Second European Workshop

on

Standardized Procedure for

Inspection of Sprayers in Europe

-SPISE –

10 to 12 April 2007

Straelen

European Standard EN 13790

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

the basis for sprayer inspection
in Europe

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Agricultural machinery - Sprayers
- Inspection of sprayers in use -
- EN 13790

During recent years, several countries have developed systems for inspection of sprayers in use. 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.

This European Standard 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
This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2003, and conflicting national standards shall be withdrawn at the latest by November 2003.

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.

The following Candidate Countries are already a member of CEN since 01 January 2004: Estonia, Lithuania, Latvia, Poland, Slovenia, Cyprus.

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).

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.
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.

This European Standard 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.
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.
Power transmission parts and blower

Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leakages
Agitation
Spray liquid tank
- Leakages
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable
Measuring systems, controls and regulation systems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices
Pipes and hoses
- Leakages
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

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.

Method of verification: inspection and function test.
4.1.3

The blower (fan, casing, air deflectors) shall be present, in good condition and mounted in a functional manner:
- all parts shall be free of mechanical deformation, wear and tear, corrosion and vibrations;
- the guard to prevent access to the fan shall be present.

Method of verification: inspection and function test.
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
4.2.1
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 sprayer 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.
Power transmission parts and blower

Pump
- Capacity
- Pulsations
- Pressure safety valve
  If applicable
- **Leakages**

Agitation
Spray liquid tank
- Leakages
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable

Measuring systems, controls and regulation systems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices

Pipes and hoses
- Leakages
- Bending/abrasion
- Out of spray

Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

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**Sometimes:** broken diaphragm

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**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.
Power transmission parts and blower
Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leakages
Agitation
Spray liquid tank
- Leakages
- Strainer
- Grating, if applicable
- **Pressure compensation**
  - Level indicator
  - Emptying
  - Non return device
  - Chemical induction bowl, if applicable
  - Can cleaning device, if applicable
Measuring systems, controls and regulation systems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices
Pipes and hoses
- Leakages
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

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 induction bowl, 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.**
Power transmission parts and blower
- Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leakages
Agitation
Spray liquid tank
- Leakages
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable

Measuring systems, controls & regulation systems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices

Pipes and hoses
- Leakages
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

European Standard EN 13790
Inspection of sprayers in use - Part 2

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.
4.5.2

All devices for adjusting pressure shall maintain a constant working pressure with a tolerance of ±10 % at constant rotational speed and reach the same working pressure after the equipment has been switched off and on again.

Method of verification: inspection and function test.
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**
Power transmission parts and blower
Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leaks
Agitation
Spray liquid tank
- Leaks
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable
Measuring systems, controls and regulation systems
- Reliability/leaks
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices
Pipes and hoses
- Leaks
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

4.5.4
**Application to one side only shall be possible by switching off the other side.**

**Method of verification: function test.**
Power transmission parts and blower
- Pump
  - Capacity
  - Pulsations
  - Pressure safety valve, if applicable
  - Leakages
Agitation
Spray liquid tank
- Leakages
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable
Measuring systems, controls and regulation systems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices
Pipes and hoses
- Leakages
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

4.5.5 / 4.5.6
The scale of the pressure gauge shall be clearly readable and suitable for the working pressure range used.

Method of verification: inspection.
Power transmission parts and blower
Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leakages
Agitation
Spray liquid tank
- Leakages
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable
Measuring systems, controls and regulation systems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge
- Other measuring devices
Pipes and hoses
- Leakages
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

European Standard EN 13790
Inspection of sprayers in use - Part 2

Minimum diameter: 63 mm

4.5.7
For analogue pressure gauges the minimum diameter of the pressure gauge cases shall be 63 mm.
Method of verification: measurement.
Power transmission parts and blower
Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leaks
Agitation
Spray liquid tank
- Leaks
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable
Measuring systems, controls and regulationsystems
- Reliability/leakages
- Constant working pressure
- Operation of controls
- Application to one side only
- **Pressure gauge**
- Other measuring devices
Pipes and hoses
- Leaks
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

4.5.8
The **accuracy of the pressure gauge shall be**
± 0.2 bar for working pressures between 1 bar (included) and 2 bar,
± 10% for working pressures > 2 bar.

**Method of verification: according to 5.2.3.**
Power transmission parts and blower
- Pump
- Capacity
- Pulsations
- Pressure safety valve, if applicable
- Leaktages
Agitation
Spray liquid tank
- Leaktages
- Strainer
- Grating, if applicable
- Pressure compensation
- Level indicator
- Emptying
- Non return device
- Chemical induction bowl, if applicable
- Can cleaning device, if applicable
Measuring systems, controls and regulation systems
- Reliability/leaktages
- Constant working pressure
- Operation of controls
- Application to one side only
- Pressure gauge

**Other measuring devices**
Pipes and hoses
- Leaktages
- Bending/abrasion
- Out of spray
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

**European Standard EN 13790**
Inspection of sprayers in use - Part 2
4.5.9
**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.
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.
4.6.3
Hoses in working positions shall not be suspended in the range of the spray.

Method of verification: inspection.
Filtering
- Filter presence
- Cleaning, if applicable
- Filters inserts changeability

European Standard EN 13790
Inspection of sprayers in use - Part 2

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.
If an shut off 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.

Method of verification: inspection.
The nozzle equipment shall be suitable for appropriate application of the plant protection products.

**Method of verification: inspection.**
4.8.2

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

Method of verification: inspection.
Nozzles
- Suitability
- Symmetry
- **Dripping**
- Switching off
- Adjustment
Distribution
- Uniformity of spray jet
- Nozzle output/sector output
- Pressure difference
- Optional patternator measurement
Blower
- Rotational speed
- Switching off
- Guide plates
- Dripping

4.8.3
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.**
4.8.4
It shall be possible to switch off each nozzle separately. In the case of multi-head nozzles, this requirement applies to each multi-head nozzle.

Method of verification: inspection and function test.
Nozzles
- Suitability
- Symmetry
- Dripping
- Switching off

Adjustment
Distribution
- Uniformity of spray jet
- Nozzle output/sector output
- Pressure difference
- Optional patternator measurement

Blower
- Rotational speed
- Switching off
- Guide plates
- Dripping

4.8.5
It shall be possible to adjust the position of the nozzles in a symmetric and reproducible manner.

Method of verification: inspection and function test.
4.9.1 Each nozzle shall form a uniform spray jet (e.g. uniform shape, homogeneous spray).

Method of verification: inspection and function test with switched off blower in the case of hydraulic nozzles and switched on blower in the case of other nozzles (for example pneumatic nozzles).
4.9.2

The output of each nozzle with the same marking shall not deviate more than 15% from the nominal output or 10% from the mean output of all nozzles within the same identification.

For symmetrical spraying, the difference between the left and right hand sides mean output shall be a maximum of 10%.

Method of verification: measurement according to 5.2.4.
4.9.3 The pressure difference at each section inlet shall be a maximum of 15%.

Method of verification: measurement according to 5.2.4.
4.9.4

NOTE: In order to provide the owner/operator with further information in addition to 4.9.1 to 4.9.3, the spray distribution may be measured by using a vertical patternator test bench according to 4.10.1 of EN 13790-1:2003.
Nozzles
- Suitability
- Symmetry
- Dripping
- Switching off
- Adjustment
Distribution
- Uniformity of spray jet
- Nozzle output/sector output
- Pressure difference
- Optional patternator measurement

Blower
- Rotational speed
- Switching off
- Guide plates
- Dripping

4.10.1
The blower shall rotate at the speed specified by the manufacturer

Method of verification: function test.
Nozzles
- Suitability
- Symmetry
- Dripping
- Switching off
- Adjustment
Distribution
- Uniformity of spray jet
- Nozzle output/sector output
- Pressure difference
- Optional patternator measurement
Blower
- Rotational speed
- Switching off
- Guide plates
- Dripping

4.10.2
If the blower can be switched off separately from other driven parts of the machine, the clutch shall work reliably.

Method of verification: function test.
Nozzles
- Suitability
- Symmetry
- Dripping
- Switching off
- Adjustment
Distribution
- Uniformity of spray jet
- Nozzle output/sector output
- Pressure difference
- Optional patternator measurement
Blower
- Rotational speed
- Switching off
- Guide plates
- Dripping

4.10.3
Adjustable air guide plates on the blower and on an additional blower casing shall function properly.

Method of verification: inspection and function test.
4.10.4
Parts of equipment shall not be sprayed, with the exception that this is necessary for the functioning of the blower and does not cause dripping.

Method of verification: inspection and function test.
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 nozzle output
5.2.5 Measurement of the pressure differences
5.2.6 Other facilities
### Annex B
(informative)

**Test report**

<table>
<thead>
<tr>
<th>Test station:</th>
<th>Test report for the inspection of air-assisted sprayers for bush and tree crops according to EN 13790-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner’s identity:</td>
<td></td>
</tr>
</tbody>
</table>

**Owner’s address:**

- **Manufacturer**
  - Serial-No
- **Mounted**
  - Yes
  - No
- **Owned by**
  - Owner
  - Business
- **Type**
  - Year of construction
  - Tractor
  - Self-propelled sprayer
  - Contract
- **Machine ring**

**Remarks:**

<table>
<thead>
<tr>
<th>Result of the inspection</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ no defect</td>
<td>□ minor defect</td>
<td>□ critical defects</td>
</tr>
</tbody>
</table>

7

A test report shall be given to the user directly following the inspection at the inspection site.

This report shall mention any malfunctions of the sprayer and inform the user of the repairs required to be made to his equipment.

The test report shall also include the results of the measurements.

An example of a test report is given in annex B.
<table>
<thead>
<tr>
<th>Subject</th>
<th>Description</th>
<th>Requirement a</th>
<th>Defect</th>
<th>General remarks on the state of the sprayer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Power transmission/blower</td>
<td>Guards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pump</td>
<td>Piston</td>
<td>Capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pulsations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diaphragm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure safety valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leaks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Agitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7 A test report shall be given to the user directly following the inspection at the inspection site. This report shall mention any malfunctions of the sprayer and inform the user of the repairs required to be made to his equipment. The test report shall also include the results of the measurements.

An example of a test report is given in annex B.
Nozzles
- Suitability
- Symmetry
- Dripping
- Switching off
- Adjustment
Distribution
- Uniformity of spray jet
- Nozzle output/sector output
- Pressure difference
- Optional paternator measurement
Blower
- Rotational speed
- Switching off
- Guide plates
- Dripping
Testmethods
- Preparation of sprayer
- Testfacilities and methods
Testreport

**Inspection sticker**

<table>
<thead>
<tr>
<th>Test station:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner's identity:</td>
<td></td>
</tr>
<tr>
<td>Owner's address:</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>Serial-No</td>
<td></td>
</tr>
<tr>
<td>☐ Mounted</td>
<td>Self-propelled sprayer</td>
</tr>
<tr>
<td>Owned by</td>
<td>☐ farmer ☐ contractor ☐ machine ring</td>
</tr>
<tr>
<td>Remarks:</td>
<td></td>
</tr>
<tr>
<td>Result of the inspection</td>
<td>Signature</td>
</tr>
<tr>
<td>☐ no defect ☐ minor defect ☐ critical defects</td>
<td>Label ☐ yes ☐ no Date</td>
</tr>
</tbody>
</table>

**8 (proposal)**
The inspection service fills the sticker in with address...and sticks it on the sprayer after the inspection has shown that the sprayer functions without fault. The sticker may also handed out if the sprayer has minor defects which the owner undertakes to remove immediately.
Concluding remarks

EN 13790 continues to be characterised by the fact that

➢ it brings together in one standard the different procedures, findings and technical requirements which have existed in the Member States up to now

➢ it is established on the basis of test methods and requirements which have proved reliable in the Member States in the past

➢ it achieves a high technical level whilst not consuming unnecessary time or money

➢ the Member States are obliged to apply this standard and to withdraw respective national standards

➢ it represents a basis for the harmonisation of sprayer inspections and the future mutual acceptance of inspections between the Member States

➢ it determines technical requirements but does not anticipate regulatory decisions made by the Member States and the EU.