



Inspector's training manual

EN-ISO16122 (2015)

Part 1: General

Part 2: Horizontal boom sprayers

Part 3: Orchard and bush sprayers

Jaco Kole¹, Paolo Balsari² and Emilio Gil³

¹ SKL – Stichting Kwaliteitseisen Landbouwtechniek – The Netherlands - j.kole@sklkeuring.nl

² DISAFA – University of Turin (Italy) – Paolo.Balsari@unito.it

³ DEAB – Polytechnic University of Catalonia (Spain) – Emilio.Gil@upc.edu

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1. Introduction

This manual is made on base of the incoming harmonized standard EN-ISO16122 about performing the periodical testing of sprayers in use. This manual gives the indication from the standard together with some extra information about how to perform the inspections.

This manual is about EN-ISO16122:1, General requirements, EN-ISO16122:2, testing of horizontal boom sprayers and EN-ISO16122:3, the testing of sprayers for bush and tree crops.

For the different items there is an explanation about how to test and how to evaluate the outcome of the measurements and there is a couple with the relevant lines on the testing form.

2. Legislation

2.1 European legislation

In 2000 the European Commission started the development of the Directive for a sustainable use of pesticides in Europe. One of the outcomes was that the quality of plant protection equipment shall be increased. There two measures were taken:

1. An Amendment to the Machinery Directive in which for application equipment for pesticides, next to the existing demands on the field of labor safety, also demand for 'environmental safety' are formulated (2009/127/EC). This directive is in force since the end of 2011, so all new application equipment in the EU should fore fill the requirements of this directive.
2. A mandatory periodical inspection of application equipment in use in the EU. This measure is a part of the Directive for a sustainable use of pesticides (2009/128/EC). In this directive are the following demands:
 - a. All equipment shall be inspected by the end of 2016
 - b. The frequency of the inspections are 5 years up to 2020 and 3 years after 2020
 - c. Equipment was is used on a low scale can have another inspection frequency based on a risk assessment.
 - d. Handheld equipment like backpack sprayers can be exempted from inspection.
 - e. The inspections shall be done on base of the requirements in this directive, or when they are ready on base of harmonized standards (EN-ISO 16122 series)
 - f. The member states shall recognize the inspections done in other member states
 - g. Each member state shall have a responsible body for the organizationOn base of this requirements, each member state can develop his own inspection scheme.

3. Standards

3.1. EN-ISO 16122(2015)

During recent years, several countries have developed systems for inspection of sprayers in use. Developments in this direction have been stimulated by public concerns about risks, and the aim of reducing the use of crop protection products.

However, there are three main arguments for the periodical inspection:

- improve the operator safety
- decrease the potential risk of environmental contamination by crop protection products
- good control of the pest with a minimum input of crop protection products.

To harmonize the requirements for the inspections of sprayers, under the CEN/ISO have experts from European and other countries developed this European and International series of Standards (EN-ISO 16122 series) under the title: Agricultural and forestry machinery – Inspection of sprayers in use, which at present consists of the following three parts:

- Part 1: General
- Part 2: Horizontal boom sprayers
- Part 3: Sprayers for bush and tree crops
- Part 4: Fixed and semi-mobile sprayers

Figure 1 Classification of spraying equipment



In the EN-ISO 16122 part 1 are defined the general requirements to be fulfilled, a classification of sprayers in order to define to application of each part of EN-ISO16122 and also the minimum requirements for the preparation of the sprayer including the minimum safety requirements dealing with operator safety during the inspection.

To have uniform inspections the next items are very important:

- The testing procedure has be uniform, all test-operators have to test the sprayers on the same way on base of the same criteria.

- The standards for inspecting the sprayer are for all inspectors and all sprayers equal
- The test equipment what will be used during the inspection has to meet the qualifications as mentioned in this standard. For uniform tests, the condition and accuracy of the equipment has be checked periodically.
- The sprayer may only be approved (and an approval sticker placed on the machine) if the machine meets all requirements.
- The testing form has to be filled in according to the truth and complete.

4. EN-ISO 16122:1 General requirements before testing

4.1 General

The owner/operator of the sprayer should preferably be present at the inspections. Visible and other known faults should be repaired before the inspection starts.

All necessary testing equipment shall be checked at regular intervals (preferably once a year) with certified equipment. Proof of calibration shall be available.

4.2 Place for inspection

The inspection shall be made in a location allowed to avoid risk of pollution of environment, this means that at least the sprayed/leaked liquid shall be collected and transferred back into the sprayer tank at the end of the test.

To allow the required reproducibility of the test, the influence of external conditions (wind, rain, etc.) shall be minimized. For this reason, the test shall be made in a covered and closed structure.

4.3 Pre-inspection

4.3.1. General

Visible and other known faults should preferably be remedied before the inspection. A preparatory 'rough inspection' should be done at the site of the ordinary inspection, in order to avoid wasting time making measurements on sprayers with very obvious serious faults

4.3.2. Cleaning

The tests must be done in a safe way for the test operator. Therefore, the sprayer has to be cleaned carefully, inside and outside.





Special attention has to be paid to rinsing and internal cleaning of the sprayer including filters and filter inserts, and external cleaning of those parts of the sprayer that are most exposed to the crop protection products when spraying.

4.3.3. Power transmission parts (PTO)

The power take-off drive shaft guard of the power input connection (PIC) shall be fitted and in good condition:

- *the different parts of the shaft, the universal joints and locking systems shall not show any mark of excessive wear and shall operate correctly*
- *the function of the guard shall be obvious and the guard shall not show any wear marks, holes, deformations or tears*
- *the restraining device that prevent the rotation of the power take-off drive shaft shall be present and shall work reliable*

The protective devices and any moving or rotating parts shall not be affected in their function.

Example



How to test

Visual inspection and function test of:

- the shaft, universal joints and locking systems on function and wear
- the guard pipes on good protection of all moving parts and wear
- the chains or other devices that prevent the guard pipes from rotating
- the protective devices on the PTO and PIC side.

4.3.4. Moving parts

All guards provided for protection of the operator shall be present and functioning correctly.

Example:



How to test

Visual inspection and function test of the presence and functionality of the protection of all moving parts of the sprayer.

4.3.4. Pipes and hoses for hydraulic transmission

There shall be no visible leakage from the hydraulic system of the sprayer, hydraulic hoses shall not show excessive bending and abrasions. They shall be free of defect such as excessive wear, cracks or cuts. Hydraulic pipes shall be retained in their intended position.

4.3.5. Structural parts and framework

All structural parts and the framework shall be in good condition, without permanent deformations. Significant corrosion or other defects which could affect the rigidity or the strength of the sprayer.

4.3.6. Foldable parts

Locking of foldable parts of the sprayer shall secure these parts in the intended positions, both in transport and working position.

Example:



How to test

Functional test of the locking of the foldable parts (for example sprayer booms or multiple row orchard sprayer) in both transport and working positions. For safe transport over the roads, the spray booms must be secured safely for transport.

4.3.7. Blower

4.3.7.1. General.

The blower (fan, casing, air deflectors) shall be present, in good condition and mounted in a functional manner:

- *Blades or not missing or damaged*
- *All parts shall be free of mechanical deformation, wear and tear, corrosion and vibrations*
- *The guard to prevent access to the fan shall be present and in good condition.*

The blower shall work properly at the nominal working range of PTO speed, e.g. no vibrations due to unbalance, no friction between the body and the fan or wrong orientation of the blades.

Example



How to test

Visual check on the condition and presence of all parts. Let the blower rotate with nominal working range of the PTO speed to check the balance of the blower.

4.3.7.2. Clutch

If the blower can be switched off separately from other driven parts of the machine, the clutch shall work reliably.

Example



How to test

Function test. Test the function of the clutch and gearbox of the blower.

4.4. Inspection

After the sprayer has passed the pre-inspection in accordance with 4.3. it shall be inspected in accordance with chapter 5 (horizontal boom sprayers) or chapter 6 (sprayers for bush and tree crops).

5. Testing horizontal boom sprayers: EN-ISO 16122:2

5.1. Leaks and dripping

5.1.1. Static leaks

With the sprayer filled with water to its nominal capacity, parked on a level horizontal surface and with the pump not running, there shall be no leakage from any part of the sprayer.

Example



How to test

Visual inspection. Fill the tank to its nominal capacity, with the pump not running and parked on a horizontal surface and verify that there is no leakage from any part of the sprayer.

5.1.2. Dynamic leaks.

There shall be no leakage from any parts of the sprayer with the pump running when not spraying as when spraying.

Example



How to test

Function test.

- Not spraying

Make the sprayer running with the section valves closed at the maximum pressure indicated by the sprayer manufacturer or when this is not known with a pressure equal to the maximum obtainable pressure of the system (consider to make open the pressure safety valve) and verify that there is no leakage from any part of the sprayer.

- Spraying

Make the sprayer running with the section valves opened at the maximum working (spraying) pressure indicated by the sprayer manufacturer or the nozzle manufacturer (if lower) and verify that there is no leakage from any part of the sprayer.

5.1.3. Spraying and dripping on parts.

Regardless of the distance of the boom above the ground, no liquid shall be sprayed on to the sprayer itself. This does not apply if needed by function (for example sensors) and it dripping is minimized.

Example



How to test

Visual inspection while spraying with the boom on different heights. There shall be no liquid sprayed on any part of the sprayer. Keep special attention to hanging hoses and nozzle protection parts.

5.2. Pump

5.2.1 Pump capacity

The pump capacity shall be suited to the needs of the equipment.

- a) The pump capacity shall be at least 90 % of its original nominal flow, given by the manufacturer of the sprayer.
- b) the pump shall have sufficient flow rate capacity in order to be able to spray while maintaining a visible agitation.

Example



How to test

Measurement of the capacity of the pump:

1. Connect the flowmeter on the outlet side of the pump as close as possible to the pump outlet considering not to have leakage or air-ingress from the connection part.
2. First test at free outlet of the pump
3. Second test at $8(\pm 0,2)$ - $10(\pm 0,2)$ bar pressure of the pump.
4. Both measured flow measurements of the capacity of the pump should be at minimum 90% of the value specified by the manufacturer of the pump.
5. Water discharged from the flow meter shall be feed back into the spray tank.

For operation instructions of the pump tester (flowmeter) see the instructions of the manufacturer of this unit

Evaluating the suitability of the pump:

The minimum flow rate capacity of the pump (l/min) =

1. Flow rate needed for spraying when using largest nozzle with maximum pressure
- +
2. Flow rate needed for agitation

How to calculate:

1. Flow rate needed for spraying when using the largest nozzle mounted on the machine with the maximum pressure of that nozzle

Step 1: determine the largest nozzle on the machine

Step 2: look in the documentation of the nozzle manufacturer for the flow rate at maximum pressure of that nozzle

Step 3:

1. Total flow rate (l/min) = number of nozzles x flow rate per nozzle (l/min)
 2. Flow rate needed for agitation
- Is: minimum: 5% of capacity spray liquid tank*

The measured capacity of the pump (under pressure) should be more as the calculated minimum needed flow rate.

Nozzle Model	Pressure [bar]		Flow Rate (l/min)	Flow Rate (5 km)
	1.5	2.0		
LU 90-01 120-01 (80 M)	1.5	0.26	6	
	2.0	0.32	7	
	2.5	0.36	8	
	3.0	0.39	9	
	3.5	0.42	10	
LU 90-015 120-015 (80 M)	4.0	0.45	11	
	4.5	0.48	11	
	5.0	0.51	11	
	1.5	0.42	11	
	2.0	0.48	11	
LU 90-015 120-015 (80 M)	2.5	0.54	11	
	3.0	0.59	11	
	3.5	0.63	11	
	4.0	0.68	11	
	4.5	0.72	11	
LU 90-02 120-02 (80 M)	5.0	0.76	11	
	1.5	0.56	11	
	2.0	0.65	11	
	2.5	0.73	11	
	3.0	0.80	11	
LU 90-02 120-02 (80 M)	3.5	0.86	21	
	4.0	0.92	21	
	4.5	0.98	21	
	5.0	1.03	21	
	1.5	0.84	21	
LU 90-03 120-03 (80 M)	2.0	0.97	21	
	2.5	1.08	21	
	3.0	1.19	21	
	3.5	1.28	31	
	4.0	1.37	31	
LU 90-03 120-03 (80 M)	4.5	1.46	31	
	5.0	1.53	31	
	1.5	1.12	31	
	2.0	1.29	31	
	2.5	1.44	31	
LU 90-04 120-04 (80 M)	3.0	1.58	31	
	3.5	1.71	41	
	4.0	1.82	41	
	4.5	1.94	41	
	5.0	2.04	41	
LU 90-04 120-04 (80 M)	1.5	1.61	31	
	2.0	1.61	31	

5.2.2. Air chamber

If present the membrane shall not be damaged and there shall be no appearance of liquid when operating at the maximum pressure recommended by the sprayer manufacturer. The air-pressure shall be the one recommended by the sprayer manufacturer or between 30% and 70% of the working pressure of the nozzles in use.

Example



How to test

Function test. Make the pump running at the maximum pressure recommended by the sprayer manufacturer and verify that there is no leakages then verify that the air-pressure inside the air-chamber is between 30% and 70% of the working pressure of the nozzles in use and that there are no pulsations on the manometer.

5.2.3. Pulsations

There shall be no pulsations of more than 10% of the pump working pressure.

Example



How to test

Functional test. When spraying at intended spraying pressures and at the nominal rotation speed of the pump, the pulsations shall be less than 10%. This shall read on the spray manometer (first shall be check if this manometer meets the requirements specified).

The cause of this pulsations can be:

- ❖ defect in the pump
- ❖ in correct pressure in or defect of the accumulator (to be checked in 5.2.2.)
- ❖ defect in the pressure regulator

On testing form:

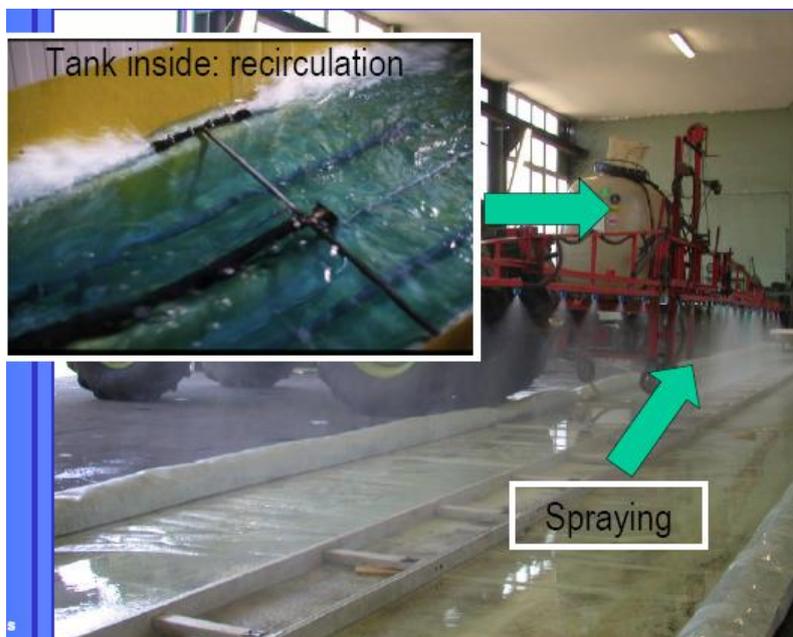
Subject												
		No defects	Critical defects	Repaired	No defects	Critical defects	Repaired	No defects	Critical defects	Repaired		
2. Pump	2.1 Capacity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. 2 Air chamber	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2. 3 Pulsations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5.3. Spray mix agitation

5.3.1. Hydraulic agitation

A clearly visible agitation shall be maintained when spraying at the maximum working pressure as recommended by the sprayer or nozzle manufacturer (which is the lowest), with the largest nozzle mounted on the sprayer, with pump rotation speed as recommended by the sprayer manufacturer and with the tank filled to the half of its nominal capacity.

Example



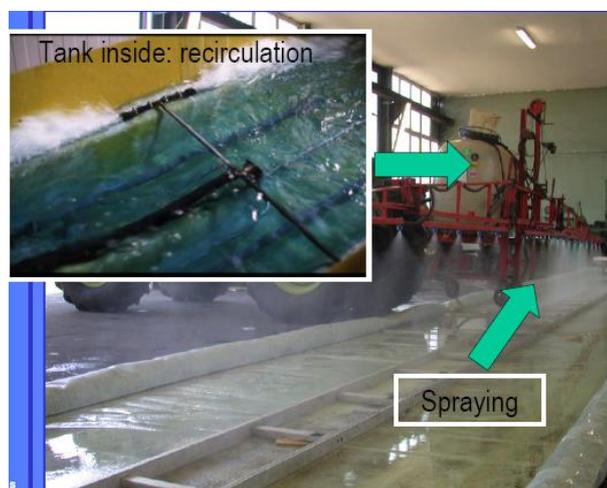
How the test

Visible inspection. When spraying on the specified conditions, there shall be a clearly visible recirculation of the spray liquid inside the tank.

5.3.2. Mechanical agitation

A clearly visible agitation shall be maintained when the agitation is working pressure as recommended by the sprayer manufacturer and with the tank filled to the half of its nominal capacity.

Example



How the test

Visible inspection. When spraying on the specified conditions, there shall be a clearly visible recirculation of the spray liquid inside the tank.

On testing form:

Subject											
		No defects	Critical defects	Repaired	No defects	Critical defects	Repaired	No defects	Critical defects	Repaired	
3. Agitation	3.1 Hydraulic agitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	3.2 Mechanical agitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			

5.4. Spray Liquid Tank

5.4.1. Lid

The tank shall be provided with a lid, well adapted and in good condition. This lid shall be tightly sealed to prevent leakage and shall prevent unintended opening. If a vent is fitted in the lid it shall prevent spillage.

Example



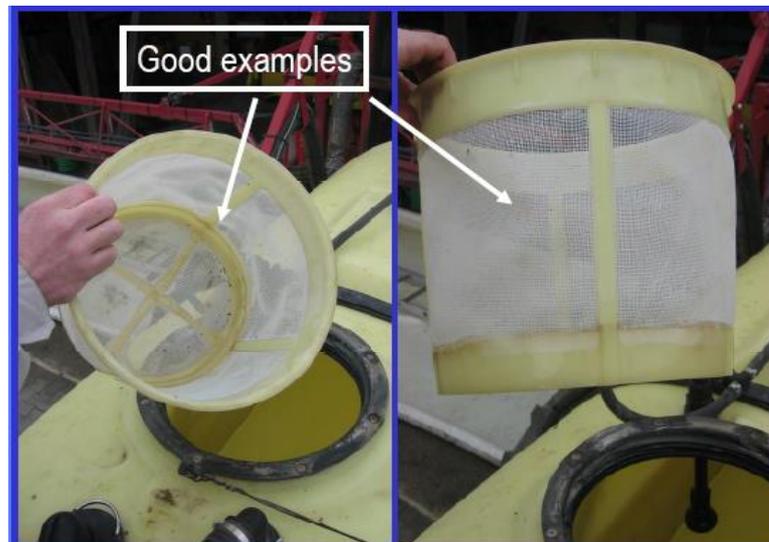
How to test

Visible inspection of the spray liquid tank lid presence, tightness and condition with the sprayer tank filled to its nominal capacity (with pump running at nominal speed and simulating driving conditions). The lid should not be damaged in such a way that leakage of spray liquid is possible when the tank is filled and the machine is driving.

5.4.2. Filling hole

There shall be a strainer in good condition in the filling hole.

Example



How to test

Visible inspection of the strainer. In order to prevent from issues to fall in the spray liquid tank, there shall be an adequate and well-fitting strainer in the filling hole of the spray liquid tank. This strainer should also be in good condition (no holes, etc.)

5.4.3. Induction hopper

If an induction hopper is present, it shall have a grating inside to prevent any object greater than 20 mm diameter to entering into the sprayer tank. It shall work properly and not leak.

Example



How to test

Visible check and function test. Visible check if the container is not damaged. Test of function, is the liquid in the container sucked in the spray liquid tank and a test of cleaning nozzles in the cleaning container and the operating elements on the unit are working properly.

Visible check of the grating in the chemical introduction container.

The function of this grating is to prevent introduction of covers from containers of crop protection products or other objects with a diameter of more than 20mm diameter in the introduction container.

5.4.4. Pressure compensation

Pressure compensation (to avoid over- or under pressure in the tank) shall be ensured.

Example



How to test

Visible check. Both in the cover or somewhere else on the spray liquid tank there should be a pressure compensation valve. The working of this valve should be checked.

5.4.5. Tank content indicator

There shall be a clearly readable liquid level indicator on the tank which is visible from the driver's position and from the position where the tank is filled.

Example



How to test

Visible check. The level indicator must be visible from the normal position of the driver and also from the position where the tank is filled. Different systems are allowed (direct, indirect, analogue or digital). There should be a readable indication of the liquid level with clear and readable marks and numbers.

5.4.6. Tank emptying

It shall be possible to empty the spray liquid tank (for example using a tap) and collect the liquid without environmental contamination and risk of exposure of the operator.

Example



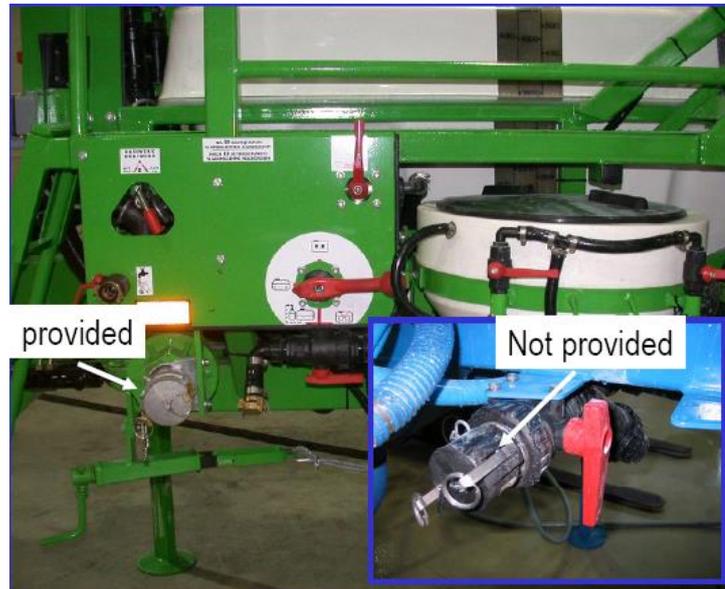
How to test

Function test. Emptying of the spray liquid tank shall be possible without the risk of environmental contamination and risk for the operator.

5.4.7. Tank filling

If a water filling device is present on the sprayer it shall be prevented that water from the sprayer returns to the water source (for example by means of a non-return valve).

Example



How to test

Visible check and function test. If there is a water filling device on the sprayer, a non-return valve in the suction line of the pump shall be provided, and shall work appropriately.

5.4.8. Cleaning device for plant production product containers.

If a cleaning device for plant protection containers is provided, this device shall work reliably.

Example



How to test

Function test. Test of the cleaning nozzles in the cleaning container.

Place an empty can on the cleaning nozzle and try the function of the nozzle, check if the holes in the nozzle are not blocked.

5.4.9. Cleaning equipment

If there are cleaning devices for cleaning the inside of the tank, the complete sprayer or the outside of the sprayer, this device shall work properly.

Example



How to test

Function test. Test of the cleaning nozzles in the cleaning container.

Place an empty can on the cleaning nozzle and try the function of the nozzle, check if the holes in the nozzle are not blocked.

On testing form:

Subject												
		No defects	Critical defects	Repaired	No defects	Critical defects	Repaired	No defects	Critical defects	Repaired		
4. Spray liquid tank	4.1 lid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.2 filling hole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3 induction hopper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.4. Pressure compensation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5 Level indicator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6 Tank emptying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.7 Water filling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.8 Can cleaning device ^s	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.9 Cleaning device ^s	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5.5. Measuring systems, controls and regulation systems

5.5.1. General

All devices for measuring, switching on and off and adjusting pressure and/or flowrate shall function.

The valves for switching on/off the spraying shall function.

Switching on and off the nozzles shall be possible simultaneously.

The controls to be operated during spraying shall be operable from the operator's position and the instruments shall be readable from this position.

NOTE Turning of the head and the upper body is acceptable to achieve these requirements.

Switching on and off individual boom sections shall be possible.



How to test

Visible check and function test. Check all operational element on their function, everything should work properly according to their specific function.

Test of the main and boom section valves:

These valves should work properly, there should be no leakages while the valves are closed, while closing these valves the spraying should stop directly. Test the main valve and the boom section valves separately. All other valves and operational elements on the sprayer also should be tested on their function.

Take place on the driver seat and test if all operation elements are reachable and all displays are clearly visible.

How to test

Special attention should be paid to the pressure regulator.

Test the pressure regulator while spraying on the next elements:

- ❖ It must be possible to increase and decrease the spraying pressure smoothly from 0 bar to the maximum spraying pressure at constant rotation of the pump;
- ❖ An established standard spraying pressure of for example 3 bar must stay constant while having a constant engine speed. A deviation of + or – 0,3 bar (10%) is allowed.
- ❖ At the established pressure of 3 bar shut and close the main valve some times. The established pressure should every time be achieved within a margin of + or – 0,3 bar (10%) at constant rotation of the pump
- ❖

5.5.2. Pressure indicator

5.5.2.1. Scale and dimension of pressure indicator.

At least one digital or analogue pressure indicator shall be present on a position where it is clearly readable from the operator's position. The pressure indicator shall be suitable for the working pressure range used.

Example



How to test

Visible inspection. The scale of the pressure gauge should be suitable to the working pressure range. For field crop sprayers, this means that the range from 0 to 8 bar should be avg. 135° of the total scale. The end value should not be too high (problems with the accuracy can occur) and also not be too low (keep peak pressures of the system in mind).

5.5.2.2. Scale of analogue pressure indicator

The scale shall be marked:

- at least every 0,2 bar for working pressures less than 5 bar;
- at least every 1,0 bar for working pressures between 5 bar and 20 bar;
- at least every 2,0 bar for working pressures more than 20 bar.

Example



How to test

Visible inspection.

5.5.2.3. Accuracy pressure gauge

The accuracy of the pressure gauge shall be:

- $\pm 0,2$ bar for working pressures at 2 bar and below
- ± 10 % of the real value for pressure at 2 bar and above.

Example



How to test

Measurement of the accuracy.

This can be done on two ways.

1. Demount the sprayer pressure gauge from the sprayer and mount it on the pressure gauge testing unit. The values of the sprayer pressure gauge are then compared with an accurate reference pressure gauge.
2. Connect the reference pressure gauge on the sprayer as close to the sprayer pressure gauge as possible. The reference pressure gauge can be mechanical or electronically. When increasing or decreasing the spraying pressure the values on both pressure gauges can be compared.



Measurements shall be carried out with both increasing and decreasing pressure. In any case accuracy of the pressure indicator shall be checked at minimum of four equally points within the relevant working pressure range. The pressure shall be stable during measurement, example no influence from pump rotations and pulsations. The test be made within a working pressure range suitable for the nozzles mounted on the sprayer under test.

The maximum deviation of the sprayer pressure gauge with the real value is + or – 0,2 bar for pressures at 2 bar or below and +/- 10 % for pressures from 2 bar and higher.

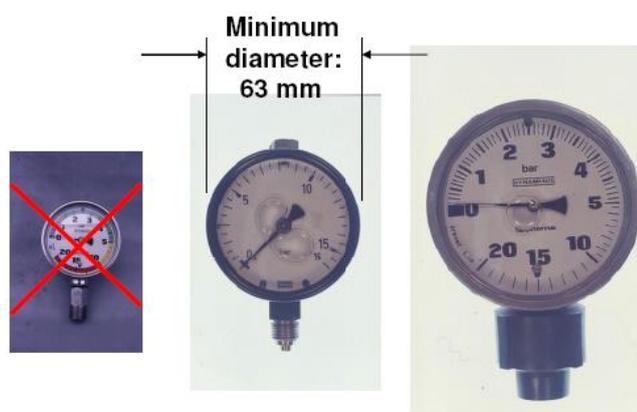
If there is an digital pressure indicator, this shall also be tested. In this case, method b. is preferred. In the other case method a. is preferred because the chance on measuring mistakes is the smallest and because most sprayers are not equipped with proper connections for connecting the reference pressure gauge directly to the sprayer.

Keep attention to a leak-free reassembling of the pressure gauge to the sprayer after testing.

5.5.2.4. Diameter analogue pressure indicator

For analogue pressure indicator the minimum diameter of the pressure gauge cases shall be 63 mm, except for those mounted on spray guns and lances which shall have a minimum diameter of 40 mm.

Example

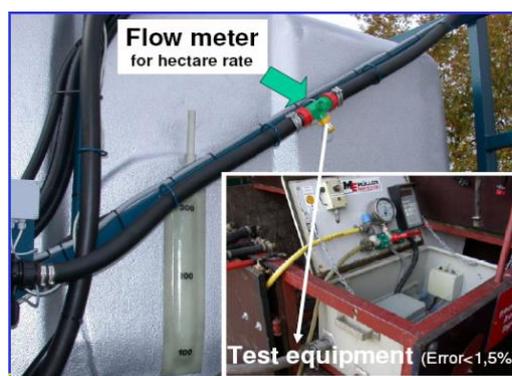


How to test

Measurement of the diameter including the body parts of the manometer. When the pressure gauge is mounted on the sprayer a pressure gauge with a diameter of 100 mm is preferred for better readability.

5.5.6. Other measuring devices

Measuring devices, especially flow meters and forward speed sensors (used for controlling the volume/hectare rate), shall measure within a maximum error of +/- 5 % of the value read on the reference instrument within the range of the measuring device.

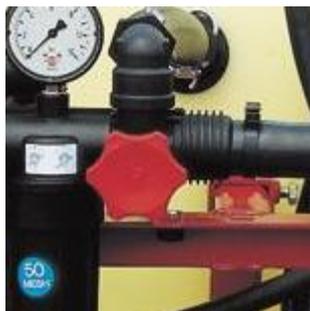


How to test

- Control measurement of flow meters.
- The control measurement of flow meters can be done in three ways:
 - Verification by nozzle flow rate measurement
 - The spray control shall be set on the correct PTO speed and at a pressure within the working range of the sprayer.
 - For a correct check of the flow meter, 3 measurements shall be done:
 - One at 30-50% of the full flow
 - One at 50-75% of the full flow
 - One at 100% of the full flow
 - For each measurement the average flow rate of the measurement of at least 5 nozzles shall be calculated, divided by then number of nozzles and compared with the flow show on the display of the spray computer.
 - The difference is maximum +/- 5% of the calculated flow.
 - Verification by installing a calibrated flow meter in the circuit
 - On the pump outlet side of the sprayer and as close as possible to the flow meter to be checked, a reference flow meter shall be installed
 - The spray control shall be set on the correct PTO speed and at a pressure within the working range of the sprayer.
 - For a correct check of the flow meter, 3 measurements shall be done:
 - One at 30-50% of the full flow
 - One at 50-75% of the full flow
 - One at 100% of the full flow
 - For each measurement, the measured value shown on the reference flow meter shall be compared with the flow show on the display of the spray computer.
 - The difference is maximum +/- 5% of the value read on the reference flow meter.
- Control measurement of speed sensors.
 - The actual forward speed shall be measured when driving with a constant speed which is the normal driving speed of the sprayer to be tested. The speed shall be calculated by measuring the time needed to drive a certain distance.
 - This calculated actual speed shall be compared to the forward speed shown on the spray computer.
 - The difference is maximum +/- 5% of the calculated forward speed.

4.5.4. Pressure adjusting devices

All devices for adjusting the pressure shall maintain a constant pressure with a tolerance of +/- 10% at constant setting and shall return within 10 seconds to the original working pressure +/- 10% after the sprayer has been switched off and on again.



How to test

Function test and measurement.

- During spraying at the normal working pressure, the pressure shown on the sprayer manometer must stay constant with a tolerance of +/-10%.
- When during spraying the sprayer has been switched off and on again, the original pressure must be achieved within 10 seconds (with a margin of +/- 10%).
- It must be possible to adjust the pressure with the pressure adjusting device, after adjusting the pressure must stay stable (with a margin of +/- 10%)

On the testing form:

Subject															
		No defects	Minor defects	Critical defects	Repaired	No defects	Minor defects	Critical defects	Repaired	No defects	Minor defects	Critical defects	Repaired		
5. Measuring systems	5.1 Function	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5.2 Leakages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5.3 Operation of controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5.4 Pressure gauge readability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5.5 Pressure gauge - marking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5.6 Pressure gauge diameter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5.7 Pressure gauge accuracy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5.8 Pressure gauge - steadiness of pointer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5.9 Other measuring devices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5.6. Lines (Pipes and hoses)

Lines (both pipes and hoses) shall not show excessive bending, corrosion and abrasion through contact with surrounding elements. Lines (both pipes and hoses) shall be free from defects such as excessive surface wear, cuts and cracks.

Example



How to test

Visible inspection of all hoses and pipes on the sprayer. These should not be bended so that the fluid will be blocked. Bended pipes and hoses, too small hoses or hoses what are inside blocked by rests of solid crop protection products will cause a pressure drop which will be visible on the distribution of the spray liquid.

Hoses and pipes which have defects such as excessive surface wear, cuts and cracks so that the woven fabric is visible have the chance that they will burst. They shall be replaced.

On testing form:

Subject										
		No defects	Critical defects	Repaired	No defects	Critical defects	Repaired	No defects	Critical defects	Repaired
6. Pipes and	6.1 Bending/abrasion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						

5.7. Filters

5.7.1 Presence and condition of the filters:

There shall be at least one filter on the pressure side of the pump and in case of positive displacement pumps also one filter on the suction side.

NOTE. Nozzle filters are not considered as pressure side filters.

The filter(s) shall be in good condition and the mesh size shall correspond to the nozzles fitted according to the instructions of nozzle manufacturers.

Example



How to test

Visible check and test. At least one filter should be present on the pressure side of the pump, nozzle filters are not considered as the pressure filter.

When the sprayer is equipped with a positive displacement pump there should also be a suction filter.

To check the condition of the filters, the filter insert shall be inspected. They have to be in good condition (no holes) and clean.

The mesh size of the filter shall be suitable to the nozzle size where the sprayer is equipped with.

Table 1 Relation between the nozzle size and the mesh size of the filters

<i>nozzle size</i>	<i>Suction filter</i>	<i>Pressure filter</i>	<i>nozzle filters</i>
0075 to 02	80	100	100
025 to 03	50	80	80 (50)
04 or bigger	30	80 (50)	50



5.7.2 Isolating device

It shall be possible, with the tank filled to its nominal volume, to clean filters without any spray liquid leaking out except for that which may be present in the filter casing and the suction lines.

Example



How to test

Functional test.

It must be possible to remove and clean the filters without spilling of spray liquid also when the spray liquid tank is filled up to his nominal volume. The only fluid what may leak is the amount that is collected in the filter casing and in the suction lines.

5.7.3 Filter inserts

Filter inserts shall be changeable.

Example



How to test

Functional test. The inserts of all filters (both pressure and suction filters) must be changeable for proper cleaning or replacing.

On testing form:

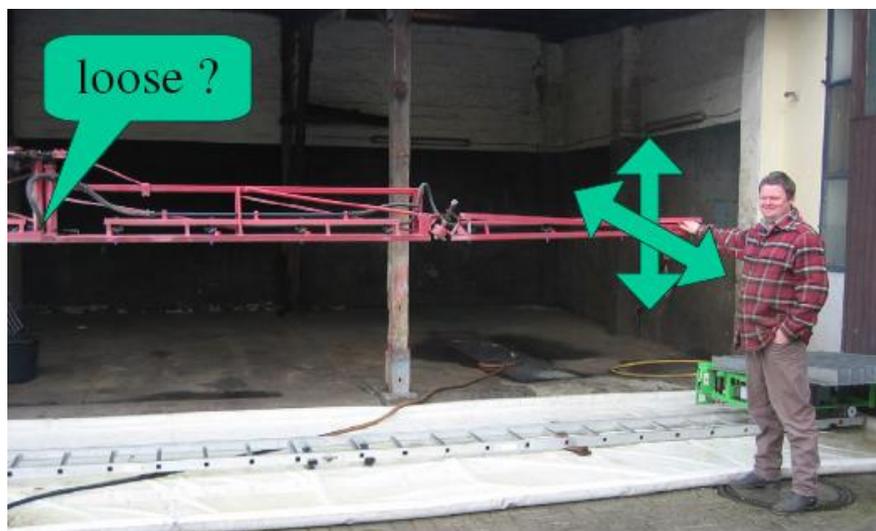
Subject		No defects	Critical defects	Repaired		No defects	Critical defects	Repaired		No defects	Critical defects	Repaired		
7.1	Filter presence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.2	Cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.3	Filters inserts changeability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5.8. Spray boom

5.8.1 Stability of the spray boom

- The boom shall be stable in all directions, i.e. not loose in any joints and not be bent.
- The right and the left parts of the boom shall be of the same length (except when the boom is intended for special function).

Example



How to test

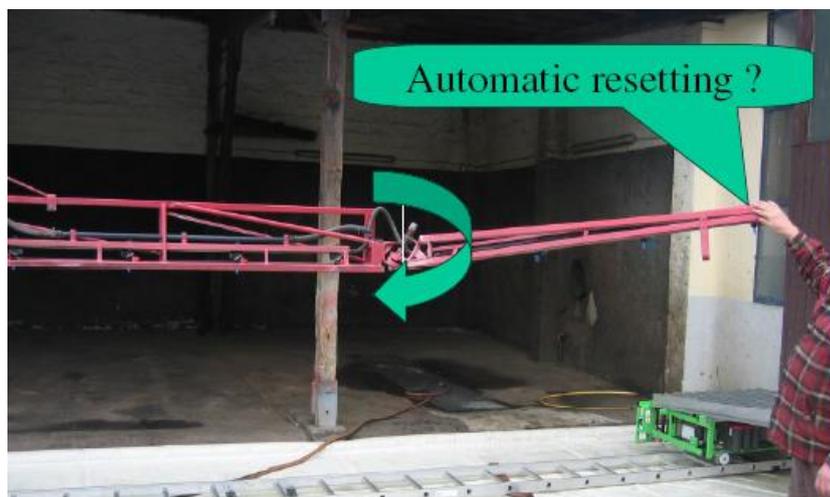
Functional inspection.

- Move the spray boom in horizontal and vertical direction. There should be no exceptional loose in any joints. The spray boom may also not be bent.
- The right and left part of the spray boom shall be of the same length.

5.8.2 Automatic resetting

When provided, the automatic resetting of booms shall operate to move backwards and/or forwards, in case of contact with obstacles.

Example



How to test

Function test.

Move the part of the spray boom in horizontal direction forward and back-ward.

The automatic resetting shall function and the boom part shall also move back in his original position.

5.8.3. Nozzle spacing/orientation

The nozzle spacing and their orientation shall be uniform along the boom.

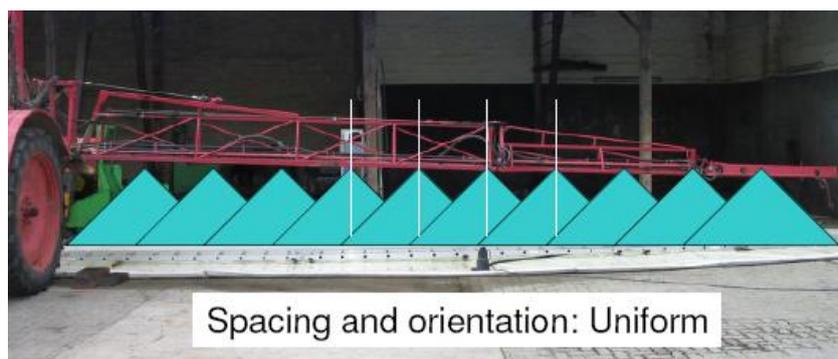
The nozzle spacing (adjacent nozzle center to center distance) shall be within $\pm 5\%$ of their nominal distance.

The verticality of the nozzle body shall be achieved with a maximum deviation of 10° .

In case of special design or applications (e.g. border spraying), nozzle body spacing, orientation and configuration shall correspond to the manufacturer's design specification.

It shall not be possible to modify unintentionally the position of the nozzles in working conditions, for example by folding/unfolding the boom.

Example



How to test

The distance between the nozzles on the boom shall be equal, for the whole boom, measure that distance, it shall be equal with a margin of $\pm 5\%$ of the nominal distance

The nozzle shall be mounted vertically, measure it, it shall be achieved with a margin of 10°

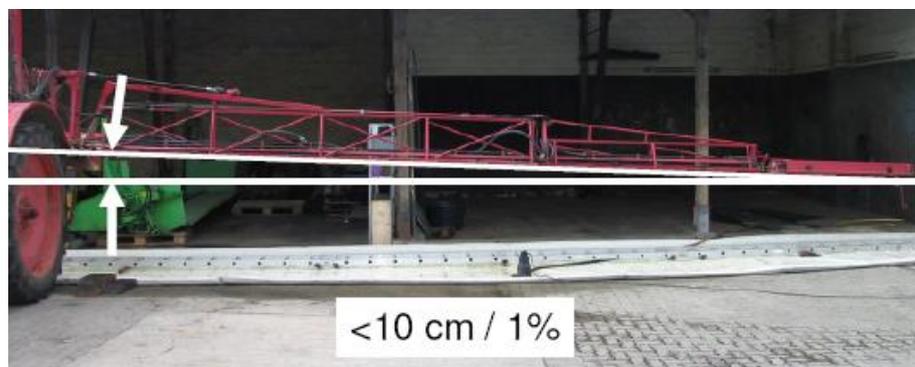
If the nozzle spacing is different because of special purpose, for example border nozzles or other special occasions, this is not valid.

5.8.4. Boom deformation

5.8.4.1. Vertical position

When measured stationary on a level surface, the distance between the lower edges of the nozzles and the surface shall not vary more than 10 cm or 0.5 % of the working width, whichever is the highest.

Example



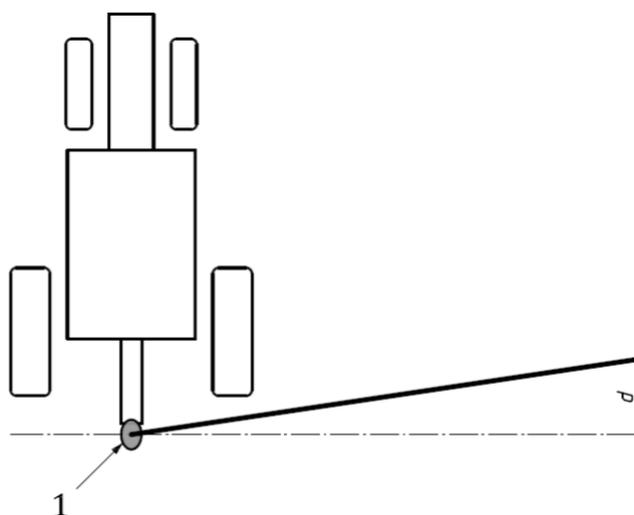
How to test

Place the sprayer on a level surface and measure the distances between the boom and the surface on different places.

- For spray booms with a working width of less than 20 meter is the maximum difference between the measured distances 10 cm.
- For sprayers with a working width of more than 20 meter, the maximum difference in measured distances is 10 cm.

5.8.4.2. Horizontal position

The boom shall not be bent in the horizontal plane: the maximum deformation d from the centre-frame to the boom end nozzle shall not exceed $\pm 2,5\%$ of the boom width.



Legenda:

- 1. Center of spray boom
- d. Maximum deviation relative to the center of the spray boom

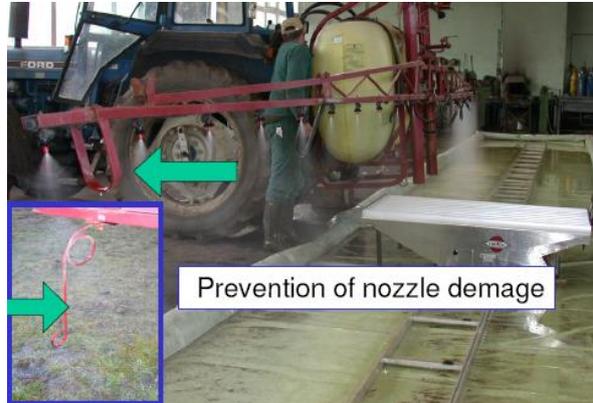
Test method:

Measurement of the deformation in the horizontal plane, the maximum distance d , between the center of the sprayer and the outer tip of the boom, shall be maximum 2,5% of the boom width.

5.8.5. Prevention form nozzle damage

Booms with a working width of 10 meter and more, shall have a device to prevent damage of the nozzles if the boom hits the ground.

Example



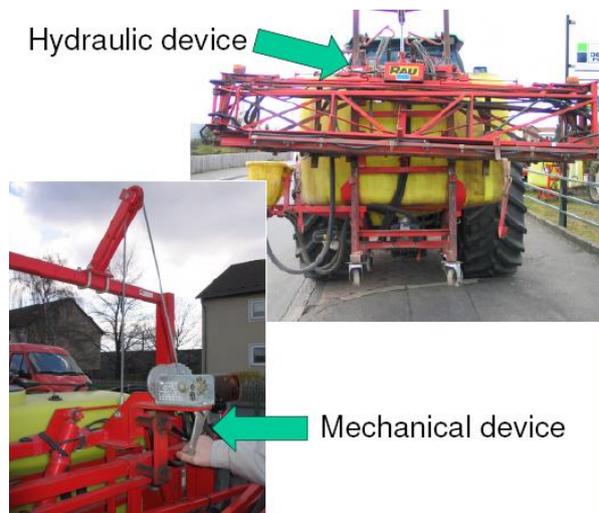
How to test

Visual inspection. If the working width of the spray boom is 10 meter or more, there shall be a unit which will prevent the nozzles for damage when the spray boom hits the ground.

5.8.6. Height adjustment

If the sprayer is equipped with a system for height adjustment of the spray boom, this device shall function.

Example



How to test

Function test and visual inspection. The height adjustment must function properly and safely. The height must stay constant while spraying. Keep special attention to the condition of the steel cable. Hydraulic cylinders may not leak.

5.8.7. Damping and slope adjustment

If the sprayer is equipped with devices for damping unintended boom movements, slope compensation systems and/or stabilization systems, this devices and systems shall function.

Example



How to test

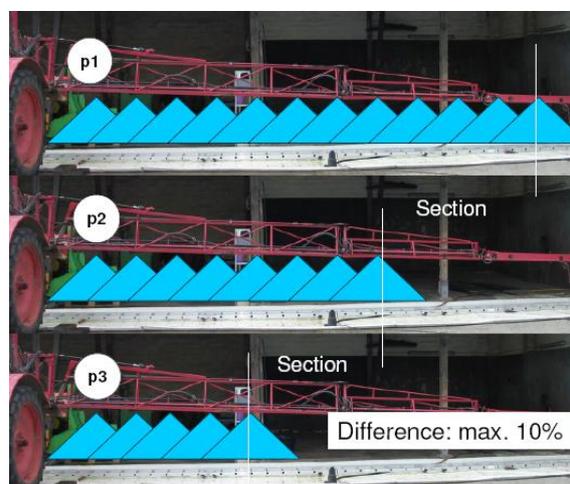
Function test and visual inspection. The suspension of the spray boom and the mechanism to keep the spray boom leveled must function smoothly. When moving the spray boom vertically, the boom must return to his original position. Items for damping boom movements must be in good condition (like springs, gas-filled dampers).

If the sprayer is equipped with a slope compensation mechanism, this mechanism must function reliable.

5.8.8. Compensative returns

If the sprayer is equipped with boom valves which can be set to return the same liquid volume to the tank when closed that would otherwise go through the nozzles on that boom section when the valve is open, than when measured at the inlet of each boom section or read on the sprayer pressure indicator, 10 seconds after a section has been closed, the pressure shall not vary more than 10 %, when the sections are closed one by one.

Example



How to test

Functional test, only when the sprayer is equipped with compensative returns.

While spraying with a pressure of 3 bar, close the sections one by one. The maximum difference in pressure seen on the sprayers pressure gauge is maximum + or - 0,3 bar (10%).

5.8.9. Pressure drop

The pressure drop between the point on the sprayer where the spray pressure is measured and the outermost end of each boom shall not exceed 10% (if a pattenator is used for measuring the cross-distribution, only one measurement at one outer end of the boom is required)

How to test

Functional test with measurement.

The test shall be carried out with the nozzle on the sprayer with the highest flow rate at a pressure in the middle of the working pressure range of the nozzle given by the nozzle manufacturer.

A calibrated reference spray nozzle shall be placed at nozzle at the outer end of the spray boom. While spraying on the above defined conditions, the pressure read on this reference manometer shall be compared with the spray manometer. The difference in pressure shall at maximum be 10%.

On testing form:

Subject															
		No defects	Minor defects	Critical defects	Repaired	No defects	Minor defects	Critical defects	Repaired	No defects	Minor defects	Critical defects	Repaired		
8. Spray boom	8.1 Stability/straightness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.2 Symmetry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.3 Automatic resetting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	8.4 Safely lockable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.5 Nozzie spacing/orientation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.6 Nozzie height (10 cm or 1 %)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	8.7 Sprayer contamination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.8 Prevention of nozzie damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.9 Boom sections control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	8.10 Height adjustment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.11 Damping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.12 Slope compensation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	8.13 Pressure variations at section inlets (< 10%)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										

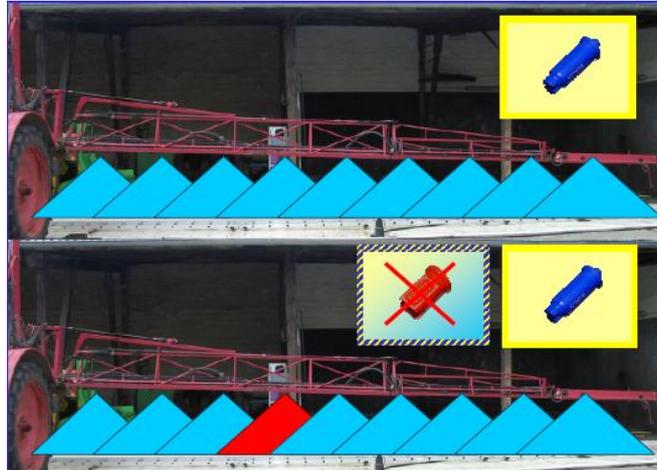
5.9. Nozzles

5.9.1 Identical nozzles

Text in the standard:

All nozzles fitted on the spray boom shall be identical (type, size, material and origin), except where they are intended for a special function for example the end nozzles for border spraying. Other components (nozzle filters, anti-drip devices) shall be equivalent all along the boom.

Example



How to test

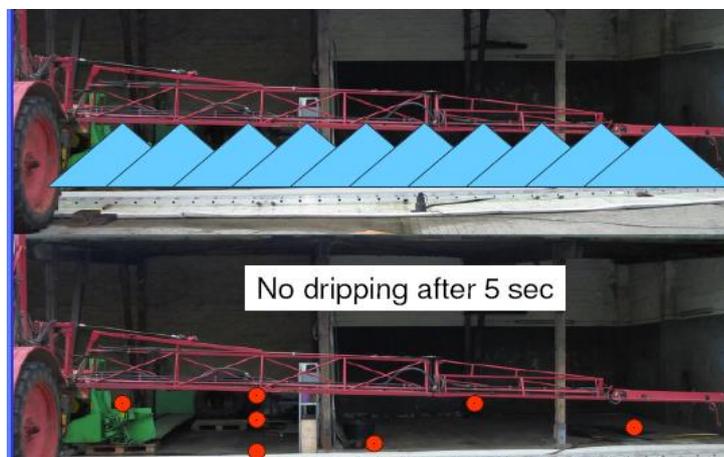
Visual inspection of all nozzles and other components what might have an influence on the spray distribution (like nozzle filters, section filters, anti-drip devices) along the spray boom. All items should be of the same type, size, material and origin.

5.9.2 Dripping of nozzles

Text in the standard

After being switched off, the nozzles shall not drip. 5 s after the spray jet has collapsed there shall be no continuous dripping.

Example



How to test

Function test and visual inspection. Stop the spraying and after maximum 5 seconds that the spray-jet collapse, all nozzles should stop spraying and continuous dripping.

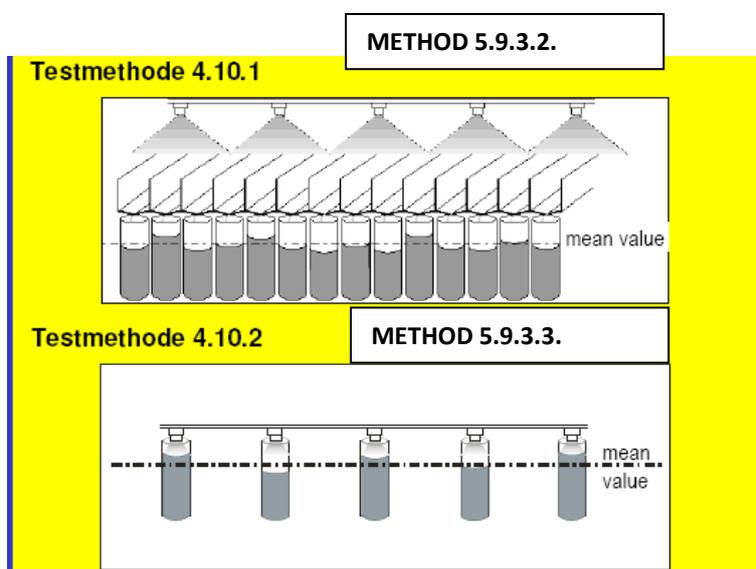
5.9.3 Transverse distribution

5.9.3.1. General

To measure the transverse distribution of the nozzles under a sprayer with a spray boom when the nozzles are used to form a uniform spray, there are two method to evaluate the transverse distribution.

The first is 5.9.3.2. where the transverse distribution is directly measured on a patternator and the results are evaluated. The second option is method 5.9.3.3., where the transverse distribution is measured on an indirect way. Everything what can be of influence on the transverse distribution is measured, and when everything is evaluated positive the assumption is that the transverse distribution is okay.

For other types of horizontal boom sprayers, like band sprayers where the intention is not to create a uniform spray pattern, there method 5.9.3.3. applies.



5.9.3.2. Transverse distribution measurement

Text in the standard:

Measurement on patternator

- a) The transverse distribution, within the total overlapped range, shall be uniform. The transverse distribution is evaluated on the basis of the coefficient of variation which shall not exceed 10 %; and
- b) the amount of liquid collected by each patternator groove within the overlapped range shall not deviate more than ± 20 % of the total mean value.

Example



How to test

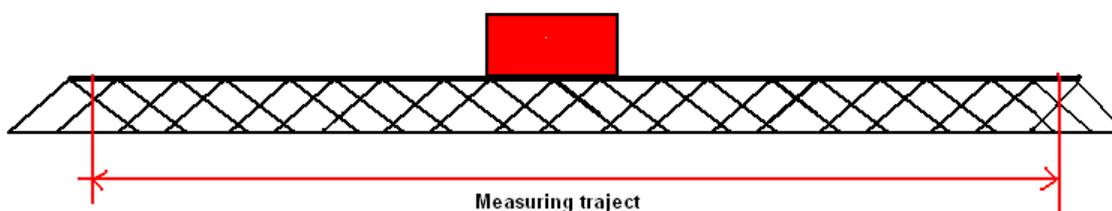
Measurement of the cross distribution with an electronic patternator or with a mechanical patternator. This measurement is very important because with this test the exact distribution of the crop protection products over the field or crop will be determined.

Important for a uniform execution of this test are:

1. test of the whole spray-boom
2. test with a correct testing height (depends on the top-angle of the nozzles)
3. test with a correct testing pressure (depends on the type of the nozzles, as determined by the manufacturer of the nozzles)

1. Test of the whole spray-boom

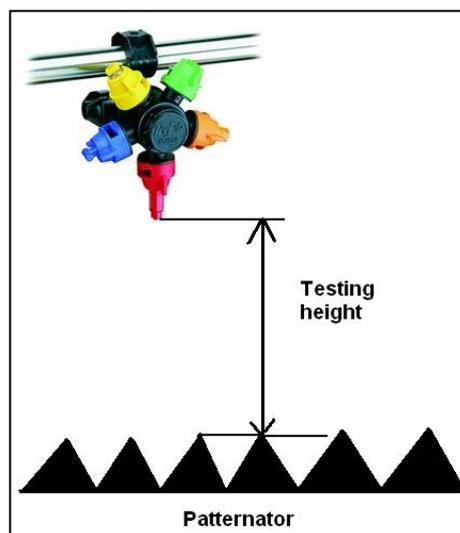
The part of the boom what will be judged is from the middle of the left two nozzles to the centre of the right two nozzles. In this area is a full overlap of the spray nozzles



2. Testing height

The correct height of the spray boom to the test patternator depends on the top angle of the nozzles what are on the machine. In the table are the correct testing heights for the different types. This is the distance measured from the nozzle tip to the patternator.

Spray angel nozzle	Testing height in cm at nozzle spacing of 50 cm
60°	85 - 95
80°	70 - 80
90°	70 - 80
110°	50 - 60
120°	45 - 55
Air/water flood jet nozzle	65 - 75



3. Testing pressure

The testing pressure depends on the type of nozzle. The testing pressure is the optimal pressure of the nozzle and is the average spraying pressure.

	Spraying area (bar)	standard test pressure (bar) for test cross distribution	Highest test pressure (bar) (during leaking test and testing agitation capacity)
Flat-fan nozzles	1 t/m 5	3	5
Hollow cone nozzles	2 t/m 5	3	5
LP-flat fan nozzles	1 t/m 2,5	2	2,5
Air-induction flat fan nozzles (Venturi nozzles)	2 t/m 6-8*	3-5*	6-8*
Air/water flood jet nozzles (Airtec/Airjet, etc)	1 t/m 4 (water) 0,75 t/m 1,5 (air)	2,5 - 3 (water) 1,0 (air)	4 (water) 1,5 (air)
Other nozzle type according to the prescription of the manufacturer			

* test pressure and maximum pressure are depended of the prescriptions of the manufacturer for use of applications in agricultural crops. The standard test pressure is the average of the lowest and highest spraying pressure as given by the manufacturer. The highest testing pressure is the pressure given by the manufacturer.



Nozzle	D [mm]	V [l/min]	l/h											
			5.0	6.0	7.0	8.0	10.0	12.0	14.0	16.0	18.0			
LU 120-01 (120 M)	1.5	0.26	27	36	46	42	34	28	24	21	19			
	2.0	0.32	37	48	59	49	38	32	27	24	21			
	3.0	0.48	54	72	89	68	51	43	36	31	27	24		
	4.0	0.64	72	96	118	90	68	57	48	41	36	31	27	24
5.0	0.80	90	120	147	112	84	70	59	50	43	36	31	27	24
6.0	0.96	108	144	176	134	100	84	71	60	51	43	36	31	27

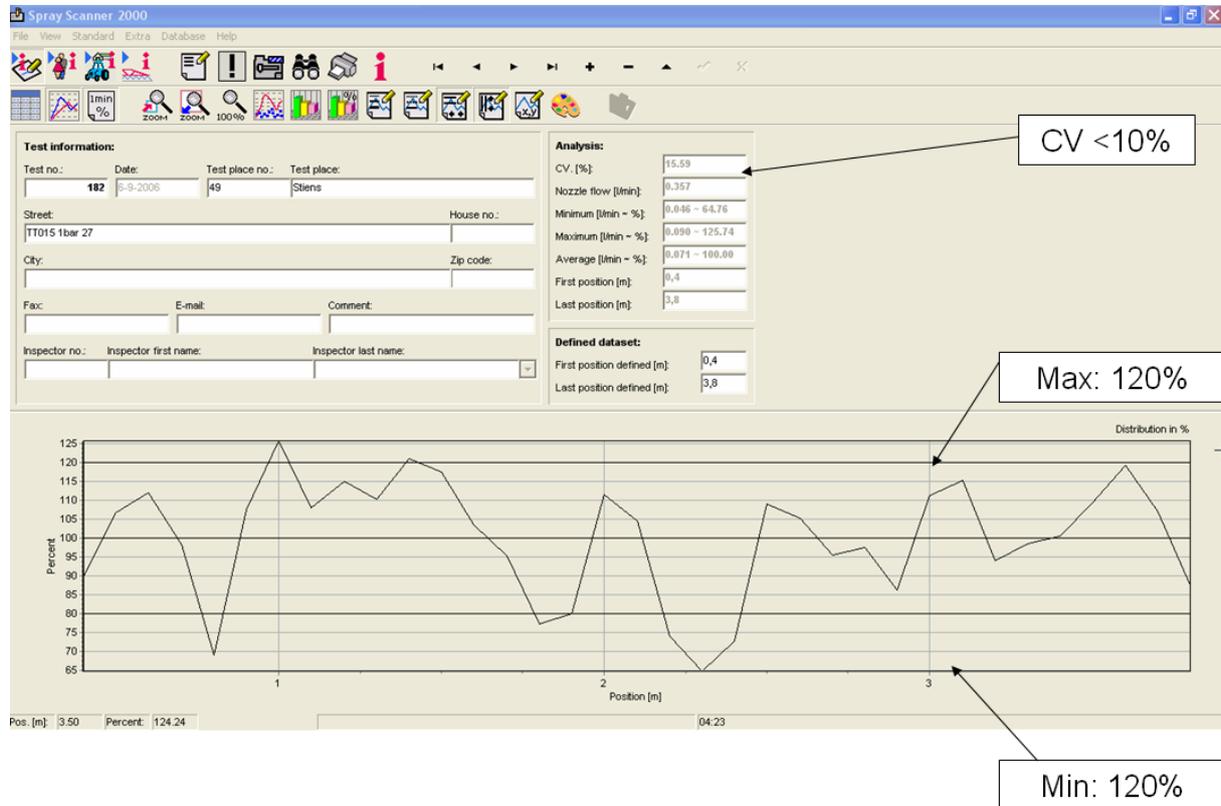
Nozzle	D [mm]	V [l/min]	l/h											
			5.0	6.0	7.0	8.0	10.0	12.0	14.0	16.0	18.0			
ID 90-01 (90 M)	1	0.10	94	76	61	47	47	39	33	29	26			
	2	0.45	130	90	77	54	54	45	39	34	30			
	3	0.51	122	102	87	61	61	51	44	38	34			
	4	0.55	132	110	94	66	66	55	47	41	37			
5	0.60	144	120	103	72	72	60	51	45	40				
6	0.64	154	126	110	77	77	64	55	48	43				

Measurement with electronic patternator:

For operation instructions of the patternator see the instructions of the manufacturer of this unit

The criteria for the cross distribution are:

- the Coefficient of Variation (CV) is < 10%
- the maximum difference with the mean value is + of – 20%



Measurement with mechanical patternator:



When using a mechanical groove patternator the Coefficient of Variation (CV) has to be calculated with this formula:

Figure 2 — The coefficient of variation (CV)

$$CV (\%) = \frac{S}{\bar{X}} \cdot 100 \tag{1}$$

$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2} \tag{2}$$

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i \tag{3}$$

where

X_i is the content of measuring glass

Example:

measuring glass	content (ml)	content (%)
1	460	121%
2	450	118%
3	420	110%
4	380	100%
5	380	100%
6	300	79%
7	400	105%
8	330	87%
9	340	89%
10	350	92%
Average	381	100%

CV (%) =	13,7%
----------	-------

5.9.3.3. Flow rate measurement

5.9.3.3.1. General

For sprayers with only one spray liquid output, with adjustable flow rate nozzle, the flow rate has to be measured but no indication of wear can be provided.

When evaluating the transverse distribution by measuring the flow rate of the nozzles, two things have to be measured:

- a. The flow rate of the nozzles (5.9.3.3.2. or 5.9.3.3.3)
- b. The pressure equilibrium in the spray boom. (5.9.3.3.4.)

Text in the standard:

5.9.3.3.2 Nominal nozzle flow rate known

The deviation of the flow rate of each nozzle of the same type and size shall not exceed

- $\pm 10\%$ of the nominal flow rate indicated by the nozzle manufacturer with a flow rate more than or equal to 1 l/min for the maximum working pressure given by the nozzle manufacturer, or
- $\pm 15\%$ of the nominal flow rate indicated by the nozzle manufacturer with a flow rate less than 1 l/min for the maximum working pressure given by the nozzle manufacturer.

5.9.3.3.3 Nominal nozzle flow rate unknown

The flow rate of a single nozzle shall not exceed $\pm 5\%$ of the average flow rate of the nozzles of the same type and size mounted on the sprayer.

5.9.3.3.4 Pressure distribution

When the nozzle flow rate is measured according to 5.9.3.3.2 or 5.9.3.3.3.:

- the pressure at each boom section inlet shall not exceed $\pm 10\%$ of the average pressure measured on all boom section inlets;
- the pressure at the inlet and outer end of each boom section shall not drop more than 10 %, when spraying with the largest nozzle set mounted on the sprayer.

a. Measuring nozzle flow rate:

Example:

Method 1: Nozzles mounted on the boom



Method 2: Nozzles removed from the boom



How to measure

How to operate the testing equipment depends on the manufacturer of the equipment and you can find in the instruction’s manual.

To perform the test, it is important to test at a uniform pressure. This testing pressure depends on the type of nozzle. The testing pressure is the optimal pressure of the nozzle and is the average spraying pressure.

	Spraying area (bar)	standard test pressure (bar) for test cross distribution	Highest test pressure (bar) (during leaking test and testing agitation capacity)
Flat-fan nozzles	1 t/m 5	3	5
Hollow cone nozzles	2 t/m 5	3	5
LP-flat fan nozzles	1 t/m 2,5	2	2,5
Air-induction flat fan nozzles (Venturi nozzles)	2 t/m 6-8*	3-5*	6-8*
Air/water flood jet nozzles (Airtec/Airjet, etc)	1 t/m 4 (water) 0,75 t/m 1,5 (air)	2,5 - 3 (water) 1,0 (air)	4 (water) 1,5 (air)
Other nozzle type according to the prescription of the manufacturer			

* test pressure and maximum pressure are depended of the prescriptions of the manufacturer for use of applications in agricultural crops. The standard test pressure is the average of the lowest and highest spraying pressure as given by the manufacturer. The highest testing pressure is the pressure given by the manufacturer.



V/min	l/ha									
	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	18.0	20.0
1.5	0.38	0.7	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8
2.0	0.52	1.0	1.3	1.8	2.4	3.0	3.6	4.2	4.8	5.4
2.5	0.65	1.3	1.7	2.3	3.0	3.6	4.2	4.8	5.4	6.0
3.0	0.78	1.6	2.1	2.8	3.6	4.4	5.2	6.0	6.8	7.6
4.0	1.04	2.1	2.8	3.6	4.4	5.2	6.0	6.8	7.6	8.4
4.5	1.15	2.3	3.0	3.8	4.6	5.4	6.2	7.0	7.8	8.6
5.0	1.26	2.5	3.3	4.2	5.1	6.0	6.9	7.8	8.7	9.6



V/min	l/ha									
	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0	18.0	20.0
3	0.38	0.7	1.0	1.4	1.8	2.2	2.6	3.0	3.4	3.8
4	0.52	1.0	1.3	1.8	2.4	3.0	3.6	4.2	4.8	5.4
5	0.65	1.3	1.7	2.3	3.0	3.6	4.2	4.8	5.4	6.0
6	0.78	1.6	2.1	2.8	3.6	4.4	5.2	6.0	6.8	7.6
7	0.91	1.8	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0
8	1.04	2.1	2.8	3.6	4.4	5.2	6.0	6.8	7.6	8.4

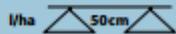
Evaluation of the outcomes of the measurements:

All measured values shall be within a range of +/- 10% of the nominal flow rate as described by the nozzle manufacturer.

For example:

For a sprayer equipped with a set of Teejet AIXR 110-04 nozzles, measured at a pressure of 3 bar.

Nominal flow according to Teejet:

bar	DROPSIZE	CAPACITY ONE NOZZLE IN l/min	i/ha 												
			4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
1.0	UC	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
2.0	XC	1.29	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.2
3.0	VC	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
4.0	VC	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
5.0	C	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
6.0	C	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5

The value according to Teejet is 1,58 L/min

-10% = 1,42 l/min

+10% = 1,74 l/min

All measured values must be within this range.

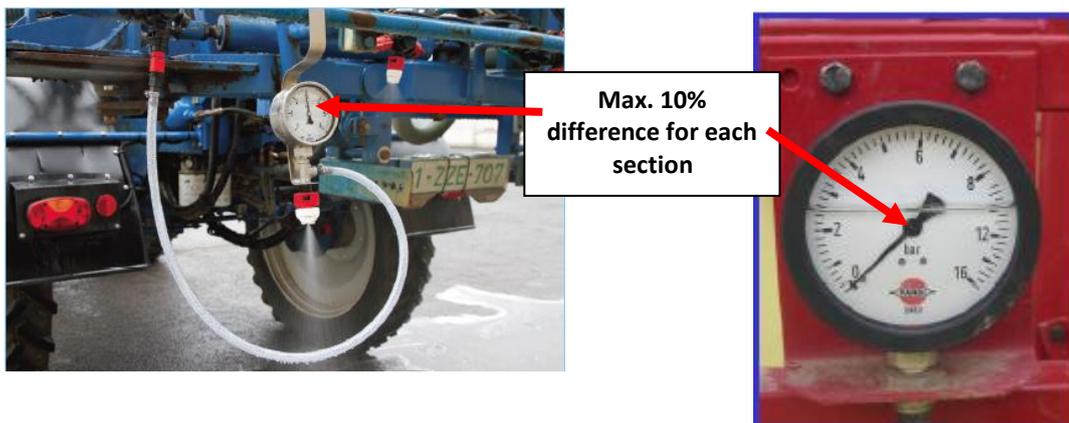
b. Measuring pressure drop:

Text in the standard:

10.2.2 The pressure drop between the measuring point for pressure on the sprayer and the end of each boom section width shall not exceed 10% of the pressure shown on the pressure gauge.

Example:

Measuring pressure at the end of each section of the boom < = > Compare to sprayer manometer



How to measure

Connect a calibrated test manometer to the last nozzle of a section, spray with two different pressures. The difference between the manometer on the sprayer and the manometer on the last nozzle on the section shall not be greater than 10%.

Repeat this for all sections.

All sections shall be within these limits.

5.10 Blower

5.10.1 Switching off

Text in the standard:

If the blower can be switched off separately from other driven parts of the sprayer, the switching off system shall function.

5.10.2 Adjustability

Text in the standard:

Adjustable air guide plates on the blower and on an additional blower casing shall function.

5.11 Spray gun and lances

5.11.1 Trigger

Text in the standard:

The trigger shall function. It shall be lockable in the closed position and not lockable in the open position.

The opening and closing system installed on the gun shall have a quick stop and opening. There shall be no continuous dripping when the trigger is "off" (closed position).

5.11.2 Adjustment of flow rate and angle

Text in the standard:

If the flow rate and/or spray angle of the spray gun is adjustable, the adjustment device shall function.

6.2 Testing requirements for air-assisted sprayers according EN-ISO 16122:3

6.2.1. Leaks and dripping

See chapter 5, item 5.2.1.

6.2.2. Pump(s)

See chapter 5, item 5.2.2.

6.2.3. Agitation

See chapter 5, item 5.2.3.

6.2.4. Spray Liquid Tank

See chapter 5, item 5.2.4.

6.2.5. Measuring systems, controls and regulation systems

See chapter 5, item 5.2.5.

6.2.6. Pipes and hoses

See chapter 5, item 5.2.6.

6.2.7. Filters

See chapter 5, item 5.2.7

6.2.8. Nozzles

6.2.8.1. Symmetry

Text in the standard:

The nozzle arrangement (e.g. nozzle types, sizes, material and production by the same manufacturer) shall be symmetrical on the left- and right-hand sides, except where they are intended for a special function (e.g. spraying on one side, fitting of nozzles to compensate the blow dissymmetry, etc.).



How to test

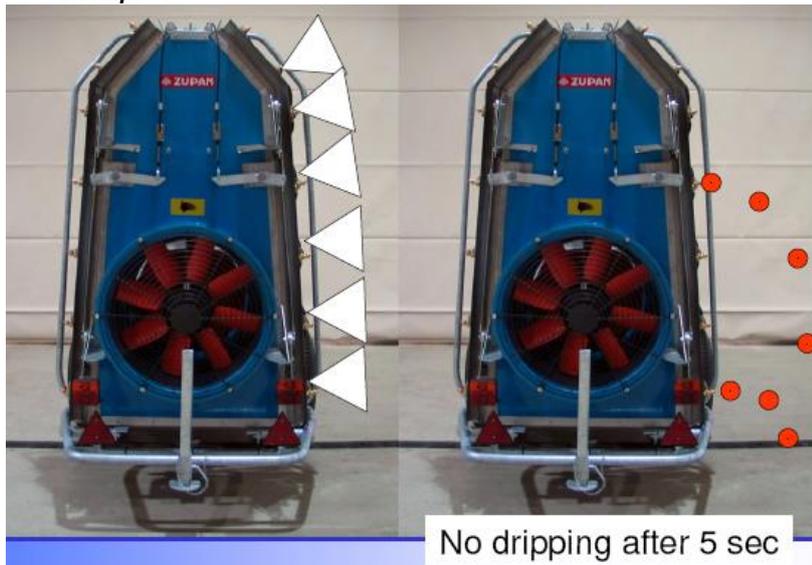
Visual check. The nozzle sets have to be of the same size, type, material or origin. Except that for a good distribution (for compensation of the blower dissymmetry) are nozzle sizes are needed to compensate this.

6.2.8.2. Dripping

Text in the standard:

After being switched off, the nozzles shall be no continuous dripping. 5 s after the spray jet has collapsed there shall be no dripping.

Example



How to test

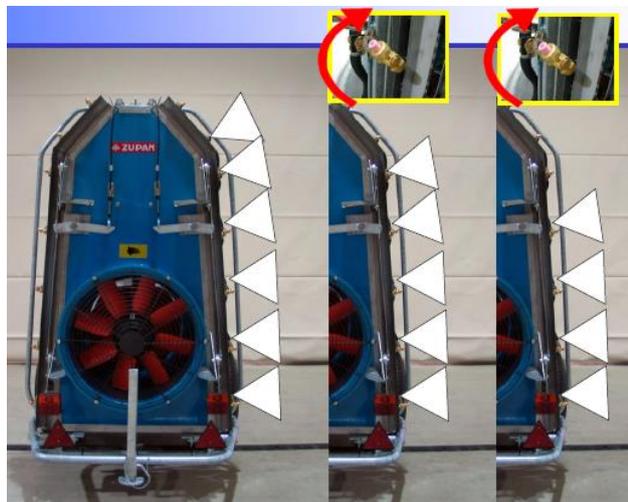
Function test and visual inspection. Stop the spraying and after maximum 5 seconds that the spray-jet collapse, all nozzles should stop spraying and dripping.

6.8.3. Individual switching off

Text in the standard:

If provided, the system for switching on and off each nozzle separately shall function. In the case of multi-head nozzles, this requirement applies to each multi-head nozzle.

Example



How to test

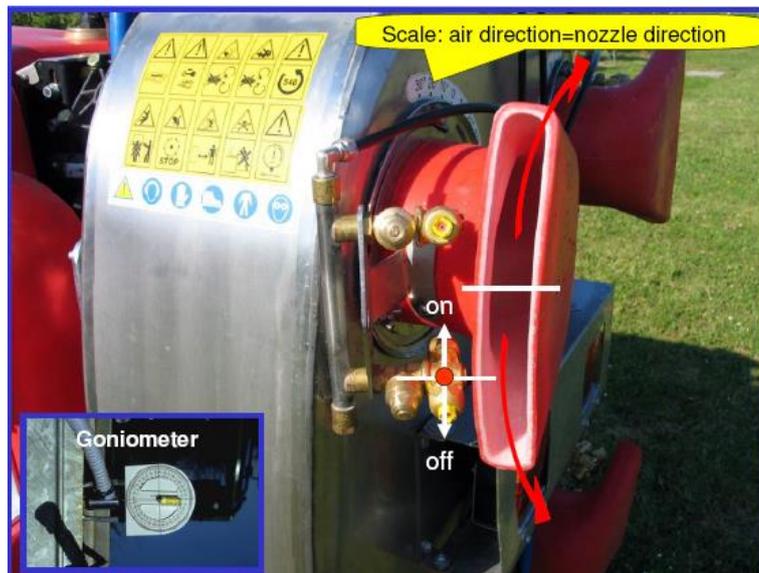
Visual check and function test. For making a good adaption to different tree sizes and shapes it must be possible to switch off all nozzles separately.

6.2.8.5. Adjustability of nozzles

Text in the standard:

It shall be possible to adjust the position of the nozzles in a symmetric and reproducible manner.

Example



How to test

Visual check and function test. For making a good adoption to different tree sizes and shapes it must be possible to change the position of the nozzles in a symmetric and reproducible manner.

6.2.9. Pressure drop

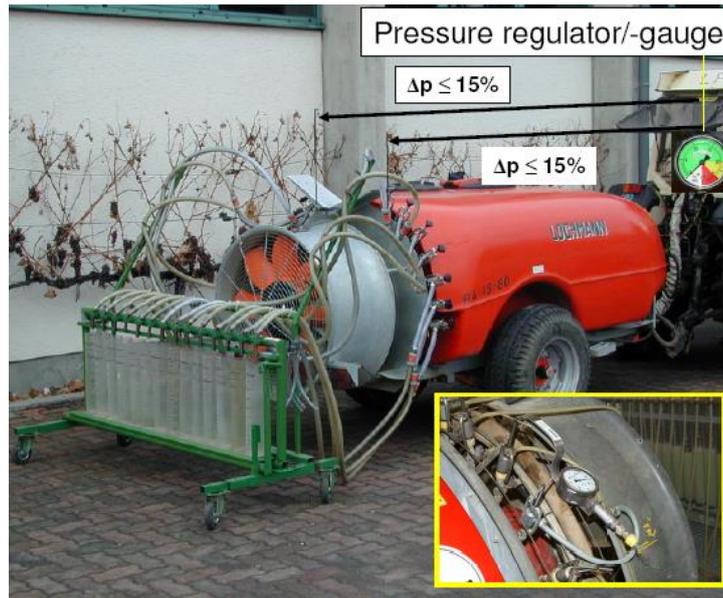
6.2.9.1 General

Text in the standard:

The pressure drop between the measuring point for pressure on the sprayer and pressure measured at the nozzle which is the furthest from the feeding point of the spray line, shall not exceed 15 % of the pressure shown on the pressure indicator.

This pressure drop requirement does not apply to spray guns with pipes longer than 5 m.

Example



How to test

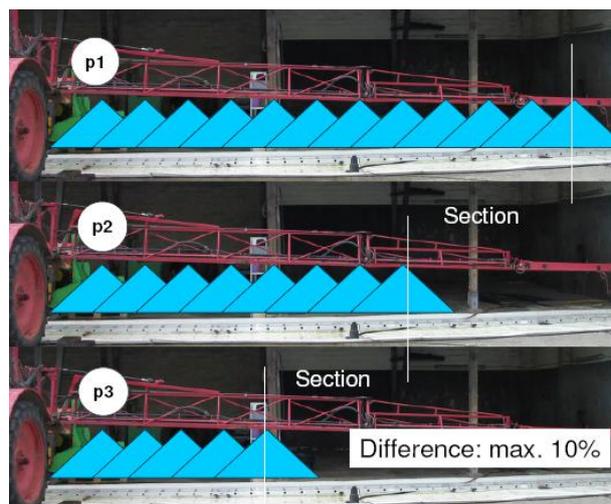
Measurement of the pressure difference. Connect an extra accurate pressure gauge at the inlet of the section. Compare the measured value with the value on the sprayer pressure gauge. The maximum difference is +/- 15%. This should be done for both the left and right side.

6.2.9.2 Compensative returns

Text in the standard:

When measured at the inlet of each section or read on the spray pressure indicator, 10 s after a section has been closed, the pressure shall not vary more than 10 %, when the sections are closed one by one. This requirement is only applicable for sprayer equipped with specific devices for compensative returns in the tank.

Example



How to test

Functional test, only when the sprayer is equipped with compensative returns.

While spraying with a pressure of 10 bar, close the sections one by one. The maximum difference in pressure seen on the sprayers pressure gauge is maximum + or - 0,3 bar (10%).

6.2.10. Distribution

6.2.10.1 Uniformity of spray-jet

Text in the standard:

With the blower switched off in the case of hydraulic nozzles and switched on in the case of other nozzles (for example pneumatic nozzles), each nozzle shall form a uniform spray jet (e.g. uniform shape, homogeneous spray).

Example



How to test

Visual check and function test. Check the spray-jet of all nozzles while spraying, clean or change blocked or damaged nozzle before measuring the nozzle output.

6.10. Flow rate measurement

6.10.1. General

For sprayers with only one spray liquid output, with adjustable flow rate nozzle, the flow rate has to be measured but no indication of wear can be provided.

Text in the standard:

6.10.2. Nominal nozzle flow rate known

The deviation of the flow rate of each nozzle of the same type and size shall not exceed — ± 15 % of the nominal flow rate indicated by the nozzle manufacturer for the maximum working pressure given by the nozzle manufacturer

6.10.3. Nominal nozzle flow rate unknown

The flow rate of a single nozzle shall not exceed $\pm 5\%$ of the average flow rate of the nozzles of the same type and size mounted on the sprayer.

c. Measuring nozzle flow rate:

Example:

Method 1: Nozzles mounted on the sprayer



Method 2: Nozzles removed from the sprayer



How to measure

How to operate the testing equipment depends on the manufacturer of the equipment and you can find in the instruction's manual.

To perform the test, it is important to test at a uniform pressure. This testing pressure depends on the type of nozzle. The testing pressure is the optimal pressure of the nozzle and is the average spraying pressure.

	Spraying area (bar)	standard test pressure (bar) for test cross distribution	Highest test pressure (bar) (during leaking test and testing agitation capacity)
Flat-fan nozzles	1 t/m 5	3	5
Hollow cone nozzles	2 t/m 5	3	5
LP-flat fan nozzles	1 t/m 2,5	2	2,5
Air-induction flat fan nozzles (Venturi nozzles)	2 t/m 6-8*	3-5*	6-8*
Air/water flood jet nozzles (Airtec/Airjet, etc)	1 t/m 4 (water) 0,75 t/m 1,5 (air)	2,5 - 3 (water) 1,0 (air)	4 (water) 1,5 (air)
Other nozzle type according to the prescription of the manufacturer			

* test pressure and maximum pressure are depended of the prescriptions of the manufacturer for use of applications in agricultural crops. The standard test pressure is the average of the lowest and highest spraying pressure as given by the manufacturer. The highest testing pressure is the pressure given by the manufacturer.



Nozzle	Drop (mm)	V/min	l/ha											
			6.0 km/h	8.0 km/h	10 km/h	12.0 km/h	14.0 km/h	16.0 km/h	18.0 km/h	20 km/h	25 km/h	30 km/h		
LU 90-01 120-01 (W M)	1.5	0.38	67	56	48	42	38	34	31	28	25	23	21	19
	2.0	0.50	77	64	55	48	43	39	35	32	29	27	24	21
	3.0	0.75	86	72	62	54	49	45	41	37	34	31	28	24
	4.0	1.00	94	78	67	59	53	49	45	41	38	35	32	28
	5.0	1.25	101	84	72	63	56	51	47	43	40	37	34	30



Nozzle	Drop (mm)	V/min	l/ha											
			6.0 km/h	8.0 km/h	10 km/h	12.0 km/h	14.0 km/h	16.0 km/h	18.0 km/h	20 km/h	25 km/h	30 km/h		
ID 90-01 120-01 (W M)	1.5	0.30	64	53	45	40	36	33	30	27	25	23	21	19
	2.0	0.40	70	58	49	44	40	37	34	31	28	26	23	20
	3.0	0.60	76	63	53	48	44	40	37	34	31	28	25	22
	4.0	0.80	81	67	57	52	48	44	41	38	35	32	29	26
	5.0	1.00	86	72	61	56	52	48	45	42	39	36	33	30

Evaluation of the outcomes of the measurements:

All measured values shall be within a range of +/- 10% of the nominal flow rate as described by the nozzle manufacturer.

For example:

For a sprayer equipped with a set of Teejet AIXR 110-04 nozzles, measured at a pressure of 3 bar.

Nominal flow according to Teejet:

Nozzle	bar	Drop Size	CAPACITY ONE NOZZLE IN l/min	l/ha Δ 50cm												
				4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
AIXR11004 (50)	1.0	UC	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	2.0	XC	1.79	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.7
	3.0	VC	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	VC	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	C	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
	6.0	C	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5

The value according to Teejet is 1,58 L/min

-10% = 1,42 l/min

+10% = 1,74 l/min

All measured values must be within this range.

d. Measuring pressure drop:

Text in the standard:

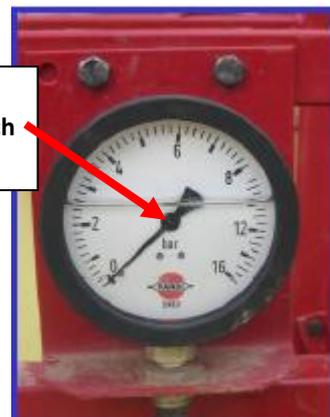
10.2.3 The pressure drop between the measuring point for pressure on the sprayer and the end of each boom section width shall not exceed 10% of the pressure shown on the pressure gauge.

Example:

Measuring pressure at the end of each section of the boom <=> Compare to sprayer manometer



Max. 10% difference for each section



How to measure

Connect a calibrated test manometer to the last nozzle of a section, spray with two different pressures. The difference between the manometer on the sprayer and the manometer on the last nozzle on the section shall not be greater than 10%.

Repeat this for all sections.

All sections shall be within these limits.

6.10.3.3 Optional vertical distribution information

In order to provide the owner/operator with further information in addition to 6.10.1 and 6.10.3.1 to 6.10.3.2, the vertical spray distribution information may be provided for example by measurement, using a vertical patternator; or by other visualization means.

NOTE Test method and vertical patternator specifications are still under development.

6.11. Blower

Text in the standard:

Adjustable air guide plates on the blower and on an additional blower casing shall function properly

Example



How to test

Function test. Test the function and adjustability of the guide blades for the air.

6.12. Spray gun and lances

6.11.1 Trigger

Text in the standard:

The trigger shall function. It shall be lockable in the closed position and not lockable in the open position. The opening and closing system installed on the gun shall have a quick stop and opening. There shall be no continuous dripping when the trigger is "off" (closed position).

6.11.2 Adjustment of flow rate and angle

Text in the standard:

If the flow rate and/or spray angle of the spray gun is adjustable, the adjustment device shall function.

7. Test report

On the testing form all relevant information about the sprayer and the performed test is summarized. Before starting the inspection, the header of the testing report has to be filled in:

- Identification testing station
- Data of the owner of the sprayer
- Identification of the machine
- Equipment of the machine

Testing station:	nr.:	TEST REPORT for the inspection of field crop sprayers According to EN-13790(1) Label nr.: Date of inspection: ... - ... -												
Owner of sprayer:		Machine identification:												
Name:		Manufacturer:												
Address:		Type:												
Postal code:		Constr. Year: Serial-No.:												
Place:		<input type="checkbox"/> Mounted <input type="checkbox"/> Trailed <input type="checkbox"/> Self-Propelled												
		Owned by: <input type="checkbox"/> Farmer <input type="checkbox"/> Contractor <input type="checkbox"/> Machine ring												
Remarks, minor defects:		Machine equipped with: (data and test values)												
		Tank: capacity: l												
		Pump: Type: <input type="checkbox"/> Piston Capacity: l/min												
		<input type="checkbox"/> Diaphragm at pressure: bar												
		<input type="checkbox"/>												
		Agitation: <input type="checkbox"/> Hydraulic <input type="checkbox"/> mechanic <input type="checkbox"/> other <input type="checkbox"/> additional agitation pump												
		Spray boom: Working width: m with sections												
		Nozzles:												
		Manufacturer: Type of nozzles: Number: Coefficient of Variation												
	 %												
	 %												
Subject		No defects	Minor defects	Critical defects	Repaired		No defects	Minor defects	Critical defects	Repaired		No defects	Minor defects	Repaired

The rest of the form will be filled in during the inspection.

The number in this manual correspond with the numbers on the testing form. For each item there is a choice to fill in:

- no defect
- minor defects
- critical defects
- repaired.

A machine can only be approved if all minor or critical defects are repaired.

7. Approval of a machine

A machine can only be approved if all minor or critical defects are repaired. If the machine is approved an inspection sticker can be placed on the machine:



On the testing form the number of the sticker has to filled in:

Testing station:	nr.:	TEST REPORT for the inspection of field crop sprayers According to EN-13790(1) Label nr.:
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After approval the test operator has to sign the form and hand it over to the farmer:

Result of the inspection:	Label <input type="checkbox"/> Yes <input type="checkbox"/> No	Signature inspector:
----------------------------------	--	----------------------

8. Test equipment

8.1. Pump capacity measurement

a) The error of the flowmeter shall not exceed 2 % of the measured value when the capacity of the pump is $> 100 \text{ l}$ and $2 \text{ l}/\text{min}$ when the capacity of the pump is $< 100 \text{ l}$. The flow shall be measured at free outlet and at one pressure between 8 bar and 10 bar, or if lower at the highest permitted working pressure for the pump

b) On sprayers not fitted with a test adapter or for pumps for which the maximum working pressure is not known, a calibration pressure gauge shall be placed at an end nozzle and the maximum working pressure recommended by the sprayer or the nozzle manufacturer during test shall be established



8.2 Verification of the sprayers pressure gauges

Specifications of pressure indicators used for verification

Analogue pressure gauges used for testing shall have a minimum diameter of 100 mm. Other minimum requirements on pressure gauges used for testing are given in Table 1.



Table 1 - Characteristics of pressure gauges used for testing (in accordance with EN 837-1)

Pressure range p bar	Scale unit max. bar	Accuracy bar	Class required	Scale end value Bar
$0 < p < 6$	0,1	0,1	1,6 1,0 0,6	6 10 16
$6 < p < 16$	0,2	0,25	1,6 1,0	16 25
$p > 16$	1,0	1,0	2,5 1,6 1,0	40 60 100

The pressure gauge shall be checked at least once a year.

Verification method of the sprayer pressure gauge

The sprayers pressure gauge shall be tested on the sprayer or on a test bench. Measurements shall be done with increasing and decreasing pressures respectively.

8.3 Flow meters for controlling the volume/hectare rate

The error of the measuring instruments in the test equipment shall not exceed 1,5 % of the measured value.

8.4 Measurement of the uniformity of the transverse volume distribution with a patternator

A patternator with grooves 100 mm wide and at least 80 mm deep measured as a distance between the top and the bottom of the groove shall be used to measure the uniformity of the transverse volume distribution.



Groove patternator shall be at least 1,5 m long. The groove width shall be adhered to with a tolerance of $\pm 2,5$ mm. Prior to the start of the test, the grooves to be used shall be checked by suitable means such as a pattern to see whether the above tolerance limits are adhered to. The graduated cylinders shall be of the same type and size and have a capacity of at least of 500 ml. Scale graduation shall be a maximum of 10 ml. The error shall not be greater than 10 ml or 2 % of the measured value.



The groove width of patternator working in steps with electronic data sampling (e.g. scanners) shall correspond to the mentioned dimensions. The tolerance is ± 1 mm. When passing the measuring track, the positioning in the single steps shall be completed with an accuracy of ± 20 mm. The measuring error of the flow volume of the single grooves at a flow volume of 300 ml/min shall be less than 4 %. The instruction handbook shall give information on how to adjust the patternator.

8.5 Measuring nozzle output

The nozzle output shall be measured at a reference pressure given by the nozzle manufacturer with the nozzles fitted on the machine. There shall be a leak free connection between the nozzle and the measuring device. The measuring error shall not exceed 2,5 % of the measured value. This means that error of the measuring glasses should not exceed the 2,5% of the measured volume. If electronic devices are used, a accuracy of 2,5% of the measured value is needed.



8.6 Measurement of the pressure variation when the sections are closed

A standard pressure gauge shall be located at the same place as a nozzle at the inlet of the section. The variation of the value indicated by the standard pressure gauge is observed when the sections are closed one by one.

8.7 Other test facilities

Tachometer (P.T.O), measuring tape (nozzle spacing and height), stop watch (flow rate, distribution), measuring cylinder (with measuring range 2 l, scale division 20 ml, error 20 ml) or flow meter (nozzle output) and air pressure gauge (pressure pulsation damper).



8.8 Weather influence

Provisions shall be taken to avoid the results of the measurements being influenced by climatic conditions. Patternators of different types can be used, if at least the same measuring results and accuracy is achieved.

The size of the test bench shall be suited to the size of the boom to be tested and to the type of spraying and also to ensure that the overlapped range is covered completely.