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## Session 3: Correct use of sprayer inspection harmonized test methods and definition of additional test methods for application equipment not covered by harmonized standards (TWG 3)

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**Results of the inquiry carried out in EU MS aiming at (1) the definition of the most critical issues during the inspection according to existing EN 13790 series and (2) identifying PAE types/technical items not yet considered by EN ISO 16122 series.**

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### **Abstract**

Among SPISE WG Activities, the Technical Working Group 3 deals with the implementation of current standards EN 13790 part 1 and part 2, methodologies in use and new methods in perspective. Both field crop sprayers and bush and tree crop sprayers are concerned.

A virtual questionnaire was sent to Member States delegates in order to identify differences in the interpretation of the requirements among Member States as well as differences in terms of practices. The measurement of the pump capacity that can be achieved either by a direct measurement or through nozzle size requirements, the use of horizontal or vertical patternators, the test mode for nozzles and related settings are implemented differently depending on the country or province. All answers were anonymous.

A second part of the questionnaire concerns a prospective study on the implementation of future EN ISO 16122 series. It was asked whether MS delegates were aware of the future publication of EN ISO 16122 parts 1 to 4 and had the opportunity to read at least one the draft documents. Finally, the questionnaire focuses on the definition of sprayer inspection methods for new kind of machines.

1- implementation of EN 13790 1 (Field crop ) & 2 ( bush and tree crops)

EN 13790-1&2 are the current standards in use to achieve sprayer inspection in Europe. Questions and § numbers cited in this questionnaire will refer to those two standards. A certain number of mandatory requirements are related to the control of key components or functions of a sprayer, such as:

4.2. Pump capacity

4.3. Agitation

4.4. Spray tank

4.8. Measurements on Boom and Nozzles... (if relevant)

Q1	The pump capacity is generally not easy to assess directly. How do you proceed in your country/province ?				TOTAL	17
	FCS		SBTC			
A. Flowmeter ( 5.2.1a )	9	53%	8	47%		
B. Undirect measurement (5.2.1b)	10	59%	10	59%		
C. No evaluation is required	1	6%	1	6%		

FCS : Field Crop Sprayers – SBTC : Sprayers for bush and tree crops

### Comments :

(1) "It's better to evaluate the agitation capacity, It's problem is that values for new sprayers are not known"

(2) "If the pump capacity is not known 5.2.1 b is used"

(3) "If no information on pump is available, 5.2.1b may be used. Pump data is provided during training of inspectors"

(4) It depends from region to region. For example in Piemonte Region the pump capacity is indirectly evaluated (B) but in Lombardia Region is evaluated with a flow meter (A). In any cases,

(5) "it depends from region to region"

### Synthesis question 1

Quite similar numbers are found concerning the direct or the indirect measurement of the pump flowrate among countries/provinces. In some countries, a flowmeter is a mandatory equipment of the inspection workshop even if the measurement is not done in practice. In one other case, data provided by the manufacturer on pump flowrate are given to the workshops.

2- Do you have a prescription about the minimum or the maximum nozzle size that has to be present on the sprayer during the inspection?

	FCS		SBTC	
A. No prescription, the nozzles sizes correspond to those provided on the	16	94%	16	94%
B. Yes, there is a prescription on the minimum size of nozzles				
C. Yes, there is a prescription on the maximum size of nozzles	1	6%	1	6%
D. Yes there is a prescription but the inspection workshop/unit has a provision of its own set of high flowrate nozzles to conduct the test				
	<b>TOTAL</b>			<b>17</b>

FCS : Field Crop Sprayers – SBTC : Sprayers for bush and tree crops

**Comments :**

- (1) "If using different nozzles sizes (multi body) all nozzles sizes /types shall be inspected"
- (2) "All nozzles present on the sprayer must be tested and in good condition, else removed or replaced"

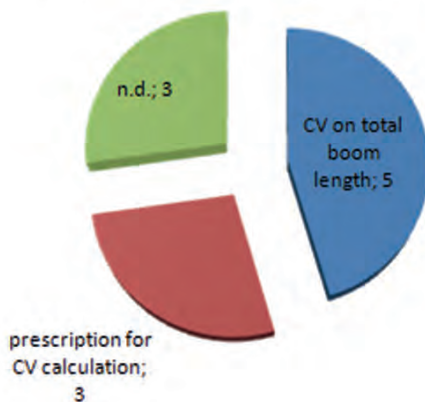
**Synthesis question 2**

A large majority stands for no peculiar prescription on nozzle size.

**3. The use of horizontal or vertical spray patternators**

3.1. Horizontal patternator for field crop sprayers

**Horizontal patternator : 11/15**



### 3.2. Vertical Patternator for Sprayers for bush and tree crops.

Only 3 replies were positive.

#### Comments :

(1) "No use of patternator... Too difficult to find some well adapted areas (closed and large enough to accept booms over 28 m width).. Otherwise you will have to travel on roads for long distances and sprayer are not made for that !"

(2) "NL used to use vertical patternator, but next year it will be optional"

(3) "Most workshops use the program/software provided by the test equipment manufacturer mainly AAMS"

(4) "Scanners from AAMS and Herbst are used, they calculate automatically."

(5) "Neither horizontal nor vertical patternators are used during the inspection. Only nozzle flow rate is measured in both cases"

(6) "A) Horizontal patternator is used only to evaluate optimum boom height. CV calculation is not requested because distribution uniformity is evaluated by nozzle flow rate measurement.

B) a) The most widely used is vertical try patternator; in some regions is also used vertical lamellae patternator b) to reach a symmetry index between the sprayer pattern of the two sprayer sides  $<10$ "

(7) "Horizontal patternator is mandatory for all field sprayers in Switzerland. Experiences are very good and especially the sensitization of the staff of testing stations and farmers is perhaps the most beneficial point of using horizontal patternators. --> Our problem is not the technical equipment but the sensitization and training of the users. Vertical patternator for bush and tree crops sprayers is not mandatory but used by some testing stations. The CV is in practice not of interest. They use the max. deviation per nozzle of  $\pm 20\%$  from the mean. Most of the testing stations state that  $20\%$  is too high. Most of them change nozzles even if the deviation is lower than  $20\%$ ..."

(8) "NSTS has patternation as an optional requirement"

(9) "The distribution has to be kept within two lines max/min  $\pm 15\%$  of average (0). Additionally also the nozzle output for every nozzle is measured (uniformity)"

(10) "We do not use horizontal or vertical patternators."

#### Synthesis question 3

11 replies out of 17 indicated the use of a horizontal patternator. In most cases the CV is calculated directly by the software provided with test bench. Very few use of a vertical patternator (3/17).

#### 4. Nozzle flow rate and pressure drop measurements

FIELD CROP SPRAYERS	
Tested nozzles are mounted on the boom (ref 5.2.5.1)	13
Nozzles are tested with the help of a test bench (ref 5.2.5.2)	2
Pressure drop is measured at a standard pressure (i.e. 3 bar)	11
Pressure drop is measured at the highest pressure permitted by the circuit	1
Pressure drop when closing sections is measured a standard pressure (i.e. 3 bar)	12
Pressure drop when closing sections is measured at the highest pressure permitted by the circuit	1
BUSH AND TREE CROP SPRAYERS	
Tested nozzles are mounted on the boom (ref 5.2.5.1)	15
Nozzles are tested with the help of a test bench (ref 5.2.5.2)	1
Pressure drop is measured at a standard pressure (i.e. 3 bar)	9
Pressure drop is measured at the highest pressure permitted by the circuit	1
Pressure drop when closing sections is measured a standard pressure (i.e. 3 bar)	9
Pressure drop when closing sections is measured at the highest pressure permitted by the circuit	1

#### Comments :

- (1) "Pressure drop and pressure drop when closing sections are measured at 8 bar"
- (2) "Pressure drop: result of this test is not binding. Generally, the test pressure is the working pressure indicated by the farmer"
- (3) "Pressure used is as appropriate to the equipment, not specified as 3 bar in either cases"
- (4) "Pressure drop is measured at the pressure for practical use."
- (5) "Pressure drop measurement: generally not mandatory. In general the reference pressure is the working pressure indicated by the farmer"
- (6) "The standard pressure is at least 4 bar for field crop sprayers and pneumatic ones (if permitted by the pump). It is about 15 - 20 bars for orchard sprayers. Nozzle can be tested on the sprayer or dismantled if the pressure is recorded during measurement AND the accuracy of the measure reaches the minimum level of 2.5%"

#### Synthesis question 4.

At a large majority, nozzles are tested on the boom/sprayer. Few answers (3/17) indicated the use of a test bench to check nozzle flow rate. Pressure drop and pressure drop when closing section are generally performed at a standard pressure. Only one answer indicated that those last tests are performed at the highest pressure. Health and safety issues are cited in comments.

#### 5. Additional measurements according to EN 13790 1-2 (comments only)

- (1) "Belgium focused on the European Directive 2009-128 EC Annex II to make the necessary adaptations of its inspection protocols. So Belgium fulfills normally 100% to Annex II but some points of EN13790 are not checked :

§4.2.3. Pressure safety valve not tested : Reason difficult to perform and danger to damage sprayer during inspection.

§4.4.3. Chemical introduction container grating: Not checked no environmental danger or danger for user.

§4.4.4. Pressure compensation in the tank: Not checked no specific reason

§4.4.6 Collect the emptied spray liquid: Not checked no specific reason danger or danger for user.

§4.4.9 Cleaning device for crop protection product containers : Not checked no specific reason points not checked for EN13790-2

§4.4.7 Non return device for water filling: Not checked no specific reason

§4.7.2. Isolating device present to clean filters without emptying sprayers: Not checked no specific reason Comparable

§4.4.8 Chemical introduction container: Not checked no environmental "

(2), (3), (4) No comment

(5) "Pressure Safety valve "

(6) "In practice most manometers are only tested if they don't work correctly during the test."

(7) "French protocol is closer to EN ISO 16122 than EN 13790"

### **Partial conclusion on EN 13790 part 1 and 2 use among countries/provinces**

Some discrepancies are identified in the interpretation of existing standards/regulations. One fundamental question is related to what has to be controlled/tested. Is it the maximum capacity of the equipment?; is it the running conditions of the equipment as used by the farmer ?; is it the minimum requirements

Some answers let appear the lack of coherence between EN 13790 and 2009/EC/128 directive requirements on some aspects. Finally, some answers raised the principle of « reality » in terms of what is reasonably testable on a sprayer, in a workshop or in a farm courtyard.

### **6. Future implementation of EN ISO 16122 series**

New standards for the inspection of sprayers (EN ISO 16122 series) may be published in a near future. Several categories of sprayers are already identified :

EN ISO 16122 part 1 : Categories of sprayers

EN ISO 16122 part 2 : Horizontal boom sprayers

EN ISO 16 122 part 3 : Sprayers for bush and tree crops

EN ISO 16122 part 4 : Fixed and semi-mobile sprayers

I had the opportunity to read at least one of the EN ISO 16122 projects : 15

I foresee problems in the implementation of these standards. 5

### **Comments**

(1) "I had not the opportunity to read any of EN ISO 16122 projects."

2) ""Problems" all inspectors need to be trained. New demands like travel speed, sensors etc will come. The pretest in part 1 will make the test take longer time, but is very valuable."

(3) "On the 16122 part 4 Belgium voted negative because of the implementation of a pump test on sprayers built according 16119-4."

(4) "It is necessary to have soon new standards for the inspection of others type of sprayer as knapsack mist blower, train sprayer, foggers ."

(5) “The problem with these standards is that they shall be taken in use by inspectors and not as normally industrial companies. Thus the price per standard is one thing; the other is the need of very many standard to be bought by the inspector (references to other standards in one standard and several standards for one type of sprayers). Thus SPISE should find a practical solutions of a more user friendly set (like made e.g. in Sweden) and a solution to an acceptable price.

It also has to be found a practical solution of the accreditation for the inspection units. It has to be taken into account that some countries have several units with a low number of inspections due to the infrastructure and size of country and more mobile units in order to visit the operators and ensure that the operator join the inspection, when other countries have workshops were several hundreds of sprayers are inspected at the same location and rarely have the possibility to have the operator present. If too complex the costs per inspection will increase and the motivation of the operator will decrease.”

(6) “Measuring capacity pump instead of measuring and evaluating agitation capacity”

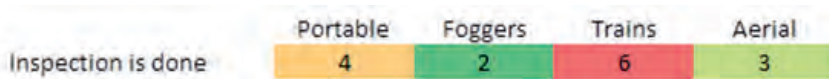
(7) “Concerning part 4, the measure of the backflow can be very difficult in practice and highly time consuming”

**Synthesis on question 6 :**

A large majority had the opportunity to read at least one of EN ISO 16122 series. Some technical problems are foreseen. A too complex method or equipment may generate difficulties for itinerant workshops realizing fewer inspections than fixed ones.

**7. Inspection of sprayers not considered by existing EN ISO 16122**

10 answers were given.



Inspected items :

Parameter	Portable	Foggers	Trains	Aerial
Pump capacity	3	1	7	1
Pressure	5	3	6	2
Flowmeter	3	2	5	1
Forward speed	2	1	3	
Spray distribution	2	2	3	
Nozzle flowrate	6	4	7	3
Pressure drop	5	1	6	2
pressure drop when spray off	2	1	4	1
Pressure distribution	3	1	4	1
backflow for agitation	3	2	4	1
direct injection	3	2	4	1
application volume	4	2	6	3
spray range	2	1	4	1
agitation	4	2	6	1

Comments :

(1) "none of these equipments are inspected yet"

(2) "Today, only train sprayers are tested in an own, voluntary system in SE. This will be adjusted to EN ISO 16122..."

(3) "At the moment Belgium is inspecting - Field crop sprayers - Orchard and Vineyard sprayers - Greenhouse and similar sprayers (Fixed and semi mobile sprayers) -

Soil disinfection machines Portable sprayers: Approximately 10 portable plot-sprayers are inspected at this moment with the Belgian "greenhouse sprayer" protocol.

This works but fits not 100% on those types of sprayers. At this moment, we perform no other inspections on other types of portable sprayers.

Foggers: No inspections at this moment. Belgium is waiting for a Standard. Train sprayers: Only one train sprayer has been inspected at this moment in Belgium, but no specific protocol was developed for this purpose. A tailor made inspection was performed, mainly based on existing field - crop protocol in Belgium and EN13790-1 standard. Furthermore, a number of railway sprayers mainly based on Unimog's are inspected by using the Belgian field crop spray protocol. Aerial sprayers : No aerial spraying in Belgium."

(4) "Portable sprayers: actually inspected only in some regions"

(5) "Only one helicopter in use. Nozzle type, drop size and distribution for train and helicopter are set due to the high speed in use in order to avoid drift.

For trains we normally also do deposit tests by the use of WSP with a speed about 20 km/h.

For helicopter, we have made deposit tests due to 60-70 km/h and 4-5 m height with nigrosine and paper rolled out perpendicular to the driving direction.

A stationary distribution test for such equipment may be incorrect if not taken into account the high speed in use.

Because the nozzle used do minimize the risk of drift (proved by experiments) we only make stationary test with these nozzles normally for the annual inspection.

I also like to add that inspection of foggers may be very difficult because of the high concentration of pesticide in practical use.

Thus here the inspection should have been carried out by a test fluid (with properties of pesticides but not toxic) or by the use of the pesticide itself.

Parameters like house construction, fogger position, RH and temperature and the mass of plants may influences and require different set up & ventilation etc and have to be taken into account (somehow..)

Why pump capacity is not measured on the helicopter is that it is used a easy mixable pesticide (Glyphosate) and also that it is complicated to fix a flow meter to the pump below the helicopter.

For helicopter use, we have to keep in mind that failures like variations in height (difficult terrain in forest), variations in swath width and variations in speed e.g. at the end of track give more variations than minor failures on e.g. pressure. The nozzle output is rather large due to the high forward speed (ca 4,7 l/min). In the helicopter a flow meter is installed. We measure nozzle output and check if this value corresponds to the flow meter in the helicopter (and adjustments are made if necessary)"

(7) "We have regulations on how to inspect the train and the aerial sprayers and some



workshop interested in to do the inspections, but the inspections are not performed yet. For the aerial sprayers only functional tests are to be performed. We wait for new standards to follow up.”

(8) “Train sprayers are currently inspected once a year, but on a voluntary basis.”

### Synthesis on Question 7

Train sprayers are already inspected by 6 countries/provinces out of 17 without a harmonized EN ISO protocol. 6 technical items are mostly preferred for the inspection related to nozzle flow rate, pressure distribution and pressure drop, application volume and agitation. The question of static measurement for trains, aerial sprayers is raised. The second most cited sprayers are portable ones.

8. If not already inspected, what would be your preferences?

10 positive replies.

Parameter	Portable	Foggers	Trains	Aerial
Pump capacity	3	2	7	3
Pressure	8	3	8	7
Flowmeter	4	3	7	6
Forward speed	3	2	6	2
Spray distribution	5	4	6	3
Nozzle flowrate	8	6	8	6
Pressure drop	6	3	6	5
pressure drop when spray off	2	3	5	3
Pressure distribution	3	2	5	4
backflow for agitation	1	3	7	3
direct injection	2	3	7	2
application volume	7	7	6	4
spray range	6	4	6	4
agitation	5	4	6	3

### Comments

(1) “We will probably demand that sprayers on train and aircraft are inspected (according to a standard if there is one) to be allowed to use but we will probably not have any Swedish inspections scheme”

(2) “I’m not sure what portable sprayers are in this connection”

(3) “Belgium has started up a specific project (SIRA-APESTICON) in order to give an answer on Chapter III, Art 8 point 3. It exists mainly out of the following 3 steps:

- a. Determining which PAE is used on Belgium territory. (Kind, Numbers, Type of pesticide,...)
- b. Developing a risk analysis method to research if derogation is applicable for identified PAE.
- c. Developing new inspection protocols where applicable”

(4) “In Switzerland we have the opinion that training of users is much more important than

controlling portable sprayers. Train sprayers are not in use anymore and very few aerial applications occur. Foggers are not tested.”

(5) “A problem with portable sprayers is that (i) an inspection will cost more than buying a new one, and (ii) failures may occur between the inspections.

Additionally wrong dosage, bad safety and environmental problems as well as poor effect may occur more due to misuse of the sprayer. Thus information and skilling in proper calibration, check for leaks, nozzle variety, by simple means for ensuring a good application without risk for operator or environment will motivate better the grower to buy a better sprayer when needed and USE the sprayer in a correct manner and also avoid huge residues of spray volume at the end.”

(6) “The new regulations are in the final step but still in progress. It will cover: glasshouse sprayers, foggers, seed treatment, granules application, other spraying equipment with the tank volume of less than 30 l.

Only for glasshouse sprayers, there is a proposal to measure pressure drop and nozzle flowrate, for the rest of equipment - functional tests and visual inspection.”

(7) “Protocols are more or less definitive... equipments to be inspected in 2015”

### **Synthesis question 8.**

Trains, portable sprayers and aerial are the most cited sprayers to be inspected. Technical items to be inspected are the same as cited in question 7. Some comments introduce the question of risk assessment for some sprayers and the need to take into account the real case scenario (use of sprayer, chemical sprayed, etc.)

### **Conclusion**

A detailed inquiry among Member States showed how inspection workshop deal with the inspection of sprayers regarding related standards and the implementation of the Annex 2 of EC/128/2009 directive. The implementation of EN 13790 showed differences in different Member States or provinces.

EN ISO 16122 projects are more or less known by ~10 MS. Additionally, some sprayer types not covered by EN ISO 16122 yet are already tested by some MS.

A potential for existing methodologies in some countries might be beneficial to CEN developments. Trains are priority number one followed by portable and aerial sprayers.

Some questions raised the problems of the access/cost of standards for individual workshops.

Consideration to inspection workshops size and volume of activity are also evoked.

## References

- EN 13790-1, 2003. Agricultural machinery - Sprayers - Inspection of sprayers in use - Part 1 : field crop sprayers
- EN 13790-2, 2003. Agricultural machinery - Sprayers - Inspection of sprayers in use - Part 2: Air-assisted sprayers for bush and tree crops.
- EN ISO 16119-1, 2013. Agricultural and forestry machinery – Environmental requirements for sprayers – Part 1: General
- EN ISO 16119-2, 2013. Agricultural and forestry machinery – Environmental requirements for sprayers – Part 2: Horizontal boom sprayers
- EN ISO 16119-3, 2013. Agricultural and forestry machinery – Environmental requirements for sprayers – Part 3: Sprayers for bush and tree crops
- PR EN ISO 16122-1, 2013. Agricultural and forestry machinery - Inspection of sprayers in use - Part 1: general
- PR EN ISO 16122-2, 2013. Agricultural and forestry machinery - Inspection of sprayers in use - Part 2: horizontal boom sprayers
- PR EN ISO 16122-3, 2013. Agricultural and forestry machinery - Inspection of sprayers in use - Part 3: vertical boom sprayers, mist blowers and similar
- PR EN ISO 16122-4, 2013. Agricultural and forestry machinery - Inspection of sprayers in use - Part 3: fixed and semi mobile sprayers