Better Training for Safer Food
Initiative

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Safe use – application equipment

Lecture 4

Consumers, Health And Food Executive Agency

European Commission

Presentation Outline

- **Use of plant protection product application equipment and its maintenance, required technical checks of sprayers, ways to improve spray quality.**
- **Consideration of available and new standards for machinery inspection.**
- **Preparing plant protection product application equipment for work, including calibration, and operation with minimum risks.**
- **Technical check of sprayers, calibration of plant protection product application equipment, ways to improve application quality.**

European Commission

European Standard EN 13790 Part 1: Field crop sprayers

The implementation of the EN 13790: The Greek experience

<u>My scope is to show you as many pictures as I can.</u>

European Standard EN 13790
Part 1: Field crop sprayers

……..the starting point for sprayer inspection in Europe

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

However, there are three main arguments for the inspection:

- test operator safety
- less potential risk of environmental contamination by crop protection products
- good control of the pest with the minimum possible input of crop protection product.

The European Standard EN 13790 consists of the following Parts, under the general title Agricultural machinery — Sprayers - Inspection of sprayers in use:

- Part 1: Field crop sprayers

- Part 2: Air-assisted sprayers for bush and tree crops

The European Standard EN 13790 specifies the requirements and methods of their verification for the inspection of sprayers in use. It relates mainly to the condition of the sprayer in respect of safety hazards for the test operator, the potential risk of environmental contamination and opportunities to achieve good application.

The compliance with the requirements defined in the following clauses shall be checked by:

--inspection,
--function tests and
--measurements.

Agricultural machinery - Sprayers - Inspection of sprayers in use - Part 1: Field crop sprayers

Matériels agricole - Pulvérisateurs - Contrôle des pulvérisateurs en service - Partie 1: Pulvérisateurs pour cultures basses

Landmaschinen - Pflanzenschutzgeräte - Prüfung von in Gebrauch befindlichen Pflanzenschutzgeräten - Teil 1: Feldspritzgeräte

In order to use crop protection products in agricultural production in Europe safely, it is necessary to define the requirements and test methods for sprayers in use. This is a relevant step after having standardized the requirements for new equipment, in respect of safety hazards (see EN 907) and potential risks of environmental contamination (see EN 12761 Parts 1 to 3).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

European Commission

Introduction

Standardising the requirements and methods for inspection of sprayers in use, takes into consideration not only the original performance of the spraying equipment, but also its use, care and maintenance. This is the logical link between new equipment of good quality and well educated and concerned users.

The inspection of sprayers in use can be done on a voluntary or mandatory basis. In both cases further official or legal specifications are necessary, e.g. on the execution management of the inspection, which organisations are authorised to carry out the inspection, time intervals between inspections etc... As the specifications of this European Standard are based on EN 907 and EN 12761, it may be the case that sprayers in use which were produced before EN 907 and EN 12761 came into force do not fulfil all the specifications given in this European Standard.

3 Inspection

The compliance with the requirements defined in the following clauses shall be checked by inspection, function tests and measurements.

NOTE Some of the tests specified in this standard involve processes which could lead to a hazardous situation. Any person performing tests in accordance with this standard should be appropriately trained in the type of work to be carried out. All national regulatory conditions and health and safety requirements should be followed.

4 Requirements and method of verification

4.1 Power transmission parts

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

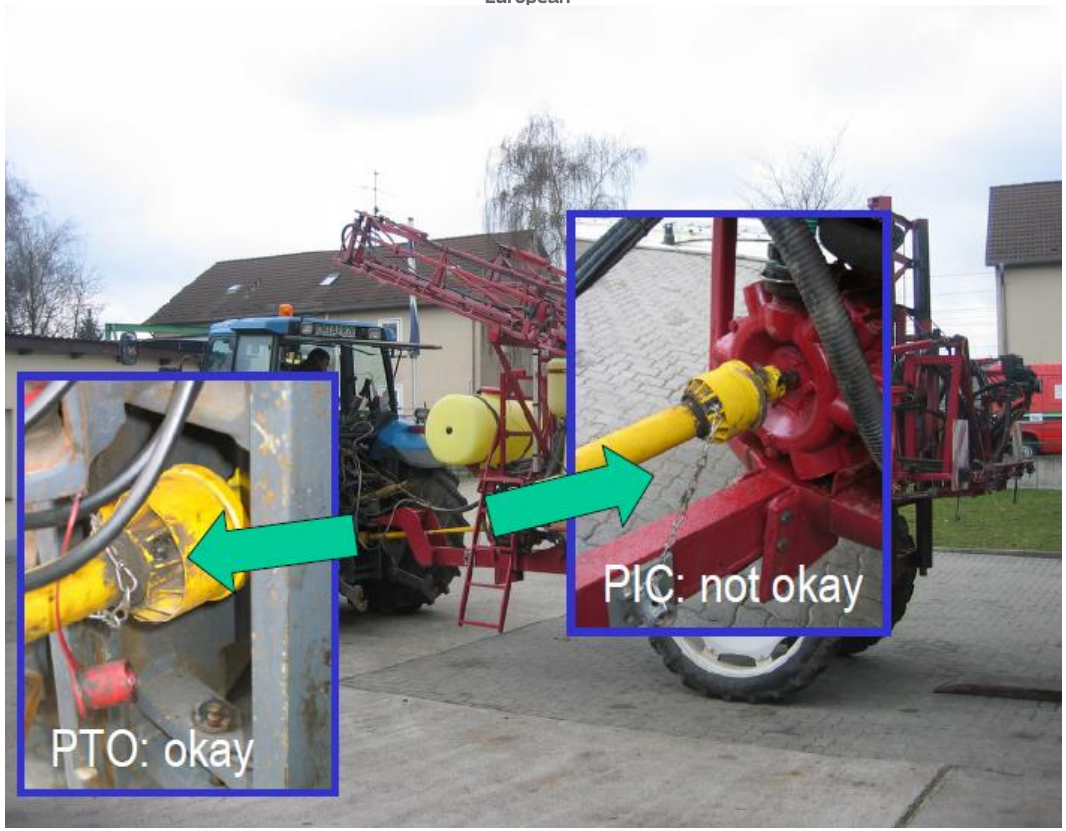
— the different parts of the shaft, the universal joints and locking systems shall not show any mark of excessive wear and shall operate correctly ;

— 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 prevents the rotation of the power take-off drive shaft guard shall be present and shall work reliably.

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

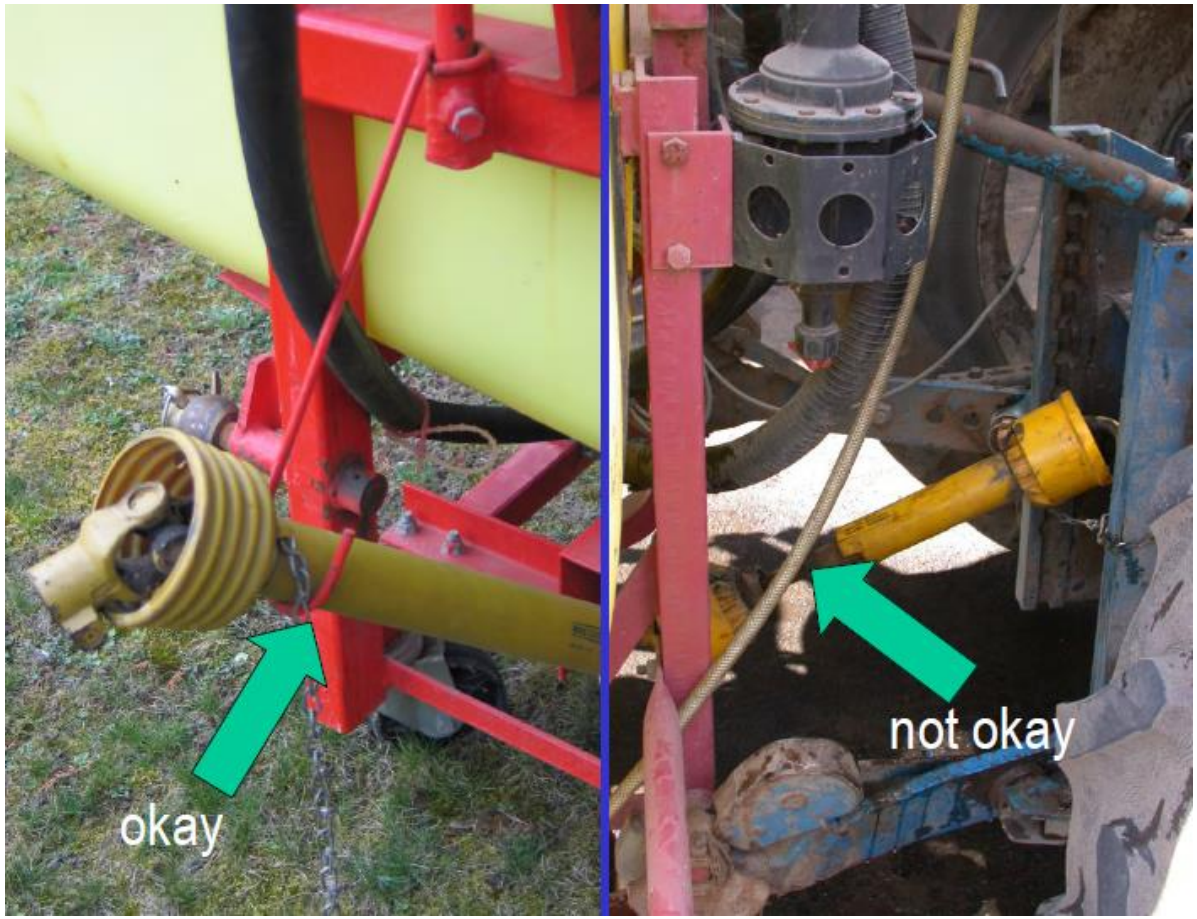
Method of verification: inspection and function test.



4.1.1

The **power take-off (PTO)** drive shaft guard and the guard of the **power input connection (PIC)** shall be fitted and in good condition: The protective devices and any moving or rotating power transmission parts shall not be affected in their function.

Method of verification: inspection and function test.



4.1.2

A device for supporting the PTO drive shaft when not in use shall be present and in good condition. The chain or device used for restraining the PTO shaft guard shall not be acceptable for this purpose. The guard of the PIC shall be fitted and in good condition.

Method of verification: inspection and function test.

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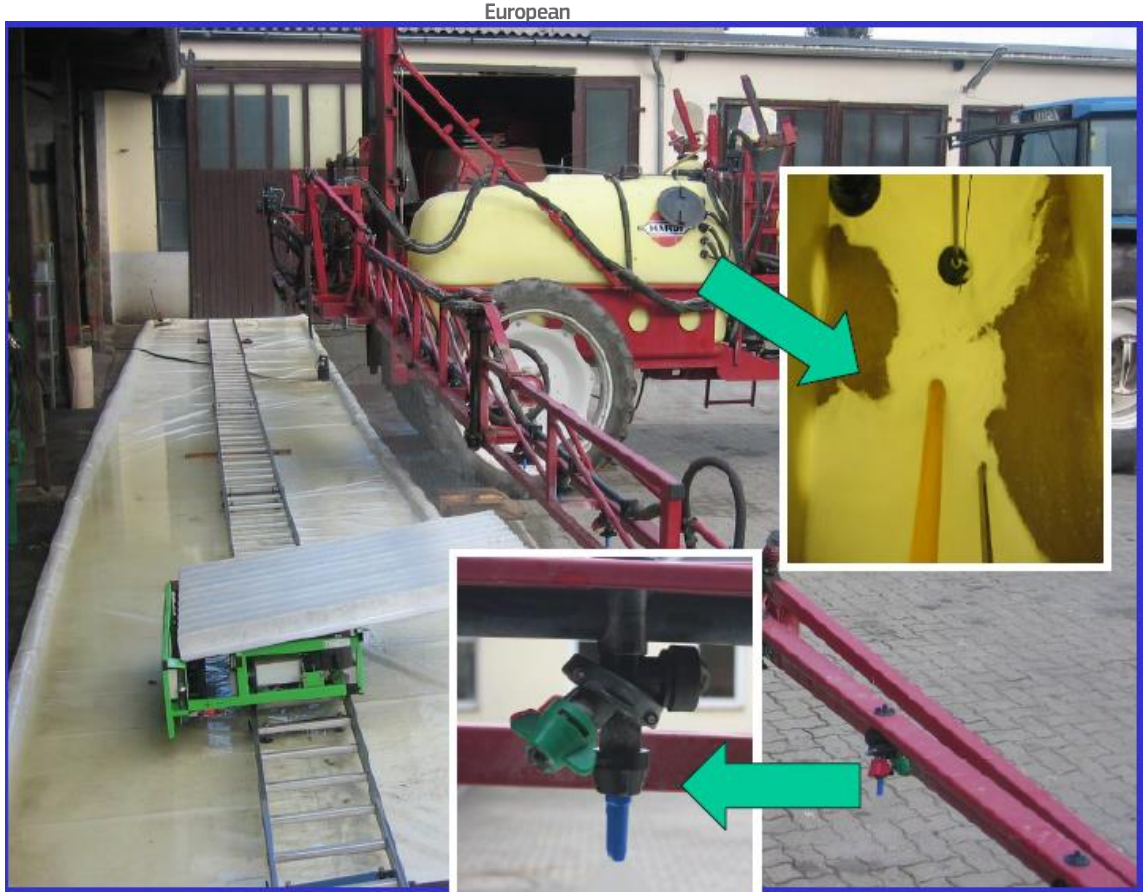
4.2.1 The pump capacity shall be suited to the needs of the equipment.

a) The pump capacity shall be at least 90 % of its original nominal flow, given by the manufacturer of the sprayer.

Method of verification: measurement according to 5.2.1.a); or

b) the pump shall have sufficient flow rate capacity in order to be able to spray at maximum working pressure as recommended by the sprayer or the nozzle manufacturer during test with the largest nozzles mounted on the boom while maintaining a visible agitation as specified in 4.3;

Method of verification: measurement according to 5.2.1.b).

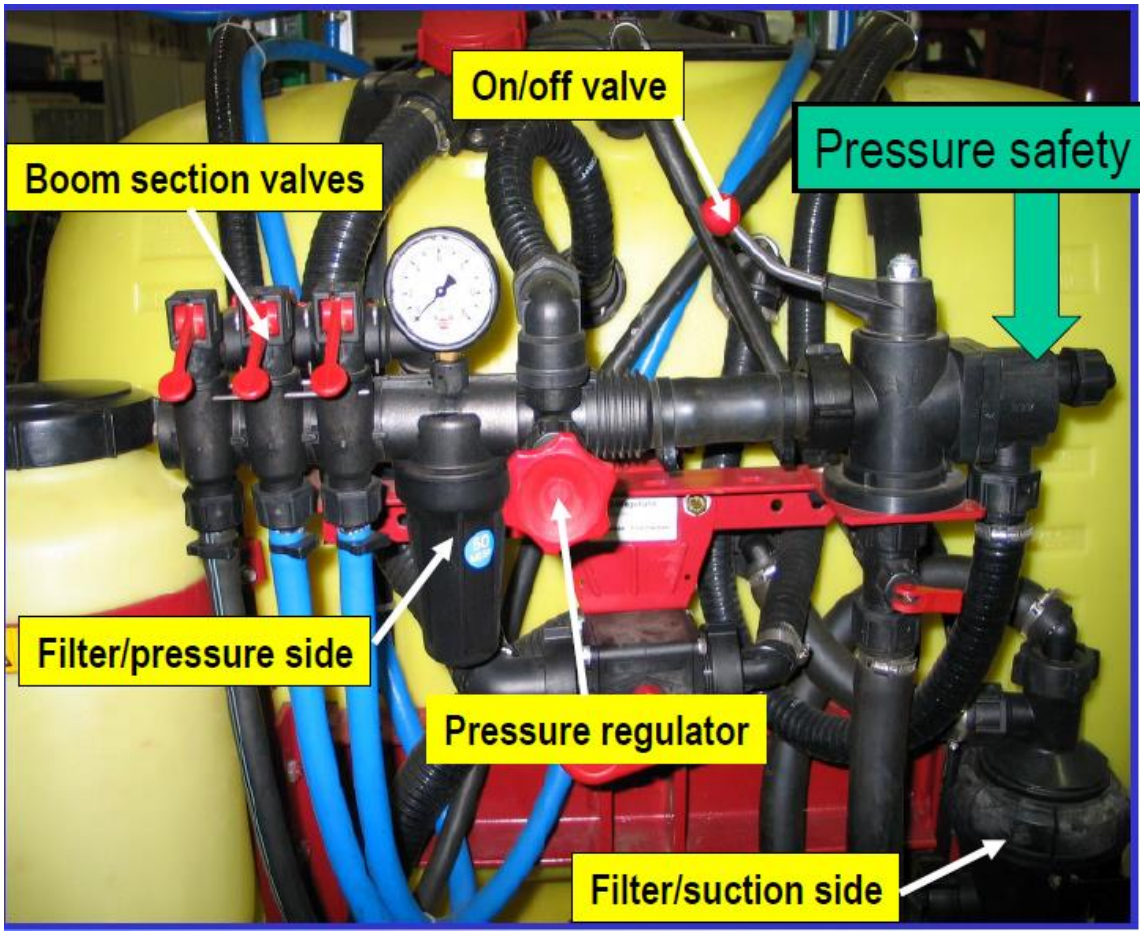


b) the pump shall have sufficient flow rate capacity in order to be able to spray at maximum working pressure as recommended by the sprayer or the nozzle manufacturer during test with the largest nozzles mounted on the boom while maintaining a visible agitation as specified in 4.3;

Method of verification: measurement according to 5.2.1.b).

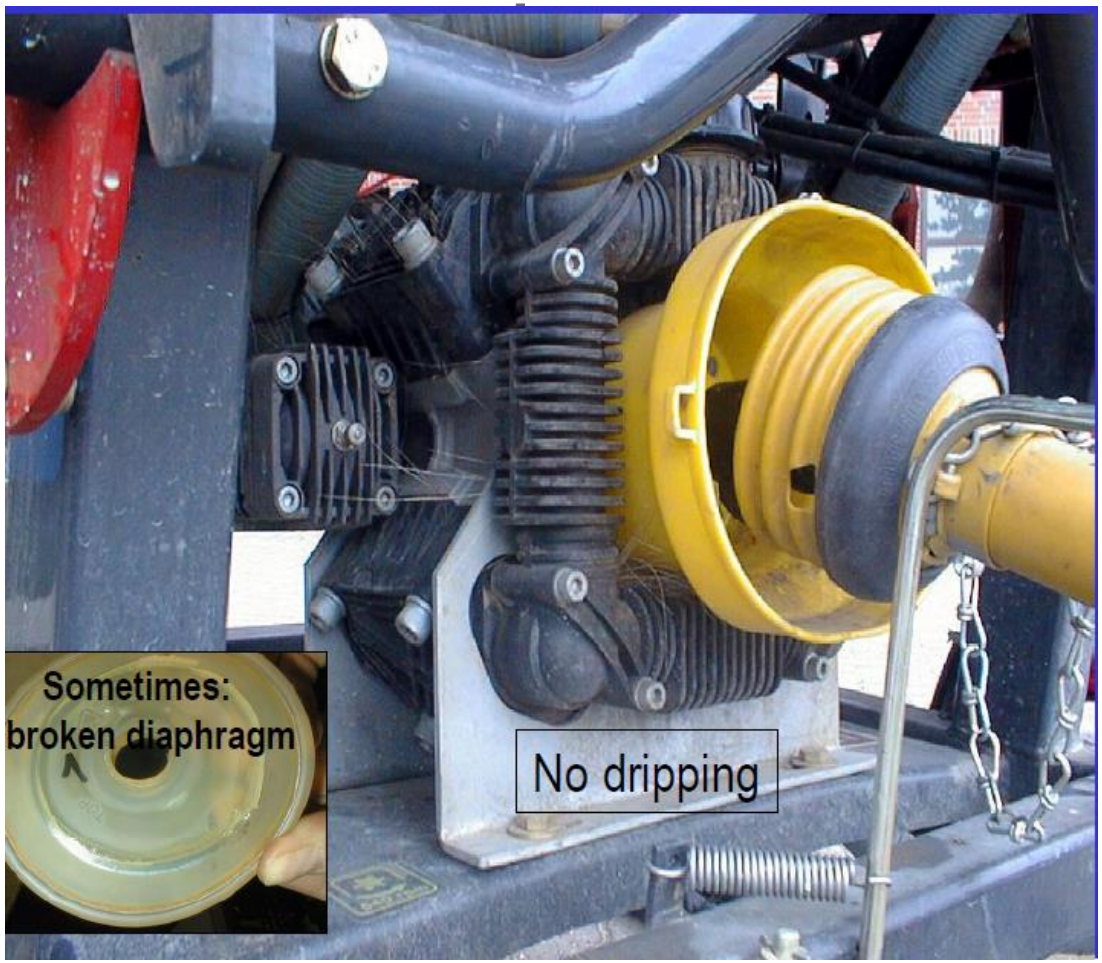
4.2.2 There shall be no visible pulsations caused by the pump.

Method of verification: inspection and function test.



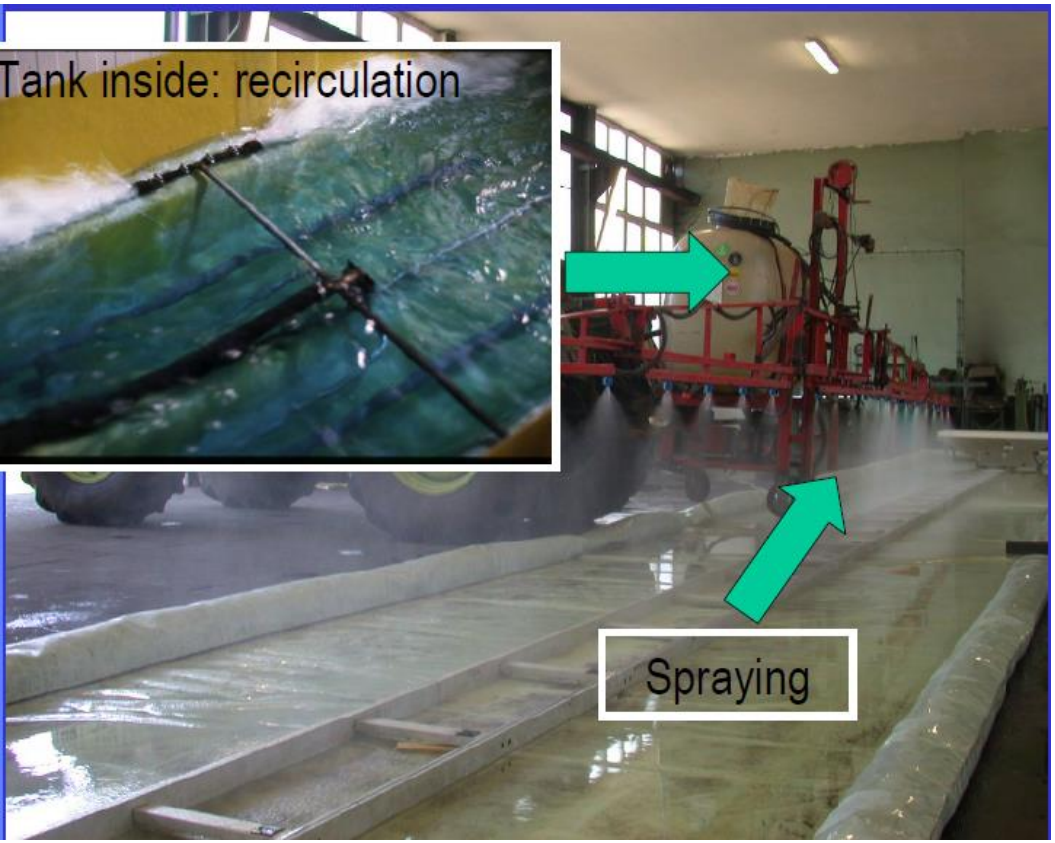
4.2.3 When there is a pressure safety valve on the pressure side of the pump, this valve shall work reliably.

Method of verification: inspection and function test.



4.2.4 There shall be no leakages (e.g. dripping) from the pump.

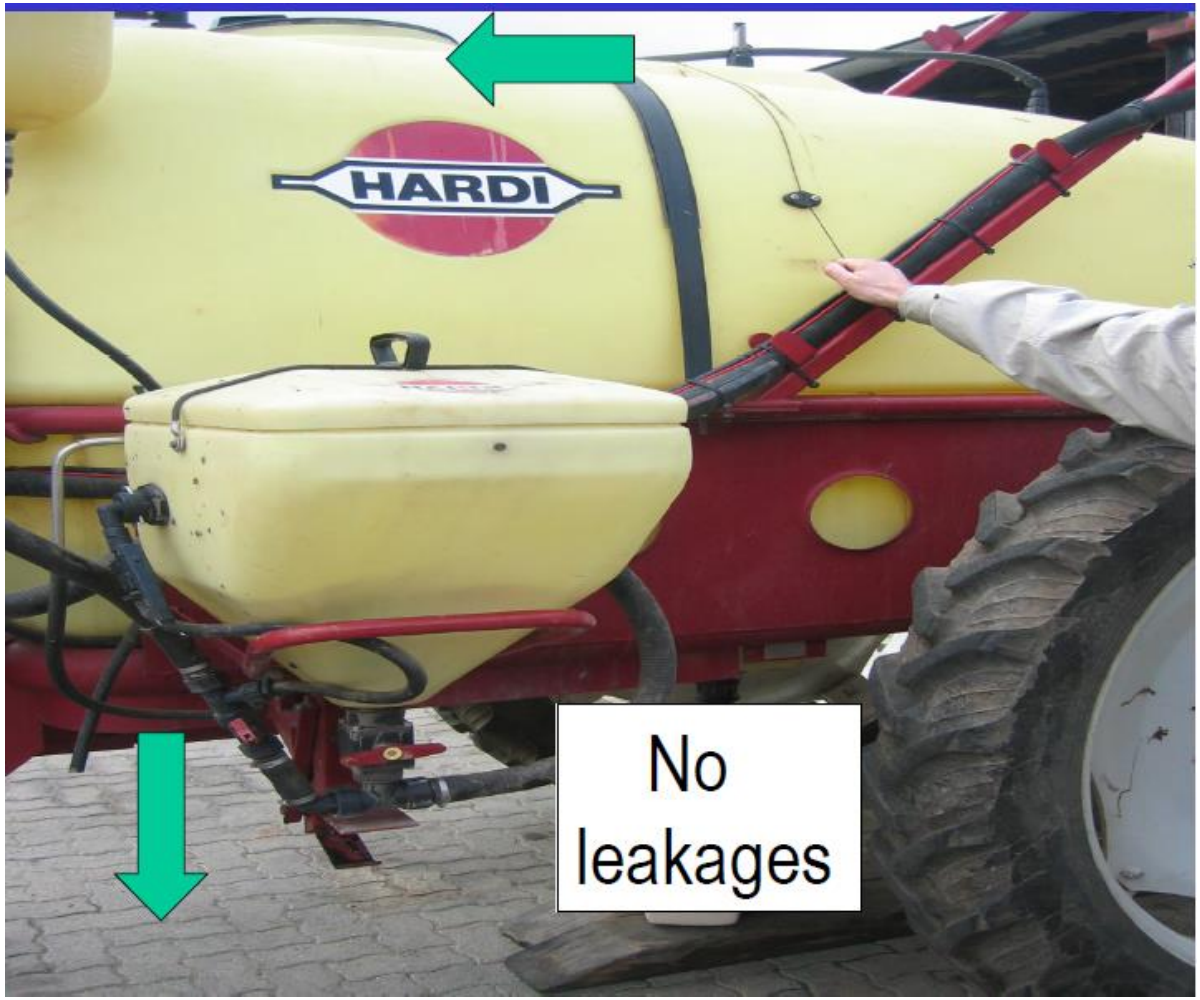
Method of verification: inspection.



4.3

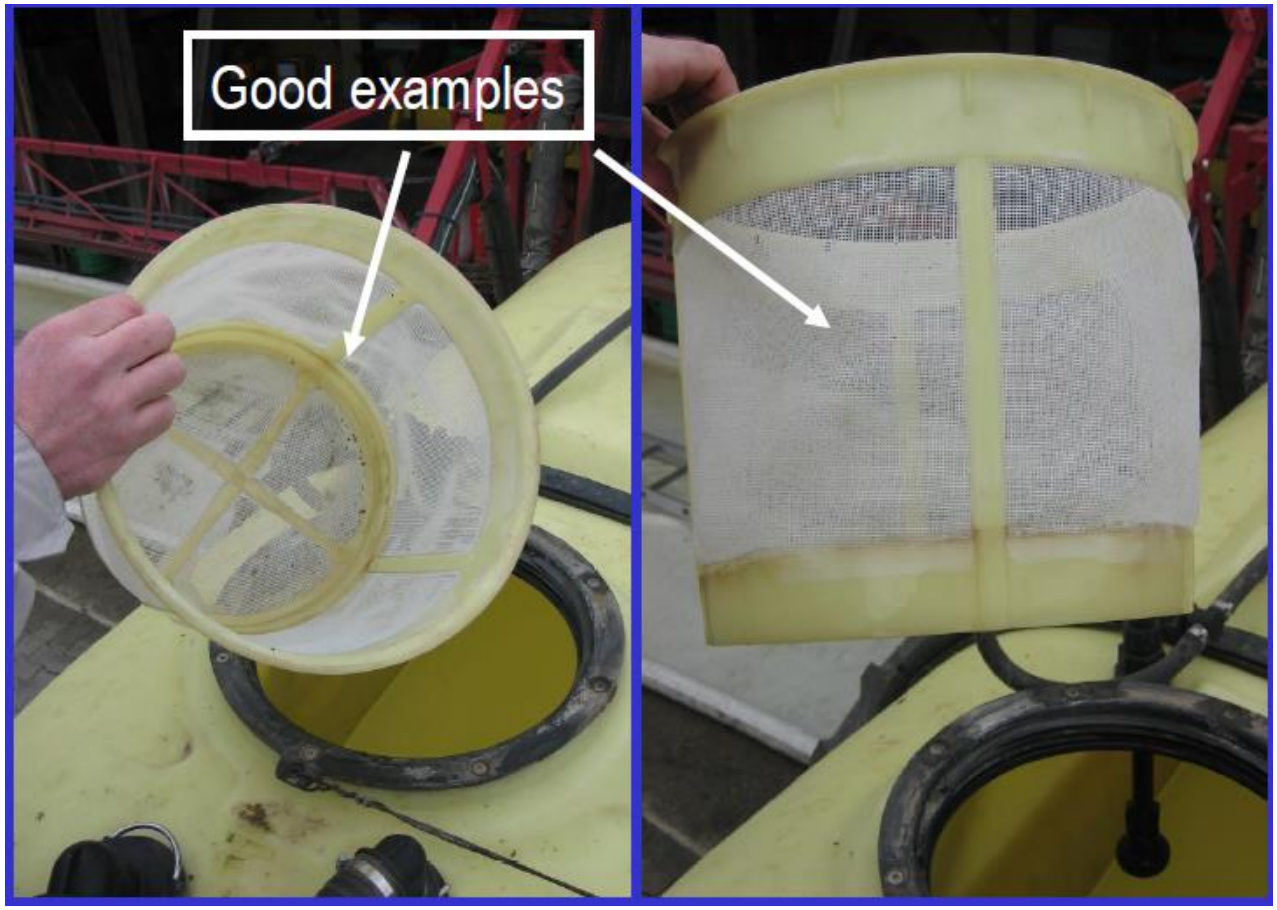
A clearly visible recirculation shall be achieved when spraying at the nominal p.t.o speed, with the tank filled to the half of its nominal capacity.

Method of verification: inspection.



4.4.1
There shall be no leakages from the tank or from the filling hole when the cover is closed.

Method of verification: inspection.



4.4.2
There shall be a strainer in good condition in the filling hole.

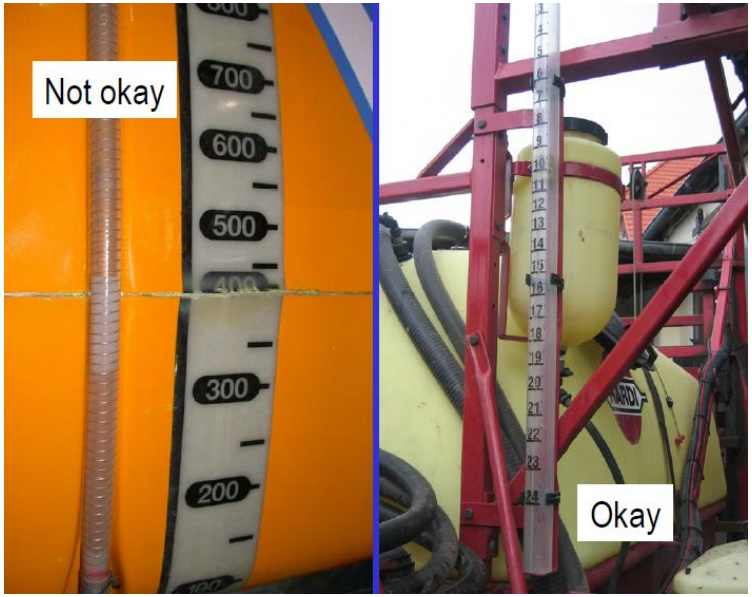
Method of verification: inspection.

4.4.3
There shall be a grating in the chemical induction bowl, if provided.

Method of verification: inspection.

4.4.4
Pressure compensation (to avoid over- or underpressure in the tank) shall be ensured.

Method of verification: inspection.

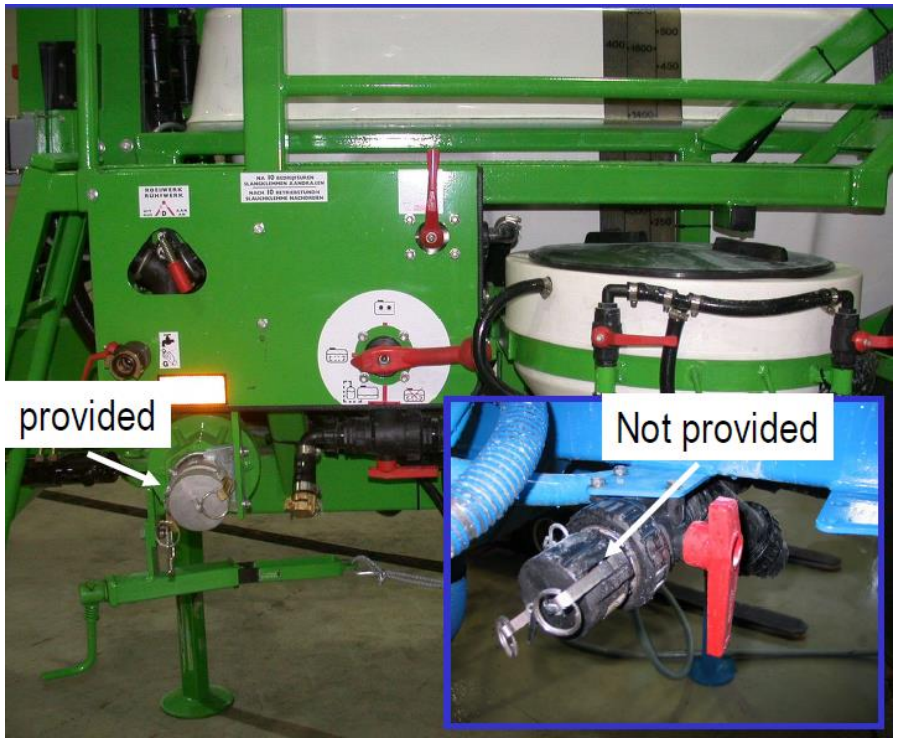


4.4.5 There shall be a clearly readable liquid level indicator on the tank which is visible from the driver's position and from where the tank is filled.

Method of verification: inspection.

4.4.6 It shall be possible to collect the emptied spray liquid simply, without tools, reliably and without spillage (for example using a tap).

Method of verification: function test.

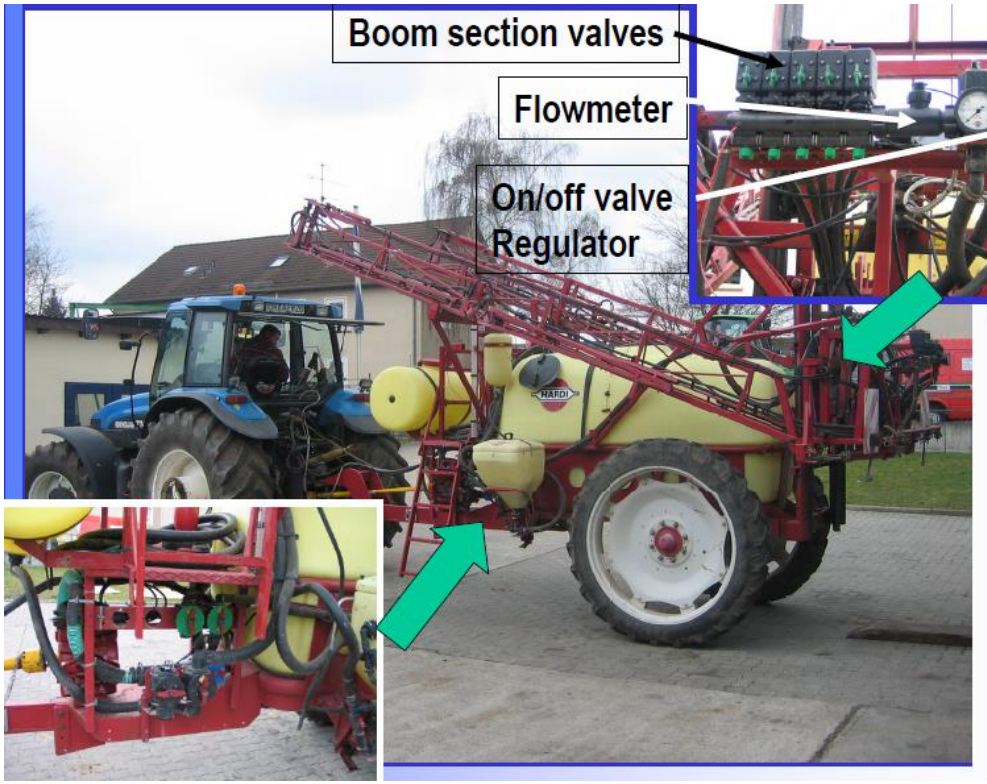


4.4.7 If there is a non-return device on the water filling device of the tank, this device shall work reliably.

Method of verification: inspection and function test.

4.4.8 The chemical introduction container, if provided, shall work reliably.

Method of verification: function test.



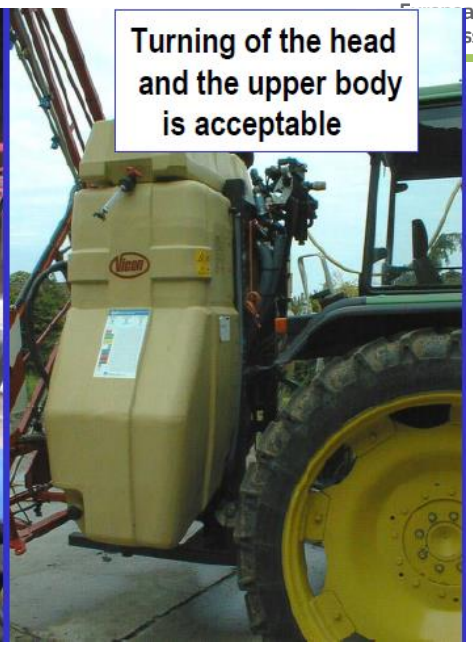
4.4.9 The cleaning device for crop protection product containers, if provided, shall work reliably.

Method of verification: function test.

4.5 Measuring systems, controls and regulation systems

4.5.1 All devices for measuring, switching on and off and adjusting pressure and/or flowrate shall work reliably and there shall be no leakages.

Method of verification: inspection and function test.



The scale shall be marked:
<5 bar: 0,2 bar
5-20bar: 1,0 bar
>20 bar: 2,0 bar

4.5.2

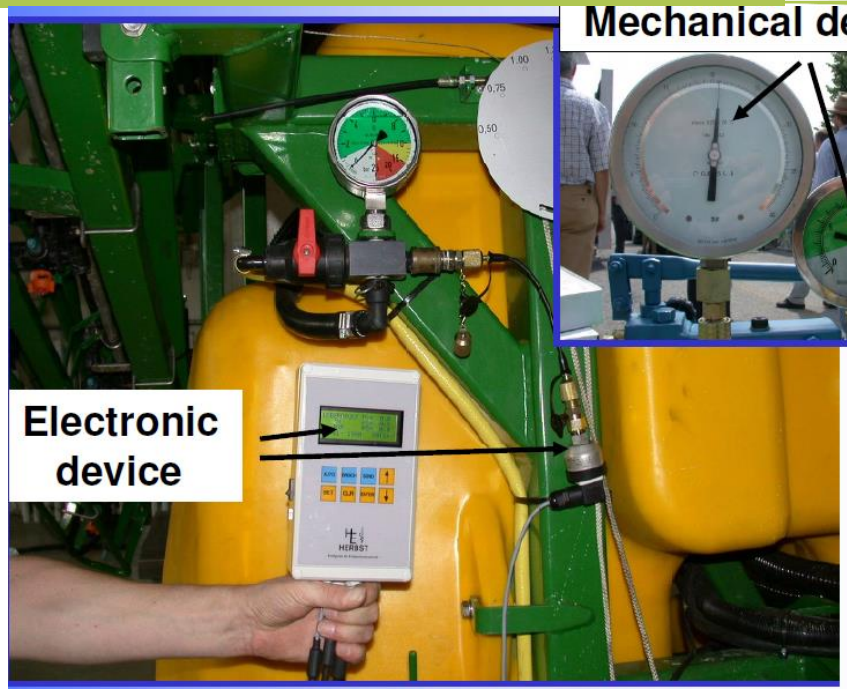
The controls necessary for spraying shall be mounted in such a way that they can be easily reached and operated during the application and information provided for example on displays that can be read respectively. Switching off and on of all nozzles shall be possible simultaneously.

Method of verification: inspection

4.5.3 / 4.5.4

The scale of the pressure gauge shall be clearly readable and suitable for the working pressure range used.

Method of verification: inspection.



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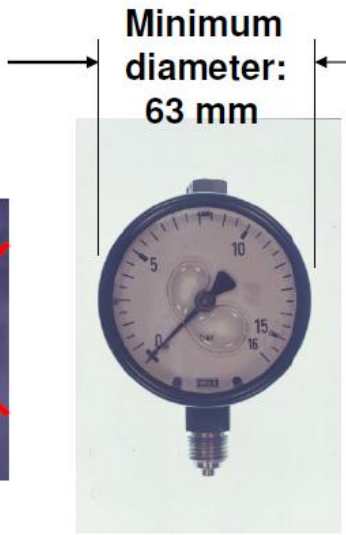


4.5.5 For analogue pressure gauges the minimum diameter of the pressure gauge cases shall be 63 mm.

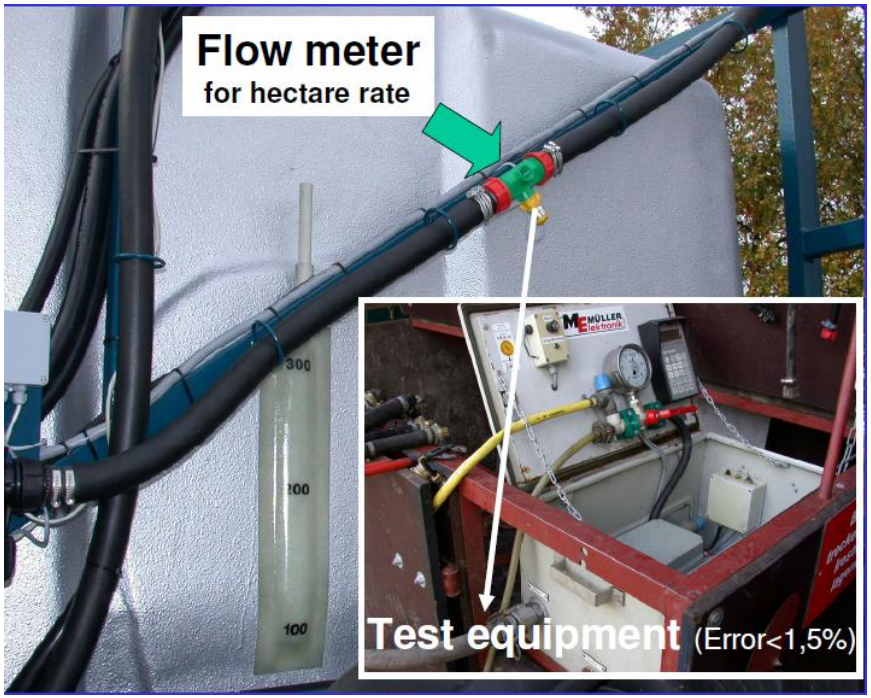
Method of verification: measurement.

4.5.6 The accuracy of the pressure gauge shall be ± 0,2 bar for working pressures between 1 bar (included) and 2 bar (included).

From a pressure of 2 bar, the pressure gauge shall measure with an accuracy of ± 10 % of the real value.

The pointer on the pressure gauge shall remain stable in order to permit reading-off of the working pressure.

Method of verification: according to 5.2.2.



4.5.7 Other measuring devices, especially flow meters (used for controlling the volume/hectare rate), shall measure within a maximum error of 5 % of the real data.

Method of verification: according to 5.2.3.

4.6.1 There shall be no leakages from pipes or hoses when tested up to the maximum obtainable pressure for the system.

Method of verification: inspection and function test.

Good examples

Bad examples

Filter/suction side

Nozzle filters are not considerd as pressure side filters

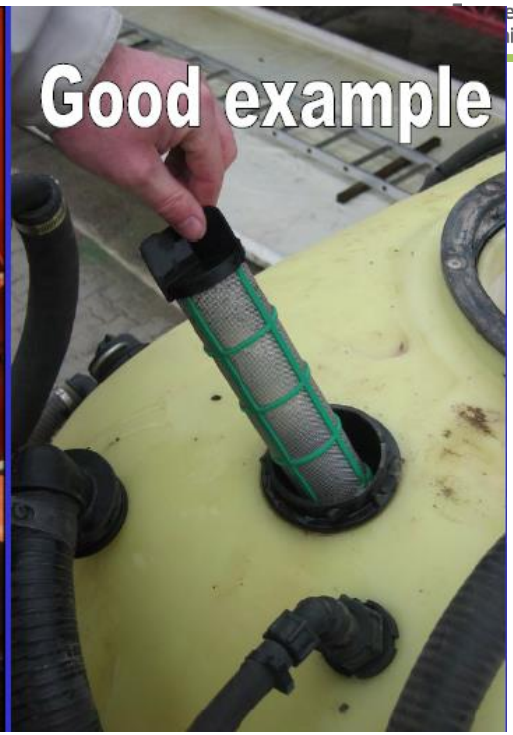
Filter/pressure side

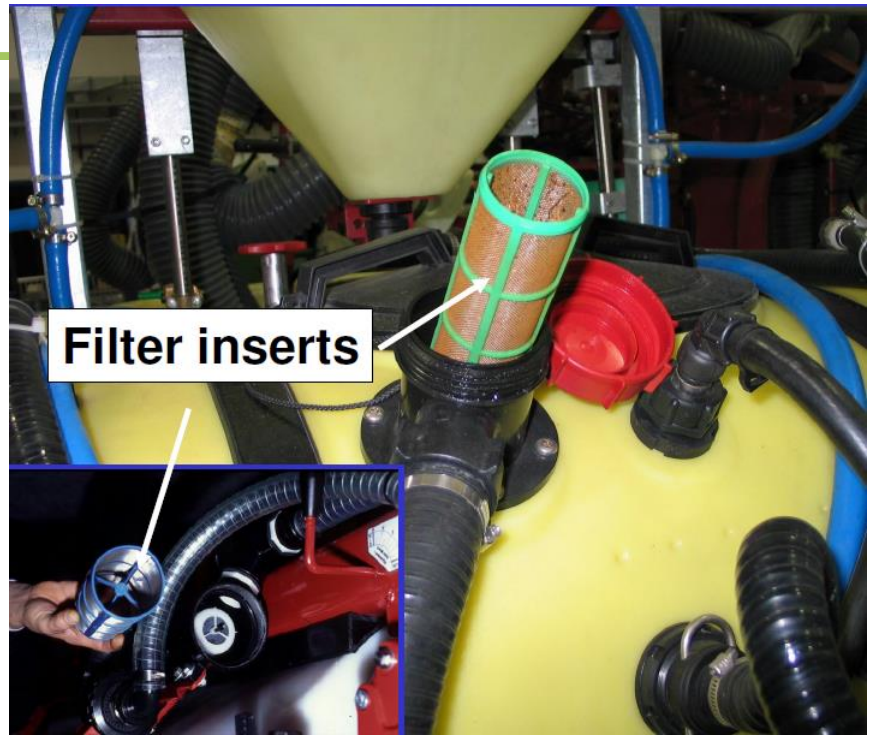
4.6.2

Hoses shall be positioned in such a way that there are no sharp bends and no abrasion which makes the woven fabric visible. **Method of verification: inspection.**

4.7.1

There shall be one filter on the pressure side of the pump and in case of positive displacement pumps also one filter on the suction side. 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 **Method of verification: inspection and function test.**

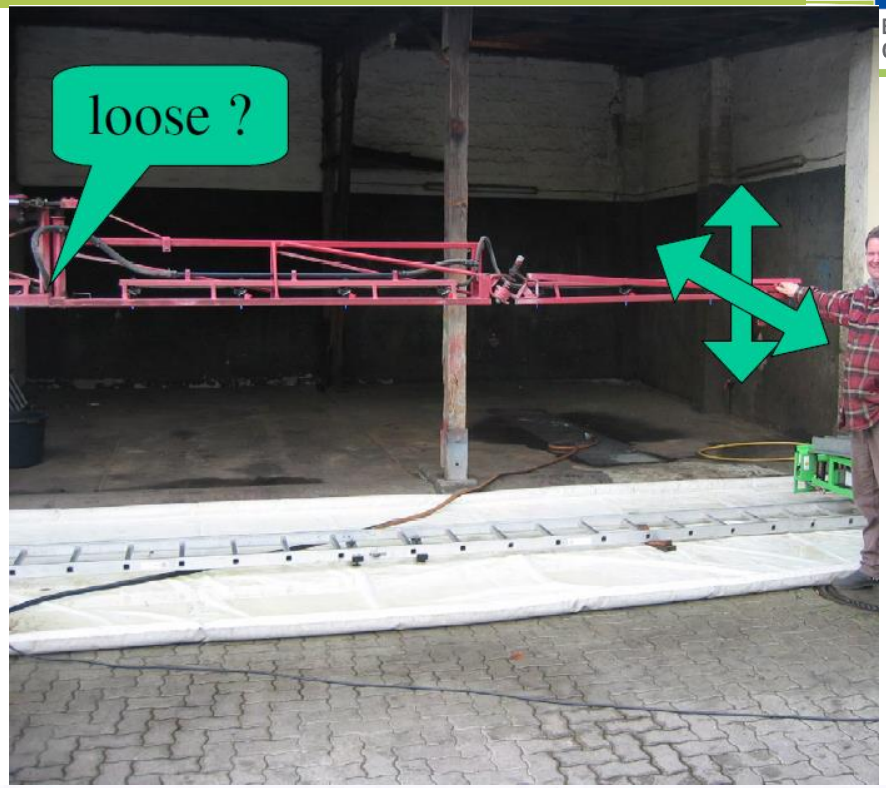


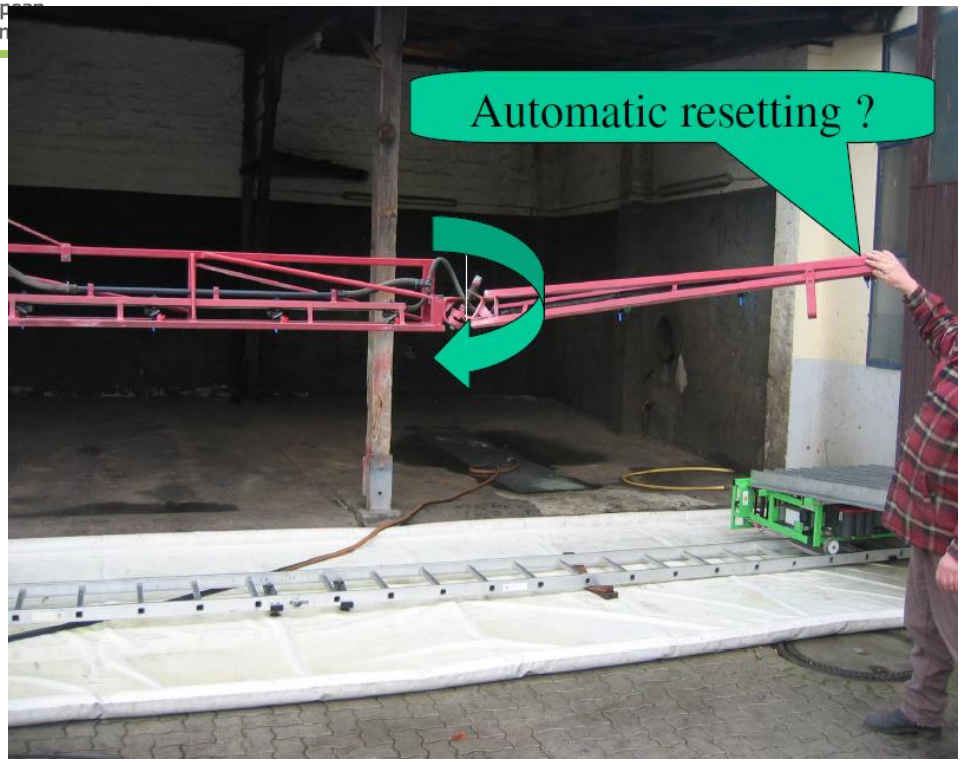


4.7.2 If an isolating device is provided, it shall be possible, with the tank filled to its nominal volume, to clean filters without any spray liquid leaking out except for that which may be present in the filter casing and the suction lines.

Method of verification: inspection.

4.7.3 Filter inserts shall be changeable.





4.8.1 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.

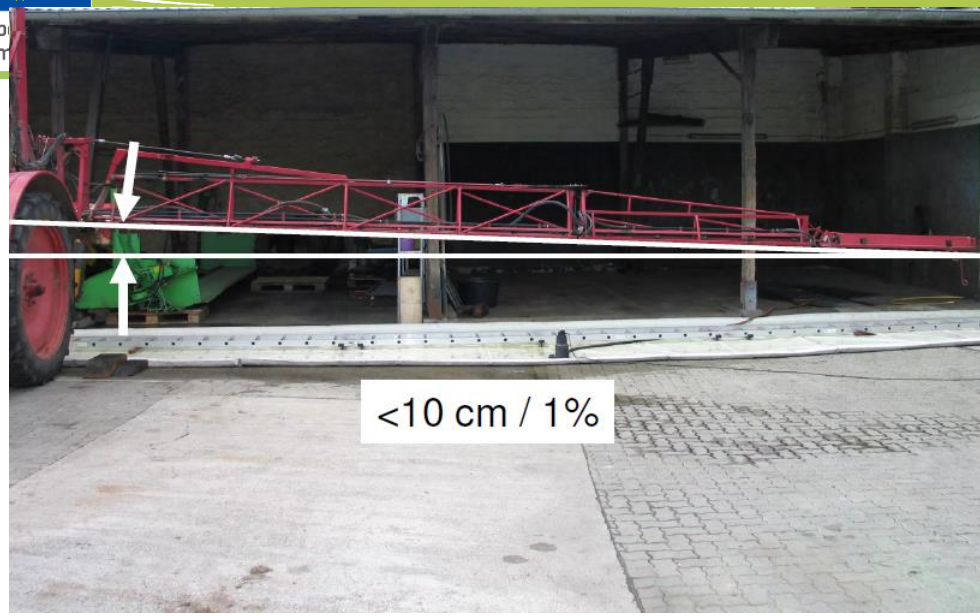
Method of verification: inspection.

4.8.2 When provided, the automatic resetting of booms shall operate if fitted with the device, to move backwards and forwards, in case of contact with obstacles.

Good examples

4.8.3 The boom shall be securely lockable in the transport position.

Method of verification: inspection and function test.

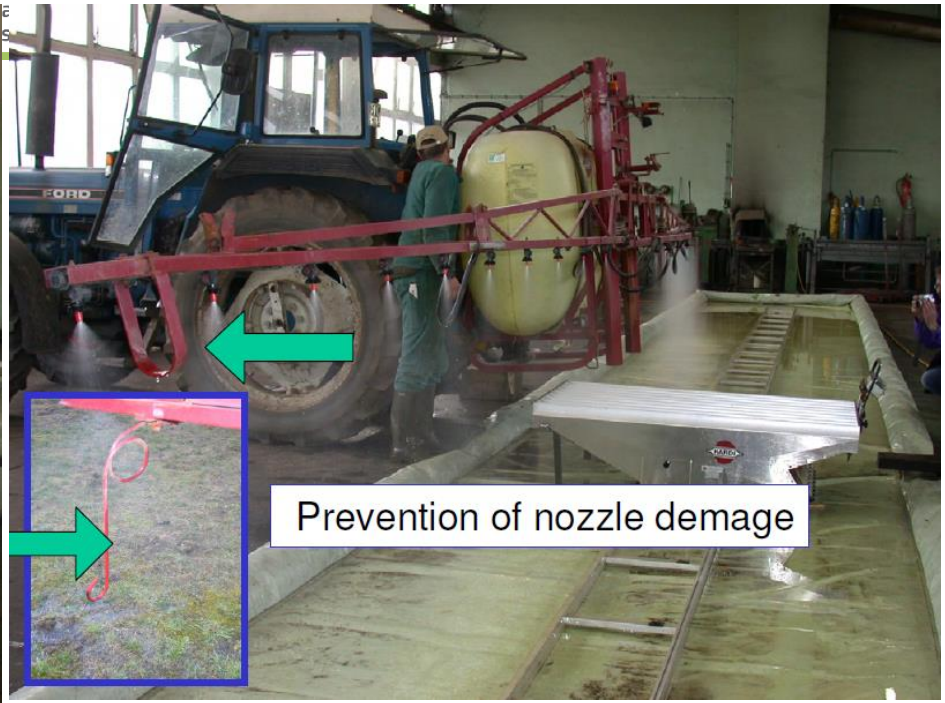


4.8.4 The nozzle spacing and their orientation shall be uniform along the boom, except for special equipment such as border spraying. By design, it shall not be possible to modify unintentionally the position of the nozzles in working conditions, for example by folding/unfolding the boom.

Method of verification: inspection and measurement.

4.8.5 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 1 % of the half working width.

Method of verification: inspection and measurement.

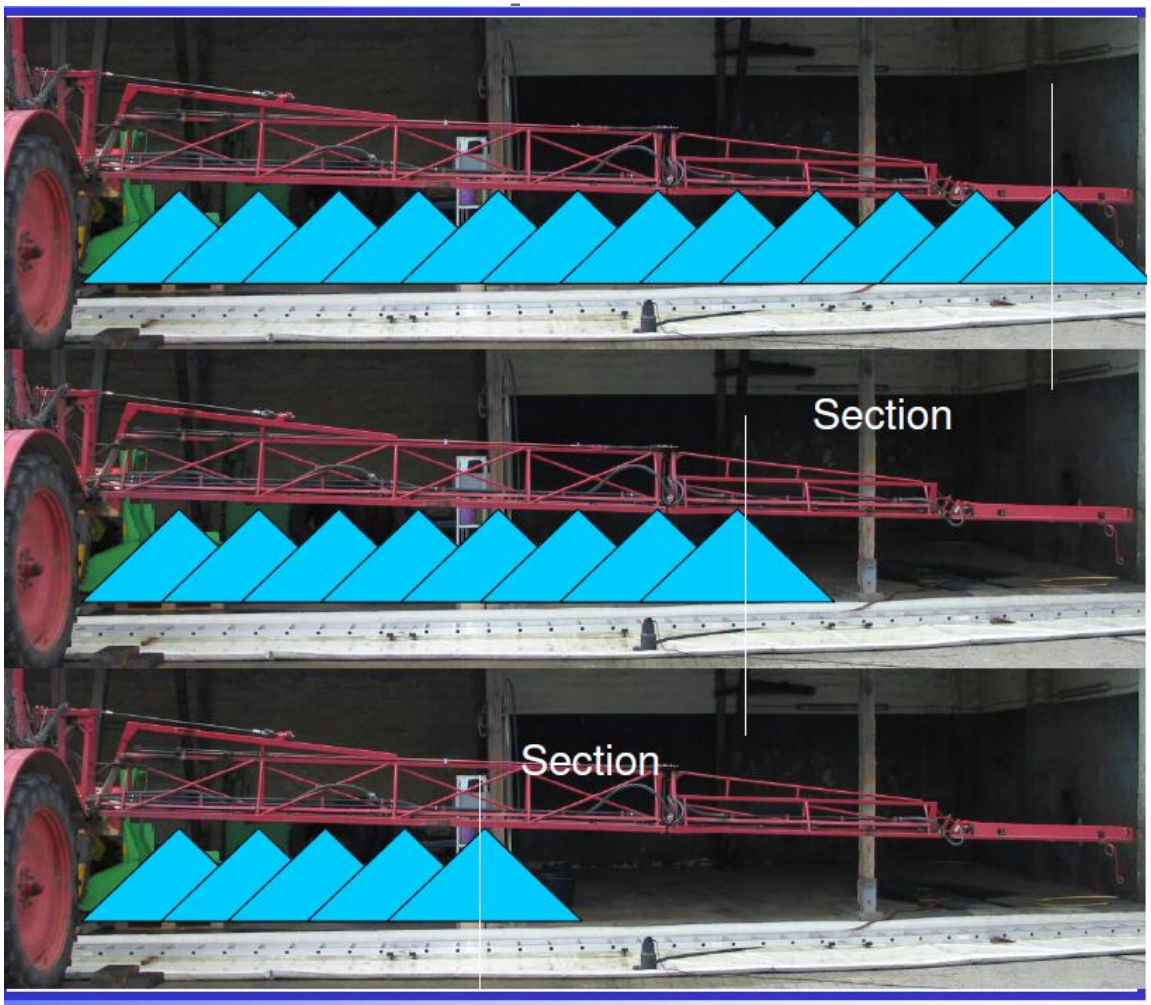


4.8.6 Regardless of the distance of the boom above the ground, no liquid shall be sprayed on to the sprayer itself. This does not apply if needed by function and if dripping is minimised.

Method of verification: inspection.

4.8.7 A device shall be fitted to prevent damage to the nozzles if the boom hits the ground, if the working width of the boom is ≥ 10 m.

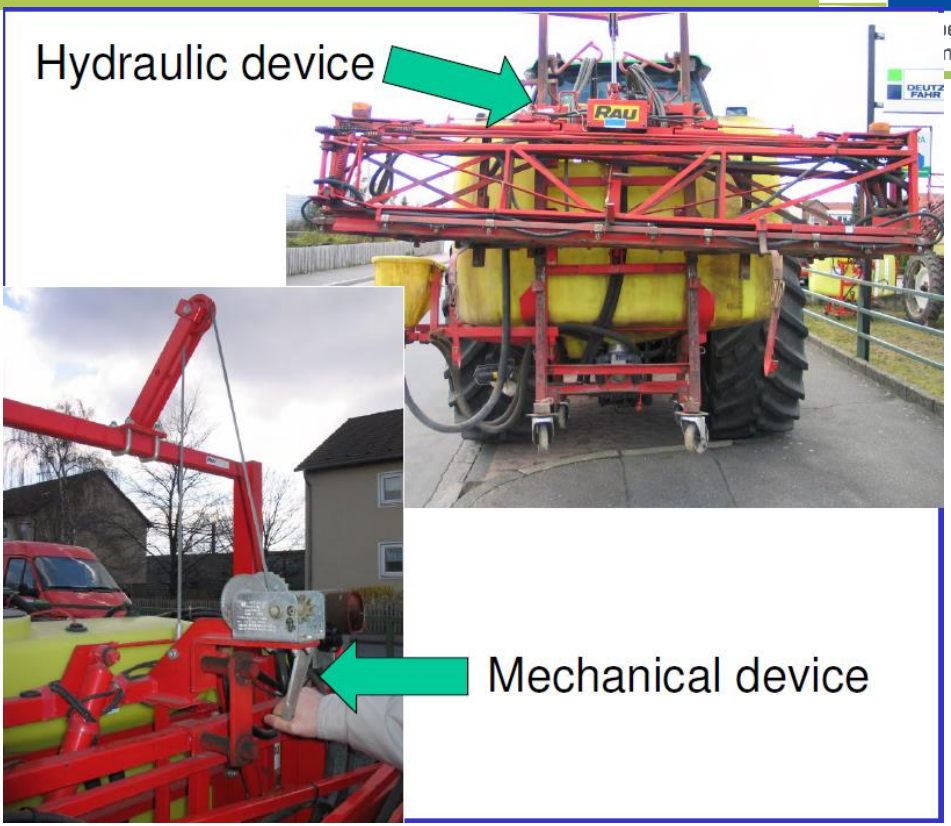
Method of verification: inspection.



4.8.8

It shall be possible to switch on and off individual boom sections.

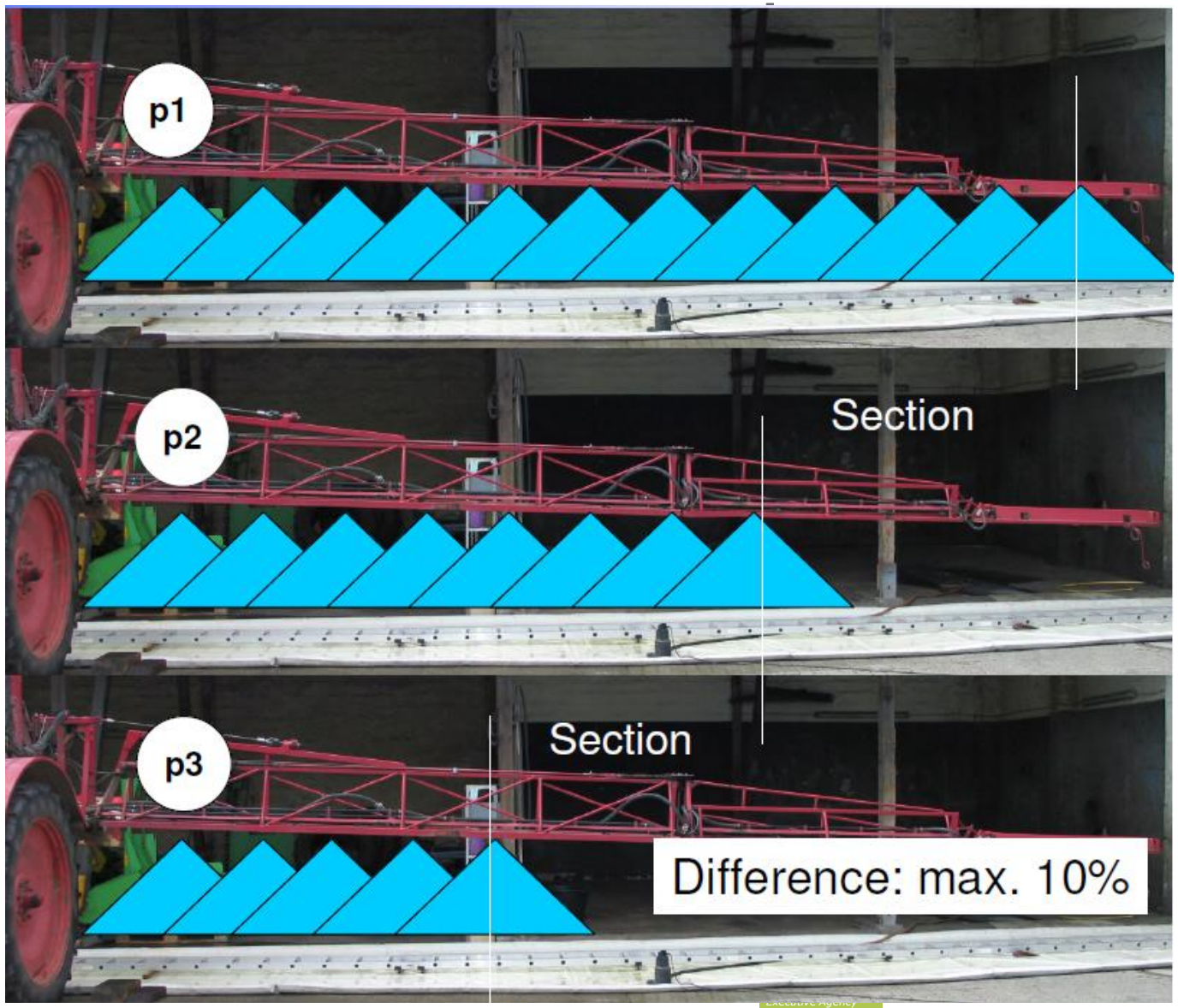
Method of verification: inspection and function test.



4.8.9 Height adjustment devices shall work reliably.

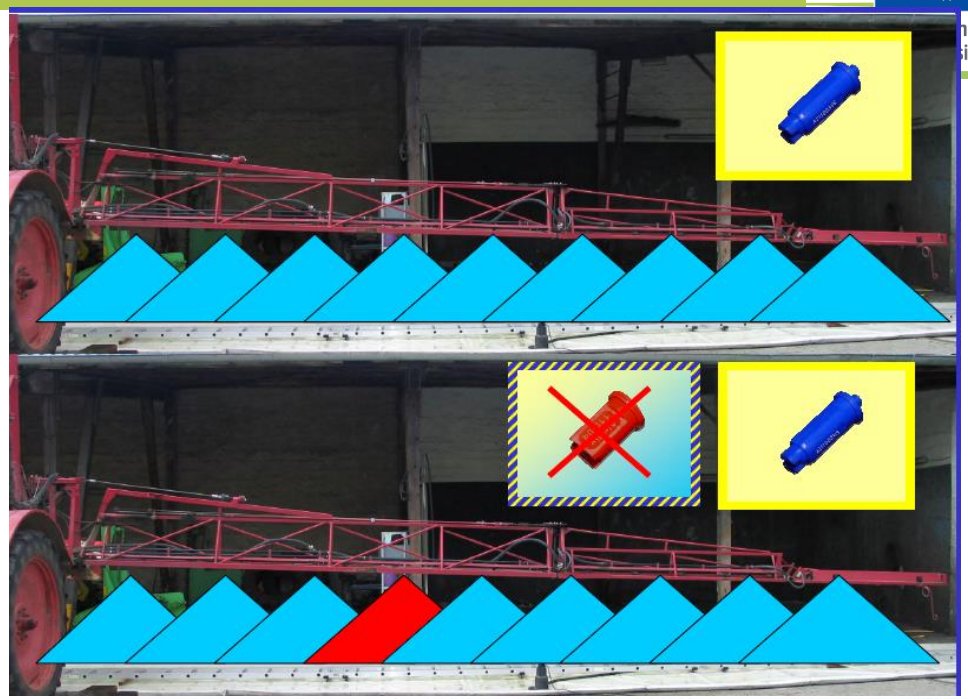
Method of verification: function test.

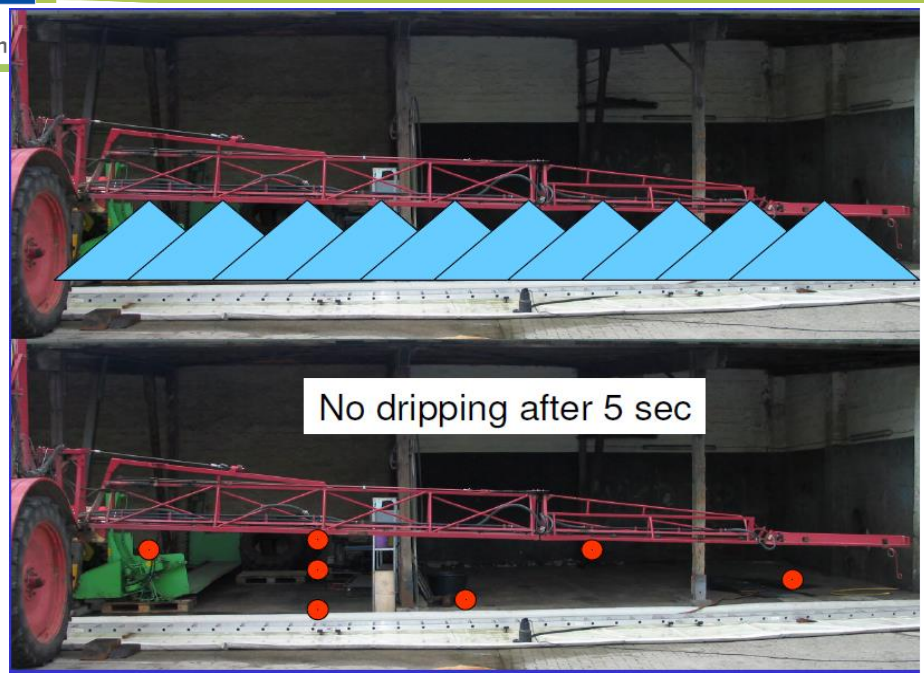
4.8.10 Devices for damping unintended boom movements and slope compensation systems shall work reliably.



4.8.11
When measured at the inlet of the boom sections, the pressure shall not vary more than 10 %, when the sections are closed one by one.

Method of verification: according to 5.2.7.





4.9.1 All nozzles shall be identical (type, size, material and origin) all along the boom, 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.

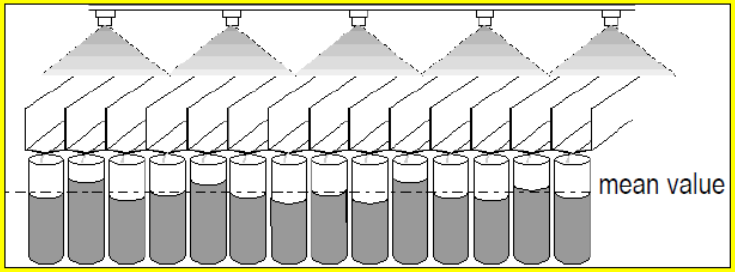
Method of verification: inspection.

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

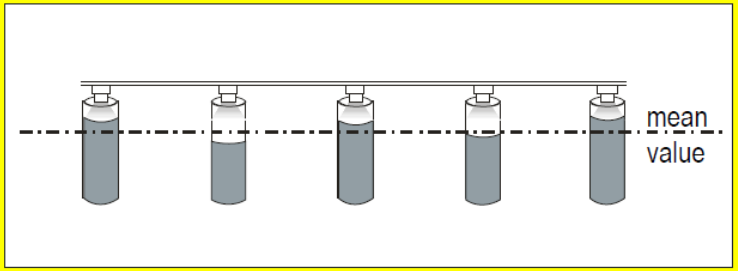
Method of verification: inspection.

European

Testmethode 4.10.1



Testmethode 4.10.2

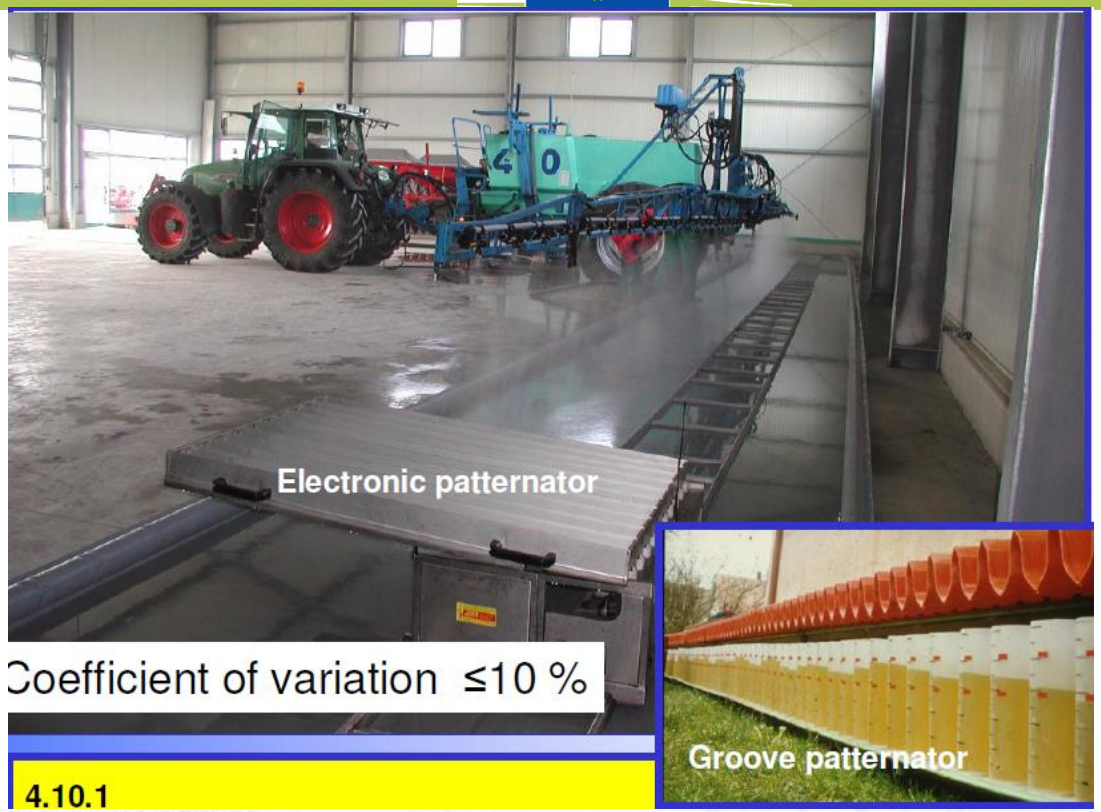


4.10 Transverse distribution

For the transverse distribution, the requirements and test methods of 4.10.1 or 4.10.2 shall apply.

NOTE 1 If nozzles are used on a boom to form a uniform spray, 4.10.1 or 4.10.2 applies; in other cases, 4.10.2 applies.

NOTE 2 A compared evaluation of the two methods given in 4.10.1 and 4.10.2 will be carried out during the revision of this standard to check whether preference may be given to one of these methods.

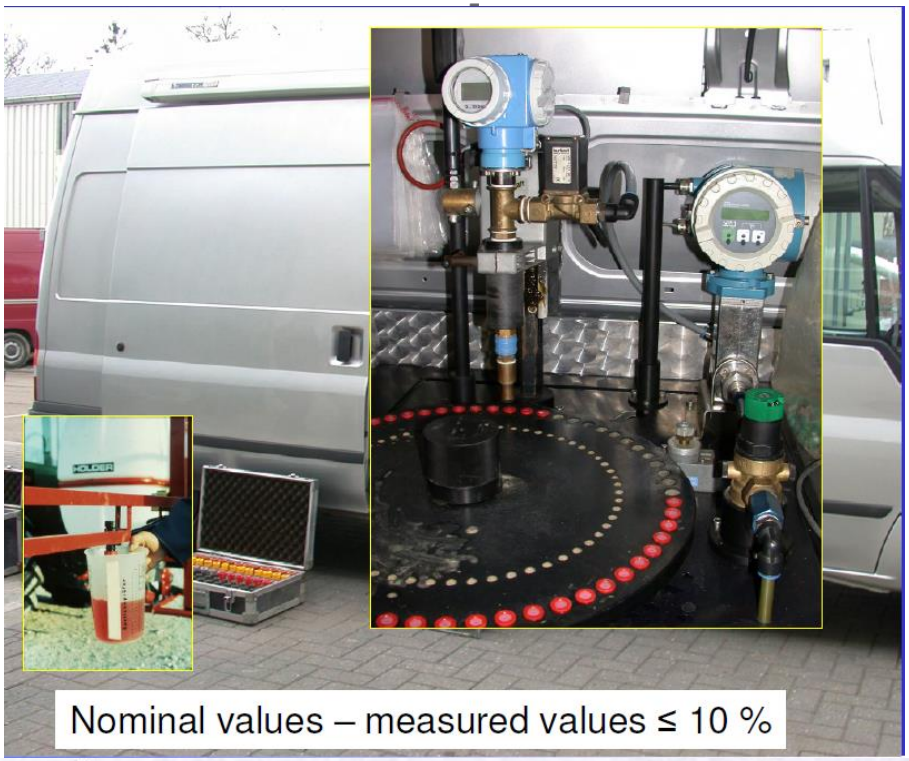


4.10.1 Measurement on patternator

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.

Method of verification: measurement according to 5.2.4.



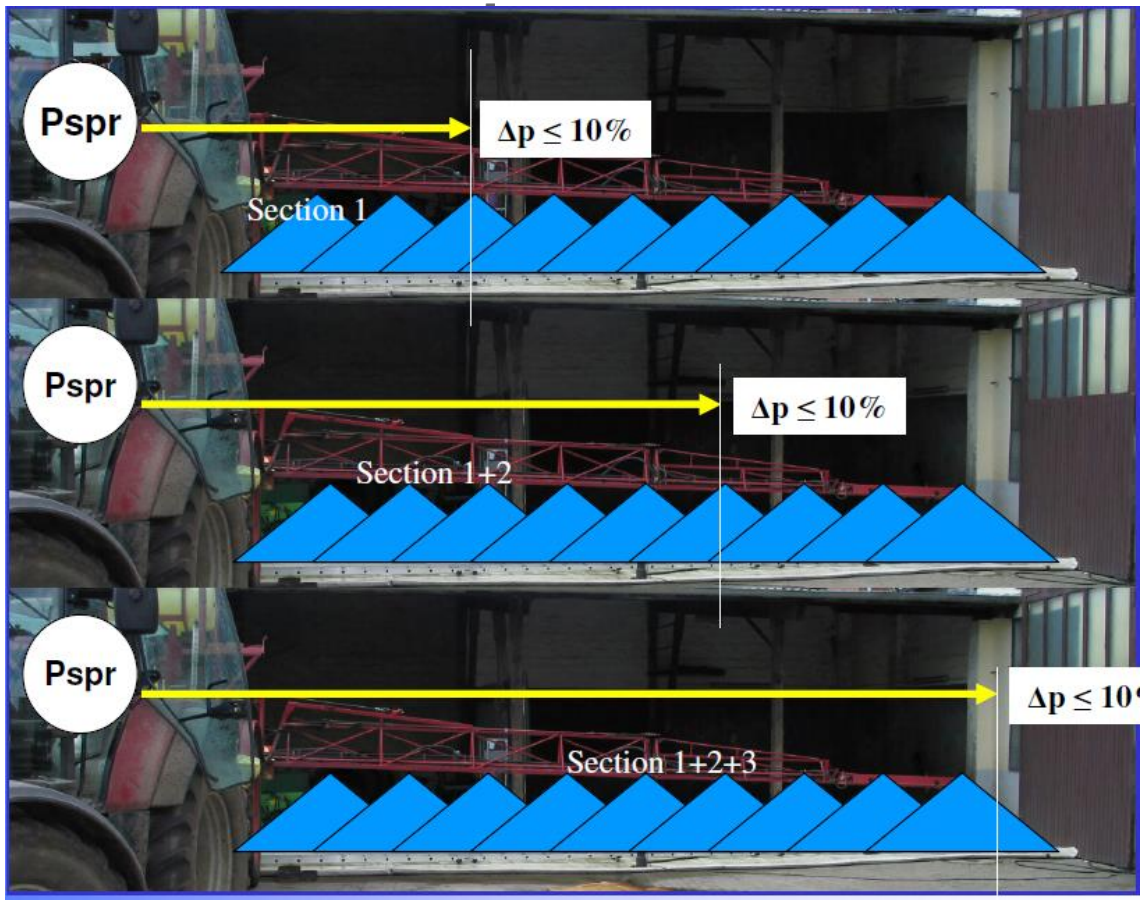
4.10.2 Flow rate measurement

4.10.2.1 The deviation of the flow rate of each nozzle of the same type shall not exceed ± 10 % of the nominal flow rate indicated by the manufacturer.

Method of verification: measurement according to 5.2.5.

4.10.2.2 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.

Method of verification: measurement according to 5.2.6.



4.10.2.2
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.

Method of verification: measurement according to 5.2.6.

5.1

Before the inspection takes place, the sprayer shall be carefully cleaned. Certain attention shall be paid to rinsing and internal cleaning of the sprayer including filters and filters inserts, and external cleaning of those parts of the sprayer that are most exposed to the crop protection product when spraying.

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. The owner/operator of the sprayer should preferably be present at the inspection.

5.2 Test facilities and methods

5.2.1 Pump capacity measurement

5.2.2 Verification of the sprayers pressure gauges

5.2.3 Flow meters for controlling the volume / hectare rate

5.2.4 Measurement of the uniformity of the transverse volume

5.2.5 Measurement of the flow rate

5.2.6 Measurement of pressure drop

5.2.7 Measurement of pressure variation when the sections are closed

5.2.8 Other test facilities

5 Test methods

5.1 Preparation of sprayer

The test shall not start if requirements of 4.1.1 are not verified.

Before the inspection takes place, the sprayer shall be carefully cleaned. Certain attention shall be paid to rinsing and internal cleaning of the sprayer including filters and filters inserts, and external cleaning of those parts of the sprayer that are most exposed to the crop protection product when spraying.

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.

The owner/operator of the sprayer should preferably be present at the inspection.

5.2 Test facilities and methods

5.2.1 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 l and 2 l/min when the capacity of the pump is < 100 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 (see 4.2.1), 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.

5.2.2 Verification of the sprayers pressure gauges

5.2.2.1 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 Δp bar	Scale unit max. bar	Accuracy bar	Class required	Scale end value Bar
$0 < \Delta p \leq 6$	0,1	0,1	1,6 1,0 0,6	6 10 16
$6 < \Delta p \leq 16$	0,2	0,25	1,6 1,0	16 25
$\Delta p > 16$	1,0	1,0	2,5 1,6 1,0	40 60 100

European Commission

Nozzles flowrate test bench

Palett model

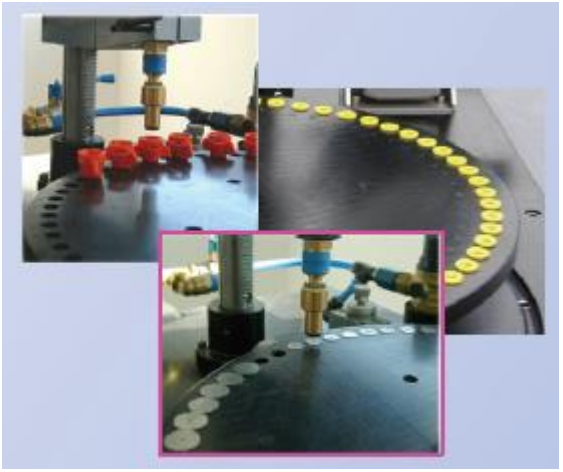
Compact model

Digital sensors

Analogue sensors

Pressure equipment for field crop sprayers

Analogue pressure gauges / 0 – 6 bar / class 1 / ⌀ 100 mm / …
Sets of fast coupling connections specific for any make of sprayers

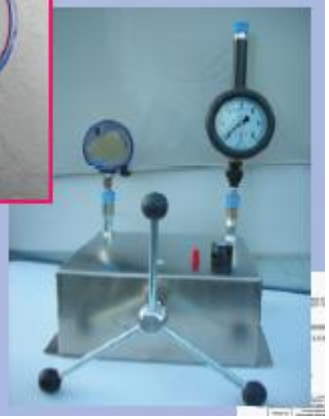


Pressure equipment for air-assisted sprayers - bush and tree crops

Folded frames
for easy transportation

Calibration equipment

	Débit (l/min) à 3,00 bar		
		moyenne	écart-type
N° du lot : "TEE2-6"	Teejet XR 8001	0,398	0,001
	Teejet XR 8002	0,808	0,001
	Teejet XR 8004	1,582	0,001
	Teejet XR 8006	2,343	0,004
	Teejet XR 8010	3,941	0,005



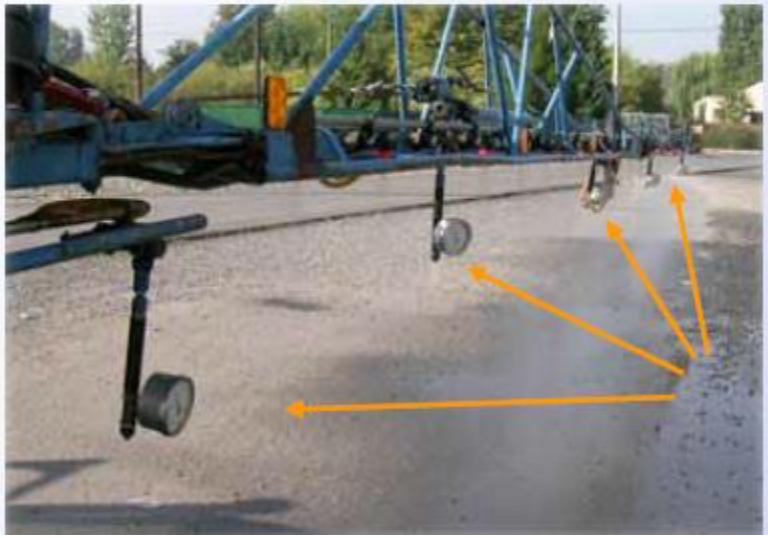
Reference nozzles to calibrate the flowrate test bench

European Commission

Consumers, Health And Food Executive Agency

European Commission

Equipment for field crop sprayers



janv-06		Débit de référence à 3 bars (l/min)				
		rép 1	rép 2	rép 3	moyenne	écart-type
N° du lot 06-3	vert	0,6003	0,6013	0,6009	0,6008	0,00051
	bleu	1,2026	1,2042	1,2044	1,2037	0,00104
	rouge	1,5894	1,5891	1,5892	1,5892	0,00015
	gris	2,3905	2,3886	2,3886	2,3892	0,00108

European Commission

Agricultural and forestry machinery — Inspection of sprayers in use

Part 1: General

ISO 16122 consists of the following parts, under the general title *Agricultural and forestry machinery — Inspection of sprayers in use*:

— *Part 1: General*

— *Part 2: Horizontal boom sprayers*

— *Part 3: Sprayers for bush and tree crops*

— *Part 4: Fixed and semi-mobile sprayers*

European Commission

Agricultural and forestry machinery — Inspection of sprayers in use
Part 1: General

Agricultural and forestry machinery — Inspection of sprayers in use
Part 2: Horizontal boom sprayers

Agricultural and forestry machinery — Inspection of sprayers in use
Part 3: Sprayers for bush and tree crops

Agricultural and forestry machines — Inspection of sprayers in use
Part 4: Fixed and semi mobile sprayers

European Commission

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 16122-1

March 2015

ICS 65.060.40

English Version

Agricultural and forestry machinery - Inspection of sprayers in use - Part 1: General (ISO 16122-1:2015)

Matériel agricole et forestier - Contrôle des pulvérisateurs en service - Partie 1: Généralités (ISO 16122-1:2015)

Land- und Forstmaschinen - Kontrolle von in Gebrauch befindlichen Pflanzenschutzgeräten - Teil 1: Allgemeines (ISO 16122-1:2015)

Annex A
(informative)

Parts of ISO 16122 dealing with specific sprayer types

Table A.1 sets out the subject of each of the other parts of ISO 16122.

Table A.1 — Parts of ISO 16122 dealing with specific sprayer types

Criteria	Part 2	Part 3	Part 4	Subject of future part of ISO 16122			
	Horizontal boom sprayers	Sprayers for bush and tree crops	Fixed and semi-mobile sprayers	Portable sprayers[a]	Foggers	Train-mounted sprayers	Aerial application platforms
Types of sprayers/ driving power							
Tractor-mounted	X	X			X		
Tractor-trailed	X	X			X		
Self-propelled	X	X			X		
Truck/all-terrain vehicle	X	X			X		
Quad-mounted	X	X			X		
Quad-trailed	X	X			X		

European Commission

Table A.1 *(continued)*

Criteria	Part 2	Part 3	Part 4	Subject of future part of ISO 16122			
	Horizontal boom sprayers	Sprayers for bush and tree crops	Fixed and semi-mobile sprayers	Portable sprayers[a]	Foggers	Train-mounted sprayers	Aerial application platforms
Transportation							
Non-assisted	X	X	X	X	X	X	X
Air-assisted	X	X	X	X			
Electrostatic	X	X					X
Form of application							
Liquid droplets	X	X	X	X	X	X	X
Liquid contact							
Solid							
Gas							
Injection							
Indirect	X	X	X	X	X	X	X
Direct (specific sprayer)	X	X	X			X	
Direct (additional device on conventional sprayer)	X	X	X			X	

Agricultural and forestry machinery — Inspection of sprayers in use

Part 2: Horizontal boom sprayers

4.2 Pump(s)

4.2.1 Capacity

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

a) The pump capacity shall be at least 90 % of its original nominal flow given by the sprayer manufacturer or another minimum pump capacity given by the sprayer manufacturer.

Compliance shall be checked by measurement according to 5.2.1.2.2 or 5.2.1.2.3.

b) Or, alternatively, the pump(s) shall have sufficient flow rate capacity in order to be able to spray while maintaining a visible agitation as specified in 4.3.1.

Compliance shall be checked by inspection.

4.5.2.2 Scale of analogue pressure indicator

The scale of analogue pressure indicators shall provide graduations:

— at least every 0,2 bar[1)] 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.

Compliance shall be checked by inspection.

4.5.2.3 Accuracy of pressure indicator

The accuracy of the pressure indicator shall be

— ± 0,2 bar for working pressures at 2 bar and below,

— ± 10 % of the real value for pressures at 2 bar and above.

This requirement shall be achieved within the working pressure range suitable for the nozzles mounted on the sprayer under test.

Compliance shall be checked by measurement according to 5.3.

4.8.3 Nozzle spacing/orientation

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

The nozzle spacing (adjacent nozzle centre to centre distance) shall be within ± 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.

Compliance shall be checked by inspection and measurement.

4.8.5 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 1 % of the half working width.

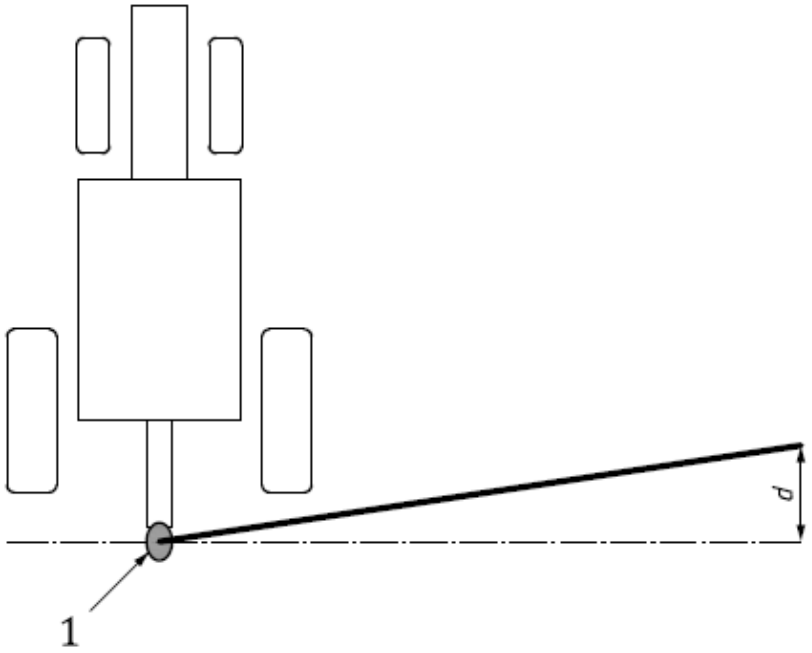
4.8.4.1 Vertical position

When measured with the sprayer stationary, the vertical distance between the lower edges of each nozzle and a horizontal reference line (e.g. on a level horizontal surface) shall not vary more than ± 10 cm or ± 0,5 % of the working width, whichever is the highest.

4.8.4.2 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 ± 2,5 % of the boom width. See Figure 1.

Compliance shall be checked by inspection and measurement.



Key

1 boom centre

d maximum deformation from centre-frame ≤ 2,5 % of boom width

The pressures shall be read at the level of the sections.

For each flow rate, the reference outflow, Q, corrected for the pressure applied during the test (P_1), shall be calculated as follows:

Q = Number of nozzles × average of single nozzle flow rates, l/min

The following formula can be used to calculate the adjusted single nozzle flow rate, d_1, for the applied pressure P_1:

$$d_1 = d_2 \times \sqrt{\frac{P_1}{P_2}}$$

where

d_2 is the single nozzle flow rate measured in 5.7 or with the measuring cylinder;

P_2 is the pressure during the measurement of the single nozzle flow rate d_2.

5.5 System for controlling forward speed

The actual travel speed shall be measured with an error not exceeding ± 2,5 %.

The measurement shall be carried out continuously over a distance of at least 50 m located on a flat area. The beginning and the end of the test distance shall be clearly marked. A reference point shall be marked on the sprayer to assist in the identification of the start and finish of the test.

— The tractor or self-propelled sprayer shall be pre-set to achieve a constant forward speed close to the operating speed. The hand accelerator can be used to set the speed of the engine.

— The set test speed shall be achieved before the 1st mark on the test track is reached.

— Timing shall start, by means of the stop watch, when the reference point on the sprayer aligns with the 1st mark on the test track.

— During travel, the speed indicated by the sensor shall be recorded.

— Timing shall stop when the reference point on the sprayer aligns with 2nd mark on the test track.

The measured forward speed shall be calculated using the following formula:

$$v = 3{,}6 \times \frac{d}{t}$$

where

v is the measured forward speed, expressed in kilometres per hour (km/h) and compared with the speed indicated by the sprayer' sensor;

d is the distance travelled, expressed in metres (m);

t is the duration, expressed in seconds (s).

5.11 Pressure distribution

The test shall be carried out with the highest flow rate nozzle provided on the sprayer and at a pressure within the working pressure range given by the nozzle manufacturer.

A calibrated test pressure indicator (see 5.3.1) shall be fitted at the same position as a nozzle at the inlet of each boom section.

The average inlet pressure from all sections shall be calculated and compared to individual inlet pressures.

A calibrated test pressure indicator shall be fitted at the same position as a nozzle at the outermost end of each boom section.

For each section, the pressure drop between the inlet and the outermost end shall be calculated using the following formula:

$$\text{Pressure drop} = 100 \times \frac{(P_0 - P_1)}{P_0}$$

where

P_0 is the inlet pressure of the section;

P_1 is the outermost end pressure of the same section.

European Commission

New Sprayer – EN ISO 16119

- A new sprayer has to fulfill EN ISO 16119 (2006/42/EC).
- The EN ISO 16119 ensures a higher level of performance than required by EN ISO 16122.
- In-factory tests are already undertaken during the production process.
- The self-certification process including the Declaration of Conformity provided with the machine is not a type approval, but it means that the sprayer delivered complies with the Machinery Directive 2006/42/EC.

European Commission

Sprayer in Use – EN ISO 16122

- In-factory inspection is not new – several examples have been present on SPISE workshops in the past
- Some manufacturers have their factory approved by D, NL, … authorities and do in-factory inspection of sprayers
- Markets as D, NL, UK have a long time experience with the test of new sprayers
- In some countries as Germany was only a reduced test demanded
- Some how is this situation history, as we have now the amendment of the Machinery Directive (MD) and Sustainable Use Directive (SUD) in force
- Today we have far more environmental requirements for new sprayers, which are more demanding than those of the inspection of sprayers in use
- Manufactures did a big effort in self certification

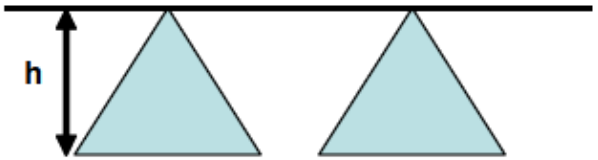
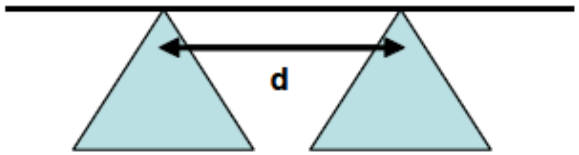
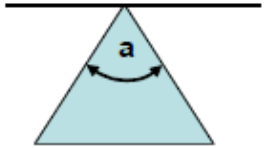
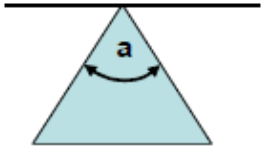
Example of Testing Procedures

Comparison of testing requirements of EN ISO 16122 and requirements for new sprayers to meet EN ISO 16119

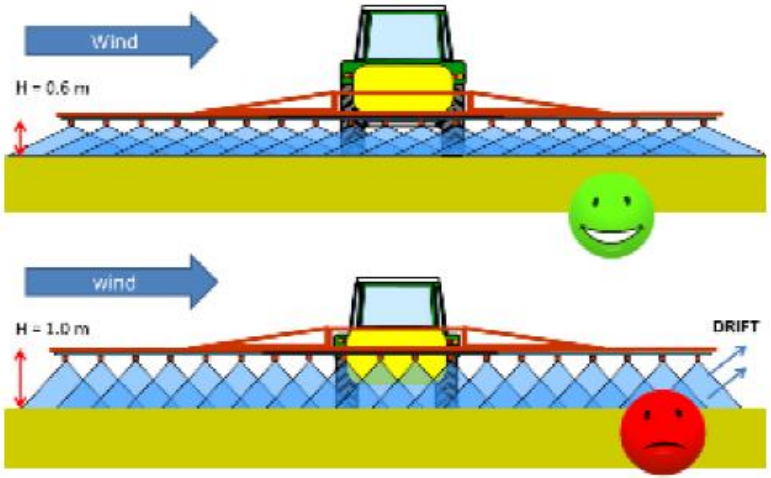
Requirements of EN ISO 16122-2	Visual check / Function test	Measurement	Factory Testing to meet CoP (EN ISO 16119)
Static leaks	x		During the tank sensor calibration. During the Pressure regulator set up.
Pump capacity		x	New pump (not wear out) - supplier quality declaration, check quality statistics from supplier. Or internal check with flow meter - selectively every X machine from Y, if internally produced pumps. - Provide information from pump supplier. - Ensure correct pump / machine configuration. (BOM list) Pump capacity on the type plate.
Nozzle spacing/orientation	x	x	Drill fixtures (Quality control), Final test area measurement, visual check, or Patternator test
Pressure drop		x	Per design, - provide Technical Construction File results discuss if measurement is needed.

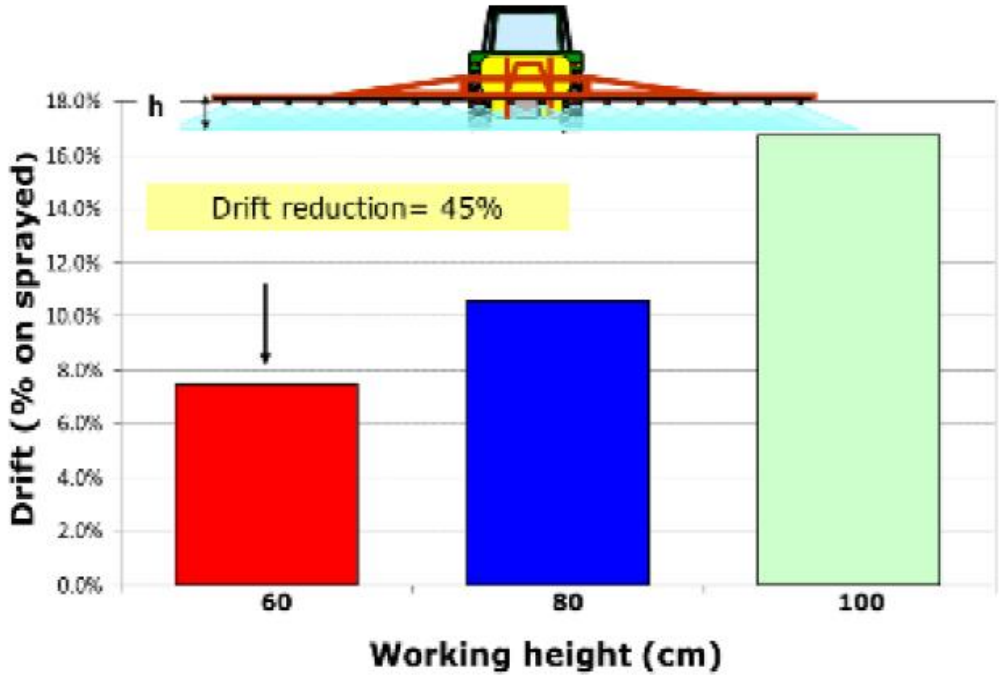

EN 13790
40
60
20
80
bar
0
100
SEP


EN 13790

	 boom height (m)		
 Nozzles spacing (m)	Hollow cone nozzles 	Flat fan nozzles 	
	α = 80°/90°	α = 80°/90°	α = 110°/120°
0,25	-	-	*0,30*
0,33	*0,50*	*0,50*	*0,40*
0,50	*0,75*	*0,75*	*0,50*

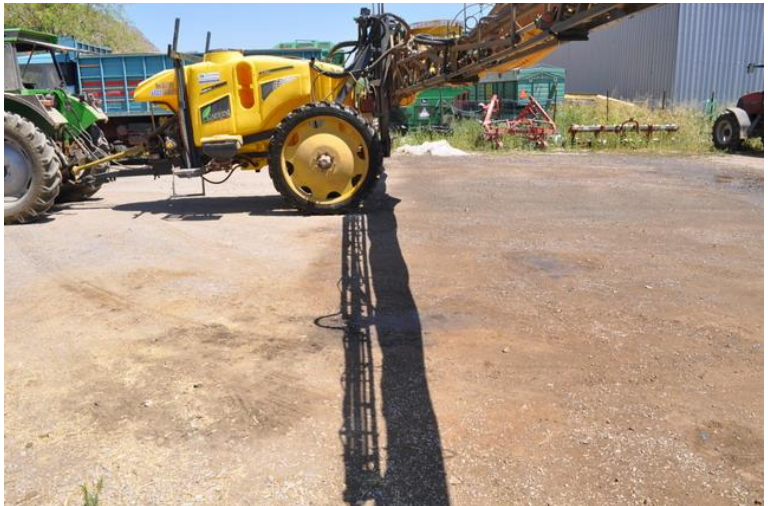
Influence of boom height on spray drift





The Greek Implementation of the EN 13790 Part 1

The Greek Implementation of the EN 13790 Part 1



The Greek Implementation of the EN 13790 Part 1

An “alternative” way to check the uniformity in Greek Whether Conditions

The Greek Implementation of the EN 13790 Part 1

The Greek Implementation of the EN 13790 Part 1

The visual observation ……

The Greek Implementation of the EN 13790 Part 1

The visual observation ……

The Greek Implementation of the EN 13790 Part 1

The visual observation ……

The Greek Implementation of the EN 13790 Part 1

A manufacturer error

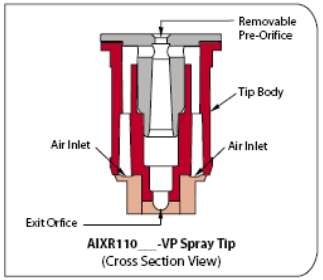
The Greek Implementation of the EN 13790 Part 1

European Commission

How to choose the correct Nozzle

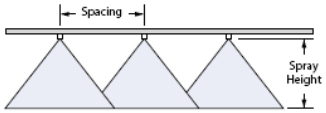
	bar	CAPACITY ONE NOZZLE IN l/min	l/ha 50 cm												
			4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
AIXR110015 (100)	1.0	0.34	102	81.6	68.0	58.3	51.0	40.8	34.0	25.5	22.7	20.4	16.3	13.6	11.7
	2.0	0.48	144	115	96.0	82.3	72.0	57.6	48.0	36.0	32.0	28.8	23.0	19.2	16.5
	3.0	0.59	177	142	118	101	88.5	70.8	59.0	44.3	39.3	35.4	28.3	23.6	20.2
	4.0	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	5.0	0.76	228	182	152	130	114	91.2	76.0	57.0	50.7	45.6	36.5	30.4	26.1
	6.0	0.83	249	199	166	142	125	99.6	83.0	62.3	55.3	49.8	39.8	33.2	28.5
AIXR11002 (50)	1.0	0.46	138	110	92.0	78.9	69.0	55.2	46.0	34.5	30.7	27.6	22.1	18.4	15.8
	2.0	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	3.0	0.79	237	190	158	135	119	94.8	79.0	59.3	52.7	47.4	37.9	31.6	27.1
	4.0	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	5.0	1.02	306	245	204	175	153	122	102	76.5	68.0	61.2	49.0	40.8	35.0
	6.0	1.12	336	269	224	192	168	134	112	84.0	74.7	67.2	53.8	44.8	38.4
AIXR110025 (50)	1.0	0.57	171	137	114	97.7	85.5	68.4	57.0	42.8	38.0	34.2	27.4	22.8	19.5
	2.0	0.81	243	194	162	139	122	97.2	81.0	60.8	54.0	48.6	38.9	32.4	27.8
	3.0	0.99	297	238	198	170	149	119	99.0	74.3	66.0	59.4	47.5	39.6	33.9
	4.0	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	5.0	1.28	384	307	256	219	192	154	128	96.0	85.3	76.8	61.4	51.2	43.9
	6.0	1.40	420	336	280	240	210	168	140	105	93.3	84.0	67.2	56.0	48.0
AIXR11003 (50)	1.0	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	2.0	0.96	288	230	192	165	144	115	96.0	72.0	64.0	57.6	46.1	38.4	32.9
	3.0	1.18	354	283	236	202	177	142	118	88.5	78.7	70.8	56.6	47.2	40.5
	4.0	1.36	408	326	272	233	204	163	136	102	90.7	81.6	65.3	54.4	46.6
	5.0	1.52	456	365	304	261	228	182	152	114	101	91.2	73.0	60.8	52.1
	6.0	1.67	501	401	334	286	251	200	167	125	111	100	80.2	66.8	57.3
AIXR11004 (50)	1.0	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	2.0	1.29	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.2
	3.0	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
	6.0	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5
AIXR11005 (50)	1.0	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	2.0	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	3.0	1.97	591	473	394	338	296	236	197	148	131	118	94.6	78.8	67.5
	4.0	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
	5.0	2.54	762	610	508	435	381	305	254	191	169	152	122	102	87.1
	6.0	2.79	837	670	558	478	419	335	279	209	186	167	134	112	95.7
AIXR11006 (50)	1.0	1.37	411	329	274	235	206	164	137	103	91.3	82.2	65.8	54.8	47.0
	2.0	1.94	582	466	388	333	291	233	194	146	129	116	93.1	77.6	66.5
	3.0	2.37	711	569	474	406	356	284	237	178	158	142	114	94.8	81.3
	4.0	2.74	822	658	548	470	411	329	274	206	183	164	132	110	93.9
	5.0	3.06	918	734	612	525	459	367	306	230	204	184	147	122	105
	6.0	3.35	1005	804	670	574	503	402	335	251	223	201	161	134	115

Note: Always double check your application rates.
Tabulations are based on spraying water at 70°F (21°C).



AIXR110___-VP Spray Tip
(Cross Section View)

CONTACT PRODUCT	SYSTEMIC PRODUCT	DRIFT MANAGEMENT
GOOD	EXCELLENT	EXCELLENT



Optimum Spray Height

	50 cm
110°	50 cm

See pages 173–187 for useful formulas and information.

How to order:
Specify tip number.
Example:
AIXR11004VP – Polymer with VisiFlo color-coding

European Commission

How to choose the correct Nozzle and the working parameters

	bar	CAPACITY ONE NOZZLE IN l/min	l/ha 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	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	2.0	1.29	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.2
	3.0	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
	6.0	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5
AIXR11005 (50)	1.0	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	2.0	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	3.0	1.97	591	473	394	338	296	236	197	148	131	118	94.6	78.8	67.5
	4.0	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
	5.0	2.54	762	610	508	435	381	305	254	191	169	152	122	102	87.1
	6.0	2.79	837	670	558	478	419	335	279	209	186	167	134	112	95.7

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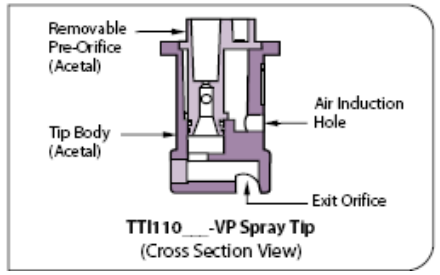
How to choose the correct Nozzle

	bar	DROP SIZE	CAPACITY ONE NOZZLE IN l/min	l/ha 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
TTI110015 (100)	1.0	XC	0.34	102	81.6	68.0	58.3	51.0	40.8	34.0	25.5	22.7	20.4	16.3	13.6	11.7
	2.0	XC	0.48	144	115	96.0	82.3	72.0	57.6	48.0	36.0	32.0	28.8	23.0	19.2	16.5
	3.0	XC	0.59	177	142	118	101	88.5	70.8	59.0	44.3	39.3	35.4	28.3	23.6	20.2
	4.0	XC	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	5.0	XC	0.76	228	182	152	130	114	91.2	76.0	57.0	50.7	45.6	36.5	30.4	26.1
	6.0	XC	0.83	249	199	166	142	125	99.6	83.0	62.3	55.3	49.8	39.8	33.2	28.5
	7.0	XC	0.90	270	216	180	154	135	108	90.0	67.5	60.0	54.0	43.2	36.0	30.9
TTI11002 (50)	1.0	XC	0.46	138	110	92.0	78.9	69.0	55.2	46.0	34.5	30.7	27.6	22.1	18.4	15.8
	2.0	XC	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	3.0	XC	0.79	237	190	158	135	119	94.8	79.0	59.3	52.7	47.4	37.9	31.6	27.1
	4.0	XC	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	5.0	XC	1.02	306	245	204	175	153	122	102	76.5	68.0	61.2	49.0	40.8	35.0
	6.0	XC	1.12	336	269	224	192	168	134	112	84.0	74.7	67.2	53.8	44.8	38.4
	7.0	XC	1.21	363	290	242	207	182	145	121	90.8	80.7	72.6	58.1	48.4	41.5
TTI110025 (50)	1.0	XC	0.57	171	137	114	97.7	85.5	68.4	57.0	42.8	38.0	34.2	27.4	22.8	19.5
	2.0	XC	0.81	243	194	162	139	122	97.2	81.0	60.8	54.0	48.6	38.9	32.4	27.8
	3.0	XC	0.99	297	238	198	170	149	119	99.0	74.3	66.0	59.4	47.5	39.6	33.9
	4.0	XC	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	5.0	XC	1.28	384	307	256	219	192	154	128	96.0	85.3	76.8	61.4	51.2	43.9
	6.0	XC	1.40	420	336	280	240	210	168	140	105	93.3	84.0	67.2	56.0	48.0
	7.0	XC	1.51	453	362	302	259	227	181	151	113	101	90.6	72.5	60.4	51.8
TTI11003 (50)	1.0	XC	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	2.0	XC	0.96	288	230	192	165	144	115	96.0	72.0	64.0	57.6	46.1	38.4	32.9
	3.0	XC	1.18	354	283	236	202	177	142	118	88.5	78.7	70.8	56.6	47.2	40.5
	4.0	XC	1.36	408	326	272	233	204	163	136	102	90.7	81.6	65.3	54.4	46.6
	5.0	XC	1.52	456	365	304	261	228	182	152	114	101	91.2	73.0	60.8	52.1
	6.0	XC	1.67	501	401	334	286	251	200	167	125	111	100	80.2	66.8	57.3
	7.0	XC	1.80	540	432	360	309	270	216	180	135	120	108	86.4	72.0	61.7
TTI11004 (50)	1.0	XC	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	XC	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	XC	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	XC	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
	6.0	XC	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5
	7.0	XC	2.41	723	578	482	413	362	289	241	181	161	145	116	96.4	82.6
TTI11005 (50)	1.0	XC	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	2.0	XC	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	3.0	XC	1.97	591	473	394	338	296	236	197	148	131	118	94.6	78.8	67.5
	4.0	XC	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
	5.0	XC	2.54	762	610	508	435	381	305	254	191	169	152	122	102	87.1
	6.0	XC	2.79	837	670	558	478	419	335	279	209	186	167	134	112	95.7
	7.0	XC	3.01	903	722	602	516	452	361	301	226	201	181	144	120	103
TTI11006 (50)	1.0	XC	1.37	411	329	274	235	206	164	137	103	91.3	82.2	65.8	54.8	47.0
	2.0	XC	1.94	582	466	388	333	291	233	194	146	129	116	93.1	77.6	66.5
	3.0	XC	2.37	711	569	474	406	356	284	237	178	158	142	114	94.8	81.3
	4.0	XC	2.74	822	658	548	470	411	329	274	206	183	164	132	110	93.9
	5.0	XC	3.06	918	734	612	525	459	367	306	230	204	184	147	122	105
	6.0	XC	3.35	1005	804	670	574	503	402	335	251	223	201	161	134	115
	7.0	XC	3.62	1086	869	724	621	543	434	362	272	241	217	174	145	124

Note: Always double check your application rates.
Tabulations are based on spraying water at 70°F (21°C).

Very Fine · Fine · Medium · Coarse · Very Coarse · Extremely Coarse



TTI110___-VP Spray Tip
(Cross Section View)

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How to choose the correct Nozzle

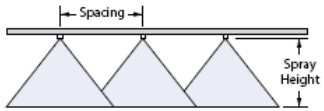
	bar	DROP SIZE 80°	DROP SIZE 110°	CAPACITY ONE NOZZLE IN l/min	l/ha 50cm 4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
XR8001 XR11001 (100)	1.0	M	F	0.23	69.0	55.2	46.0	39.4	34.5	27.6	23.0	17.3	15.3	13.8	11.0	9.2	7.9
	1.5	F	F	0.28	84.0	67.2	56.0	48.0	42.0	33.6	28.0	21.0	18.7	16.8	13.4	11.2	9.6
	2.0	F	F	0.32	96.0	76.8	64.0	54.9	48.0	38.4	32.0	24.0	21.3	19.2	15.4	12.8	11.0
	2.5	F	F	0.36	108	86.4	72.0	61.7	54.0	43.2	36.0	27.0	24.0	21.6	17.3	14.4	12.3
	3.0	F	F	0.39	117	93.6	78.0	66.9	58.5	45.8	39.0	29.3	26.0	23.4	18.7	15.6	13.4
	4.0	F	VF	0.45	135	108	90.0	77.1	67.5	54.0	45.0	33.8	30.0	27.0	21.6	18.0	15.4
XR80015 XR110015 (100)	1.0	M	F	0.34	102	81.6	68.0	58.3	51.0	40.8	34.0	25.5	22.7	20.4	16.3	13.6	11.7
	1.5	M	F	0.42	126	101	84.0	72.0	63.0	50.4	42.0	31.5	28.0	25.2	20.2	16.8	14.4
	2.0	F	F	0.48	144	115	96.0	82.3	72.0	57.6	48.0	36.0	32.0	28.8	23.0	19.2	16.5
	2.5	F	F	0.54	162	130	108	92.6	81.0	64.8	54.0	40.5	36.0	32.4	25.9	21.6	18.5
	3.0	F	F	0.59	177	142	118	101	88.5	70.8	59.0	44.3	39.3	35.4	28.3	23.6	20.2
	4.0	F	F	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
XR8002 XR11002 (50)	1.0	M	M	0.46	138	110	92.0	78.9	69.0	55.2	46.0	34.5	30.7	27.6	22.1	18.4	15.8
	1.5	M	F	0.56	168	134	112	96.0	84.0	67.2	56.0	42.0	37.3	33.6	26.9	22.4	19.2
	2.0	M	F	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	2.5	M	F	0.72	216	173	144	123	108	86.4	72.0	54.0	48.0	43.2	34.6	28.8	24.7
	3.0	F	F	0.79	237	190	158	135	119	94.8	79.0	59.3	52.7	47.4	37.9	31.6	27.1
	4.0	F	F	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
XR110025 (50)	1.0		M	0.57	171	137	114	97.7	85.5	68.4	57.0	42.8	38.0	34.2	27.4	22.8	19.5
	1.5		M	0.70	210	168	140	120	105	84.0	70.0	52.5	46.7	42.0	33.6	28.0	24.0
	2.0		F	0.81	243	194	162	139	122	97.2	81.0	60.8	54.0	48.6	38.9	32.4	27.8
	2.5		F	0.90	270	216	180	154	135	108	90.0	67.5	60.0	54.0	43.2	36.0	30.9
	3.0		F	0.99	297	238	198	170	149	119	99.0	74.3	66.0	59.4	47.5	39.6	33.9
	4.0		F	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
XR8003 XR11003 (50)	1.0	M	M	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	1.5	M	M	0.83	249	199	166	142	125	99.6	83.0	62.3	55.3	49.8	39.8	33.2	28.5
	2.0	M	F	0.96	288	230	192	165	144	115	96.0	72.0	64.0	57.6	46.1	38.4	32.9
	2.5	M	F	1.08	324	259	216	185	162	130	108	81.0	72.0	64.8	51.8	43.2	37.0
	3.0	M	F	1.18	354	283	236	202	177	142	118	88.5	78.7	70.8	56.6	47.2	40.5
	4.0	M	F	1.36	408	326	272	233	204	163	136	102	90.7	81.6	65.3	54.4	46.6
XR8004 XR11004 (50)	1.0	C	M	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	1.5	M	M	1.12	336	269	224	192	168	134	112	84.0	74.7	67.2	53.8	44.8	38.4
	2.0	M	M	1.29	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.2
	2.5	M	M	1.44	432	346	288	247	216	173	144	108	96.0	86.4	69.1	57.6	49.4
	3.0	M	M	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	M	F	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
XR8005 XR11005 (50)	1.0	C	C	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	1.5	C	M	1.39	417	334	278	238	209	167	139	104	92.7	83.4	66.7	55.6	47.7
	2.0	C	M	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	2.5	M	M	1.80	540	432	360	309	270	216	180	135	120	108	86.4	72.0	61.7
	3.0	M	M	1.97	591	473	394	338	296	236	197	148	131	118	94.6	78.8	67.5
	4.0	M	M	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
XR8006 XR11006 (50)	1.0	C	C	1.37	411	329	274	235	206	164	137	103	91.3	82.2	65.8	54.8	47.0
	1.5	C	C	1.68	504	403	336	288	252	202	168	126	112	101	80.6	67.2	57.6
	2.0	C	M	1.94	582	466	388	333	291	233	194	146	129	116	93.1	77.6	66.5
	2.5	C	M	2.16	648	518	432	370	324	259	216	162	144	130	104	86.4	74.1
	3.0	C	M	2.37	711	569	474	406	356	284	237	178	158	142	114	94.8	81.3
	4.0	C	M	2.74	822	658	548	470	411	329	274	206	183	164	132	110	93.9
XR8008 XR11008 (50)	1.0	VC	C	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	1.5	VC	C	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5
	2.0	C	C	2.58	774	619	516	442	387	310	258	194	172	155	124	103	88.5
	2.5	C	C	2.88	864	691	576	494	432	346	288	216	192	173	138	115	98.7
	3.0	C	M	3.16	948	758	632	542	474	379	316	237	211	190	152	126	108
	4.0	C	M	3.65	1095	876	730	626	548	438	365	274	243	219	175	146	125
XR8010† XR11010†	1.0			2.28	684	547	456	391	342	274	228	171	152	137	109	91.2	78.2
	1.5			2.79	837	670	558	478	419	335	279	209	186	167	134	112	95.7
	2.0			3.23	969	775	646	554	485	388	323	242	215	194	155	129	111
	2.5			3.61	1083	866	722	619	542	433	361	271	241	217	173	144	124
	3.0			3.95	1185	948	790	677	593	474	395	296	263	237	190	158	135
	4.0			4.56	1368	1094	912	782	684	547	456	342	304	274	219	182	156
XR8015† XR11015†	1.0			3.42	1026	821	684	586	513	410	342	257	228	205	164	137	117
	1.5			4.19	1257	1006	838	718	629	503	419	314	279	251	201	168	144
	2.0			4.83	1449	1159	966	828	725	580	483	362	322	290	232	193	166
	2.5			5.40	1620	1296	1080	926	810	648	540	405	360	324	259	216	185
	3.0			5.92	1776	1421	1184	1015	888	710	592	444	395	355	284	237	203
	4.0			6.84	2052	1642	1368	1173	1026	821	684	513	456	410	328	274	235

Note: Always double check your application rates.
Tabulations are based on spraying water at 70°F (21°C).
†Available in all stainless steel only.

Very Fine · Fine · Medium · Coarse · Very Coarse · Extremely Coarse

CONTACT PRODUCT	SYSTEMIC PRODUCT	DRIFT MANAGEMENT
EXCELLENT	GOOD	GOOD
GOOD*	VERY GOOD*	VERY GOOD*

*At pressures below 30 PSI (2.0 bar)



Optimum Spray Height

	50 cm
80°	75 cm
110°	50 cm

See pages 173–187 for drop size classification, useful formulas and information.

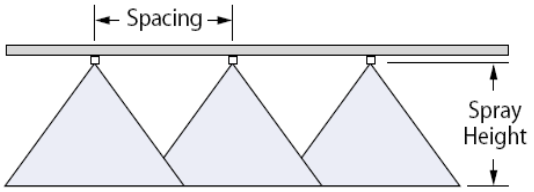
How to order:
Specify tip number.
Examples:

- XR8004VS – Stainless Steel with VisiFlo color-coding
- XR11004-VP – Polymer with VisiFlo color-coding (110° only)
- XR11004-VK – Ceramic with polypropylene VisiFlo color-coding
- XR8010SS – Stainless Steel
- XR11004VB – Brass with VisiFlo color-coding (110° only)

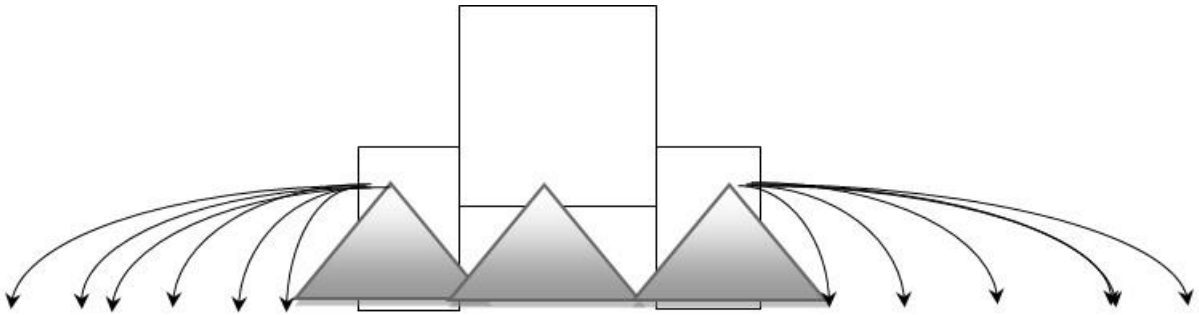
	bar	DROP SIZE 80°	DROP SIZE 110°	CAPACITY ONE NOZZLE IN l/min	l/ha 50 cm: 4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
XRC80015 (100)	1.0	M		0.34	102	81.6	68.0	58.3	51.0	40.8	34.0	25.5	22.7	20.4	16.3	13.6	11.7
	1.5	M		0.42	126	101	84.0	72.0	63.0	50.4	42.0	31.5	28.0	25.2	20.2	16.8	14.4
	2.0	F		0.48	144	115	96.0	82.3	72.0	57.6	48.0	36.0	32.0	28.8	23.0	19.2	16.5
	3.0	F		0.59	177	142	118	101	88.5	70.8	59.0	44.3	39.3	35.4	28.3	23.6	20.2
	4.0	F		0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
XRC8002 XRC11002 (50)	1.0	M	M	0.46	138	110	92.0	78.9	69.0	55.2	46.0	34.5	30.7	27.6	22.1	18.4	15.8
	1.5	M	F	0.56	168	134	112	96.0	84.0	67.2	56.0	42.0	37.3	33.6	26.9	22.4	19.2
	2.0	M	F	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	3.0	F	F	0.79	237	190	158	135	119	94.8	79.0	59.3	52.7	47.4	37.9	31.6	27.1
	4.0	F	F	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
XRC110025 (50)	1.0		M	0.57	171	137	114	97.7	85.5	68.4	57.0	42.8	38.0	34.2	27.4	22.8	19.5
	1.5		M	0.70	210	168	140	120	105	84.0	70.0	52.5	46.7	42.0	33.6	28.0	24.0
	2.0		F	0.81	243	194	162	139	122	97.2	81.0	60.8	54.0	48.6	38.9	32.4	27.8
	3.0		F	0.99	297	238	198	170	149	119	99.0	74.3	66.0	59.4	47.5	39.6	33.9
	4.0		F	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	1.0	M	M	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3

CONTACT PRODUCT	SYSTEMIC PRODUCT	DRIFT MANAGEMENT
EXCELLENT	GOOD	GOOD
GOOD*	VERY GOOD*	VERY GOOD*

*At pressures below 30 PSI (2.0 bar)



The Greek Problem (and not only): How can we implement the EN 13790 in case of spraying field crops with trees (e.g. olive crops) ?



ΑΚΡΟΦΥΣΙΟ ΜΠΑΡΑΣ HYPRO XT-020

ΚΩΔΙΚΟΣ	BAR	ΛΙΤ/1'	ΛΙΤΡΑ/ΣΤΡΕΜΜΑ						ΜΗΚΟΣ ΨΕΚΑΣ.	ΛΙΑΝΙΚΗ ΤΙΜΗ	
			6 Km/h	8 Km/h	10 Km/h	12 Km/h	14 Km/h	16 Km/h		ΧΩΡΙΣ ΦΠΑ	ΜΕ ΦΠΑ
20-183	2	6.5	12.5	9.4	7.5	6.3	5.4	4.7	5.18 ΜΕΤΡΑ @3 BAR	70,00	86,10
	3	7.9	15.3	11.4	9.2	7.6	6.5	5.7			
	4	9.1	17.6	13.2	10.5	8.8	7.5	6.6			
20-175	ΚΙΤ ΑΝΤΑΛΛΑΚΤΙΚΟ ΜΠΕΚ XT-020 									23,57	28,99

20-116	ΚΕΝΤΡΙΚΟ ΜΠΕΚ ΜΠΑΡΑΣ T-12 ΚΟΜΠΛΕ
20-125	ΚΕΝΤΡΙΚΟ ΜΠΕΚ ΜΠΑΡΑΣ T-3 ΚΟΜΠΛΕ

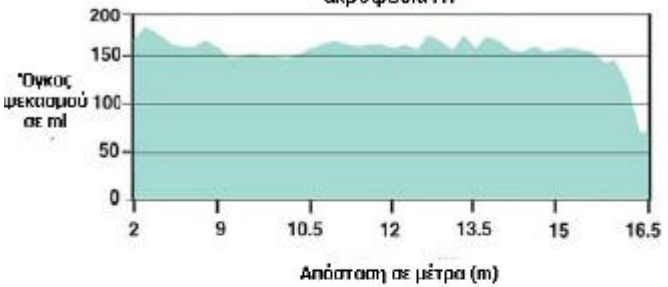
Τυπικές εφαρμογές του ακροφυσίου XT

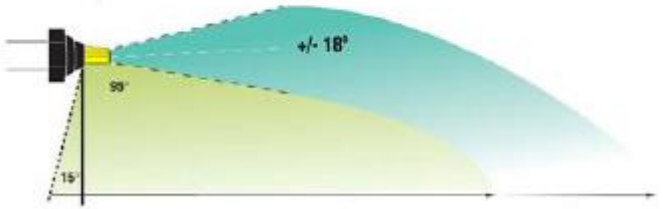
Επέκταση ψεκασμού σε μία μπάρα

Ψεκασμός με ακροφύσιο XT χώρις μπάρα

Ψεκασμός με χρήση μεσαίου ακροφυσίου

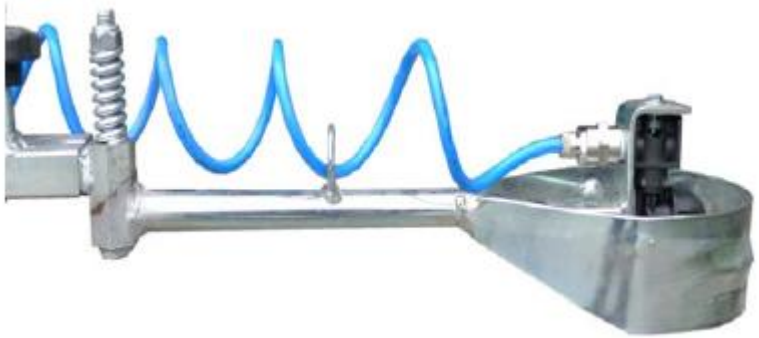
Τυπικό ίχνος ψεκασμού που παράγεται από τα ακροφύσια XT

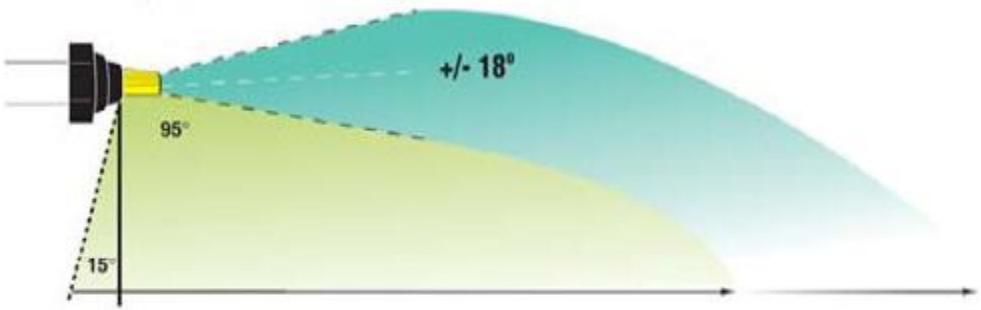




Ρυθμιζόμενο μήκος λοβού ψεκασμού

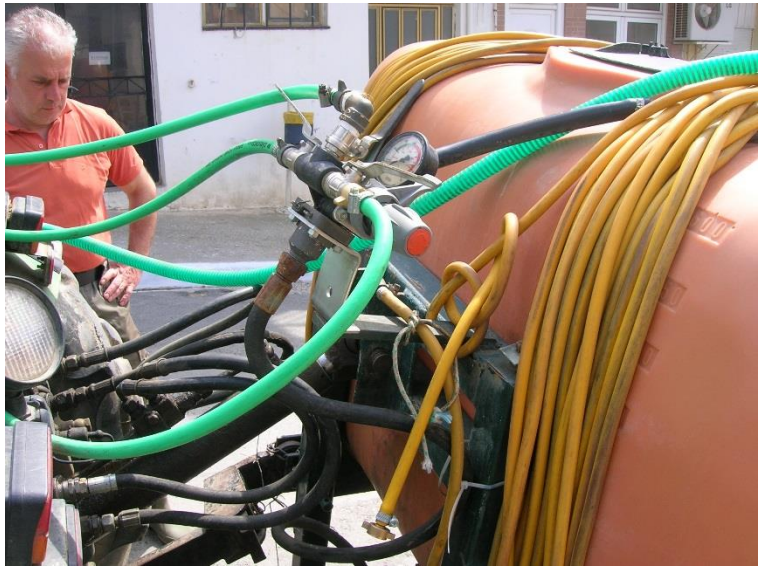
Ο λοβός ψεκασμού μπορεί να συρρηθεί ή να μεγεθεί ρυθμίζοντας την γωνία του ακροφυσίου

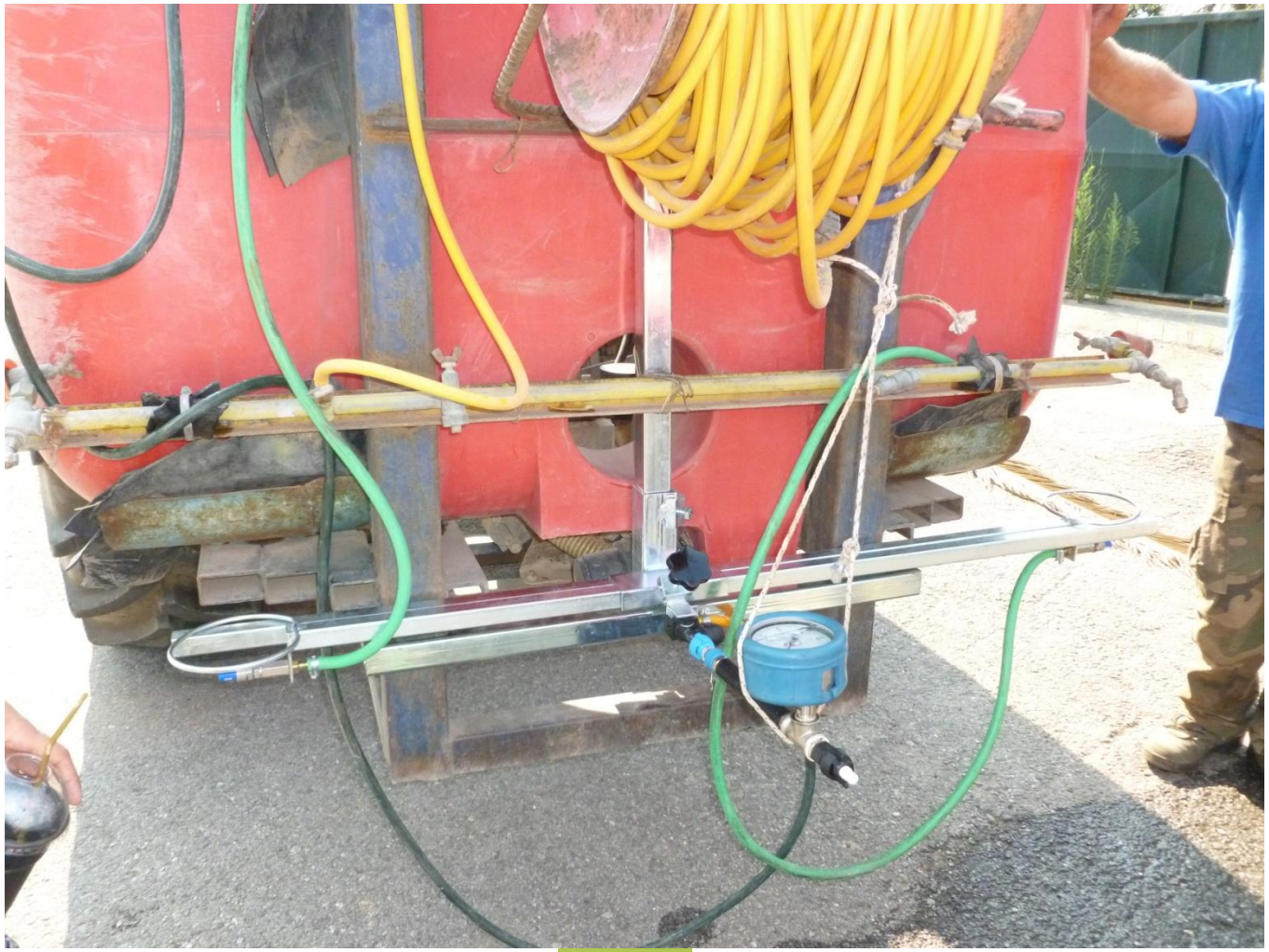


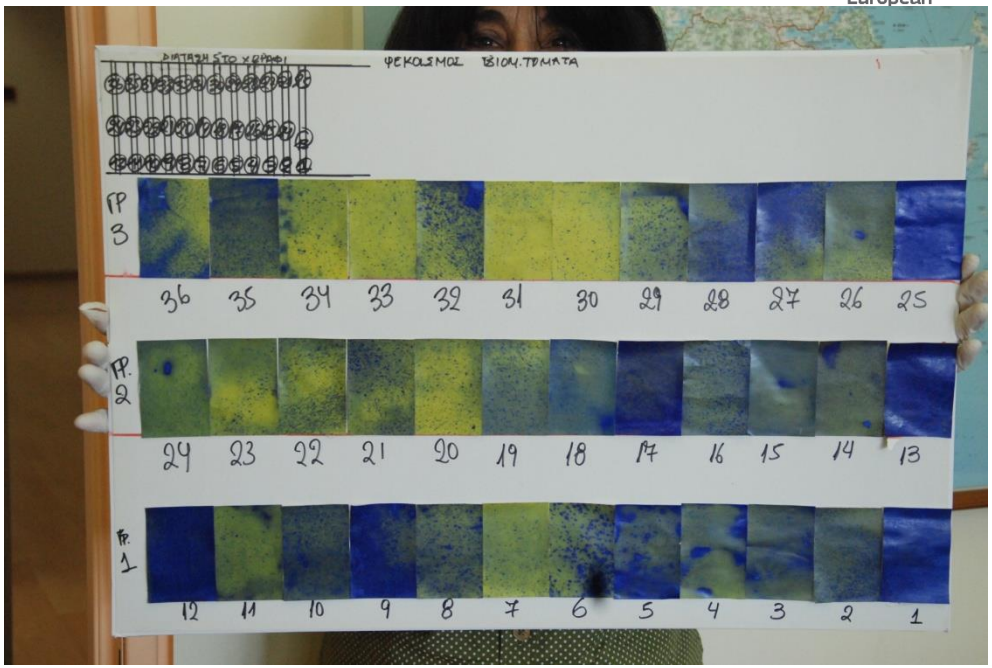


Ρυθμιζόμενο μήκος λοβού ψεκασμού

Ο λοβός ψεκασμού μπορεί να αυξηθεί ή να μειωθεί ρυθμίζοντας την γωνία του ακροφυσίου







Downy Mildew

Nozzle type	Air induction		Conventional					Low drift (pre-orifice)			
Nozzle design	Flat fan		Flat fan			Hollow cone		Flat fan		Inclined fan	
Spray quality	'Finer'	'Coarser'	Fine	Medium	Coarse	Fine	Medium	Medium	Coarse	Medium	Coarse
Likely drift potential	Low	Low	High	Med/low	Low	High	High	Low	Low	Medium	Low
HYPRO nozzle example *(Use Hypro nozzle tables to select the appropriate nozzle size and pressure)*	 Guardian Air*	 ULD/Drift Beta	 Hypro	 Flat fan and VP	 Flat fans	 Hollow cone	 Disc&cone	 Hypro	 Lo-Drift	 Guardian	
Soil-acting herbicides											
Pre and early post emergence	▲	▲		▲	▲			▲	▲	▲	▲
Foliage-acting herbicides											
Small grasses (<3 leaves)			▲▲	▲		▲	▲				
Grasses (>3 leaves)	▲		▲	▲▲				▲		▲	
Broad leaved weeds (up to 2 cm across)			▲▲	▲▲							
Broad leaved weeds (2 - 5 cm across)	▲▲		▲	▲▲			▲			▲	
Broad leaved weeds (>5 cm across)	▲▲▲			▲▲			▲	▲		▲	
Large weeds: non-selective (e.g. glyphosate)	▲▲▲	▲		▲▲	▲			▲▲	▲	▲	▲
Cereal PGRs and eyespot fungicides											
Pre and post GS32	▲▲▲			▲▲				▲		▲	
Cereal fungicides											
T_0 - up to GS23	▲▲		▲	▲▲			▲	▲		▲	
T_1 and T_2 - GS 24-49	▲▲▲	▲	▲	▲▲			▲	▲		▲	
T_3 - after GS50 (ear spray)	▲▲▲			▲▲			▲				
Cereal insecticides											
Autumn	▲		▲	▲▲			▲				
Ear spray	▲▲		▲▲	▲		▲	▲				
Oilseed rape fungicides											
Vegetative phase	▲		▲	▲▲			▲	▲		▲	
From green bud	▲▲▲		▲	▲▲			▲	▲		▲	
Oilseed rape insecticides											
Vegetative phase			▲	▲▲			▲				
From green bud	▲▲▲		▲▲	▲		▲	▲				

Nozzle selection

for conventional boom sprayers treating cereals and oilseed rape

Nozzle type	Air induction		Conventional					Low drift (pre-orifice)			
	Flat fan		Flat fan			Hollow cone		Flat fan		Deflector	
Likely spray quality	Small droplet	Large droplet	Fine	Medium	Coarse	Fine	Medium	Medium	Coarse	Medium	Coarse
Soil-acting herbicides											
Pre- and early post-emergence	▲	▲✱		▲	▲			▲	▲	▲	▲
Foliage-acting herbicides											
Grass weeds – 3 leaves or less			▲▲	▲✱		▲	▲				
Grass weeds – more than 3 leaves	▲✱		▲	▲▲				▲		▲	
Broad-leaved weeds – up to 2cm across			▲▲	▲▲✱							
Broad-leaved weeds – 2–5cm across	▲✱		▲	▲▲			▲			▲	
Broad-leaved weeds – more than 5cm	▲▲✱			▲▲			▲	▲		▲	
Non-selective (eg glyphosate)	▲▲	▲✱		▲▲	▲			▲▲	▲	▲	▲
Cereal plant growth regulators (PGR) and eyespot fungicides											
Up to GS32	▲✱			▲▲				▲		▲	
After GS32	▲▲✱			▲▲				▲		▲	
Cereal fungicides											
Up to GS23	▲✱		▲	▲▲			▲	▲		▲	
Up to GS24–49	▲▲	▲✱	▲	▲▲			▲	▲		▲	
After GS50 (ear spray)	▲▲✱			▲▲			▲				
Cereal insecticides											
Cereals: autumn spray	▲✱		▲	▲▲			▲				
Cereals: ear spray			▲▲	▲✱		▲	▲				
Oilseed rape fungicides											
Vegetative stage	▲✱		▲	▲▲			▲	▲		▲	
From green bud	▲▲✱		▲	▲▲			▲	▲		▲	
Oilseed rape insecticides											
Vegetative stage			▲	▲▲✱			▲				
From green bud			▲▲	▲✱		▲	▲				

Key

▲ = nozzles offering acceptable efficacy

▲▲ = preferred nozzles for efficacy

✱ = nozzles offering best drift control

Nozzle selections indicated are based on spray volumes of 100-200L/ha and forward speeds of 8–16km/h and using a typical range of pressures for each nozzle design. Generally, higher spray pressures give a smaller droplet size distribution therefore, a finer spray; wider spray angles give a finer spray.

Spray deposits and efficacy

Timing

Application timing is critical for high levels of efficacy. Timeliness is related to work rates that, in turn, depend on:

- Application volume
- Sprayer speed
- Boom width
- Sprayer filling time.

Application volume

For a given dose, higher volumes tend to deposit less active ingredient particularly on small plants. Hence many products give improved control at low volume. However, higher volumes suit those products requiring greater leaf coverage (eg protectant fungicides).

When choosing an application volume, important sources of information are:

- Product label
- Code of Practice for Using Plant Protection Products
- Chemical manufacturers'/suppliers' websites or other information
- A qualified agronomist.

Nozzle colour

Industry standards specify that nozzles are colour-coded by flow rate.

Colour	Flow rate at 3.0 bar pressure, L/min	Common designation
Orange	0.4	'01'
Green	0.6	'015'
Yellow	0.8	'02'
Lilac	1.0	'025'
Blue	1.2	'03'
Red-brown	1.4	'0.35'
Red	1.6	'04'
Brown	2.0	'05'
Grey	2.4	'06'
White	3.2	'08'

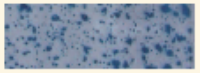
Nozzles and droplet size

Different commercial designs of air induction (AI) nozzle produce different droplet sizes. Those giving a small droplet size will often give higher levels of efficacy, but can also produce more drift than those generating a large droplet size. Recommendations are therefore given on the main chart (left) for AI nozzles giving small or large droplets.

Nozzles producing small or large droplets can be identified from the bar charts (right). Average droplet sizes from different designs of AI nozzles are shown relative to the same size conventional (flat fan) nozzle.

All measurements were made under standard testing conditions with all nozzles operating at 3.0 bar pressure. In each bar chart small droplet designs appear at the lower end, whereas large droplet designs are in the upper part.

small droplet



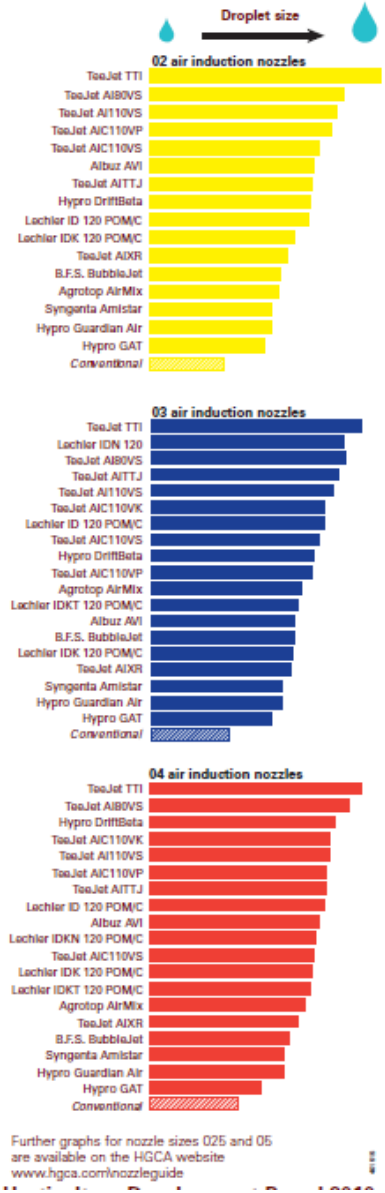
large droplet

conventional

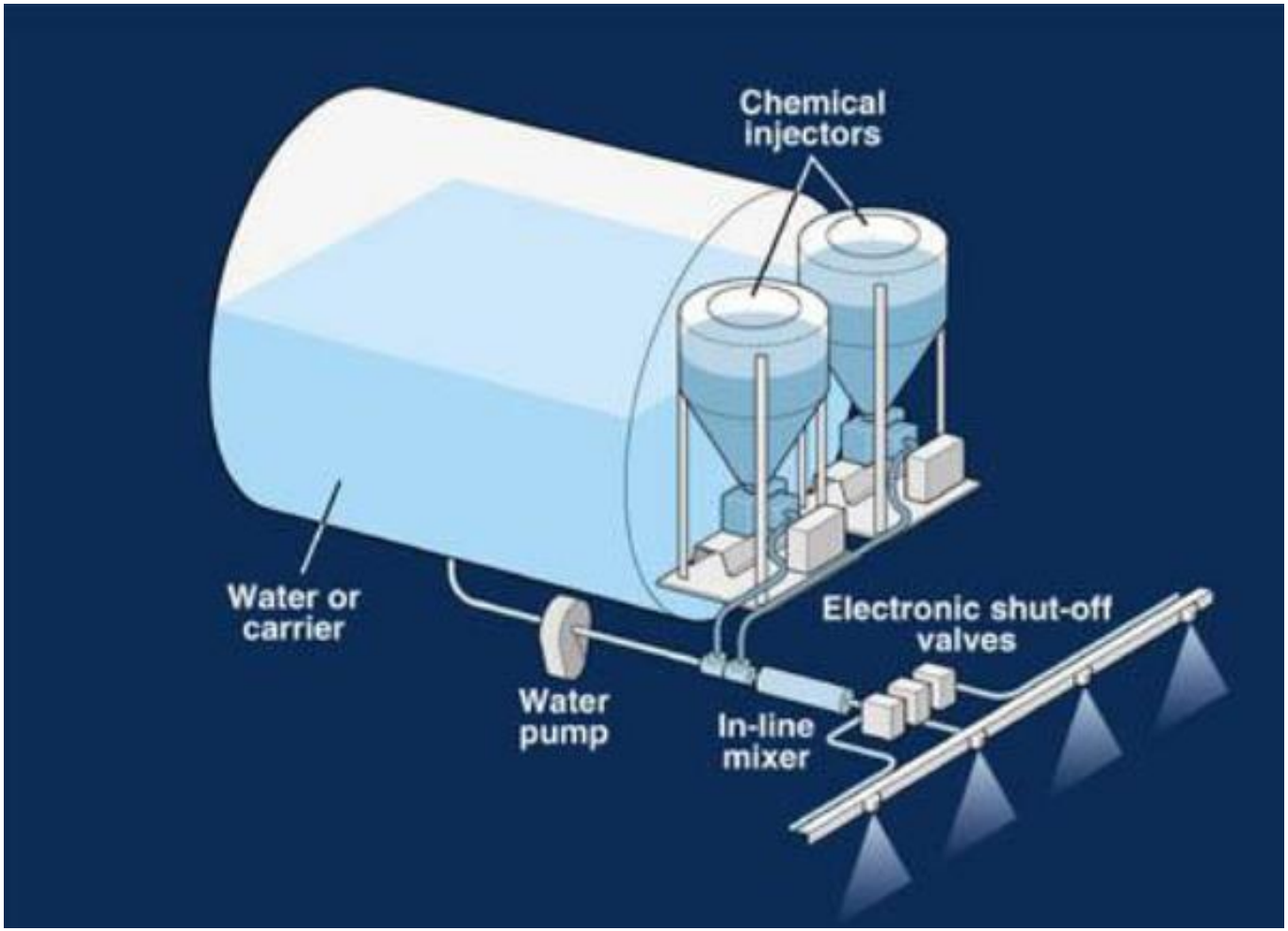
Spray drift

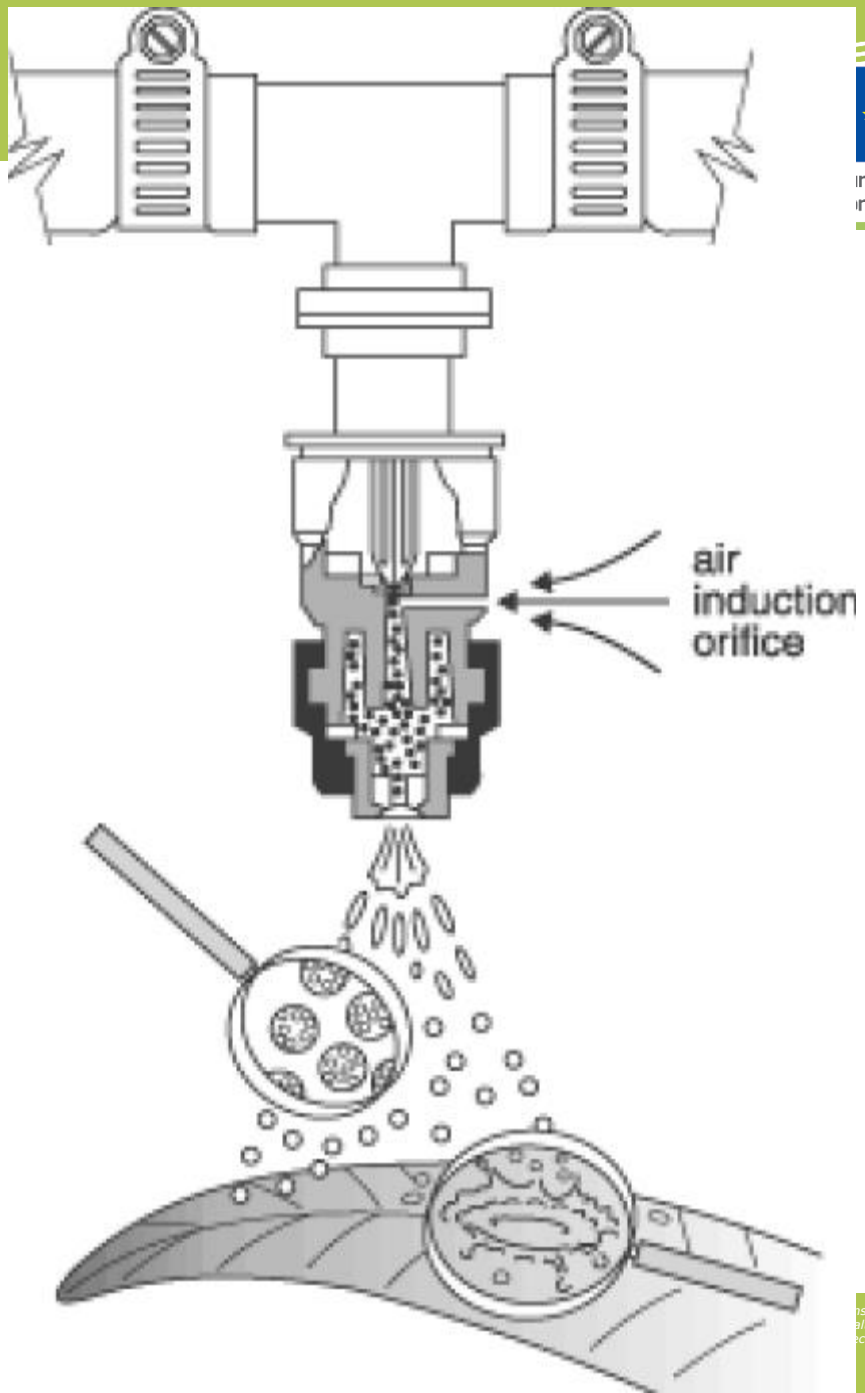
The risk of drift is mainly related to:

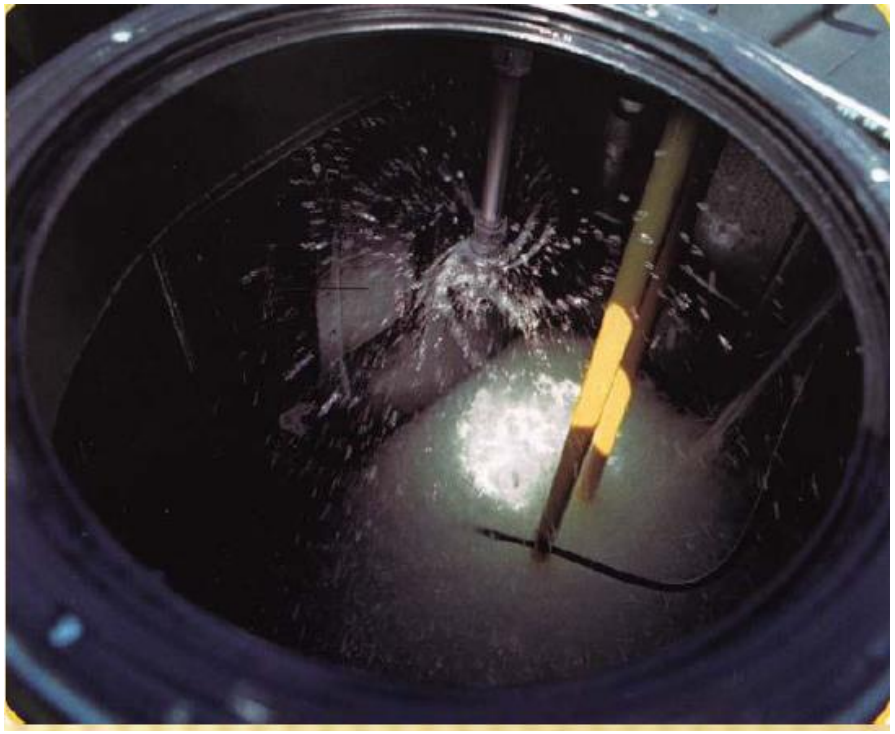
- **Boom height** – for 110° nozzles, the boom should be stable and 500mm or less from the top of the crop.
- **Nozzle type, size and pressure** – LERAP star ratings indicate if a nozzle is capable of operating with less drift than the conventional reference '03' nozzle.
- **Wind speed** – at boom height should be between 2.0-9.6km/h (0.5-2.6m/s).



Further graphs for nozzle sizes 025 and 05 are available on the HGCA website www.hgca.com/nozzleguide


Chemical injectors
Water or carrier
Water pump
In-line mixer
Electronic shut-off valves


air
induction
orifice



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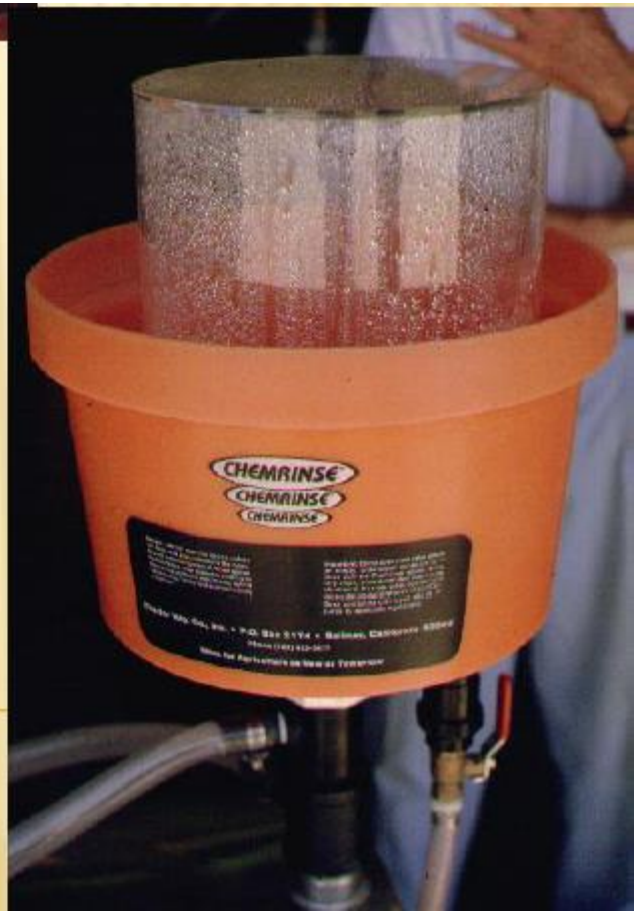
που συγκεντρώνει
ίως δοχείου



References:

- First European Workshop on Standardized Procedure for the Inspection of Sprayers in Europe -SPISE- 27 to 29 April 2004 - Braunschweig (Germany). Presentation by Dr.-Ing Heinz Ganzelmeier
- The LIFE 07/ENV/GR/000266 EcoPest Strategic plan for the adaptation and application of the principles for the sustainable use of pesticides in a vulnerable ecosystem
- SAGE10 (LIFE09 ENV/GR/000302 SAGE 10) Establishment of Impact Assessment Procedure as a tool for the sustainability of agro-ecosystem-The case of Mediterranean olives

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