2,19
3,0	0,40	0,60	0,80	1,00	1,20	1,60	2,00	2,40

## SPISE ADVICE for self-inspection, maintenance and calibration of knapsack sprayers

### FOLDED LEAFLET FOR SPRAYER USERS handy instruction on self-inspection & calibration



- Check-list (inspection items)
- Calibration table
- Calibration example
- Nozzle flow rate table

#### SPISE ADVICE CHECK-LIST

##### On-farm self-inspection and calibration of the knapsack sprayer \*

Use personal protection equipment: coverall, gloves, boots, protective glasses or face shield.

##### BEFORE FILLING

- Is the sprayer harness complete and in good condition to ensure safe carrying of a loaded sprayer?
- Is the sprayer tank undamaged to keep it tight when filled with water?
- Is the strainer in the sprayer's tank opening or other type of filling filter clean and in good condition to prevent coarse dirt from entering the tank?
- Is the in-line filter on the pressure side clean and in good condition to prevent the nozzle from clogging?
- Is the liquid hose in good condition, not damaged, not bended and securely connected to avoid leakages?

##### AFTER FILLING WITH CLEAN WATER

- Is the sprayer's nominal capacity and liquid level clearly readable?
- Is the sprayer, when filled with water to its nominal capacity, maintaining a tight seal when at rest, when put on by the operator and operating under pressure?
- Is the pump working properly to produce adequate liquid pressure?
- Is the pressure regulator operating properly to enable appropriate adjustment of liquid flow?
- Is the pressure gauge indicating pressure to appropriately control spray application?
- Is the response of shut-off valve immediate upon opening and closing?
- Is the shut-off valve capable of being reliably locked to avoid unintentional opening?
- Is the shape of spray jet produced by the nozzle correct, i.e. as specified by the sprayer or nozzle manufacturer?

##### Lever operated sprayer

- Is the pump lever securely connected and operating unhindered, i.e. without excessive resistance?
- Is the vent valve or other device for pressure compensation letting the air into the tank when the liquid level drops during spray application?

##### Compression sprayer

- Is the pump piston operating without any problem, i.e. moving smoothly?
- Is the relief valve opening to let the air out when the pressure exceeds the maximum value?

\* This check-list of the self-inspection procedure is to be used as an example that may be subject to modifications according to local legislation or conditions. A detailed instruction is available on: [www.spi-se.eu](http://www.spi-se.eu)

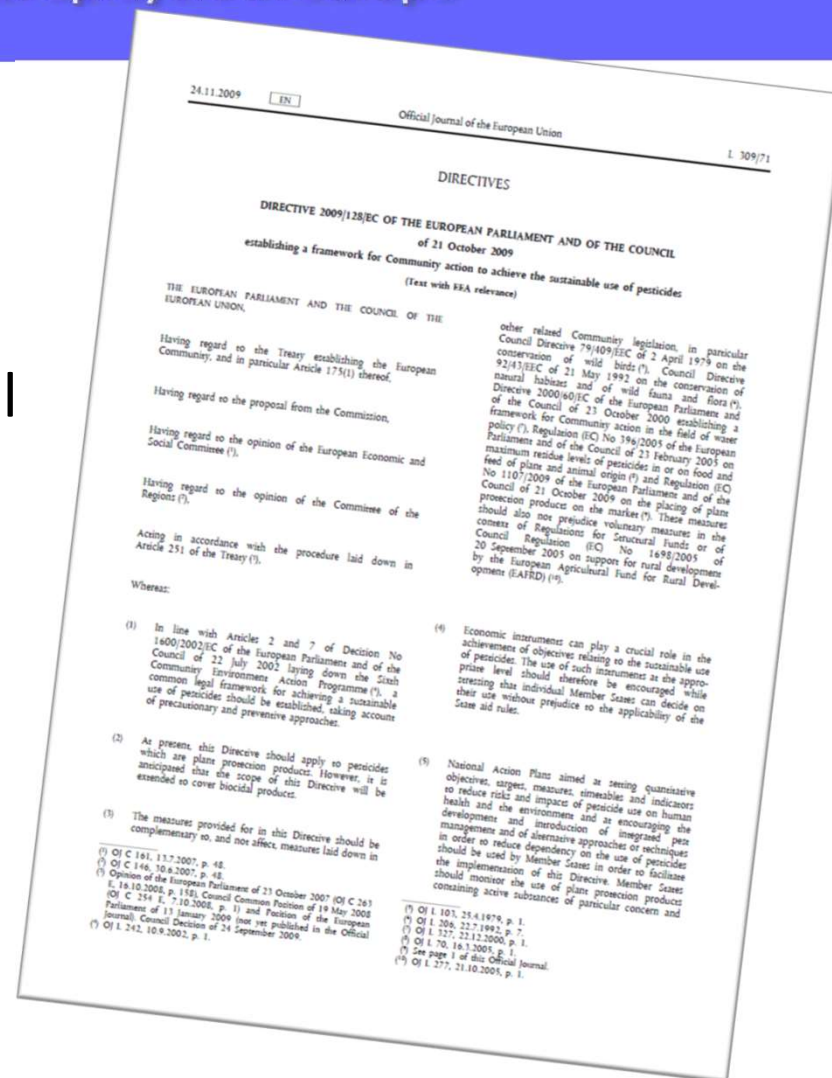
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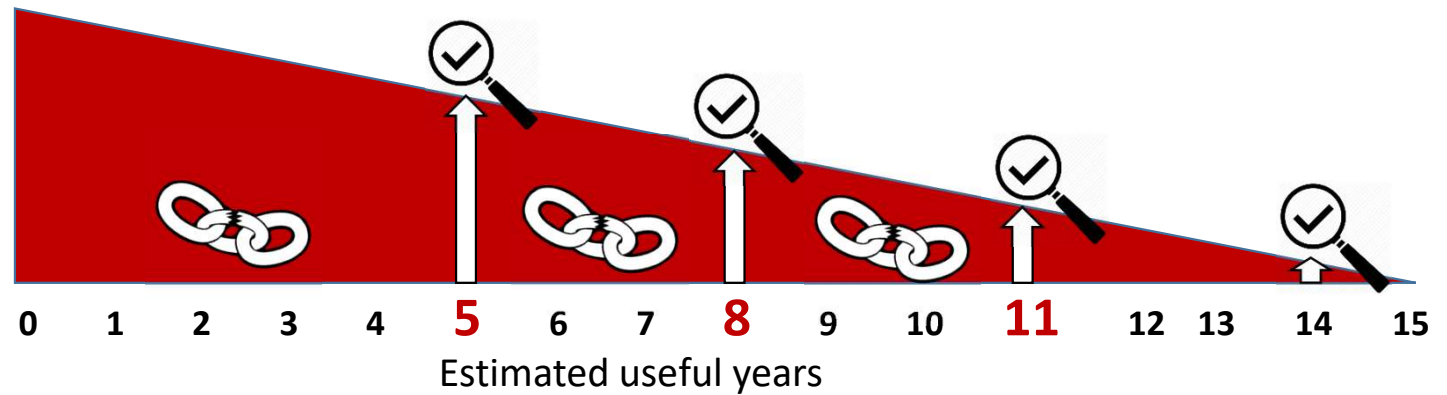
1. Member States shall ensure that pesticide application equipment in professional use shall be subject to inspections at regular intervals.

After 2020 the interval between inspections shall not exceed **three years**.

2. New equipment shall be inspected at least once within a period of **five years** after purchase.



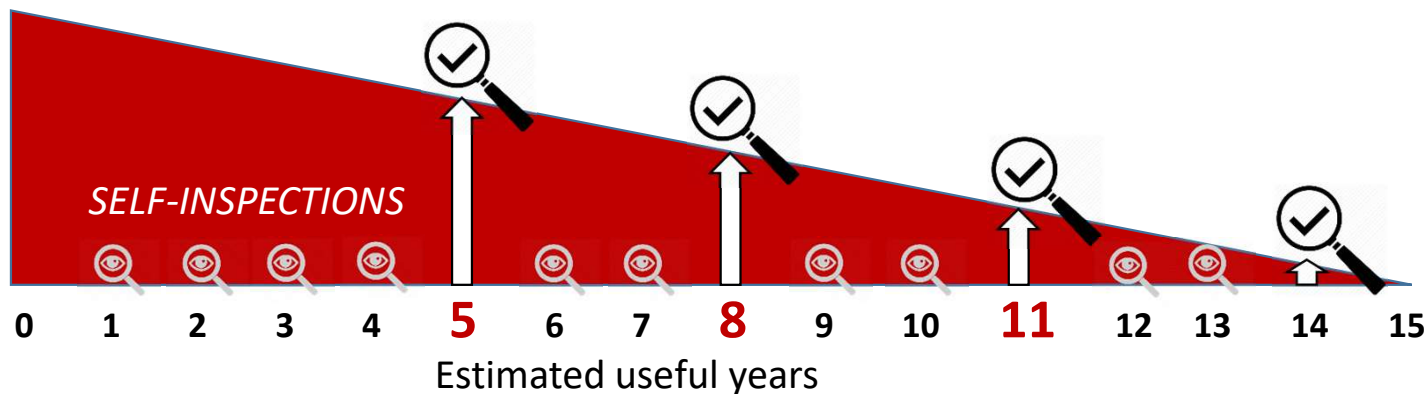
## Field crop and fruit crop sprayers



### High risk of failures and malfunctions

- worn, clogged, damaged nozzles,
- leakages,
- leaking anti-drip valves,
- defective manometers,
- damaged or deformed filters.

## Field crop and fruit crop sprayers



**Regular self-inspections, good maintenance and proper calibration are needed to:**

- ensure top technical performance and reliable operation of PAE
- minimise risk posed to the operator and environment
- learn about the machines and demands imposed on them
- gain useful skills in case of emergency or repair
- enable appropriate preparation of machines for the successful mandatory inspection.

**SPiSE ADVICE** for self-inspection, maintenance and calibration of field crop sprayers

TWG 20



# **SPISE ADVICE** for self-inspection, maintenance and calibration of field crop sprayers

## CONTENTS

### **1. Introduction**

- **Rationale**

- requirement of SUD
- long intervals between inspections

- **Target audience**

- users of sprayers
- farm managers,
- advisors,
- plant protection service supervisors
- providers of obligatory training

- **Reference to EN ISO standards**

- requirements for new sprayers (16119-1)
- verification methods (19932-2)
- Inspection (16122-1,2)

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### **2. Typical defects**

- **Consequences of sprayer defects**
  - environmental contamination
  - unsatisfactory efficacy



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### 3. Maintenance

- **Regular cleaning**
- **Tank**
- **Pump**
- **Filters**
- **Pipes and hoses**
- **Spray boom**
- **Nozzles**



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- **Pipes and hoses**
- **Spray boom**
- **Nozzles**



#### **4. Operator safety**

- **Personal protection**
- **Sprayer cleaning**

## SPISE ADVICE for self-inspection, maintenance and calibration of field crop sprayers

### CONTENTS

#### 5. Self-inspection *(inspection items put in form of questions)*

- **Before starting the sprayer**

- 1) Attaching to tractor
- 2) Tank lid
- 3) Strainer
- 4) Readability of liquid level
- 5) Drain valve
- 6) Pump lubrication
- 7) Filters
- 8) Nozzles
- 9) Nozzle filters



- **After starting the sprayer**

- |                                  |                                      |
|----------------------------------|--------------------------------------|
| 10) Spray boom protection        | 18) Pressure repeatability           |
| 11) Spray boom operations        | 19) Pressure compensation            |
| 12) Breakaway mechanism          | 20) Agitator                         |
| 13) Boom stabilisation & damping | 21) Self-spraying                    |
| 14) Tightness                    | 22) Spray jet quality                |
| 15) Valves                       | 23) Anti-drip valves                 |
| 16) Pressure gauge               | 24) Fan and air sleeve               |
| 17) Pressure stability           | 25) Filling and cleaning accessories |

**Recommendation:**

*to be considered to modify or upgrade the sprayer by easy replacement of parts that may improve the work comfort and safety.*

## **SPISE ADVICE** for self-inspection, maintenance and calibration of field crop sprayers

### CONTENTS

#### **5. Self-inspection** (*inspection items put in form of questions*) - *EXAMPLE*

##### ***(5) Is the drain valve working properly?***

Check that opening the drain valve allows unobstructed emptying the tank and that the valve is tight when closed.

##### ***Recommendation:***

*The drain valve should enable collecting the liquid drained from the tank without exposing the operator to contamination and without posing risk for the environment.*

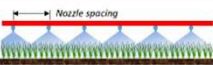

## SPISE ADVICE for self-inspection, maintenance and calibration of field crop sprayers

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#### 6. Calibration




**CALIBRATION OF FIELD CROP SPRAYER**

- Determine the required spray volume depending on the type of application, plant growth phase and the type of sprayer.
- Check the nozzle spacing on the spray boom.
 
- Calculate the travel speed of the sprayer based on the measurement of the travel time (*t*) on a defined distance (*d*) (min. 50 m).
 

$$\text{Travel speed [km/h]} = \frac{\text{Driving distance [m]}}{\text{Driving time [s]}} \times 3,6$$

Time 1700 m	45	48	50	52	54	56	58	59	60	62	64	66	68	70	72	74	76	78	80	85	90
Speed km/h	8,0	7,5	7,2	6,9	6,7	6,4	6,2	6,0	5,8	5,6	5,5	5,3	5,3	5,0	4,9	4,7	4,5	4,4	4,2	4,0	3,8
- Calculate the required nozzle flow rate to apply the spray volume at the calculated operating speed, or use the nozzle catalogue / calibration disc.
 

$$\text{Nozzle flow rate [L/min]} = \frac{\text{Spray volume [L/ha]} \times \text{Nozzle spacing [m]} \times \text{Travel speed [km/h]}}{600}$$
- In the table of the nominal nozzle flow rates (see nozzle catalogue), select the nozzles and the pressure for which the flow rate is closest to the one calculated above.
- Install the selected nozzles, start the sprayer and set the nominal pressure, read in the table. Using a measuring jug, measure the volume of water sprayed out over one minute. Repeat the measurements for a few on each section and if the result does not match the required flow, correct the pressure and repeat the measurement.
 
- Make the records of the obtained results in the table below.

SPRAY VOLUME l/ha	NOZZLES		TRACTOR		SPEED CHECK		CALCULATED SPEED km/h	CALCULATED FLOW RATE l/min	PRESSURE bar
	Spacing m	Type Size	Gear	RPM rev/min	Distance m	Time s			

- Filling with **clean water**
- **Spray volume** to be applied
- Measuring **nozzle spacing**
- Determining **travel speed**
- Calculating **required nozzle flow**
- Selecting **nozzle & pressure**
- Verification of **nozzle flow**

## SPISE ADVICE for self-inspection, maintenance and calibration of field crop sprayers

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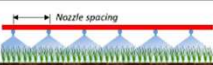

#### EXAMPLE

#### Table of Nozzle Flow Rate


## 6. Calibration




**CALIBRATION OF FIELD CROP SPRAYER**

- Determine the required spray volume depending on the type of application, plant growth phase and the type of sprayer.
- Check the nozzle spacing on the spray boom.
 
- Calculate the travel speed of the sprayer based on the measurement of the travel time (*t*) on a defined distance (*d*) (min. 50 m).
 

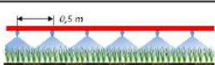
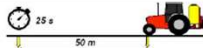
$$\text{Travel speed [km/h]} = \frac{\text{Driving distance [m]}}{\text{Driving time [s]}} \times 3,6$$

Time /1000 m	45	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	85	90
Speed km/h	8,0	7,5	7,2	6,9	6,7	6,4	6,2	6,0	5,8	5,6	5,5	5,3	5,1	5,0	4,9	4,7	4,5	4,4	4,2	4,0
- Calculate the required nozzle flow rate to apply the spray volume at the calculated operating speed, or use the nozzle catalogue / calibration disc.
 


$$\text{Nozzle flow rate [L/min]} = \frac{\text{Spray volume [L/ha]} \times \text{Nozzle spacing [m]} \times \text{Travel speed [km/h]}}{600}$$
- In the table of the nominal nozzle flow rates (see nozzle catalogue), select the nozzles and the pressure for which the flow rate is closest to the one calculated above.
- Install the selected nozzles, start the sprayer and set the nominal pressure, read in the table. Using a measuring jug, measure the volume of water sprayed out over one minute. Repeat the measurements for a few on each section and if the result does not match the required flow, correct the pressure and repeat the measurement.
 
- Make the records of the obtained results in the table below.

SPRAY VOLUME L/ha	NOZZLES		TRACTOR		SPEED CHECK		CALCULATED SPEED km/h	CALCULATED FLOW RATE L/min	PRESSURE bar
	Spacing m	Type Size	Gear	RPM rev/min	Distance m	Time s			

**EXAMPLE OF FIELD CROP SPRAYER CALIBRATION**

- A winter wheat is to be sprayed at spray volume 150 L/ha.
- The nozzle spacing is 0,5 m.
 
- The tractor with sprayer covered a distance of 50 m in 25 seconds. It was driven at the 3<sup>rd</sup> gear and 1600 RPM. The travel speed is calculated as follows:
 

$$\text{Travel speed} = \frac{50 \text{ m}}{25 \text{ s}} \times 3,6 = 7,2 \text{ km/h}$$
- The nozzle flow rate needed to apply the spray volume 150 L/ha at travel speed 7,2 km/h is calculated as follows:
 
$$\text{Nozzle flow rate} = \frac{150 \text{ L/ha} \times 0,5 \text{ m} \times 7,2 \text{ km/h}}{600} = 0,9 \text{ L/min}$$

Pressure bar	Nozzle size							
	01	015	02	025	03	04	05	06
1,5	0,28	0,42	0,57	0,70	0,85	1,13	1,41	1,70
2,0	0,33	0,49	0,65	0,81	0,98	1,31	1,63	1,96
2,5	0,37	0,55	0,73	0,91	1,10	1,46	1,83	2,19
3,0	0,40	0,60	0,80	1,00	1,20	1,60	2,00	2,40
4,0	0,46	0,69	0,92	1,15	1,39	1,85	2,31	2,77
5,0	0,52	0,77	1,03	1,28	1,55	2,07	2,58	3,10
6,0	0,57	0,84	1,11	1,40	1,64	2,21	2,75	3,28
7,0	0,61	0,90	1,19	1,52	1,79	2,37	2,96	3,54
8,0	0,65	0,96	1,27	1,62	1,91	2,53	3,17	3,79
- The selected nozzle size is 025 of which the nominal flow rate is 0,91 L/min (closest to the calculated one) is obtained at 2,5 bar.
- At the 2,5 bar set on the pressure gauge the actual flow rate of the 025 nozzles is only 0,8 L/min. The repeated measurement at 3,0 bar read on the pressure gauge results in the required flow rate 0,9 L/min.
 
- The results of calibration are recorded in the table below.

SPRAY VOLUME L/ha	NOZZLES		TRACTOR		SPEED CHECK		CALCULATED SPEED km/h	CALCULATED FLOW RATE L/min	PRESSURE bar
	Spacing m	Type Size	Gear	RPM rev/min	Distance m	Time s			
150	0,5	025	3	1600	50	25	7,2	0,9	2,5 3

Nominal flow rates of the most commonly used sizes of nozzles

Pressure bar	Nozzle size							
	01	015	02	025	03	04	05	06
1,5	0,28	0,42	0,57	0,70	0,85	1,13	1,41	1,70
2,0	0,33	0,49	0,65	0,81	0,98	1,31	1,63	1,96
2,5	0,37	0,55	0,73	0,91	1,10	1,46	1,83	2,19
3,0	0,40	0,60	0,80	1,00	1,20	1,60	2,00	2,40
4,0	0,46	0,69	0,92	1,15	1,39	1,85	2,31	2,77
5,0	0,52	0,77	1,03	1,28	1,55	2,07	2,58	3,10
6,0	0,57	0,84	1,11	1,40	1,64	2,21	2,75	3,28
7,0	0,61	0,90	1,19	1,52	1,79	2,37	2,96	3,54
8,0	0,65	0,96	1,27	1,62	1,91	2,53	3,17	3,79

More details about the nozzles, including information on the recommended pressure ranges and size of generated droplets, can be found in nozzle catalogues offered by the nozzle manufacturers or available on their websites.

## SPISE ADVICE for self-inspection, maintenance and calibration of field crop sprayers

### FOLDED LEAFLET FOR SPRAYER USERS handy instruction on self-inspection & calibration



- Check-list (inspection items)
- Calibration table
- Calibration example
- Nozzle flow rate table

#### SPISE ADVICE

##### On-farm self-inspection, maintenance and calibration of the field crop sprayer \*

- Use personal protection equipment: overall, gloves, boots, protective glasses or face shield.
- Connect the sprayer to the tractor and fill it with clean water to half the volume of the tank.

##### BEFORE STARTING THE SPRAYER

- Is the sprayer connected safely to the tractor?
- Is the tank lid in good condition and properly fitted to prevent contamination due to loss of spray liquid?
- Is the strainer in the sprayer's tank opening clean and in good condition to prevent coarse dirt from entering the tank?
- Is the sprayer's tank nominal volume and liquid level clearly readable?
- Is the drain valve working properly?
- Is the pump properly lubricated (oil level, greasing)?
- Are all filters clean and in good condition?
- Are the nozzles properly fitted in the intended order/configuration?
- Are the nozzles and nozzle filters clean and in good condition?

##### AFTER STARTING THE SPRAYER

- Is the spray boom properly protected from uncontrolled unfolding?
- Are the mechanisms of raising and unfolding of the spray boom working properly?
- Is the breakaway mechanism of the spray boom working properly?
- Are the boom damping and stabilization systems working properly?
- Are the tank and other components of liquid system tight and prevent leaks?
- Are pressure regulation valve, main shut-off valve, section valves and manifold valves working properly?
- Is the pressure gauge responding to pressure adjustment?
- Are the indications of pressure gauge stable?
- Are the indications of pressure repeatable after turning the main shut-off valve on and off?
- Is the pressure constant after turning selected section valves on and off?
- Is the agitator causing visible water movement in the tank?
- Are the sprayer components protected from self-spraying?
- Are the spray jets produced by the nozzles even, with no signs of damage?
- Are the anti-drip valves working properly?

##### Air-assisted sprayer

- Are the fan and air sleeve in good condition?

##### Extra equipment

- Are the installations and devices for filling and cleaning of sprayer working properly?

\* This check-list of the self-inspection procedure is to be used as an example that may be subject to modifications according to local legislation or conditions. A detailed instruction is available on: [www.spi-se.eu](http://www.spi-se.eu)

# SPISE ADVICE for self-inspection, maintenance and calibration of field crop sprayers

**FOLDED LEAFLET FOR SPRAYER USERS**  
handy instruction on self-inspection & calibration





## Final conclusions for carrying out the in-farm self-inspections of sprayers

- meaningful risk mitigation measure
- on yearly basis
- visual and simple functional check
- preferably at the start of plant protection season
- as a good practice before calibration of the equipment
- with basic tools and the standard calibration kit



## SPISE ADVICE manuals on self-inspection of PAE are meant to:

- propose a harmonized procedure of regular calibration and technical checks
- support implementation of Art. 8 of SUD
- meet requirement for training/information
- stimulate voluntary activities for complete adoption of SUD





*thank you ;-)*