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# Agricultural and forestry machinery — Sprayers and liquid fertilizer distributors — Environmental protection —

Part 3: Air-assisted sprayers for bush  
and tree crops

The European Standard EN 12761-3:2001 has the status of a  
British Standard

ICS 13.020; 65.060.25

## National foreword

This British Standard is the official English language version of EN 12761-3:2001.

The UK participation in its preparation was entrusted to Technical Committee AGE/15, Equipment for crop protection and application of liquid fertiliser, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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Matériel agricole et forestier - Pulvérisateurs et distributeurs  
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Pulvérisateurs à jet porté pour arbustes et arboriculture

Land- und Forstmaschinen - Pflanzenschutzgeräte zum  
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## Foreword

This European Standard has been prepared by Technical Committee CEN/TC 144 "Tractors and machinery for agriculture and forestry", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by September 2001, and conflicting national standards shall be withdrawn at the latest by September 2001.

This standard consists of the following parts, under the general title Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors – Environmental protection:

Part 1 : General

Part 2 : Field crop sprayers

Part 3 : Air-assisted sprayers for bush and tree crops

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## 1 Scope

This standard specifies requirements and methods for their verification for design and performances of air-assisted sprayers for bush and tree crops with respect to minimizing the risk of environmental contamination.

This part applies in connection with EN 12761-1:2001 which contains general guidelines for agricultural sprayers.

## 2 Normative references

This European Standard incorporates, by dated or undated reference, provision from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 907:1997, Agricultural and forestry machinery – Sprayers and liquid fertilizer distributors – Safety.

EN 12761-1:2001, Agricultural and forestry machinery - Sprayers and liquid fertilizer distributors - Environmental protection - Part 1 : General.

ISO 4102, Equipment for crop protection – Sprayers - Connection threading.

ISO 4287, Geometrical Product specification (GPS) – Surface texture: Profile method – Terms, definition and surface texture parameters.

ISO 4288, Geometrical Product Specifications (GPS) – Surface texture: Profile method – Rules and procedures for

the assessment of surface texture.

ISO 5682-1, Equipment for crop protection – Spraying equipment – Part 1 : Test methods for sprayer nozzles.

ISO 5682-2, Equipment for crop protection – Spraying equipment – Part 2 : Test methods for hydraulic sprayers.

ISO 5682-3:1996, Equipment for crop protection – Spraying equipment – Part 3 : Test method for volume/hectare adjustment systems of agricultural hydraulic pressure sprayers.

ISO 9357, Equipment for crop protection – Agricultural sprayers – Tank nominal volume and filling hole diameter.

ISO 13440: 1996, Equipment for crop protection – Agricultural sprayers – Determination of the volume of total residues

ISO 14710, Equipment for crop protection – Air-assisted sprayers – Dimensions of nozzle swivel nuts.

## 3 Terms and definitions

For the purposes of this standard, the terms and definitions given in EN 12761-1:2001 apply.

## 4 Requirements

### 4.1 General

#### 4.1.1 Spray tank

#### **4.1.1.1 Surfaces**

Depth of roughness of inner and outer walls of the tank shall be such that  $R_z \leq 100 \mu m$  as specified in ISO 4287, and measured according to ISO 4288.



#### 4.1.1.2 Filling

Filling devices shall be designed to avoid any return of liquid from the tank to the filling supply.

The filling hole diameter shall comply with ISO 9357. The opening lid shall be tightly sealed to avoid spillage.

The total tank volume shall be at least 5 % more than its nominal volume. Tanks with nominal volume greater than 200 l shall have a nominal volume which is a multiple of 100 l.

Strainers shall have a minimum depth  $d$  as given in Table 1 and measured according to Figure 1.

Strainers shall be installed in filling openings and shall have a mesh size less than 2 mm. Also any gap(s) between the tank filling hole and the strainer shall not exceed 2 mm (see Figure 1).

The filling capacity of the tank with strainer when filled with water shall be at least 100 l/min for tanks with a nominal volume of 100 l or more. For tanks with a nominal volume less than 100 l, it shall be possible to fill the tank within 1 min.

Strainers of the chemical introduction bowl, if available, shall have a filter with a maximum mesh size of 20 mm.

**Table 1 — Minimum depth of strainers**

Nominal tank capacity (C) l	Minimum depth <sup>1)</sup> (d) mm
C ≤ 150	60
150 < C ≤ 400	100
400 < C ≤ 600	150
C > 600	250

<sup>1)</sup> measured from the upper edge of the strainer down to its bottom



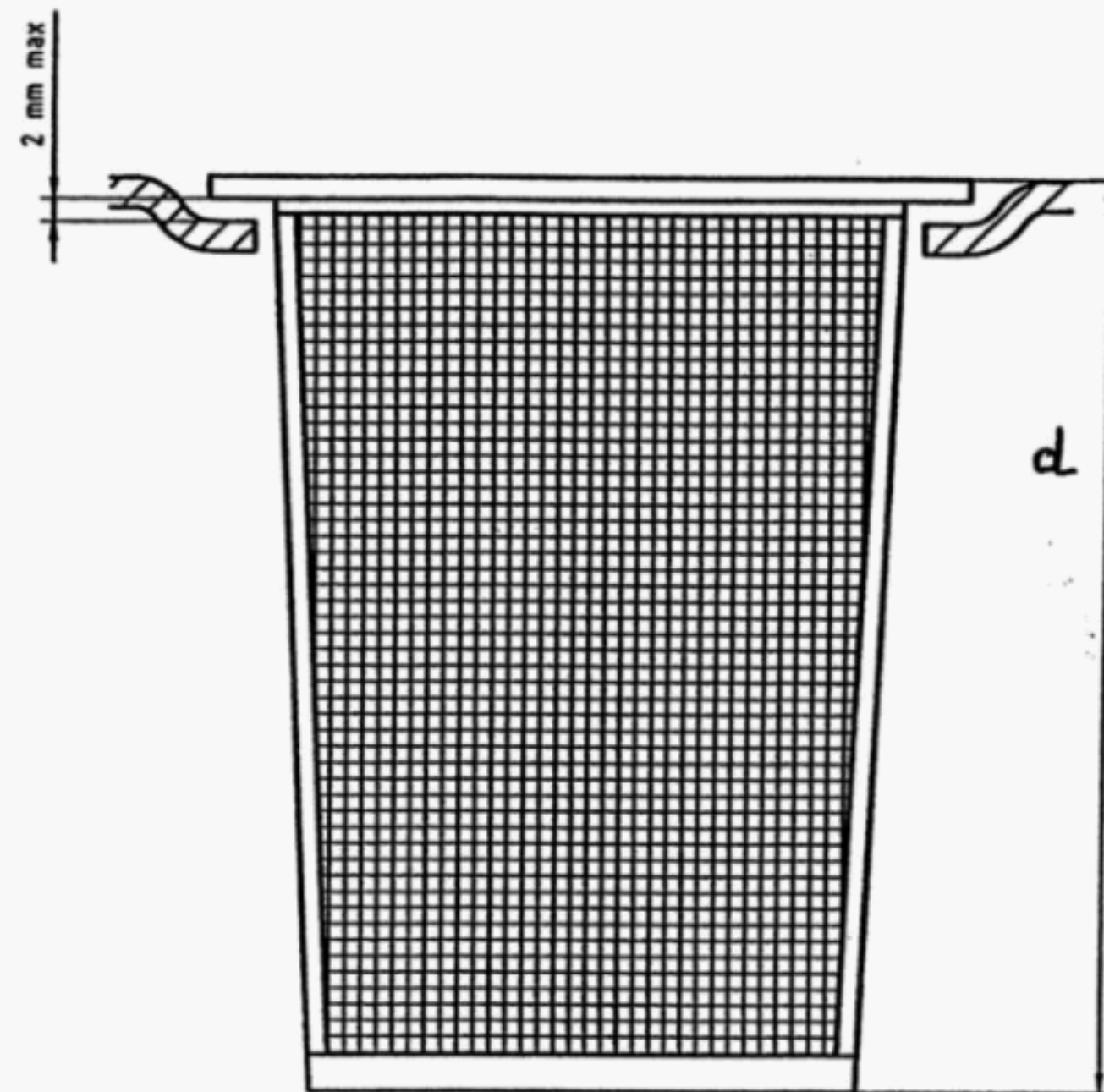


Figure 1 - Determination of the depth of the strainer and width of gaps

#### 4.1.1.3 Emptying

The volume of total residual as defined in 2.1 of ISO 13440:1996 shall not exceed :

- 4 % of the nominal tank volume for a tank volume less than 400 l ;
- 3 % of the nominal tank volume for a tank volume between 400 l (included) and 1000 l (included) ;
- 2 % of the nominal tank volume for a tank volume more than 1000 l.

The volume of total residual shall be determined in accordance with ISO 13440.

An emptying device in accordance with 4.5.3 of EN 907:1997 shall allow the complete emptying of the residual in the tank when the sprayer is in a horizontal position. Complete emptying of the residual is achieved if there are no visible puddles at the bottom of the tank after 5 min drainage.

It shall be possible to collect the liquid at the outlet without contaminating the operator or equipment parts, e. g. stays.

The tank outlet shall be guarded against accidental opening.

#### 4.1.1.4 Tank contents indicator

The indication of contents shall correspond to ISO 9357. It shall be durable and easily visible from the driver's position and from where the tank is filled.

The acceptable tolerances of the indication are:

- a) 7,5 % for each graduation mark for volumes up to 20 % of the nominal tank volume ;

- b) 5 % for each graduation mark for volumes above 20 % of the nominal tank volume.

The tolerances shall be measured with a maximum error on measurement of 1 % with the sprayer in a horizontal position.

Other means of visually checking the contents of the tank are allowed if they achieve equivalent accuracy.

#### **4.1.1.5 Mixing**

Tanks shall be equipped with devices (e.g. agitators) to ensure an even concentration of mixture. The maximum allowable deviation is  $\pm 15$  % when tested in accordance with ISO 5682-2.

#### **4.1.2 Hoses and lines**

The bending radius of hoses shall be within limits recommended by the hose manufacturer. Hoses shall not have any deformation which can disturb the liquid flow.

Pressure lines shall be equipped with quick-acting shut-off valves (e.g. tip-over lever valves).

#### **4.1.3 Filter**

Sprayers equipped with a positive displacement pump shall have a suction filter.

On the pressure side, the liquid going to the nozzles shall be filtered by means of central filters or filters in the lines of spraying sections. The mesh size of filters shall correspond to the size of nozzles fitted on the sprayer. This applies also to nozzle and pump filters.

Blockages shall be indicated to the driver, for example by an appropriate positioning of the central pressure filters and pressure gauge.

Filters shall be easily accessible and filter insets shall be removeable. For quick cleaning the filter tissue of the inset shall be easily accessible.

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

#### **4.1.4 Nozzles**

It shall be possible to fix nozzles in predetermined positions, to ensure that the spray is correctly directed, by appropriate means such as marking, by using locking systems or patterns.

When the spraying stop control has been activated, the dripping shall not exceed 2 ml per nozzle during 5 min. The measuring is started 8 s after the flow has been shut off.

The flowrate of each individual nozzle, measured according to ISO 5682-1, shall not deviate by more than 5 % from the data of the flowrate tables.

The swivel nuts of nozzles shall correspond to ISO 14710.

#### **4.1.5 Measuring systems**

The working pressure, the volume application rate (in l/ha) where relevant, the adjustment controls and the tank volume indication shall be clearly readable from the driver's position. Turning of the head and the upper body is tolerable.

Each measuring system of the sprayer, e.g. for flowrate, forward speed, pressure, shall measure within a maximum error of  $\pm 5\%$  of the true value.

On sprayers which shall be fitted with a pressure gauge complying with 4.6 of EN 907:1997, the accuracy of the pressure gauge shall be :

$\pm 0,2$  bar for working pressures between 1 bar (included) and 8 bar (included) ;

$\pm 0,5$  bar for working pressures between 8 bar and 20 bar (included) ;

$\pm 1$  bar for working pressures more than 20 bar.

The pressure gauge shall be clearly readable. The pressure indication shall be stable. The scale of the pressure gauge shall be marked

every 0,2 bar for working pressures less than 5 bar ;

every 1,0 bar for working pressures between 5 bar (included) and 20 bar (included) ;

every 2,0 bar for working pressures more than 20 bar.

#### **4.1.6 Nozzle output**

It shall be possible to measure the flowrate of each individual nozzle.

In the case of multi-head nozzles, this requirement applies to each multi-head nozzle.

#### **4.1.7 Test adapters**

When the measurement of nozzle output (see 4.1.6) is performed by collecting the liquid and when it is not possible to connect a 3/4" hose directly, the manufacturer/supplier shall provide sealing adapters which can be

fitted to swivel nuts according to ISO 14710.

For the test of the equipment's pressure gauge there shall be a connection with a 1/4" inner thread according to ISO 4102. Otherwise the manufacturer/supplier shall provide a suitable adapter.

It shall be possible to connect a flowmeter between the pump and the pressure regulator without damaging any hoses or removing the couplers from the hoses. Suitable adapters with 3/4" or 1" or 2" hose socket shall be provided by the manufacturer/supplier.

#### **4.1.8 Adjustment of liquid and air-flow**

It shall be possible to switch off the blower(s) independently from other driven parts of the machine.

It shall be possible to switch off the spray of each side of the sprayer independently.

It shall be possible for one person to adjust the liquid and air-jets according to the respective crop type and height in a reproducible way, by appropriate means such as marking, locking systems or patterns.

It shall be possible to switch each nozzle off and to adjust the direction of their spray independently.

In the case of multi-head nozzles, this requirement applies to each multi-head nozzles.

### **4.2 Adjustment of the volume application rate**

The maximum error for all the below measurements shall be 2,5 %.

**4.2.1** Pressure adjustment devices shall maintain a constant working pressure at constant revolutions of the pump. After switching off and on the sprayer and its individual sections, the working pressure shall return to its original value within 7,5 %. This applies also if the pressure has been adjusted in the meantime.



**4.2.2** Volume/hectare adjustment systems shall meet the following requirements :

- a) 7 s after variations in operating conditions, the measured volume application rate shall be within  $\pm 10$  % of the mean volume application rate in the new constant operating condition ;

NOTE Changes in operating conditions are effected for instance by switching off nozzles or varying the speed and switching of sections of the spray boom.

- b) during repeated adjustments of the same volume application rate (l/ha), the coefficient of variation calculated from 7 measurements shall not exceed 3 % ;
- c) whilst spraying with constant p.t.o.-revolutions and at a constant driving speed, the maximum deviation from of the mean volume application rate (l/ha) shall not exceed 5 % ;
- d) the acceptable deviation on the measured volume application rate (l/ha) or respective flowrate (l/min) from the values required are as follows :
- 1) 6 % for the mean deviation ; and
  - 2) 3 % for the coefficient of variation.

The test of the volume/hectare adjustment system shall be carried out in accordance with ISO 5682-3. Requirement a) shall be checked according to 5.1 and 5.2 of ISO 5682-3:1996. Requirements b), c) and d) shall be checked according to 5.3 of ISO 5682-3:1996.

**4.2.3** The pressure drop between the measuring point for pressure on the air-assisted sprayer and the nozzle (including anti-drip device, if available) or the orifice plate shall not exceed 10 % of the pressure shown on the pressure gauge.

**4.2.4** Appropriate calibration aids (at least a measuring jar with a capacity of 1 l and an accuracy of 2,5 %) shall be supplied together with the sprayer.

**4.3 Distribution of liquid and air**

**4.3.1 Liquid**

During spraying and independent of the volume of liquid in the tank, the measured volume application rate (l/ha) shall be within  $\pm 10$  % of the mean value calculated from 5 measurements.

This shall be checked in accordance with ISO 5682-2.

The flowrate of each nozzle shall not deviate by more than 10 % from the data given in the flowrate tables provided by the sprayer manufacturer.

The flowrate of all nozzles with the same characteristics, for example nominal flowrate, type, etc. shall not deviate by more than 10 % from the mean flowrate.

The flowrate of the left and right sides shall be within 50 %  $\pm 5$  % of the total flowrate.

These requirements for flowrate shall be checked with a measuring error of less than  $\pm 2,5$  % of the true value.

**4.3.2 Air**

The real output of the fan shall not deviate more than 10 % from the nominal output.

It shall be possible to adjust the sprayer so that the maximum air velocity produced by the fan is symmetrical at the right and the left side.

NOTE This requirement will be reviewed when results from the test method defined in ISO/FDIS 9898:1999 are available.

#### **4.4 Rinsing water tank**

A water tank (or tanks) for rinsing the spraying equipment shall be provided except on mounted sprayers of capacity less than or equal to 400 l. This tank shall not be combined with the clean water tank for the operator's use (see 4.11 of EN 907:1997). It shall have a volume of at least 10 % of the nominal tank volume or at least 10 times the volume of residual which can be diluted (see 2.2 of ISO 13440:1996). In the latter case, the volume of residual of tank shall be specified in the instruction handbook.

Water tanks shall be designed so that they can be connected with the equipment in such a way that the rinsing of the pipes is possible even when the tank is filled to its nominal volume. In addition, the dilution of the volume of residual in the tank shall be possible.

### **5 Marking**

Clause 5 of EN 12761-1:2001 applies.

### **6 Instruction handbook**

Clause 6 of EN 12761-1:2001 applies.

Additionally, recommendations concerning the adjustment of the fan (e.g. air velocity), in particular to avoid drift, and the avoidance of crop damage shall be given.

### **7 Additional requirements for cleaning device for crop protection product cans**

Devices for cleaning crop protection product cans, when provided, shall be designed so that the volume of residue after cleaning is less than 0,01 % of the nominal can volume. This requirement shall be checked according to the test method given in Annex A.

NOTE : An example of a cleaning device that meets this requirement is given in Annex B.

The collection and transfer of rinsing water to the tank of the sprayer shall be possible.



## Annex A (normative)

### Test method for cleaning crop protection product cans

#### A.1 Test procedure

The test shall be carried out with a reference can conforming to A.2 and a reference product conforming to A.3.

The reference can filled with the reference product shall be emptied directly before the test.

Cleaning with the device to be tested shall be carried out according to the manufacturer's recommendations. The cleaning duration shall be a maximum of 30 s.

The residue of the reference product in the reference can shall be determined after the cleaning procedure using simple methods of analysis (for example photometry or titration).

#### A.2 Reference can

The reference can shall have a nominal volume of 10 l and shall correspond to figure A.1. The handle shall be squeezed off.

In addition, it shall have the following characteristics :

material : Polyethylene, non coloured ;

weight : 400 g ± 20 g ;

maximum volume : 11 l ± 0,2 l (at 20° C).

The reference can shall be stable on even ground. It shall be free from dirt.

#### A.3 Reference product

Table A.1

Constituent	Composition (%)
polysaccharide (based on xanthan)	0,7
methyl cellulose	0,3
soda	0,2
bactericidal means of preservation	0,1
duasyn blue acid	0,1
water	98,6
NOTE : The constituents are known for example as : Rhodopol 23 (polysaccharide), Tylose H 300 (methyl cellulose) and Kobate C (bactericidal means of preservation)	

Dimensions in millimeters

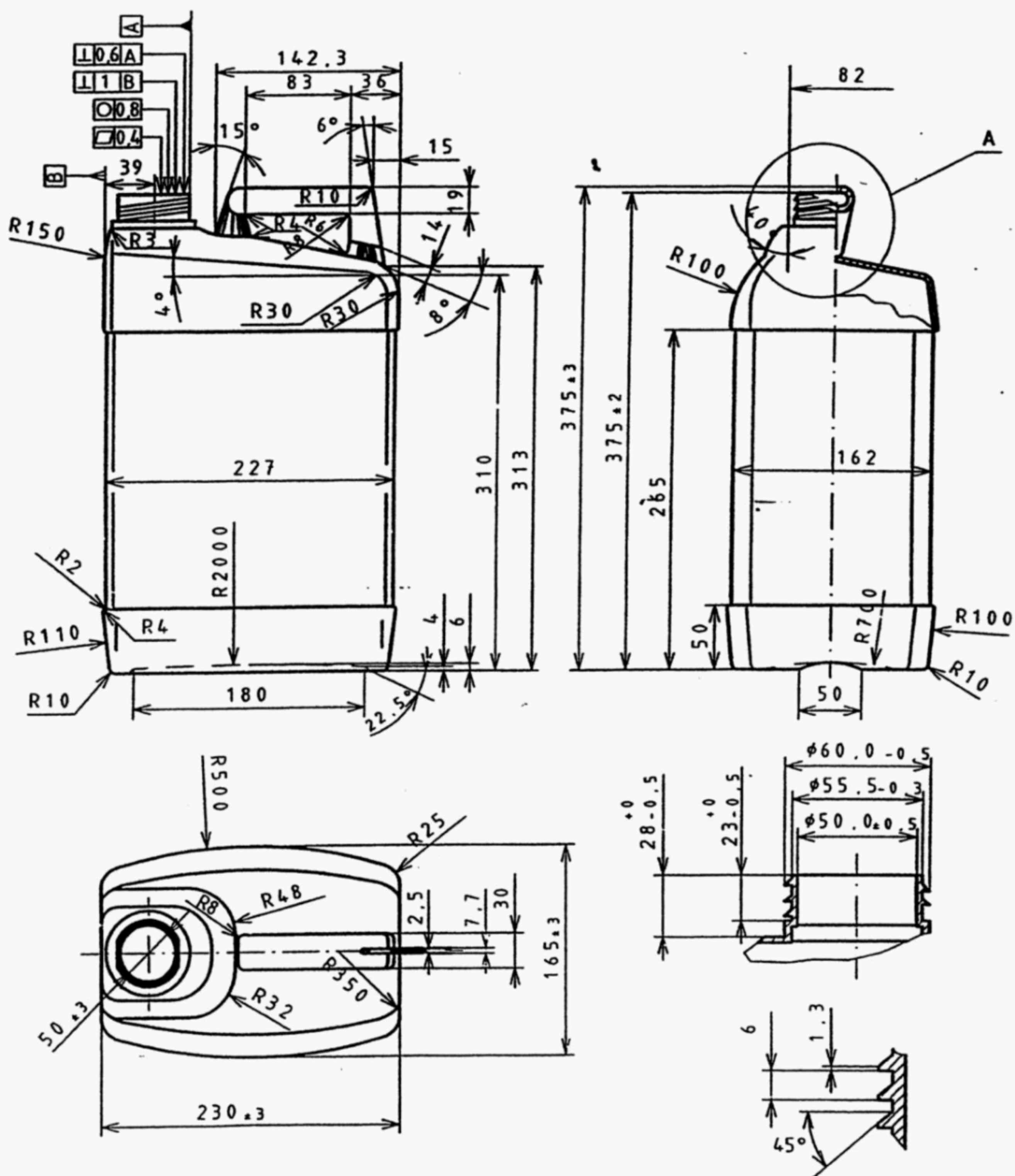


Figure A.1 — Reference can

## **Annex B** (informative)

### **Example of device for cleaning of crop protection product cans**

#### **B.1 General**

The device is described in figures B.1 to B.4 and specified by B.2 to B.5.

#### **B.2 Plate**

The plate on which the can is placed is 30 mm wide and 100 mm long (see figure B.2). The plate is designed so that the liquid flows out of the can freely.

When the can is pressed down on the plate, the valve opens. Releasing the pressure closes the valve automatically.

#### **B.3 Nozzle pipe**

The dimensions of the nozzle pipe are as follows :

outside diameter : 20 mm ;

length (including nozzle) : 180 mm.

#### **B.4 Nozzle**

The rotating nozzle, see figure B.3, has the following characteristics :

output : 22 l/min to 25 l/min at 3 bar ;

number of openings : 3 (flat spray) ;

distribution angle : 300° (see figure B.3) ;

speed : 750 rpm to 1 250 rpm at 3 bar ;

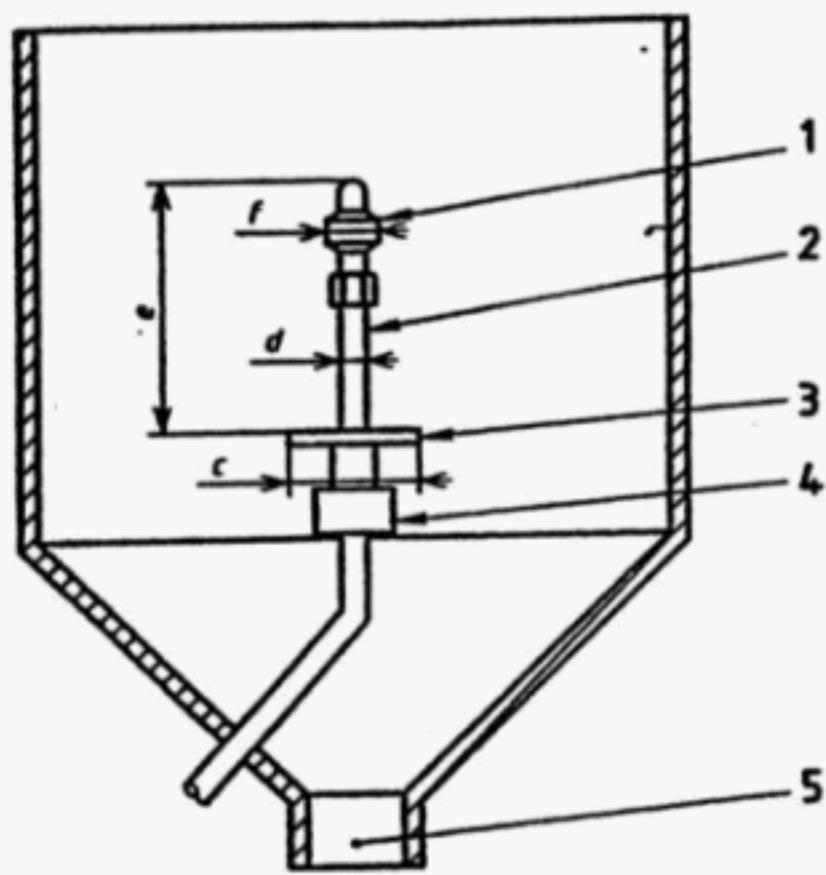
outside diameter : 38 mm.

#### **B.5 Frame**

For flexible packaging (e.g. bags, sacks), a cone-shaped frame is used (see figure B.4).

The frame is detachable.

Dimensions in millimeters



- Key
- 1 – Nozzle
  - 2 – Nozzle pipe
  - 3 – Plate
  - 4 – Valve
  - 5 – Tip

Figure B.1 – Cleaning device

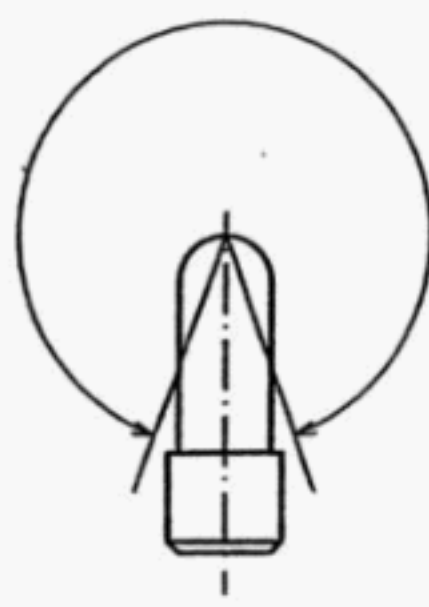


Figure B.3 - Nozzle

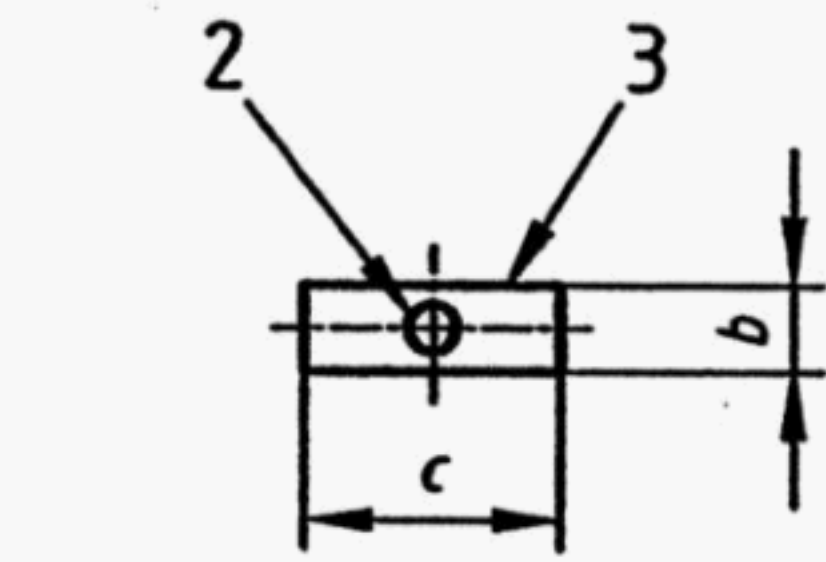


Figure B.2 – Plate

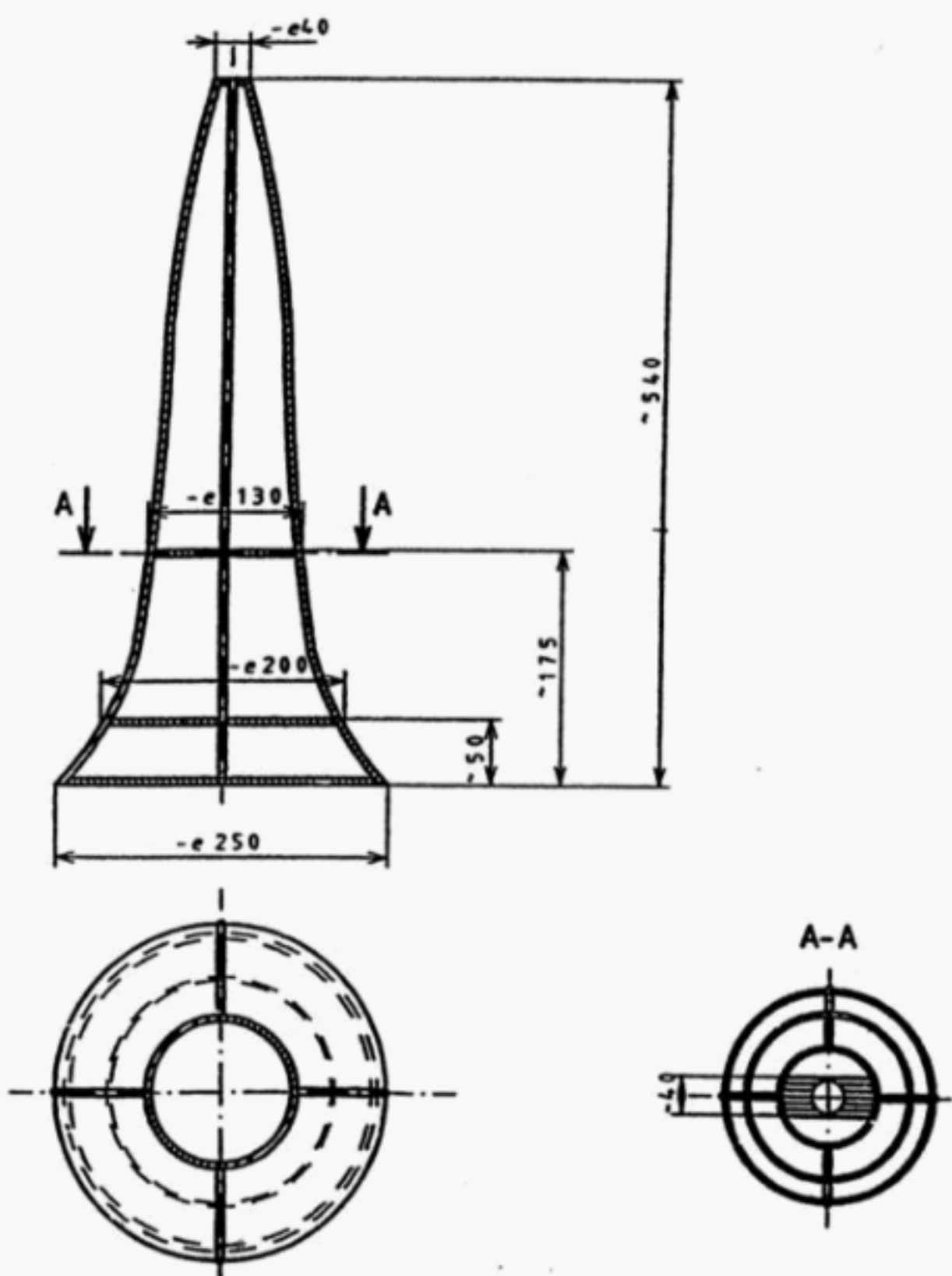


Figure B.4 – Frame

## Bibliography

- [1] EN 12761-2:2001, Agricultural and forestry machinery - Sprayers and liquid fertilizer distributors - Environmental protection - Part 2 : Field crop sprayers
- [2] ISO/FDIS 9898:1999, Equipment for crop protection – Test method for air-assisted sprayers for bush and tree crops



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