

## Advice for functional inspection of postharvest application equipment

Francesc Solanelles

Centre de Mecanització Agrària. DARP  
Generalitat de Catalunya  
Rovira Roure, 191  
25198 Lleida. Spain

### 1. Introduction

Postharvest pesticide applications are made just before fruits and vegetables are put in the market. So, the risk for the consumer health of using equipment not well adjusted or in bad condition is very high.

There are different kinds of equipment for postharvest pesticide application, with clear differences in design, use, adjustment, etc. So, the inspection methodology should be able to adapt to each case.

The guideline is based mainly on the EN ISO 16122-4 standard, which has been adapted to the special features of postharvest pesticide application equipment, not considered in the inspection standard of fixed and semi-mobile sprayers

Mainly, the following kind of equipment for postharvest applications can be found,

- Drencher. Fruit containers are sprayed with high amounts of water. The containers can be static or moving along a belt, but the application time has to be always monitored. There are also on-line drenchers, where the fruits, without containers, go through small “waterfalls” of the application liquid, with the help of brushes.
- Bath. Fruits are immersed in a container full of application liquid. The duration of the application is the time fruits take to go through the container.
- Pesticide application equipment with or without wax. Fruits are sprayed by means of nozzles. Wax can be used as well to get a film that protects the fruits and make them more attractive. This equipment is usually placed in the sorting and packaging line.
- Washers. Fruits are washed using water with soap and a fungicide. The products are applied as foam. Afterwards fruits can be rinsed and dried.

### 2. Preinspection

#### 2.1. Presence of the operator during the inspection

The operator of the application equipment has to be present during the inspection. All the previously spotted defects have to be repaired before the inspection

#### 2.2. Assessment of the risk for the inspector

The inspector has to check the application equipment, in order to avoid risks during the inspection, which can result on health problems or injuries.

The guards of the moving parts of the transmission have to work properly.

All the guards for the protection of the operator have to be in place and be in good condition.

#### 2.3. Cleaning

The application equipment has to be clean, so that the inspector cannot be exposed to contamination hazard.

#### 2.4. Equipment framework

The framework and other similar elements have to be in good condition. Defects that can affect the resistance of the equipment are not allowed.

#### 2.5. Air unit

If available, the blowing unit has to be in good condition. It has to work properly, without any vibration of friction.

### 3. Inspection

#### 3.1. Leaks

##### 3.1.1. Static leaks

With the application unit off and the spray tank filled to its nominal capacity, there has to be no leaks in the tank, the pump or the associated pipes and hoses.

##### 3.1.2. Dynamic leaks

With the application unit working at the pressure indicated by the manufacturer, there shall be no visible leaks.

If available, the direct injection systems have to avoid any backflow that can contaminate the water source with chemicals.

#### 3.2. Pump capacity

The pump capacity has to be suited to the sprayer requirements. The pump has to provide enough liquid flowrate to allow the spray application and, at the same time, a visible agitation.

#### 3.3. Agitation

##### 3.3.1. Hydraulic agitation

The agitation has to be visible:

- when spray application is made at the maximum working pressure
- with the largest nozzles mounted on the application unit
- with the pump rotation speed recommended by the manufacturer
- with the tank filled to half the nominal capacity.

##### 3.3.2. Mechanical agitation

A clearly visible agitation has to be maintained with the spray tank filled to half the nominal capacity.

##### 3.3.3. Pneumatic agitation

A clearly visible agitation has to be maintained with the spray tank filled to half the nominal capacity.

#### 3.4. Spray tank

##### 3.4.1. Lid

All the spray tanks shall be provided with a lid. The lid has to adjust properly to the filling hole and it has to be in good condition.

##### 3.4.2. Induction hopper

If available, the induction hopper has to prevent any object with a diameter higher than 20 mm from entering the sprayer tank.

##### 3.4.3. Pressure compensation

If required, it has to be a pressure compensation device to avoid over-pressure and under pressure inside the spray tank.

##### 3.4.4. Tank contents indicator

The volume of liquid in the tank has to be readable from where the tank is filled.

##### 3.4.5. Tank emptying

It has to be possible to empty the tank in a way that the remaining liquid can be collected without contamination of the environment and without risk of exposure of the operator.

#### 3.5. Measurement and regulation systems. Other control systems

Devices for the measurement, reading or regulation of the working pressure or the liquid flowrate have to work properly. All the control systems, which have to be operated during the application, shall be operable from the operator's position. Also, it shall be possible to read all the displays from this position.

##### 3.5.1. Pressure indicators

Pressure indicators have to be placed so that it is possible to read the pressure.

The pressure range of the pressure indicators has to match the working pressure of the application equipment.

It is recommended that the minimum diameter of the analogue pressure indicators is 63 mm.

The scale of the analogue pressure indicators shall provide graduations at least every 0.2 bar for working pressures less than 5 bar and at least 1.0 bar for working pressures between 5 and 20 bar.

The accuracy of the pressure indicators shall be a  $\pm 0.2$  bar for working pressures less or equal to 2 bar and 10% of the real value for working pressures higher than 2 bar.

#### 3.5.2. Pressure adjustment devices

Pressure adjustment devices have to be able to keep a constant pressure with a tolerance of  $\pm 10\%$  and return to the original pressure  $\pm 10\%$ , 10 s after the application unit has been switched off and on again.

#### 3.5.3. Direct injection and dosing systems

The injection dose of the chemicals shall not deviate more than 10% from what is set on the injection device.

#### 3.5.4. System to switch off the application in the absence of fruits

In all the application equipment without liquid recirculation, it shall be a device to switch off the application system, whenever no crop is present in the application zone.

#### 3.5.5. System to control the duration of the application

It has to be possible to control the duration of the application time.

#### 3.5.6. Position control system

The different devices (sensors, actuators) to control the position of the application system have to work properly.

#### 3.5.7. Temperature control system

If available, devices to adjust the temperature have to work properly.

The range and accuracy of the temperature measuring systems have to be suitable for the working conditions.

The temperature measurement error has to be less than 10% of the real value.

#### 3.5.8. Other control devices

All the other regulation and control systems of the application equipment have to work properly and be in good condition.

#### 3.6. Pipes and hoses

Lines shall not have excessive bending, corrosion and abrasion because of contact with surrounding elements. They shall not either show excessive wear or cracks.

#### 3.7. Filters

All required filters have to be in good condition and the size of the mesh shall correspond to the nozzles fitted.

It shall be possible to clean the filters with the spray tank filled to its nominal volume, without leaks, except for the liquid contained in the filter casing and suction lines.

Filters shall be changeable according to the manufacturer instructions

#### 3.8. Application unit

##### 3.8.1. Nozzles identification

All the nozzle have to be clearly identifiable

##### 3.8.2. Dripping

After switching off the spray, there has to be no continuous dripping from nozzles 5 s after the spray jet has collapsed.

##### 3.8.3. Spray boom. Stability and alignment

The boom has to be stable in all directions, without excessive movements caused by wear or permanent deformation.

The vertical distance, between the bottom of each nozzle tip and a reference horizontal plane, shall not deviate more than 10 cm or 0.5% of the working width.

##### 3.8.4. Spray boom. Nozzle similarity

All the nozzles mounted in a spray boom have to be of the same type, size, material and manufacturer, except if they are intended for a special function

##### 3.8.5. Spray boom. Nozzles. Orientation and separation

The separation and orientation of the nozzles shall be uniform.

The separation between de nozzles (distance between the centre of two neighbouring nozzles) shall not deviate more than 5% from the nominal distance.

For special functions, the separation between the nozzles shall agree with the manufacturer instructions.

It shall not be possible to modify unintentionally the position of the working nozzles.

#### 3.8.6. Vertical spray boom. Symmetry

The nozzle arrangement on both sides of the boom must be symmetric, except for special functions.

#### 3.9. Distribution

##### 3.9.1. Uniformity

The spray jet of each nozzle must be uniform.

Holes and other liquid application devices different of nozzles shall not be clogged.

Other application devices, such as foam or jet curtains and liquid falls shall produce a uniform application.

##### 3.9.2 Nozzle flow rate

Nominal flow rate known

The deviation of the flow rate of each nozzle of the same type and size shall not exceed  $\pm 15\%$  of the nominal flow rate indicated by the manufacturer.

Unknown nominal flow rate

The flow rate of each single nozzle shall not deviate more than  $\pm 5\%$  of the mean flow rate of all the nozzles of the same type and size mounted on the application equipment.

In the case of only two nozzles of the same type and size, the mean value is not considered, but the deviation between the two nozzles.

If there is only one nozzle, with adjustable flow rate, the flow rate will only be measured as information.

##### 3.9.3. Pressure distribution

###### 3.9.3.1. Pressure drop

The pressure drop between the point of the sprayer where the pressure is measured and the outermost end of each boom section shall not exceed 10%

###### 3.9.3.2. Compensative returns

If compensative returns are available, 10 s after a boom section has been closed, the pressure shall not vary more than 10% when the sections are closed one by one.

#### 3.10. Rollers. Brushes

Rollers, brushes and other devices that carry fruits through the application zone, shall work properly, at the intended velocity, and be in good condition

#### 3.11. Cleaning devices

If available, devices for cleaning the spray application equipment have to work properly.

If available, pesticide can cleaning devices have to work properly.

It is recommended that a clean water container or source ( e.g. a tap) is available for the equipment operator

## 4. Test report

A test report shall include the results of the pre-inspection and the specific part of the equipment and shall be given to the owner.

The test report shall give at least the following information: Test station;

Name and contact details of the inspector and, where different, the testing organization and signature;

Date of inspection;

Owner's identity;

Owner's address;

Equipment type (drencher / bath / spray application, etc.);

Serial number or other identification;

Year of construction/production;

Any malfunction of the equipment. If the malfunction is a result of the design this should be noted;

Any information on malfunctions of the equipment useful to identify the corrective work required;

Results of measurements.

NOTE National or local regulations may give additional requirements for reporting of inspections

## 5. References

1. EN ISO 16122, 2015. Agricultural and forestry machinery - Inspection of sprayers in use. Parts 1, 4.
2. Directive 128/2009/EC Article 8 and Annex II