

Berichte

aus der Biologischen Bundesanstalt für Land- und Forstwirtschaft

Reports

from the Federal Biological Research Centre for Agriculture and Forestry

Heft 25

1997

Synopsis of Testing Plant Protection Equipment in the Federal Republic of Germany

**Legal Requirements and Publications of the
Federal Biological Research Centre
for Agriculture and Forestry (BBA)**



BBA

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compiled by

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Herausgeber

Biologische Bundesanstalt für Land- und Forstwirtschaft,
Braunschweig, Deutschland

Verlag:
Eigenverlag

Vertrieb:
Saphir-Verlag, Gutsstraße 15, D-38551 Ribbesbüttel
Telefon 0 53 74/65 76
Telefax 0 53 74/65 77

ISSN-Nummer: 0947-8809

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Preface

This brochure provides a compilation of the most important regulations about the testing of plant protection equipment in the Federal Republic of Germany. From the Plant Protection Act and from the Regulatory Ordinance about Plant Products and Plant Protection Equipment an extract of those parts is made which refer to plant protection equipment. It is noted that in law cases the German text is legally binding.

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SECTION I

Obligatory Testing of Plant Protection Equipment

Preliminary Remarks to the Procedure of declaration for plant protection equipment (§§ 25 to 29 of the Plant Protection Act)

The Act on the Protection of Crop Plants (Plant Protection Act) of 15th September 1986 significantly widened the official testing of plant protection equipment. From 1st July 1988, a procedure of declaration which regulates the placing of plant protection equipment on the market became legally binding.

Under the law, plant protection equipment may only be placed on the market if it is designed so that, when used for its intended purpose and in a correct manner for the application of plant protection products, it has no harmful effects on human or animal health and on the ground water, nor any other harmful effects, in particular on the natural balance, which can be avoided with the current state of art (Article 24 Plant Protection Act). The requirements for plant protection equipment are specified in detail in the Regulation on Plant Protection Products and Plant Protection Equipment of 28th July 1987.

They apply to all plant protection equipment except small devices. The Federal Biological Research Centre for Agriculture and Forestry (BBA) may work out and publish criteria (features) against which compliance with these requirements is measured. For this purpose, it has set up an expert group on the equipment declaration procedure composed of representatives of the official crop protection services and of manufacturers. The group advises the BBA on the criteria which have to take account of the current state of technology. A number of BBA guidelines which summarize the criteria valid for the different types of equipment and lay down regulations and provisions concerning the examination procedure are generally available.

Covering plant protection equipment except small equipment, the procedure of declaration took effect on 1st July 1988 under which a manufacturer, distributor or importer of plant protection equipment which is put on the market for the first time (new equipment) has to declare to the BBA that the type of equipment fulfils the requirements pursuant to Article 24 of the Plant Protection Act. The declaration has to be supplemented by comprehensive and detailed documentation on the basis of which BBA examines compliance with the mentioned legal requirements (features).

The BBA keeps and regularly publishes a list of plant protection equipment which registers only equipment which complies with the mentioned requirements. If equipment is suspected of not fulfilling the requirements, the BBA may request the equipment to be sent in for examination. If an examination shows that the equipment does not comply with the requirements, it will be deleted from the plant protection equipment list. As a consequence, it is not marketable. Intentional or negligent contravention of this legal regulation may be punished by a fine.

Extract which refer to plant protection equipment of the

**Act
concerning the Protection of Crop Plants
(Plant Protection Act – Pflanzenschutzgesetz)**

15. September 1986

The Bundestag, with the consent of the Bundesrat, has adopted . the following Act:

**Section One
General Provisions**

**Article 1
Purpose**

Purposes of this Act are:

1. the protection of plants, particularly crop plants, against harmful organisms and against non-parasitic impairments;
2. the protection of plant products against harmful organisms;
3. the prevention of damage by the muskrat (*Ondatra zibethicus* L.);
4. the aversion of dangers which may result from the use of plant protection substances or other plant protection measures, in particular where the health of man and animals and the natural balance are concerned;
5. the enforcement of legislation issued by institutions of the European Communities in the field of plant protection.

**Article 2
Definitions**

(1) Within the meaning of this Act,

11. plant protection equipment (Pflanzenschutzgeräte) shall be equipment and devices intended to be used for applying plant protection substances;

Section Five
Plant Protection Equipment

Article 24
Marketing

Plant protection equipment may be marketed only if it is designed such that when it is used correctly and in accordance with its intended purpose for the application of plant protection substances it does not produce any harmful effects on human and animal health or on the groundwater or does not have any other harmful effects, particularly on the natural balance, which, on the basis of the current state of the art, are avoidable.

Article 25
Declaration

(1) Before plant protection equipment – with the exception of small items of equipment – is marketed for the first time, the manufacturer, the marketing firm (if it intends to market the plant protection equipment for the first time) or the importer must declare to the Federal Biological Research Centre that the equipment type fulfils the requirements set out in Article 24.

(2) The declaration must contain:

1. the name and address of the manufacturer, marketing firm or importer;
2. the designation of the equipment type and the field of use.

(3) The declaration must be accompanied by:

1. the instructions for use;
2. a description of the equipment type and
3. the other documentation necessary for evaluation.

(4) The documentation referred to in paragraph 3 above must be resubmitted or supplemented in the event of modifications to the equipment type which influence the application of the plant protection substances.

(5) The Federal Biological Research Centre may waive the declaration if the plant protection equipment is intended for research, investigation, trial or exhibition purposes.

Article 26
Plant protection equipment list

(1) The Federal Biological Research Centre shall keep a list of the equipment types for which a declaration as specified in Article 25 has been submitted (plant protection equipment list).

(2) The Federal Biological Research Centre shall announce entries in the plant protection equipment list, and the deletion of such entries, in the Federal Gazette (Bundesanzeiger).

Article 27 Testing

(1) The Federal Biological Research Centre may test plant protection equipment to establish whether it fulfils the requirements of Article 24. It shall in particular test plant protection equipment in the case of which the declaration or the accompanying documentation gives rise to doubts as to whether the equipment fulfils the requirements of Article 24.

(2) in specific cases, the Federal Biological Research Centre may order the manufacturer, marketing firm or importer to supply it with a particular item of plant protection equipment for testing.

Article 28 Results of the testing

If the testing reveals that an item of plant protection equipment does not fulfil the requirements, the Federal Biological Research Centre shall delete the relevant entry from the plant protection equipment list. In the event of minor shortcomings the Federal Biological Research Centre may initially refrain from deleting the entry and set the manufacturer, marketing firm or importer a reasonable deadline for eliminating the shortcomings. Until the end of the period set, plant protection equipment of this equipment type may, notwithstanding Article 24, continue to be marketed with these shortcomings.

Article 29 Instructions for use

The instructions for use shall be supplied together with an item of plant protection equipment when it is marketed. They must additionally contain:

1. the name and address of the manufacturer, marketing firm or importer;
2. the designation of the equipment type and the field of use.

Section Eight
Authorities

Article 33

Federal Biological Research Centre

(1) The Federal Biological Research Centre is an autonomous superior federal authority in the purview of the Federal Minister of Food, Agriculture and Forestry.

(2) In addition to the functions which have been or shall be assigned to it by this Act, by regulatory ordinances as provided for in Articles 7, 17, 19, 30 (1) or by other statutory regulations, the Federal Biological Research Centre shall have the following terms of reference:

4. to participate in the monitoring of plant protection equipment of the equipment types entered in the plant protection equipment list;
5. to test plant protection equipment;
6. to test and develop plant protection methods;

(3) The Federal Biological Research Centre may test and examine:

3. equipment and devices which are used in plant protection but which are not plant protection equipment.

(4) The Federal Biological Research Centre shall publish a descriptive list of the authorized plant protection substances and the plant protection equipment entered in the plant protection equipment list (descriptive plant protection list), detailing the features and properties important with regard to application of the plant protection substances and use of the plant protection equipment, as well as the suitability of the plant protection substances for specific fields of application, soil conditions and climate conditions and the suitability of the plant protection equipment for specific fields of use. Investigation results derived from actual plant protection practice may be utilized in the descriptive plant protection list.

Extract which refer to plant protection equipment of the
Regulatory Ordinance
about Plant Protection Products and Plant Protection Equipment
(Plant Protection Order – Pflanzenschutzmittelverordnung)

28. July 1987

Section Two
Plant protection equipment

Article 4
Requirements

(1) The requirements for plant protection equipment - excepted small items of equipment - which shall be marketed, follows from appendix 1.

(2) The BBA may publish features in the Federal Law Gazette, which - by opinion of the BBA - are necessary to judge about the fulfilling of the requirements.

Article 5
Small items of equipment

Small items of equipment are those,

1. which are driven by hand or condensed gas and which have a maximum filling capacity of 5 l or 1 l if they shall be marketed ready for use with condensed gas or
2. those which will applicate the plant protection products only by the force of gravity and which have a maximum filling capacity of 20 l for watering cans, of 3 l for granule applicators and of 1 l for all other equipment

and for one person it must be possible to carry the equipment.

Article 6
Declaration

(1) The declaration according to article 25 of the act must be given in a single issue.

(2) The instructions for use must follow the appendix 2.

(3) The description of the type of equipment must contain:

1. a complete representation in connection with a description of technique and function and sufficient illustrations of the plant protection equipment,
2. illustrations of all important items for application of plant protection products, especially those for ration and distribution.

Appendix 1 (to Article 4, paragraph 1)

Quality of plant protection equipment

Plant protection equipment (machines for applying plant protection products) must be manufactured in such a way, that

1. it works reliably,
2. it can be used properly and in correspondence to its purpose.
Explanation: Details about the use in correspondence to its purpose will be provided by the instruction manual,
3. a sufficient quality of dosing and evenness of distribution is granted,
4. when used and operated properly plant protection products must be deposited sufficiently on target areas,
5. parts of it which will heat up cannot come into contact with plant protection pesticides during filling or emptying of the tank,
6. it can be filled up in a safe manner,
7. its function will not be affected by pollution,
8. maximum and minimum limits of filling levels in the tanks can be determined easily,
9. there is a sufficient difference between nominal and total capacity of the tank,
10. plant protection products cannot run out unintentionally,
11. the filling level of plant protection products or mixtures can be determined easily,
12. it can be adjusted easily, sufficiently accurate and reproducibly,
13. it is equipped with enough and sufficiently accurate measuring systems,
14. it can be safely operated, supervised and immediately switched off from the operator's place,
15. it can be emptied safely, easily and completely,
16. it can be cleaned in an easy and thorough way,
17. parts which wear are changeable,
18. measuring instruments can be connected for testing.
19. Sufficient complete and easy to be readable dosing instructions must be fixed at the plant protection equipment in a durable way. If this is not possible durable dosing instructions must be added.

20. On plant protection equipment the machine type or the belonging to a certain type and the year of production must be indicated for identification.
21. On atomizers data as type, size and important data for spraying must be indicated.
Explanation: Identification must be performed by codes (e.g. type number, symbols, colours etc.) which can be decoded by the aid of tables to supply the information required.

Appendix 2 (to Article 6, paragraph 2)

Instructions for use

The instructions for use must contain particular items

1. about the outfit of the plant protection equipment in correspondence to its purpose,
2. about the filling of the equipment and about precautions,
3. about the field of use and the adjustment of the equipment,
4. about the rest volume, which can not be applicated in a proper way by the equipment,
5. about the emptying and cleaning of the equipment,
6. about the checking of the dosing,
7. about the mesh-width of the strainers,
8. about intervals for checking the equipment if it is still in good function, and if it doses and distributes still accurately,
9. about restriction on the use of special plant protection products,
10. about necessary preparations for different fields of use,
11. about possibilities of connection with other equipment enclosing precautions,
12. about checking the plant protection equipment.

**First Regulation
Concerning Alterations of the Ordinance for
Plant Protection Products and
Plant Protection Equipment**

of 11 June 1992

In conformity with Article 30, paragraph 1, Nos. 1 and 3 of the Plant Protection Act of 15 September 1986 (Bundesgesetzblatt I, p. 1505) the Federal Minister of Food, Agriculture and Forestry orders the following:

Article 1

The Ordinance for Plant Protection Products and Plant Protection Equipment of 28 July 1987 (Bundesgesetzblatt I, p. 1754) shall be altered as follows:

1. Behind Article 6 the following rule will be inserted:

"Article 7

Testing

(1) At intervals of four semi-annual periods persons authorized to dispose and owners (owners) shall have their plant protection equipment, which is used for field crops, with the exception of small units, tested by official or officially recognized test stations. Plant protection equipment for field crops in the sense of this Regulation shall have horizontally operating, spray booms or air assisted spray booms as they are primarily used in field cropping, either rear- or surface-mounted or as trailer or self-propelled units.

(2) The testing shall cover the requirements of appendix 1, paragraph 1, Nos. 1 to 3, 6, 7, and 10) to 15. The parts to be tested are ensuing from appendix 3.

(3) Plant protection equipment used after the 30 June 1993 for the first time shall have to be tested within six calendar months from the date of its first use. The latter shall be satisfactorily shown through appropriate documents. The testing shall be limited to finding out whether or not the parts of plant protection equipment mentioned in appendix 3, Nos. 2, 6 and 9 meet the respective requirements of appendix 1.

(4) Owners shall establish proof of the semi-annual period in which the plant protection equipment has to be tested according to paragraph 1, sentence 1, by having a test sticker affixed to it which corresponds to the design in appendix 4. The test sticker shall be provided with entries and affixed by the test station, showing the respective address, calendar year and semi-annual period provided the testing has proved the unobjectionable functioning of the equipment. The testing body can provide the test sticker with a test number. The test sticker can be affixed by the test station if the plant protection equipment only shows minor failures and if the owner engages himself to remedy the failures immediately.

(5) The test sticker shall be affixed to the plant protection equipment in a clearly visible and unremovable manner; it shall be made in such a way that it will get destroyed during removal.

(6) The test sticker shall become invalid upon the end of the semi-annual period indicated on it. If plant protection equipment that is in use and is expected to have such a test sticker has no valid one, the body which is the competent authority according to national law shall have to withdraw the permission for using the respective plant protection equipment until the required test sticker is acquired and affixed.

(7) If a second-hand plant protection equipment, which is subject to testing, is imported after the 30 June 1993, owners shall have it tested according to paragraph 2 before they first use it in their country.

(8) The owner of plant protection equipment, which is in use on 30 June 1993, shall have it tested for the first time according to paragraph 1

1. by 31 March 1996, if it has been voluntary tested between 1 January 1992 and 30 June 1993 and if a respective proof can be established by the owner,
 2. for the rest, by 31 December 1993.
2. The previously valid Article 7 shall be deleted.
3. In Article 8, sentence 2, the semicolon shall be replaced by a full stop and the wording thereafter shall be deleted.
4. Appendix 1 shall be altered as follows:
- a) References to the appendices shall have the following form:
"(see Article 4, paragraph 1 and Article 7, paragraph 2, sentence 1)".
 - b) To mark new paragraphs: "(1)" shall precede sentence 1 and "(2)" sentence 2.
5. The following appendices shall be added:

Appendix 3

(see Article 7, paragraph 2, sentence 2)

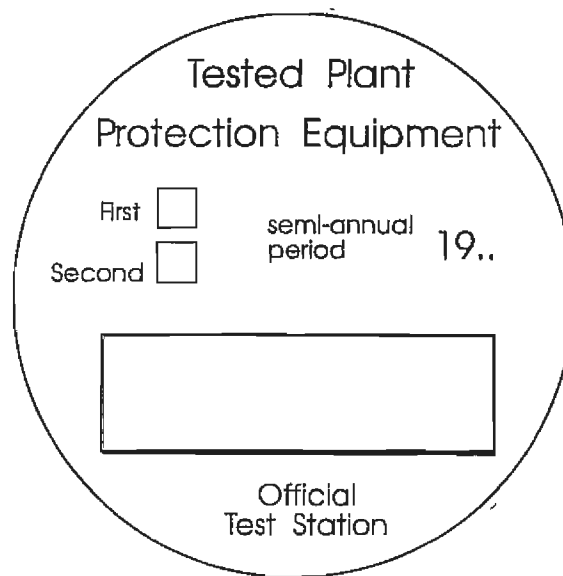
Parts to be tested:

- | | |
|----------------------|---|
| 1. drive | 6. tubing |
| 2. pump | 7. filtration |
| 3. agitator | 8. spray boom or air assisted
spray boom |
| 4. spray liquid tank | 9. nozzles |
| 5. controls | |

Appendix 4

(see Article 7, paragraph 4, sentence 1)

Design of test sticker



Is the test made in a test workshop which has been officially recognized according to national law the words "Official test station" shall be replaced by the words "Officially recognized test workshop".

Article 2

The Federal Minister of Food, Agriculture and Forestry can promulgate the wording of the Ordinance for Plant Protection Products and Plant Protection Equipment in its version valid from 1 July 1992 in the "Bundesgesetzblatt".

Article 3

This Regulation shall enter into force on 1 July 1993.

Approval has been given by the Federal Council.

Bonn, 11 June 1992

The Federal Minister

of Food, Agriculture and Forestry

I. Kiechle

Features for the Testing of Plant Protection Equipment

In conformity with Article 4, paragraph 2 of the Regulatory Ordinance about Plant Protection Products and Plant Protection Equipment of 28 July 1987 the Federal Biological Research Centre for Agriculture and Forestry, Braunschweig (BBA) published features in the Federal Law Gazette, which - by opinion of the BBA - are necessary to judge about the fulfilling of the requirements.

The features are published for the following 7 types of equipment:

1. Field sprayers
2. Air-assisted sprayers for orchards, vineyards and hops
3. Pedestrian manual powered sprayers
4. Pedestrian motor powered sprayers and blowers
5. Seed treatment machines
6. Granules applicators
7. Fogging machines

Explanation:

At the left side of each page you see the 7 columns which represent the seven types of equipment. A "I" in the column says that the text on the right side is applicable for that type of equipment, indicated on top of the page. A "0" says not applicable.

The columns are followed in row by ciphers which show the numbering of the requirements and features. A cipher followed by two zeros says, that this is a requirement (extra bold print) given by the Plant Protection Act , all other numbers belong to features.

Examples:

type of equipm.

1 2 3 4 5 6 7

I I I I I I I **2.0.0** means the legal requirement number 2 and is applicable for all types of plant protection equipment.

0 0 0 0 I 0 0 **10.3.1** means feature 3.1 of the legal requirement number 10 and is applicable for seed treatment machines (a "I" in the fifth column).

FACHGRUPPE ANWENDUNGSTECHNIK

- Application Techniques Division -

Messeweg 11/12

D 38104 Braunschweig

type of equipm.

1 2 3 4 5 6 7

- I I I I I I I I 1.0.0 Plant protection equipment (machines for applying plant protection products) shall work reliably.**
- I I 0 0 0 0 0 1.1.1 On p.t.o.-pumps the tolerable maximum revolutions per minute shall be indicated on the data plate.
- I I 0 0 0 0 0 1.2.1 Armatures for connecting spray-hoses shall allow a safe positioning of the hoses to avoid sharp bending.
- I 0 0 0 0 0 0 1.3.1 Spraybooms with a working width up to 10 m shall be able to move backwards automatically in case of contacts with obstacles in the field.
Explanation: If the sprayer is moved forward with at least 4 km/h and the obstacle is in a distance of 90 % of the half working-width, measured from the middle of the track, the sprayboom shall be able to give way without being damaged.
- I 0 0 0 0 0 0 1.3.2 Spraybooms with a working width more than 10 m shall be able to move back-and forward automatically in case of contact with obstacles in the field.
Explanation: If the sprayer is moved forward with at least 4 km/h or backwards with at least 2 km/h and the obstacle is in a distance of 90 % of the half working-width, measured from the middle of the track, the sprayboom shall be able to give way without being damaged.
- I 0 0 0 0 0 0 1.3.3 Spraybooms or boom sections shall return immediately to their original position after contact with obstacles.
Explanation: In stationary position spraybooms or sections of them which had been moved according to explanation 1.3.1 and 1.3.2 shall return immediately and automatically to their original position after having been released.
- I I I I 0 0 I 1.4.1 Non pressurized spray-tanks shall have pressure compensation.
- 0 0 0 I 0 0 0 1.5.1 The throttle lever of the motor shall not change position itself.
Explanation: The duration of test is 5 minutes.
- 0 0 0 0 0 0 I 1.5.2 A chosen running position shall not change itself.
- 0 0 0 0 0 I 0 1.6.1 Rubbing off or damaging of granules shall be prevented up to an unavoidable degree.
- 0 0 0 0 0 I 0 1.7.1 The machine shall be protected against dripping water (rain) in such a way, that no humidity reaches granules in the machine.

type of equipm.
1 2 3 4 5 6 7

- I I I I I I I I** 2.0.0 **Plant protection equipment shall be manufactured in such a way, that it can be used properly and in correspondence to its purpose.**
Explanation: Details about the use in correspondence to its purpose will be provided by the instruction manual.
- I 0 0 0 0 0 0 2.1.1 The working width has to correspond with the usual width of seed drills, cultivators etc. (2.0 m; 2.25 m; 2.5 m; 3.0 m; 3.33 m) and shall be a whole-number-multiple of it.
- I 0 0 0 0 0 0 2.2.1 It shall be possible to switch spray booms off and on in at least two sections.
- I 0 0 0 0 0 0 2.2.2 The maximum section width is 4.5 m.
- I 0 0 0 0 0 0 2.3.1 One person shall be able to adjust the spray boom to the height of the crop with a force of less than 50 daN.
- I 0 0 0 0 0 0 2.4.1 The height of the liquid atomisers above the ground shall be adjustable within a range of at least 1.0 m. The minimum distance between the atomisers and the target area shall correspond with the atomisers outfit. For equipment that is to be used in cultures higher than 1.0 m the height of the liquid atomisers above the ground shall be adjustable within a range of 1.2 m.
Explanation: For three-point-linked machines an average lifting height of 0,5 m should be assumed.
- I I 0 0 0 0 0 2.5.1 In all positions of height above the ground the sprayed liquid shall not get in contact with parts of the equipment, with the exception that it is required for special functions, however dripping shall be avoided.
- I I I I 0 0 I 2.6.1 Number, position and size of the liquid atomisers have to be chosen in such a way, that the spray liquid can be applied at the quantity required.
- I I I I 0 0 0 2.7.1 The liquid output of the pump shall correspond with the quantity of liquid needed by the equipment.
Explanation: The liquid output of the pump is to measure with a maximum allowable error of 2.5 %.
- 0 0 I 0 0 0 0 2.7.2 Pressure waving shall be small.
Explanation: Pressure waving is small, if it does not deviate more than 25 % from the mean pressure.
- I I 0 0 0 0 0 2.8.1 It shall be possible to switch off the blower separately from other driven parts of the machine.
Explanation: This can be obtained by a clutch, a belt-drive cocking-handle or turning away the air-flow.

type of equipm.
1 2 3 4 5 6 7

- 01 00000 2.9.1 The liquid- and air-jets shall be adjustable by one person to the respective cultivation type and height of the crop.
- 01 00000 2.10.1 The application to one side only shall be possible by switching off the other.
- 01 00000 2.10.2 The equipment has to be constructed in such a way, that the required working width and -height can be obtained at both sides by hydraulic pressure spraying or air assisted spraying - irrespective of the number of rows-.
- 11 00000 2.11.1 For spray tanks with 200 l and more the nominal tank capacity shall always end up at complete 100 l.
- 1111 000 2.12.1 Each nozzle shall form a uniform spray jet, the pattern of which shall not change unintentionally during operation.
- 11 00000 2.12.2 The jet direction and, if applicable, jet pattern of the nozzles shall be adjustable in a reproducible manner by suitable technical aids.
Explanation: Suitable aids are, e. g., fixed marks, locking devices, or adjusting gauges.
- 01 00000 2.12.3 It shall be possible to switch off each single nozzle.
- 01 00000 2.13.1 It shall be possible to obtain the required pressures.
- 0011 000 2.14.1 The weight of the equipment with a filled tank shall not be more than 28 kg, and one person shall be able to pick it up, to carry it and to put it down.
- 0011 000 2.14.2 The distance between the centre of gravity and the back plate of knapsack equipment, also with filled tank, shall not exceed 150 mm.
Explanation: The distance is to calculate from the measured support force and -distances of the horizontal standing equipment. The accuracy of measurement should be at least 2 mm for distances and 0.2 N for force. Other methods with a corresponding accuracy can be used.
- 0000001 2.14.3 The weight of equipment - with filled tank - which shall be carried during action shall not be more than 28 kg, and one person shall be able to pick it up, to carry it and to put it down.
- 0011 000 2.15.1 The carrying straps of knapsack equipment shall be adjustable in length.
- 0011 000 2.15.2 One carrying strap of knapsack equipment shall be hooked easily.
Explanation: Easy hooking is provided if one can do it with one hand and the necessary force will not be more than 1.5 daN.

type of equipm.
1 2 3 4 5 6 7

- 0011000 2.15.3 They shall not press into the shoulders.
Explanation: For filled equipment up to a total weight of 7.5 kg the width of the carrying straps shall be at least 25 mm, for heavier equipment at least 30 mm.
- 0011000 2.15.4 They shall not loosen unintentionally.
Explanation: Straps shall be safe against loosening themselves e. g. by force of gravity or spring.
- 0000001 2.15.5 If there are carrying straps they shall not press into the shoulders.
Explanation: For filled equipment up to a total weight of 7.5 kg the width of the carrying straps shall be at least 25 mm, for heavier equipment at least 30 mm.
- 0011000 2.16.1 Within 40 cm from the nozzle the process of droplet development shall be finished and the spray jet shall be fully developed.
- 0011001 2.17.1 Flexible tubes shall follow their way without sharp bending.
- 0001000 2.18.1 Vibrations shall be absorbed against the carrying frame.
Explanation: Vibrations are thought to be absorbed if the motor unit is fixed elastically to the carrying frame.
- 0011001 2.19.1 The nominal volume of the tank shall be specified in whole litres.
- 0010000 2.19.2 Spray tanks which are pressurised at intervals shall have an additional capacity of at least 25 % of their nominal capacity.
- 0001000 2.20.1 The air-flow of the blower shall be at least 400 m³/h.
Explanation: When measuring the air-flow the maximum allowable error evaluates to 5 %.
- 0001000 2.20.2 The velocity of air 6 m away from the outlet shall be at least 3 m/s.
Explanation: The velocity of air is to measure with a maximum allowable error of 5 %.
- 0001000 2.20.3 When the equipment stands on the ground, the blowers running in idle motion shall not suck foreign parts from the ground.
Explanation: This will be fulfilled if the sucking whole will be for instance at least 10 cm off the ground.

type of equipm.
1 2 3 4 5 6 7

01 00000 2.21.1 The velocity of air shall not exceed the following values.

cultivation	air velocity	measuring position
vineyard	30 m/s	0.6 m from the middle of blower
orchard	40 m/s	0.75 m from the middle of blower
hops	40 m/s	1 m from the middle of blower

Explanation: The measurement positions are located at the vertical planes left and right of the vertical middle plane of the blower. Measurement has to take place in the direction of air-flow. In case, the instruction manual has to name those equipment adjustments which prevent exceeding of the maximum allowed velocity for the respective cultures.

01 00000 2.21.2 The maximum air velocity produced by the blower shall be symmetric at the right and the left of the blower. The deviation at comparable measuring points shall not exceed 10 % of the mean.

Explanation: The measurements shall be performed at distances corresponding to feature 2.21.1, up to 3 m height every 25 cm and for more than 3 m height every 50 cm up to the required working height.

1 000000 2.22.1 The nozzles at the end of spraybooms with a working width of 10 m or more shall be protected against damage by ground contact (e. g. by protection distance holder).

0000100 2.23.1 Should the occasion arise that a container for plant protection products belongs to the machine its capacity shall be big enough for at least 1 h of seed treatment.

0000001 2.23.2 The capacity of the petrol tank shall be big enough to fog out the whole capacity of the chemical tank.

0000010 2.24.1 The deposit installation shall have a fixation.

0000010 2.25.1 If the granules have to be put into the soil, security shall be provided that no granules remain uncovered on soil, even if the machine is put up at the end of the field.

11 00000 2.26.1 Cleaning gadgets for containers of plant protection products attached to the equipment shall be in accordance with DIN 11 218 from October 1995.

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I I I I I I I I 3.0.0 Plant protection equipment shall be manufactured in a way to secure a sufficient quality of dosing and evenness of distribution.

I I 0 0 0 0 0 3.1.1 During spraying and continuously decreasing liquid level in the tank the application rate (l/ha) shall not deviate more than 10 % from the mean.

0 0 I I 0 0 0 3.1.2 During the whole time of emptying the tank the output of spray-liquid in l/min shall not deviate more than 10 % from the mean.

0 0 0 0 0 0 I 3.1.3 It shall be possible to fog out a determined amount of liquid with an accuracy of 10 %, independent of the filling height in the tank.

I 0 I I 0 0 0 3.2.1 If nozzles are used on a boom to form a uniform spray the transverse volume distribution will be measured on a 10 cm groove patternator and for a given pressure and nozzle height the coefficient of variation shall not exceed 7 %, for other specified ranges of pressure and height it shall not exceed 9 %. The range of height shall be at least 20 cm. The maximum tolerable height is 90 cm.

Explanation: The coefficient of variation is calculated by the formula:

$$C_v = \frac{\sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}}}{\bar{X}} \cdot 100\% \quad \text{with} \quad \bar{X} = \frac{\sum X_i}{n}$$

With nozzles with overlapping spray patterns, this requirement holds only for the fully overlapped areas.

I I 0 0 0 0 0 3.3.1 Tanks shall be equipped with agitators which prevent more than 15 % deviations in concentration of a 1 % OB 21 (Cupravit) suspension.

Explanation: For this test follow BBA - guide-line 1-1.2.1 part VII.

I I 0 0 0 0 0 3.3.2 Feature 3.3.1 shall also be fulfilled after a standstill of 15 h followed by 10 min of agitating with nominal revolutions per minute.

I I 0 0 0 0 0 3.3.3 Also during emptying of the tank in the nozzles' supply line deviations in concentration shall not exceed 15 %.

0 0 0 I 0 0 0 3.3.4 It shall be provided that the concentration of the liquid does not change essentially during emptying the tank.

Explanation: This feature will be fulfilled if there is no more than 15 % deviation of a 1 % OB 21 (Cupravit) suspension during operation.

I 0 0 0 0 0 0 3.4.1 The output of adjacent nozzles of the same type on spray booms shall not deviate more than 5 % from their mean output.

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- 0111000 3.4.2 The output of adjacent nozzles of the same type on spray booms shall not deviate more than 10 % from their mean output.
- 0000001 3.4.3 If there is more than one atomiser the output rate of each single atomiser with the same characteristic shall be within 10 % deviation of the common mean value.
- 1000000 3.5.1 Spray booms with more than 10 m working width shall allow movements independent of the sprayer(e.g. pendulum) to keep its position parallel to the ground.
- 1111000 3.6.1 During correct use in correspondence to its purpose the pressure pulsation at the pressure side of the pump shall not exceed more than 25 % from the wanted spraying pressure.
- 0100000 3.7.1 The nominal output of the blower shall not deviate more than 10 % from the real output.
Explanation: The nominal output has to be measured with a maximum allowable error of 5 %.
- 0001000 3.8.1 The at a time adjusted output with constant revolutions of the engine shall not exceed 10 % of the mean output also for all by the instruction manual allowed directions and differences in height between nozzle and tank.
- 0000100 3.9.1 During seed treatment the seed and the plant protection product shall always be in correct relation.
- 0000100 3.9.2 With continuously working seed treatment machines the dosing of the plant protection product shall be interrupted automatically when the flow of seed stops.
- 0000100 3.9.3 The flow of seed shall be interrupted automatically when the flow of plant protection product stops.
- 0000100 3.10.1 At the outlet of the seed treatment machine the plant protection product product shall adhere to the seed with a maximum allowable tolerance of not more than 7 % of the mean value. The mean value shall not deviate more than 10 % from the target dose.
Explanation: To determine the target dose use guide-line 4-1.1.3 of BBA - guide-lines part II.
- 0000100 3.11.1 The applied plant protection product amount on at least 80 % of single seeds shall not deviate more than 50 % from the mean value.
Explanation: Determine uniformity of distribution according to BBA - guide-line 4-1.1.3 part II with barley.

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- 0000010 3.12.1 For the distribution in longitudinal axis the applied granule masses in 25 consecutive sections of 20 cm length each shall not deviate more than 30 % from the mean value of the 25 sections.
- 0000010 3.13.1 During use on a 10 % slope in working direction and cross to it the output shall not deviate more than 10 % from the nominal value, even when the container is emptied to the minimum level appointed by the manufacturer.
Explanation: Determine the output by collecting granules for at least 60 s with a maximum allowable error of 1 %.
The nominal output is to be measured with the machine in horizontal position and with half filled container.
- 0000010 3.14.1 The output of the single hoppers, each adjusted to the same dose, shall not deviate more than ± 10 % from the mean value of all hoppers.
Explanation: Determine the output by collecting granules for at least 60 s with a maximum allowable error of 1 %.
- 0000110 3.15.1 It shall be possible to adjust the appointed amount in such a way, that a maximum tolerance of ± 10 % will be kept.
- 0000010 3.16.1 During emptying the container the output and distribution of granules shall be uniform.
Explanation: This requirement is applicable for levels between 10 and 100 % of the nominal container capacity.
- 0000100 3.16.2 During emptying the container the output of the plant protection product shall be uniform.
Explanation: This requirement is applicable for levels between 10 and 100 % of the nominal container capacity.
- 1111111 4.0.0 Plant protection equipment shall be manufactured in such a way, that when used and operated properly plant protection products shall be deposited sufficiently on target areas.**
- I 000000 4.1.1 The 10 % volumetric droplet diameter of nozzles mounted in a spray boom shall not be smaller than 115 μm if there is no drift reducing equipment in use like for example air-assistance.
Explanation: For the measurement follow Guideline 1-1.2.4 of Part VII of the Guidelines for Plant Protection Equipment Tests of the Federal Biological Research Centre (BBA). For comparable measurements nozzles of the size 02 with a 10 % volumetric droplet diameter of 115 μm at 2.5 bar are deposited at the BBA. These nozzles can be used for comparable measurements with different droplet size analysing systems as e. g. image analysing and Malvern. These nozzles are available at the BBA.

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I I I I I I I 5.0.0 Plant protection equipment shall be manufactured in such a way, that parts of them which will heat up cannot come into contact with plant protection products during filling or emptying of the tank.

I I I I I I I 6.0.0 Plant protection equipment shall be manufactured in such a way, that they can be filled up in a safe manner.

I I I I 0 0 0 6.1.1 Tank filling devices shall work in such a way that the liquid does not flow back.

I I I I 0 0 I 6.2.1 Strainers in filling openings shall allow filling of tanks with a nominal capacity up to 100 l within 1 min, bigger tanks with a flow rate of at least 100 l/min.

I I 0 0 0 0 0 6.2.2 The filling openings of tanks shall have the following minimum diameters:

nominal tank capacity [l]	∅ of filling opening [mm]
up to 150	150
150 to 600	200
more than 600	300

I I 0 0 0 0 0 6.2.3 Tank filling strainers shall have the following minimum depths:

nominal tank capacity [l]	depth of strainer[mm]
up to 150	60
150 to 400	100
400 to 600	200
more than 600	250

Explanation: The depth will be measured from the upper edge of the strainer down to its bottom.

0 0 I I I 0 0 6.2.4 The filling openings of non pressure tanks shall have minimum diameters of at least 100 mm.

0 0 I I I 0 0 6.2.5 For pressure tanks it shall be made sure by suitable shape or an additional feeding hopper that the upper diameter of the filling opening has at least 100 mm.

0 0 0 0 I I 0 6.2.6 The filling openings of containers for dry used plant protection products shall have minimum diameters of at least 200 mm.

0 0 0 0 0 0 I 6.2.7 For tanks it shall be made sure by suitable shape or an additional feeding hopper that the upper diameter of the filling opening has at least 100 mm.

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- 0011001 6.3.1 Regardless of the amount filled into the machines, they shall not tip over when put on a 8.5° inclined plane.
- 0000100 6.4.1 With appropriate filling the seed treatment liquid shall not splash back.
- 1111111 7.0.0 Plant protection equipment shall be protected against dirt in such a way, that its function will not be affected.**
- 1100000 7.1.1 Plant protection equipment shall have a sucking filter with a maximum mesh width of 0.5 mm.
- 1111000 7.2.1 The liquid going to the atomisers shall be filtered central on the pressure side. Explanation: Central filters may also be those in pipes. For equipment with manual handled atomisers these may be nozzle strainers. For pedestrian motor powered sprayers and blowers, working without a pump, central filtering is not necessary.
- 1111001 7.2.2 Their mesh width shall be smaller than the smallest diameter of the smallest size of nozzle to be used.
- 1100000 7.2.3 Plugging of central pressure filters shall be recognisable from the operators place.
- 1100000 7.2.4 If there are filters in lines and additional directly in front of the nozzles the meshwidth of the linefilters shall be equal or smaller then those of the nozzlefilters.
- 1111000 7.2.5 At the maximum required flowrate the pressure drop at each filter shall not exceed 5 %.
- 1111100 7.3.1 With exception of compression sprayers strainers shall be installed in filling openings and shall have a mesh width between 0.5 and 2 mm. Explanation: For compression sprayers it shall be possible to put on filling strainers. Appropriate filling strainers have to be offered by the manufacturer.
- 1111000 7.3.2 The maximum force required to remove the strainer shall not exceed 4 daN.
- 1111001 7.3.3 Spaces between tank filling opening and strainer shall not exceed 2 mm.
- 0000001 7.3.4 There shall be a strainer in the filling opening or in the additional feeding hopper with a mesh width between 0.5 and 2 mm.
- 1100000 7.5.1 Chemical introduction bowls shall be equipped with a strainer (guarding sieve) with a maximum mesh width of 2 cm.

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- 0000100 7.6.1 Continuously working seed treatment machines shall have a dust - sucking - off - installation.
Explanation: A joining for a dust - sucking - off - installation is sufficient, if an appropriate installation is in the setting up place and if it can be connected to the equipment.
- IIIIIII 8.0.0 **Plant protection equipment shall be constructed in such a way, that maximum and minimum limits of filling levels in the tanks can be determined easily.**
- IIIIIII 9.0.0 **Plant protection equipment shall be constructed in such a way, that there is a sufficient difference between nominal and total capacity of the tank.**
- IIII000 9.1.1 Non pressurized tanks shall have an additional capacity of at least 5 % of the nominal capacity.
- 0000101 9.2.1 Tanks and containers shall have an additional capacity of at least 5 % of the nominal capacity.
Explanation: This is not applicable for the original chemical tanks and containers.
- IIIIIII 10.0.0 **Plant protection equipment shall be constructed in such a way, that plant protection products cannot be released unintentionally.**
- IIIIIII 10.1.1 Tank lids shall seal well.
- IIII001 10.1.2 Sealings shall fit well and shall be fixed tightly in their position.
- II00000 10.2.1 Dripping of more than 2.0 ml (on average) per nozzle shall be avoided by suitable devices.
Explanation: Beginning of dripping is taken from the moment of break down of the spray jet.
- 0000001 10.2.3 With equipment for stationary use the plant protection product flow shall be interrupted automatically when the machine stops during use.
- 0000001 10.2.4 Dripping of more than 2.0 ml per nozzle shall be avoided by suitable devices.
Explanation: Beginning of dripping is taken from the moment of closing the shut-off valve.
- 0000100 10.3.1 Installations for sucking off the dust shall be constructed in such a way, that no dust enters the environment.

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- 0 0 0 0 0 1 0 10.4.1 After switching off the granules metering system it shall be sure, that no more granules than unavoidable come out of the applicator.
- 1 1 1 1 1 1 1 11.0.0 Plant protection equipment shall be constructed in such a way, that the filling level of plant protection products or mixtures can be determined easily.**
- I 1 0 0 0 0 0 11.1.1 Tanks shall have durable volume scale according to DIN 11219 from June 1977 which is well visible from the operator's place.
Explanation: If the volume scale is not well visible from the operator's place there shall be an additional easily visible level indicator system. With trailed air-assisted sprayers this feature is fulfilled if there is a volume scale on the left and right side of the tank.
- I 1 0 0 0 0 0 11.1.2 The tolerances of the volume scales and the level indication systems are:
a) Up to 20 % of the nominal tank capacity 7.5 % of the respective graduation mark of the scale.
b) In case of more than 20 % of the nominal tank capacity 5 % of the respective graduation mark of the scale.
Explanation: Determination has to be done with a maximum allowable error of 1 %.
- 0 0 1 1 0 0 1 11.2.1 The determination of the level in the tank shall be possible by a scale (following DIN 11219 from June 1977) with a maximum allowable error of 10 %.
Explanation: The determination of level also is given, if the content can be measured indirectly, e.g. by using a level finder with markings.
- 0 0 0 0 1 1 0 11.3.1 The determination of the level shall be possible by a scale.
Explanation: Determination is also ensured by an inside scale.
- 1 1 1 1 1 1 1 12.0.0 Plant protection equipment shall be constructed in such a way, that it can be adjusted easily, sufficiently accurate and reproducibly.**
- I 1 0 0 0 0 0 12.1.1 Pressure adjustment devices shall keep the working pressure unchanged at constant revolutions of the pump.
Explanation: That also means, that after switching off and on the working pressure shall return to its original value. This applies also if in the meantime different pressures were adjusted. The deviations shall not exceed 5 %.

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- 0011000 12.2.1 Easy and supervisible adjustment of the output shall be given during use, too.
Explanation: With motor powered equipment the easy adjustment of the output during use can be achieved by adjusting the revolutions of the engine or with manual powered equipment by using a pressure regulator at the handle or by changing the pumping frequency. For equipment which atomises with pressure supervisibility is given if it has a pressure gauge.
- 1100000 12.3.1 Devices intended to produce a constant application rate shall meet the features 12.3.2 to 12.3.6 .
Explanation: The tests are carried out according to the BBA - guide-line 1-1.2.3 part VII.
- 1100000 12.3.2 Deviation from the mean application rate at a constant stage shall not exceed 10 % within 5 s after variations of operating conditions.
Variations in working conditions for instance can be switching off nozzles, speed variations (also those between switching off and on nozzles) and the switching of sprayboom - sections.
- 1100000 12.3.3 Variations in the application rate (l/ha) following variations in speed shall reach a constant stage within 5 s.
- 1100000 12.3.4 During repeated adjustments of the same application rate (l/ha) the coefficient of variation calculated from 7 measurements shall not exceed 3 %.
- 1100000 12.3.5 Whilst spraying with constant p.t.o.-revolutions and with constant speed the maximum deviations from the mean application rate (l/ha) shall not exceed 5 %.
- 1100000 12.3.6 For the deviation of the measured application rate (l/ha) or respective output (l/min) from the values required the following limits are fixed:
1. for the medium deviation 6 % and
2. for the coefficient of variation 3 %.
- 0000100 12.4.1 With repeated and uniform adjustments the output of seed and plant protection product shall not deviate more than 10 % from the output of the first adjustment.
Explanation: Five repetitions will be done with the same seed and the same plant protection product.
- 0000100 12.5.1 The dose of seed plant protection product shall be adjustable at an easily accessible place.
- 0000100 12.5.2 For measuring the dose of plant protection product it shall be possible to collect it totally before reaching the seed.

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- 0000010 12.6.1 The drive shall make sure, that the revolutions respectively the moving of the granule metering mechanism do not deviate more than 10 % from the adjusted nominal value.
- 0000011 12.7.1 With repeated and uniform adjustments the output shall not deviate more than 10 % from the output of the first adjustment.
Explanation: Five repetitions are required.
- 0000111 12.8.1 The adjustment of metering mechanism shall be clearly visible.
- 1111111 13.0.0 Plant protection equipment shall be constructed in such a way, that it is equipped with enough and sufficiently accurate measuring systems.**
- 1100000 13.1.1 The error of measuring systems for dosing measure shall not exceed 5 % of the real data.
- 1100000 13.2.1 Equipment with hydraulic pressure atomisers shall have a pressure gauge suited for the spray pressure to be adjusted by following the dose instruction. After 1993-12-31 the reading of the spray pressure adjusted by following the dose instruction shall be possible even if central pressure filters are plugged.
- 1100000 13.2.2 It shall at least meet classification 2.5 according to DIN 16005 from February 1989.
- 1111000 13.2.3 A definite reading shall be possible.
Explanation: If the liquid flow pulsates at more than 5 Hz the pressure gauge shall be damped.
- 1100000 13.2.4 Pressure gauges with a non linear scale or pointers, which circulate more than one time shall meet at least classification 2.5 according to DIN 16005 from February 1989 within the spray pressure range.
- 1000000 13.2.5 Up to 5 bar the scale of the pressure gauge shall be graduated each 0.2 bar.
- 0100000 13.2.6 Up to 20 bar the scale of the pressure gauge shall be graduated each 1 bar and each 2 bar if the pressure is more than 20 bar.
- 1100000 13.2.7 The minimum diameter of manometers housings is 60 mm.
- 0011000 13.2.8 Equipment with pressure atomisers shall have a pressure gauge.
- 0011000 13.2.9 The pressure gauge shall show the pressure with at least 0.25 bar accuracy.

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- I I I I I I I** 14.0.0 **Plant protection equipment shall be constructed in such a way, that it can be safely operated, supervised and immediately switched off from the operator's place.**
- I I I I I I I 14.1.1 Adjusting devices shall be in reach of the operator.
Explanation: Stretching out of the arms, with tractor powered equipment also backwards, is tolerable.
- I I I I I I I 14.2.1 The adjusting device shall allow easy handling and shall not hinder.
Explanation: Easy handling of the adjustment devices normally means that it is freely accessible and that it is positioned and constructed according to its function. That for instance means for tractor mounted equipment that the armature shall be adaptable to the respective tractor model. The operator's free movement shall not be restricted by the adjustment devices.
- I I 0 0 0 0 0 14.3.1 The working pressure, if necessary the application rate (l/ha), the adjustment at the armature and the actual volume in the tank shall be clearly readable from the operator's place.
Explanation: Turning of the head and the upper body is tolerable.
- 0 0 I I 0 0 I 14.4.1 Important armatures for the work shall be positioned in the field of vision.
Explanation: Turning of the head and the upper body is tolerable. Important armatures are e.g.: shut off valves, adjustable pressure regulators, pressure gauges and flow rate indicators.
- I I I I 0 0 0 14.5.1 Pressure lines shall be equipped with quick-acting shut-off valves (e.g. tip-over lever valves).
- I I I I I I I** 15.0.0 **Plant protection equipment shall be constructed in such a way, that it can be emptied safely, easily and completely.**
- I I I I 0 0 I 15.1.1 For tanks up to 400 l the technical rest volume of liquid shall not exceed 4 % of the nominal tank capacity and for bigger tanks it shall not exceed 3 %.
Explanation: The technical rest volume is the remaining liquid in the equipment, which cannot be applied properly. The measurement has to follow BBA - guide-line 1 - 1.2.2 of part VII.
- I I 0 0 0 0 0 15.1.2 If the equipment is to be used on slopes then - up to a described maximum degree of slope - the rest volume remaining in the tank on slopes shall not exceed the limits stated in feature 15.1.1 in all directions of slopes.
Explanation: The rest volume on the slope is the remaining liquid in the equipment, which cannot be applied properly. The measurement has to follow BBA - guide-line 1 - 1.2.2 of part VII.

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- 0 0 0 0 1 0 0 15.1.4 The content of the mixing tank shall be applicable in a proper way down to a remnant of not more than 1 % of the nominal tank capacity.
- I I 0 0 0 0 0 15.2.1 In horizontal position tanks shall be able to drain totally.
- I I 0 0 0 0 0 15.2.2 There shall be an easily accessible and sufficiently dimensioned tank outlet which allows quick and total emptying.
Explanation: The outlet shall be free accessible from one side. The technical rest volume in the tank shall drain within 5 min. Total emptying is accomplished if there are no visible puddles at the bottom of the tank.
- I I 0 0 0 0 0 15.2.3 It shall be possible to collect the draining liquid at the outlet without contaminating the operator or equipment parts, as for instance stays.
- 0 0 I I 0 0 I 15.2.4 In a definite position the equipment shall be able to drain totally.
- 0 0 0 0 0 I 0 15.2.5 In a definite position tanks shall be able to drain totally.
- 0 0 0 0 I I I 15.2.6 It shall be possible to collect the draining liquid without contaminating the operator or equipment parts, as for instance stays.
- 0 0 0 0 I I I 15.3.1 Total emptying of the tank shall be possible by one person.
- 0 0 0 0 I 0 0 15.4.1 It shall be possible to empty the mixing device.
- I I I I I I I 16.0.0 Plant protection equipment shall be constructed in such a way, that it can be cleaned in an easy and thorough way.**
- I I I I 0 0 I 16.1.1 Filters shall be installed at a freely accessible place.
- I I I I 0 0 I 16.1.2 Filter insets shall be removable.
- I I I I 0 0 I 16.1.3 For quick cleaning the filter tissue of the inset shall be freely accessible.
- I I 0 0 0 0 0 16.1.4 At a nominal tank capacity of more than 200 l it shall be possible - also with a full tank - to clean the sucking filter without wasting more liquid than the volume in the filter-housing and in case, in the sucking hose.

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- I I I I I I I 16.2.1 Depth of roughness Rz, in accordance with ISO 4287-1, of inner and outer walls of the tanks shall be less than 0.1 mm.
- I I 0 0 0 0 0 16.3.1 Additional water tanks for rinsing the equipment shall have a capacity of at least 10 % of the nominal tank capacity or of at least 10 times of the technical rest volume to be diluted.
Explanation: In case, the dilutable technical rest volume is to be specified in the instruction manual.
- I I 0 0 0 0 0 16.3.2 An additional water tank shall make possible
- a rinsing of the pipes with filled up spray tank,
- a dilution of the dilutable technical rest volume and
- a cleaning of the outer surface of the equipment.
- I I I I I I I 17.0.0 **Plant protection equipment shall be constructed in such a way, that parts which wear are changeable.**
- I I I I I I I 17.1.1 Wearing parts shall be accessible and changeable in an easy way.
Explanation: Wearing parts are for instance atomisers, filter insets, antidrip valves, pumpvalves, diaphragms and piston sealings.
- I I I I I I I 18.0.0 **Plant protection equipment shall be constructed in such a way, that measuring instruments can be connected for testing.**
- I I 0 0 0 0 0 18.1.1 For the test of the equipment's pressure gauge there shall be a connection with a 1/4 " thread.
Explanation: Otherwise the declarer has to provide a suitable adapter.
- I I 0 0 0 0 0 18.1.2 Between the pump and the pressure regulator it shall be possible to connect a flowmeter without disconnecting any hoses on the machine.
Explanation: Suitable adapters with 1" hose socket have to be provided by the declarer.
- 0 I 0 0 0 0 0 18.1.3 It shall be possible to catch up the liquid output of each single nozzle. If it is not possible to connect a 3/4" hose directly, the declarer has to provide sealing adapters.
- I I I I I I I 19.0.0 **Sufficient complete and easy be readable dosing instructions shall be fixed at the plant protection equipment in a durable way. If this is not possible durable dosing instructions shall be added.**

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- I I I I 0 0 0 19.1.1 The flow rate of the nozzles shall not deviate more than 10 % from the data of the dosing tables.
Explanation: The maximum tolerable error for measuring the flow rate is 2.5 %.
- 0 0 0 0 I 0 0 0 19.2.1 Dosing instructions as standard values based on water shall at least give information about the adjusting of seed and plant protection product flow rate (if need be in relation to the seed and its hectoliter weight). Changeable dose mechanism are to be taken in consideration.
- I I I I I I I 20.0.0 **On plant protection equipment the machine type or the belonging to a certain type and the year of production shall be indicated for identification.**
- I I I I I I I 21.0.0 **On atomisers data as type, size and important data for spraying shall be indicated.**
Explanation: **Identification shall be performed by codes (e.g. type number, symbols, colours etc.) which can be decoded by the aid of tables to supply the information required.**

**Federal Biological Research Centre
for Agriculture and Forestry
Messeweg 11/12
3300 Braunschweig
Federal Republic of Germany**

Explanations on the Procedure of Declaration

Description of the equipment type pursuant to article 6 paragraph 3 of the Regulatory Ordinance on Plant Protection Products and article 25 paragraph 3 of the Plant Protection Act

and

Hints for the description of equipment types and description of the structure of combination tables

Preamble

Under the Plant Protection Act, the manufacturer, the marketing firm or the importer of plant protection equipment has to declare to the Federal Biological Research Centre for Agriculture and Forestry (BBA) in Braunschweig that the equipment type fulfils the requirements set out in article 24 of the Act before the equipment is marketed for the first time.

This declaration must be accompanied by all pieces of documentation required under article 25 paragraphs 2 and 3 of the Plant Protection Act (see section C of this form), otherwise the declaration cannot be accepted.

Every equipment type for which a declaration and the accompanying documents have been submitted will be registered in the plant protection equipment list by BBA and can be marketed.

If the documentation lodged with a declaration is incomplete, the equipment type will not be registered in the list. **Equipment of this type must not be marketed.**

The equipment type is only registered in the list and may only be marketed after all required documentation has been submitted.

Registrations in the plant protection equipment list are announced in the Federal Gazette (Bundesanzeiger) and the BBA bulletins every two months.

The requirements set out in article 24 of the Plant Protection Act have been detailed by the following BBA guidelines:

- Features of field sprayers
- Features of air-assisted sprayers for orchards, vineyards and hops
- Features of pedestrian, manual-powered sprayers
- Features of pedestrian, motor-powered sprayers
- Features of seed dressing equipment
- Features of granules applicators
- Features of fogging machines

The guidelines are available from:
Saphir Verlag, Gutsstraße 15, D-38551 Ribbesbüttel, Germany.

A Definitions

A.1 Equipment type -

stands for plant protection equipment of one manufacturer, marketing firm or importer which do not differ essentially as to design and facilities, which are of the same kind (see B.1) and which shall be marketed under a uniform type name and on the basis of the same declaration.

A.2 Version -

stands for plant protection equipment of one equipment type, which do not differ essentially in design an specification.

A.3 Option -

Comprises different construction features and specifications of plant protection equipment of one equipment type that influence application of the plant protection products but are not criteria demarcating an equipment type or version.

A.4 Kinds of equipment

1. Field sprayers
Plant protection equipment equipped with a horizontal spray boom such as mainly used on field crops (e. g. tractor mounted sprayers, trailed sprayers, self-propelled sprayers).
2. Air-assisted sprayers
Equipment mainly used in orchards, vineyards and hops (e. g. tractor-mounted, trailed, self-propelled sprayers).
3. Pedestrian, manual-powered sprayers
All pedestrian sprayers which are not powered by motors, mainly used in horticulture, orchards, vineyards, storage protection and forestry.
4. Pedestrian, motor-powered sprayers
All pedestrian motor-powered sprayers, mainly used in horticulture, vineyards, storage protection and forestry.
5. Seed dressing equipment
Equipment to apply plant protection products to seeds.
6. Granules applicators
Equipment to apply granular plant protection products.
7. Fogging machines
Equipment for fogging liquid plant protection products.

If a piece cannot be clearly classified under one of these kinds of equipment, the BBA shall be consulted.

B Demarcation of types of equipment, versions and options

B.1 Demarcation of types of equipment

B.1.1 Manufacturer (not manufacturing site/workshop)

B.1.2 Kinds of equipment

- a) Field sprayers
- b) Air-assisted sprayers
- c) Pedestrian, manual-powered sprayers
- d) Pedestrian, motor-powered sprayers
- e) Seed dressing equipment
- f) Granules applicators
- g) Fogging machines

B.1.3 Obvious and fundamental differences with regard to the mode of operation

- attached
- trailed
- mounted
- self-propelled
- hand-held
- shoulder-/back-portable
- continuous (only with B.1.2 e)
- discontinuous (only with B.1.2 e)

B.1.4 Disproportionately great number of addenda to one type of equipment

B.1.5 Disproportionately great number of versions of one type of equipment

B.2 Demarcation of versions

B.2.1 Nominal capacity of tank (B.1.2 a, b, c, d, f, g)

B.2.2 Design and flow rate at nominal pump pressure (B.1.2 a, b, c, d, e, g, if existing)

B.2.3 Design and working width of spray/spreader boom (B.1.2 a, c, d, if existing)

B.2.4 Design and flow rate at nominal number of revolutions of fan (B.1.2 a, b, d, f, g, if existing)

B.2.5 Dosage facility/-ies, controller (B.1.2 a, b, c, d, e, f, g)

B.2.6 Flowrate per hour (B.1.2 e)

B.2.7 Number of dosage facilities (B.1.2 f)

B.2.8 Agitation (B.1.2 e)

C Description of the equipment type

All pieces of documentation listed in the following have to be submitted together with the declaration. If documents are missing, the declaration cannot be accepted, meaning that the equipment type cannot be registered in the plant protection equipment list for the time being and therefore must not be marketed!

C.1 The description of the equipment type must contain:

1. a total representation including data on technique and functions:
 - a) total representation
 - b) data on the intended outfit of the equipment type (combination table, see C.2)
 - c) description form sheet
 - d) operation scheme and description of function
2. sufficient pictorial representations of the machine: photos, charts or leaflets shall show the equipment type with all its versions and complete optional equipment.
3. individual representation of all parts important for the application of plant protection products, in particular of the dosage and distribution facilities (if existing):

a) agitator	g) strainers, filters
b) pump	h) spray boom
c) tank filling and measuring device for plant protection products	i) fan/spray device
d) drain device	j) application rate regulator
e) atomizer	k) dosage device
f) controller	l) mixing device

C.2 Standard equipment of the equipment type (combination table)

The components of a type of equipment must be unambiguously classed with the version(s) they belong to.

All versions of an equipment type which have to be demarcated from each other on the basis of the criteria listed under B.2 are registered with their names.

It is recommended to do this in the form of a combination table.

Examples of combination tables for the different kinds of equipment have been appended.

That way of representation is recommended also for types of equipment which are presently manufactured as one version only, bearing in mind that there may be several versions in future. All possible optional devices have to be attached to the versions.

C.3 Description form sheets

Form sheets for the description of kinds of equipment can be requested from BBA. The sheets provide for descriptions of all parts of the equipment type including optional equipment which influences the application of the plant protection product. For some kinds of equipment, there are code lists to be used when filling in the form sheet. Where a code list applies, the square in the form sheet is filled in with either the relevant code number or the text belonging to it. If none of the descriptions given by the code list apply, code number 99 is entered together with a detailed description of the facts.

As the description form sheets have been designed to cover all plant protection equipment of one kind, some points may not apply in some cases. This must be indicated by entering "not applicable". If some points require several entries, such as with equipment with tanks of different designs and sizes, the information may be entered all together under the respective points or on separate copies of the same points. Information which needs more space than provided for by the form sheet has to be entered on a separate sheet. At any rate, it must be clear to which point the information refers.

C.4 Instructions for use

C.4.1 Under article 29 of the Plant Protection Act, the instructions for use must contain:

1. name and address of the manufacturer, marketing firm or importer,
2. name of the equipment type and
3. its field of use (as marked on the form sheet pertaining to the declaration).

C.4.2 In addition under annex 2 of article 6 (2) of the Regulatory Ordinance on Plant Protection Products the instructions for use must contain:

1. Information on the outfit of the plant protection equipment in correspondence to its purpose.
The combination table or another unambiguous list of possible combinations of equipment must be included in the instructions for use.
2. Information on the filling of the tank and necessary safety precautions.
The tank filling and the precautions for safety of the user and the environment must be described clearly. If applicable, the AID leaflet "Filling of Plant Protection Devices" (leaflet no 2079) should be used and amended according to the particular device.
3. Ranges of operations and settings.
Name the ranges of operations and settings which are covered by the declaration given under article 25 of the Plant Protection Act. This includes data on the performance of the pump/fan according to the speed of the PTO, on steps to adjust the air flow and on

the maximum slope with which the permitted amount of remaining chemical is not exceeded.

4. Remaining amount of substance which cannot be applied by the device as intended.
If the description form sheet demands such data, these have to be included in the instructions for use. The data should differentiate between that part of substance which can be diluted and that which cannot. If not, give the amount of plant protection substance which cannot be applied as intended.
5. Emptying and cleaning of equipment.
The procedure must be described clearly, including precautions for users' and environmental safety.
6. How to check dosage.
Indicate a practicable method and explain it with the help of an example.
7. Mesh width of strainers.
Indicate the largest inside mesh width.
8. Intervals between checks of equipment for proper functioning and accuracy of dosage and distribution.
The intervals need not necessarily be time intervals.
9. Limitations concerning the use of certain plant protection products.
The instructions for use have to contain a list of either plant protection products which are permitted or such which are not permitted with the equipment. If negative effects of combinations of registered plant protection products are known, these have to be included in the list.
10. Adjustment of the plant protection equipment to other operations.
Explain the settings for the different operations. The instructions for use should, for instance, explain adjustment of a combined sprayer and atomizer or of a field sprayer to band spraying.
11. Possible combinations with other machines and equipment.
Name safety precautions.
12. Checking of the plant protection equipment.
The instructions for use must describe the connections according to features 18.1.1 and 18.1.2 and name the sources and correct designations of adapter pieces, if needed.

C.5 Other hints

Documentation which has been tabled at the Federal Biological Research Centre before does not have to be submitted anew if modifications are made, but has to be clearly referred to in a new declaration.

If a declaration refers to documentation which has been submitted to BBA by another party, that party's consent is needed.

The pieces of documentation mentioned under C.1 need not be submitted separately. Reference may be made to other documentation submitted in the framework of the same declaration.

Information which is subject to secrecy and not to be published in the descriptive list of plant protection equipment is to be marked as such.

D Modifications

For modifications of the equipment type which influence the application of the plant protection products, the documentation describing the equipment type must be submitted anew, or supplemented. All modifications of the declared equipment type and, if there are, corrections of the former descriptions shall be submitted collectively.

If plant protection equipment is later equipped with parts which have not been subject of the declaration before, the following conditions must be met for the equipment to continue to fulfil the requirements of article 24 of the Plant Protection Act and be marketed:

1. If

- atomizers
- pressure gauges
- strainers
- pipes
- pumps
- electronic monitors and
- electronic controls

in plant protection equipment are to be replaced by others, all parameters of the new parts must be within the ranges of the parameters of those parts which are described by the declaration and which are now to be replaced.

This has to be proven by expert opinion or by official BBA approval.

Explanations:

a) pumps

- Type of pump (old and new), manufacturer and workshop have to be included in the information on the outfit of the plant protection equipment (e. g. in combination table).
- Instructions for use must be delivered to the buyer.

b) electronic monitors

- The flow meter type planned by the manufacturer must be used.
- Instructions for use must be delivered to the buyer.

c) electronically measuring and controlling device

- The manufacturer's original controls with flow meter, pressure controls, electric by-pass and shut-off valves and electric operation unit have to be used unless the manufacturer agrees to another interlace.

Note: The standardized interlace (interlace - board computer) may be used later.

- Instructions for use must be delivered to buyer.

2. Procedure of "supplementary declaration"

- controls
- monitors with flow meter component
- electronic measuring and controlling devices with modified control panel by the manufacturer or with controls by other manufacturers
- field spray booms
- twin fluid nozzles and their accessories and
- recycling facilities for sprayers and air assisted sprayers

may be modified if the respective parts do have the official BBA approval and a supplementary declaration was made to BBA by the manufacturer (importer) of the parts.

Explanations on the "supplementary declaration" procedure

- a) The manufacturer (importer) of the respective item of equipment applies for testing through BBA of the item in combination with one or several equipment types.
- b) After successful testing by BBA, the manufacturer of the item of equipment makes a supplementary declaration to BBA. That supplementary declaration has to be accompanied by:
 - a description of the item and reference to BBA testing of the item,
 - a list of equipment types (including manufacturer, types and versions of the equipment) on which the item can be mounted,
 - instructions for mounting and use of the item in combination with each equipment type.
- c) The manufacturer delivers together with the equipment item:
 - instructions for mounting and use
 - written statement concerning the recognition of warranty and liability arising from the modification or re-equipment
- d) The BBA announces
 - the supplementary declarations like "normal" declarations in the Federal Gazette (Bundesanzeiger)
 - the supplementary declarations as such in the BBA information bulletin.

3. A new declaration is required in all other cases.

The information concerning modification of an equipment type must make clear whether a new version is added to the equipment type by the modification or whether a version is cancelled. The following structure will be useful:

Corrections:

Modifications:

Additions:

Cancelled:

The pages of the description form which are concerned by the modification are replaced. Other pieces of documentation concerned are either supplemented or replaced.

A new declaration is required if a modification of an equipment type affects a demarcation as under B.1. This kind of modification leads to a **new equipment type** and cannot be covered by a supplement to an existing declaration.

Example of Combination Table for Field Sprayers

Version	Version			Option													
	tank	pump	field spray boom	con-troller	band-spray/nd device	agltator shut-off	electrical remote controller	electronical regulator	yaw compensator	boom extension	dobble nozzle carrier	flat spray nozzles*					
1	X			X		X	X	X	X		X	X	X	X			
2	X			X		X	X	X	X		X	X	X	X			
3	X			X		X	X	X	X		X	X	X	X			
4	X			X		X	X	X	X		X	X	X	X			
5		X		X		X	X	X	X		X	X	X	X			
6		X		X		X	X	X	X		X	X	X	X			
7		X		X		X	X	X	X		X	X	X	X			
8		X		X		X	X	X	X		X	X	X	X			
9				X		X	X	X	X		X	X	X	X			
10				X		X	X	X	X		X	X	X	X			
11				X		X	X	X	X		X	X	X	X			
12				X		X	X	X	X		X	X	X	X			
13				X		X	X	X	X		X	X	X	X			

* Name manufacturer, size and material of nozzle

Example of Combination Table for Air-assisted Sprayers

	Version						Option																						
	tank			pump			fan			con- troller									nozzle inserts*										
Name of version																													
1	X						X			X											X			X			X		
2	X						X														X						X		
3	X							X					X														X		
4	X							X				X															X		
5	X								X				X								X						X		
6	X								X				X									X					X		
7	X								X				X								X						X		
8	X											X										X					X		
9		X							X				X								X						X		
10		X							X				X									X					X		
11			X							X				X									X				X		
12				X							X				X						X			X			X		
13			X										X								X			X			X		

* Name manufacturer, size and material of nozzle

Example of Combination Table for portable, manual-powered Sprayers

Name of version	Version								Option										
	tank		pump		spray-boom		fan		con-troller				standard nozzles *						
	tank 10 l (T 10)	tank 15 l (T 15)	piston pump (PP)		spray pipe 1 nozzle	radial 340 m ³ /h	radial 720 m ³ /h	shut-off valve			pipe extension 40 cm	pipe extension 100 cm	dovetail nozzle*	diameter 0.8 mm	diameter 1.0 mm	diameter 1.5 mm	adjustable nozzle *	atomizing nozzle*	hollow cone nozzle*
1	X		X		X		X	X		X	X	X							
2	X		X		X	X		X		X	X	X							
3	X			X	X		X		X	X	X	X	X	X	X	X	X	X	X
4	X			X	X		X		X	X	X	X	X	X	X	X	X	X	X
5		X	X		X		X		X										
6		X	X		X		X		X				X						
7		X		X	X		X		X				X	X	X	X	X	X	X
8		X		X	X		X		X				X	X	X	X	X	X	X
9		X	X		X		X	X		X	X	X	X						
10		X	X		X	X		X		X	X	X	X						
11		X		X	X		X	X		X	X	X	X	X	X	X	X	X	X
12		X		X	X		X	X		X	X	X	X	X	X	X	X	X	X

* Name manufacturer, size and material of nozzle

Example of Combination Table for portable, motor-powered Sprayers

Name of version	Version								Option										
	tank		pump		spray-boom		fan		con-troller		standard nozzles *								
	tank 10 l (T 10)	tank 15 l (T 15)	pliston pump (PP)		spray pipe 1 nozzle	radial 340 m ³ /h	radial 720 m ³ /h	shut-off valve	pipe extension 40 cm	pipe extension 100 cm	dovetail nozzle*	diameter 0.8 mm	diameter 1.0 mm	diameter 1.5 mm	adjustable nozzle *	atomizing nozzle*	hollow cone nozzle*		
1	X		X		X		X	X		X	X	X	X	X	X	X	X		
2	X		X		X	X		X		X	X	X	X	X	X	X	X		
3	X			X	X		X		X	X	X	X	X	X	X	X	X		
4	X		X		X	X		X		X	X	X	X	X	X	X	X		
5		X	X		X		X		X			X	X	X					
6		X	X		X		X		X			X	X	X					
7		X		X	X		X		X			X	X	X					
8		X		X	X		X		X			X	X	X					
9		X	X		X		X	X		X	X	X	X	X	X	X	X		
10		X	X		X	X		X		X	X	X	X	X	X	X	X		
11		X		X	X		X	X		X	X	X	X	X	X	X	X		
12		X		X	X		X	X		X	X	X	X	X	X	X	X		

* Name manufacturer, size and material of nozzle

Example of Combination Table for seed dressing equipment

Version										
Name of version	Version						Option			
	dosage device		flow per hour			mixing device	aspiration device	dust filter	bagging device	automatic capacity control
dosage device 1	dosage device 2	4 t/h	10 t/h	20 t/h	drum 120 mm	drum 200 mm				
1	X		X			X		X	X	X
2	X					X		X	X	X
3	X			X			X	X	X	X
4	X			X	X		X	X	X	X
5		X	X			X		X	X	X
6		X		X		X		X	X	X
7		X		X			X	X	X	X
8		X			X		X	X	X	X

* Name manufacturer, size and material of nozzle

Example of Combination Table for Granules Applicators

Name of version	Version								Option			
	con- tainer		dosage device									
			kind		number							
	container 15 l	container 20 l	cam wheel	cell wheel	1	2	3	4	5	tall wheel drive	1-side fold	2-side fold
1	X		X		X					X	X	
2	X		X			X				X	X	
3	X		X				X			X	X	X
4	X			X	X					X	X	
5	X			X		X				X	X	
6	X			X			X			X	X	X
7		X	X		X					X	X	
8		X	X			X				X	X	
9		X	X				X			X	X	X
10		X		X	X					X	X	
11		X		X		X				X	X	
12		X		X			X			X	X	X
13		X		X				X		X	X	X
14		X		X				X		X	X	X

* Name manufacturer, size and material of nozzle

SECTION II

Voluntary Testing of Plant Protection Equipment

Preliminary Remarks to the Voluntary testing of plant protection equipment (§ 33 of Plant Protection Act)

Testing of plant protection equipment on a voluntary basis has developed over several decades and remains an important part of the tasks of the Federal Biological Research Centre for Agriculture and Forestry (BBA) after the compulsory procedure of declaration was introduced. The voluntary testing differs from the declaration procedure in so far as it is carried out on the actual equipment and -in conformity with article 33, paragraph 3, No. 3 of the Plant Protection Act- also on equipment and devices which are used in plant protection but which are not plant protection equipment (e. g. equipment for weed control by heat). It is carried out together by the BBA and the examination authorities of the Laender. The BBA carries out the technical examination on modern and efficient test facilities (see page 149 and following), producing exact and verifiable results, while the examination authorities of the Laender take over field tests in field cropping, viticulture, fruit, hop and vegetables growing and forests to test the practical performance of the equipment. The BBA co-operates with a total of 16 examination authorities, some of which have their own large testing facilities.

The voluntary tests are based on the Plant Protection Act, the Regulatory Ordinance and on the later following BBA-publications.

As the equipment is examined under both technical and practical aspects, its suitability can be safely evaluated. The test results of BBA and of the authorities which tested the practical use are discussed with the examination authorities involved in the framework of the expert group on the equipment registration procedure (formerly working and evaluation committee). If the equipment performs well in the tests, it is recognized for a five-year period and may be marked with a "sticker of approval" (figure 1). Apart from complete plant protection equipment tests are also carried out for equipment parts such as nozzles, controls etc.



Figure 1: BBA sticker of approval which is awarded for a five-year period if equipment or equipment parts are found to be suitable for their purpose in voluntary official tests

The tests include examination of safety aspects by the Federal Association of Agricultural Professional Associations. Official test reports are published for approved equipment and equipment parts. The approved equipment and equipment parts are published annually.

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Requirements for Plant
Protection Equipment
Testing**

Part VII

November 1992

1-2.1

Supplementary requirements and recommendations for plant protection equipment to be tested in compliance with Article 33 of the Plant Protection Act

Preliminary document published by the Department of Plant Protection Products and Application Techniques of the Biologische Bundesanstalt Braunschweig

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This preliminary guideline document supersedes the following publications of the Federal Biological Research Centre for Agriculture and Forestry:

- Leaflet No. 43: Requirements for Seed Treatment Machines (Equipment Type 5)
- Leaflet No. 46: Requirements for Field Sprayers (Equipment Type 1)
- Leaflet No. 47: Requirements for Plant Protection Equipment for Application of Plant Treatment Granules (Equipment Type 6)
- Leaflet No. 52: Requirements for Mobile Sprayers and Air-Assisted Sprayers for Orchards, Vineyards and Hops (Equipment Type 2)
- Leaflet No. 53: Requirements for Pedestrian, Hand-held Sprayers (Equipment Type 3)
- Leaflet No. 54: Requirements for Pedestrian Motor Powered Sprayers, Air-assisted Sprayers and Dusting Equipment (Equipment Type 4)

Section A of the preliminary guideline document lists additional requirements for equipment types 1-6 that must be met in addition to the legal requirements in order to pass testing according to Article 33 of the Plant Protection Act.

Section B provides recommendations for each equipment type. If the tested equipment fulfils these recommendations, this will be recorded in the equipment test report after the positive test decision has been made.

A Additional Requirements for Voluntary Equipment Testing

Field sprayers and air-assisted sprayers (equipment type 1)

1. Mode of operation

- 1.1 Operation of the equipment should ensure efficient plant protection.
- 1.2 From the principle of constant pressure, deviation of within $\pm 25\%$ from the specification is permissible, provided the conditions specified under 1.3 are fulfilled and provided the equipment has a device for regulating and adjusting pressure changes (e.g. a dosing mechanism for adjusting the spray mixture output to the travelling speed in order to keep the spray application rate constant).
- 1.3 The uniformity of cross distribution is measured by a 10 cm groove patternator. Measured values may not deviate by more than $\pm 15\%$ from the mean in the pressure range specified by the applicant. With overlapping nozzles, this requirement holds only for the fully overlapped area.

2. Equipment

- 2.1 In trailed and self-driven equipment, the track width and regulation devices must be adapted to meet the current standards for tractors and agricultural machinery. A minimum ground clearance of 35 cm must be maintained.

3. Application rate

- 3.1 The application rate depends on which specific plant protection product is to be used. It is set in accordance with the label instructions for that specific product. The labelling specifications must comply with Article 15 (3) aa of the Plant Protection Act.
- 3.2 The test measurements will be made at a travelling speed of 6 km/h, whereby either the power take-off speed (non-motorized equipment) or the engine speed (motorized equipment) specified in the instruction manual will be used, as applicable.

4. Equipment parts

4.1 Pumps

- 4.1.1 The pump output must comply with the values specified in the dosage table for the equipment in question, and a minimum capacity of 5 l/min must be maintained for each meter of working width. Hydraulic agitation systems must also meet the conditions specified in items 3.3.1 to 3.3.3.

4.2 Spray tank

- 4.2.1 Should be of compact design.
- 4.2.2 Protective coating or varnish should not dissolve or detach.

- 4.2.3 The tank filling strainer should be easy to remove and should be located along the upper edge for easy access.

4.3 Spray boom

- 4.3.1 Vertical and horizontal vibration must be kept to a minimum when travelling across uneven terrain.
- 4.3.2 To prevent endangerment of operating personnel and to keep following vehicles from diminishing the spray cover, the use of front spray booms is permissible only in special equipment with low nozzle-to-ground distances.
- 4.3.3 In cross distribution testing, the nozzles must be 40 to 60 cm above the target area for working widths up to and including 12 metres; distances of 60 to 90 cm can be specified in working widths greater than 12 metres.

4.4 Instrument panel

- 4.4.1 The display range and scale division of the spray pressure gauge must ensure proper display of the optimum pressure range for the utilized nozzle types. More than one spray pressure gauge must be installed, if necessary.

5. Instruction manual

- 5.1 The optimum distance between the spray boom and the target area and the optimal pressure range must be indicated.
- 5.2 Must provide instructions for nozzle use and dosage table or diagram indicating the spray application rate (l/ha) as a function of the pressure indicated on the pressure gauge and as a function of the travelling speed for the specified nozzle types.
- 5.3 The number, configuration and size of nozzles should ensure that the spray mixture is applied at the rate specified in the dosage table. The pressure in each nozzle must not exceed or fall below the optimum pressure range (cf. item 1.3).
- 5.4 Must indicate the spacing of nozzles on the boom.
- 5.5 For equipment with tank volumes of 200 litres or more, the manual must describe how to clean and/or flush the pumps and pipes and control gauges and nozzles whilst spray mixture is still present in the tank.
- 5.6 All documents must be submitted in German.

B Recommendations for Voluntary Equipment Testing of Field sprayers and air-assisted sprayers (equipment type 1)

1. Ease of operation

- 1.1 Should be designed for simple and easy operation and maintenance.
- 1.2 Points to be greased and lubricated should be readily accessible and clearly marked.

2. Equipment

- 2.1 Equipment should be designed for one-man operation.
- 2.2 Nozzle-to-ground distance should be adjustable to 2.5 m.
- 2.3 Should have an extra water tank that holds enough water to permit 1:10 dilution of residual tank fluid, *i.e.*, spray mixture that can no longer be properly ejected.
- 2.4 Equipment without item 4.3.1 should have a chemical introduction bowl that facilitates spray mixture preparation and enhances user protection . It must also have a device for rinsing the product containers.
- 2.5 The tank filling opening should not be located further than 0.55 m from the outer edge of the filling side of the tank.
- 2.6 If the distance between the upper edge of the tank filling opening (in filling position) is more than 1.2 m from the standing position, the machine should have a device to help the operator climb up to ensure that the distance specified above will be maintained.

3. Application rate

- 3.1 Should ensure an application rate of at least 200 to 600 l/ha.
- 3.2 Spray application rates should be varied, as far as possible, by adjusting the travelling speed or, better yet, by using different nozzles or nozzle tips, while keeping the pressure as constant as possible.

4. Equipment parts

4.1 General comments

- 4.1.1 Parts subject to wear should be readily accessible and exchangeable.

4.2 Pumps

- 4.2.1 The pressure accumulator should be pre-pressurized for pulsation damping and should be equipped with a pressure gauge.

4.3 Spray tank

- 4.3.1 Equipment without item 2.4 should have mixing device that facilitates the preparation of spray mixture.
- 4.3.2 The tank filling strainer should be easy to remove and should be located along the upper edge for easy access.

4.4 Sprav boom

- 4.4.1 Booms with a working width of more than 10 m should have both vertical and horizontal vibration compensation devices in order to keep horizontal vibration to a minimum.

4.5 Instrument panel

- 4.5.1 Dosing device should be dependent on power take-off shaft speed.
- 4.5.2 Should be possible to reroute the return flow to the suction intake line in order to minimize the amount of residual mixture that can no longer be properly applied.
- 4.5.3 Should be positioned so as to be operated in front of or beside the driver, and control gauges should be readily visible in the front or side field of vision.

4.6 Filter

- 4.6.1 Should be possible to set the central pressure filter in self-cleaning mode.

5. Instruction manual

- 5.1 Should include information on the nozzle particle size spectrum.
- 5.2 Should be laid out according to German industrial standards (DIN 8414) or ISO recommendations (ISO 3600).

**A Additional Requirements for Voluntary Testing of
Sprayers and air-assisted sprayers for orchards, vineyards and hops
(equipment type 2)**

1. Mode of operation

- 1.1 Operation of the equipment should ensure efficient plant protection.
- 1.2 With the data specified in item 2.3, the equipment design should ensure that at least one of the following working width and height specifications can be achieved on both sides when spraying with or without air-assistance, regardless of the number of lines or rows :

Orchards

Working width \leq 3 m and working height \leq 3 m

Working width \leq 4 m and working height \leq 4 m

Working width \leq 6 m and working height \leq 6 m

Working width \leq 8 m and working height $>$ 6 m

Vineyards

Working width \leq 1.6 m and working height \leq 1.8 m

Working width \leq 1.8 m and working height \leq 2.2 m

Working width \leq 2.0 m and working height \leq 2.2 m

Working width \leq 2.5 m and working height \leq 2.2 m

Hops

Working width \leq 3.2 m and working height \geq 8.5 m

Working width \leq 6.4 m and working height \geq 8.5 m

Working width \leq 9.6 m and working height \geq 8.5 m

Working width \leq 10.5 m and working height \geq 8.5 m

2. Application rate

- 2.1 The application rate depends on which specific plant protection product is to be used. It is set in accordance with the label instructions for that specific product. The labelling specifications must comply with Article 15 (3) aa of the Plant Protection Act.
- 2.2 Test measurements will be made at a travelling speed of up to 6 km/h in vineyards and orchards, and up to 2 km/h in hops, whereby either the power take-off shaft speed (non-motorized equipment) or the engine speed (motorized equipment) specified in the instruction manual will be used, as applicable.
- 2.3 The achieved Application rate of the equipment must lie within the following recommended limits:

Orchards

400 to 2000 l/ha without air assistance

300 to 1000 l/ha for air-assisted spraying

Vineyards
400 to 2000 l/ha without air assistance
300 to 1000 l/ha for air-assisted spraying

Hops
500 to 5000 l/ha without air assistance
300 to 3500 l/ha for air-assisted spraying

3. Equipment parts

3.1 Pumps

3.1.1 The operating pressure of equipment with hydraulic nebulisation must lie within the following limits:

	WITHOUT AIR ASSISTANCE	WITH AIR ASSISTANCE
Orchards	40-60 bar	≤ 40 bar
Vineyards	20-60 bar	≤ 20 bar
Hops	50-60 bar	≤ 40 bar

3.2 Spray tank

3.2.1 Should be of compact design.

3.2.2 Protective coating or varnish should not dissolve or detach.

3.2.3 The tank filling strainer should be easy to remove and should be located along the upper edge for easy access.

3.3 Nozzles

3.3.1 The number, configuration, size and spraying angle (and swirl plates) of nozzles should ensure that the spray mixture is applied at the rate specified in the dosage table.

3.3.2 The output of nozzles of the same size must not deviate by more than 10 %.

3.4 Instrument panel

3.4.1 The display range and scale division of the spraying pressure gauge must ensure proper display of the optimum operating pressure range; more than one pressure gauge must be installed, if necessary.

4. Instruction manual

4.1 Should indicate how instrument controls specified in BBA Leaflet 44 are to be performed and, in particular, where measuring devices are to be attached, if applicable.

4.2 The manufacturer must provide examples showing instrument settings that ensure good spray distribution.

- 4.3 If pipe filters are used, the manual must specify how often they are to be cleaned.
- 4.4 For equipment with tank volumes of 200 litres or more, the manual must describe how to clean and flush the pumps and pipes and control gauges and nozzles whilst spray mixture is still present in the tank.
- 4.5 All documents must be submitted in German.

B Recommendations for Voluntary Equipment Testing of Sprayers and air-assisted sprayers for orchards, vineyards and hops (equipment type 2)

1. Ease of operation

- 1.1 Should be designed for simple and easy operation and maintenance.
- 1.2 Points to be greased and lubricated should be readily accessible and clearly marked.

2. Equipment

- 2.1 Equipment should be designed for one-man operation.
- 2.2 In equipment for hops, the ground clearance should not be less than 300 mm.
- 2.3 Endangered equipment parts should be protected from ground contact. Equipment used in orchards should also be protected from bulky pieces of wood.
- 2.4 Should have an extra water tank that holds enough water to permit 1:10 dilution of residual tank fluid, *i.e.*, spray mixture that can no longer be properly ejected.
- 2.5 Should have a chemical introduction bowl that facilitates spray mixture preparation, enhances user protection if not equipped with 4.2.2. The equipment must also have a device for rinsing the product containers.
- 2.6 The tank filling opening should not be located further than 0.55 m from the outer edge of the filling side of the tank.
- 2.7 If the distance between the upper edge of the tank filling opening (in filling position) is more than 1.2 m from the standing position, the machine should have a device to help the operator climb up to ensure that the distance specified above will be maintained.

3. Application rate

- 3.1 Spray application rate should be variable by using different nozzles or nozzle tips, whereby the pressure should remain as constant as possible .

4. Equipment parts

- 4.1 Pumps
- 4.2 The pressure accumulator should be pre-pressurized for pulsation damping and should be equipped with a pressure gauge.

4.2 Spray tank

- 4.2.1 If equipment is to be used on sloping terrain or has a tank volume of up to 1000 litres, it should be possible to pump the tank empty on slopes with a downward gradient of over 20% or, otherwise, on slopes with a downward gradient of over 10%.

4.2.2 Equipment without item 2.5 should have an mixing device that facilitates the preparation of spray mixture.

4.3 Oscillating sprayer

4.3.1 Oscillating sprayer movement while travelling across uneven terrain should be kept within narrow limits.

4.4 Fan

4.4.1 The airstream generated by the equipment should be symmetrical with respect to its flow volume and velocity left and right of the equipment. Fluctuations in flow volume and maximum velocity should not deviate from the mean value by more than 7.5 %.

4.4.2 The fan should not be allowed to suck in drops of spray, plant debris or dirt, etc.

5. Instruction manual

5.1 Should indicate which flow volume is required for the hydraulic agitator to maintain uniform dispersion during spraying operations.

5.2 Should include data on the particle size spectrum of the nozzles.

5.3 Should be laid out in accordance with German industrial standards (DIN 8414) or ISO recommendations (ISO 3600).

A Additional requirements for voluntary equipment testing

Pedestrian manual-powered sprayers (equipment type 3)

1. Operation

1.1 The equipment must permit quick, plant-protective operation.

2. Outfit

2.1 If filled equipment weighs more than 10 kg, it must be easy for a second person to help take the equipment up and put it down.

2.2 Carrying straps must not pinch.

2.3 Handles which lie in the hand during treatment may not have any pressing edges.

2.4 There must be devices to prevent dripping as far as possible.

3. Equipment parts

3.1. Pumps

3.1.1 Liquid pumps (piston and diaphragm pumps) must be adapted to the nozzles in output and pressure.

3.1.2 The power required for pumping should be within tolerable limits.

3.1.3 Air pumps for equipment where the tank must be put under pressure have to allow pumping-up in about three minutes. The piston cross section has to be so as to signal exceeding of the maximum working pressure by stiffness.

3.2 Tank

3.2.1 It must be possible to spray the tank empty when it is in a horizontal position.

3.2.2 Varnish or any other coatings must not dissolve or detach.

3.3 Control gauges

3.3.1 Apart from in very small equipment, there must be some device to keep the spray pressure within a deviation of $\pm 15\%$ throughout the time the tank is emptied.

3.4 Nozzles

3.4.1 The number, arrangement and assortment of nozzles must permit adjustment to the crop.

3.4.2 The output of flat-jet nozzles may deviate, with constant pressure, by a maximum of $\pm 5\%$ from the tabular value.

3.5 Hoses and spray lances

- 3.5.1 Hose lines on the equipment must be long and flexible enough to allow working without unusual fatigue even with the arm stretched.
- 3.5.2 Hose lines must remain flexible down to a temperature of 0° C.

4. Instruction manual

- 4.1 All documents must be written in German.
- 4.2 There must be special information about use of the nozzles and an application table showing the nozzle output as a function of pressure.

B Recommendations for voluntary equipment testing

Pedestrian manual-powered sprayers (equipment type 3)

1. Equipment/accessories

1.1 The weight of the basic equipment should be limited as follows:

Equipment weight (kg)		
Usable tank contents (l)	Pressure accumulator sprayers (automatic)	Others
3	-	0.8
5	4.5	1.2
10	6.5	4
15	8	6

1.2 Straps should be padded.

1.3 Handles which are held in the hand during application should be comfortably shaped.

A Additional requirements for voluntary equipment testing

Pedestrian motor-powered sprayers and blowers (equipment type 4)

1. Mode of operation

1.1 The equipment must permit quick, plant-protective operation.

2. Outfit

2.1 The jet pattern must be easy to adjust, variable and reproducible.

2.2 The equipment must be of light weight, not exceeding 25 kg with full tanks.

2.3 It must be possible for one person to lift the equipment, carry it, and put it down, and easy for a second person to assist.

2.4 Carrying straps may not pinch.

2.5 Handles which lie in the hand during treatment may not have any pressing edges.

2.6 Combination equipment must be easy to re-equip.

3. Equipment parts

3.1 Pumps

3.1.1 Sprayers have to be equipped with a pump.

3.1.2 The pumps must be adapted in pressure to the specified nozzle equipment.

3.2 Spray tank

3.2.1 Must be possible to be sprayed empty in horizontal position.

3.2.2 Varnish or any other coatings must not dissolve or detach.

3.3 Control gauges

3.3.1 Air-assisted sprayers must have a gauge showing the spray mixture flow.

3.3.2 Sprayers without air-assistance must have a controlling device keeping the spray pressure within a +/-15 % deviation throughout the time the tank is emptied.

3.4 Nozzles

3.4.1 Output and drop size must be variable in air-assisted sprayers.

3.4.2 In sprayers without air-assistance, the number, arrangement and size assortment of nozzles must allow adjustment to the crop.

3.4.3 The output of flat-jet nozzles may deviate, with constant pressure, by a maximum of $\pm 5\%$ from the tabular value.

3.5 Hoses and spray lances

3.5.1 Hose lines on the equipment must be long and flexible enough as to allow working without unusual fatigue even with the arm stretched.

3.5.2 Hose lines must remain flexible down to a temperature of 0°C .

3.6 Fans

3.6.1 Fans of air-assisted sprayers and dusters must be adapted to the specified purpose in air output and velocity.

3.7 Motor

3.7.1 The motor must start easily, run reliably and with low noise.

4. Instruction manual

4.1 All documents must be written in German.

4.2 There must be an application table showing output as a function of pressure or motor speed.

B Recommendations for voluntary equipment testing

Pedestrian motor-powered sprayers (equipment type 4)

1. Outfit

- 1.1 Carrying straps should be padded.
- 1.2 Handles which are held in the hand during treatment should be comfortably shaped.
- 1.3 Lubrication and oil check points should be readily accessible and clearly marked.
- 1.4 The equipment should permit liquid output of up to 3.2 l/min.

2. Equipment parts

2.1 Pumps

- 2.1.1 Air-assisted sprayers should have pumps.

A Additional requirements for voluntary equipment testing

Seed dressing equipment (equipment type 5)

1. Mode of operation

- 1.1 The equipment must permit quick and seed-protective operation.
- 1.2 Wet dressings must stick to the seed with a +/-5 % deviation from the index value at the outlet of the dressing machine.
- 1.3 There may be no blockages of the equipment.

2. Operability

- 2.1 A single person must be able to easily operate shut-off and stop devices and control measuring and regulating devices of the equipment.
- 2.2 Seed dressing equipment must permit easy and quick adjustment to the seed to be treated and the dressing used.

3. Outfit

- 3.1 Equipment parts which come into contact with seed and seed dressing must be easy to clean.
- 3.2 Any lubrication and oil check points must be readily accessible and clearly marked.
- 3.3 If the equipment is designed for dressing seeds of different crops, any alterations must be easily feasible.

4. Seed dressing supply

- 4.1 A single person must be able to completely empty or exchange the seed dressing container within a few minutes.
- 4.2 The operator must be able to see from his place when the minimum filling level is reached.

5. Dosage device

- 5.1 Dosage devices of combination equipment must permit easy and quick adjustment to the various seed dressing methods by one person.

6. Instruction manual

- 6.1 Must contain tables giving index values for setting the dosage devices for various kinds of seed and dressings.
- 6.2 All documents must be written in German language.

B Recommendations for voluntary equipment testing

Seed dressing equipment (equipment type 5)

1. Outfit

- 1.1 Combination equipment should be designed so as to allow treatment against seed-borne diseases first, and against other diseases later.
- 1.2 It should be guaranteed that the equipment can apply the most usual seed dressings, including combined ones.
- 1.3 The bagging should fit the seed stream.

2. Dosage device

- 2.1 Should have manual start.

A Additional Requirements for Voluntary Testing of Granule applicators (equipment type 6)

1. Mode of operation

- 1.1 Operation of the equipment must ensure efficient plant protection.
- 1.2 Application of the plant protection product must comply with the specifications in the instruction manual.
- 1.3 The application rate depends on which specific granules are to be used and on the developmental stage of the crops. The application rate is set in accordance with the label instructions for that specific product. The labelling specifications must comply with Article 15 (3) aa of the Plant Protection Act.

2. Ease of operation

- 2.1 Equipment parts for instrument adjustment must be readily visible and have gauges that are easy to read.

3. Equipment

- 3.1 If the equipment is designed for use in different crops, it must be easy to adapt them for each type of crop in question.
- 3.2 In equipment to be used in combination with sowing or planting machines or any other machines specified by the applicant, the operator or personnel in a professional repair shop, if necessary, should be able to attach these machines easily with the help of enclosed assembly instructions.

4. Tank

- 4.1 Protective coating or varnish should not dissolve or detach.
- 4.2 Must be possible to empty quickly and completely.

5. Instruction manual

- 5.1 Must explain how to achieve trouble-free flow of granules from the equipment to the site of application.
- 5.2 All documents must be submitted in German.

B Recommendations for Voluntary Equipment Testing of Granule applicators (equipment type 6)

1. Outfit

- 1.1 Equipment should be designed for one-man operation.
- 1.2 Operator working place should be designed for controllability.
- 1.3 Points to be greased and lubricated should be readily accessible and clearly marked.
- 1.4 Parts subject to wear should be readily accessible and exchangeable.

2. Dosing mechanisms

- 2.1 Should permit stepless dose adjustment.

Testing of Plant Protection Equipment

Requirements for Nozzles

Based on:

1. **BBA-Features** of field sprayers and of air assisted sprayers in orchards, vineyards and hops and
2. **Supplementary requirements** for the testing of plant protection equipment under Article 33 of the Plant Protection Act (BBA guideline for the testing of plant protection equipment, part VII, 1-2.1).

Notes:

- 2.12.1 e. g. means the number of the feature to be tested according to the BBA Guideline.
F means that requirements hold for field sprayers.
R means that requirements hold for orchard, vineyard and hop sprayers.

2.12.1 F + R

Each nozzle must form a uniform spray jet, the pattern of which must not change unintentionally during operation.

2.12.2 F + R

The jet direction and, if applicable, jet pattern of the nozzles must be adjustable in a reproducible manner by suitable technical aids.

Explanation: Suitable aids are, e. g., fixed marks, locking devices, or adjusting gauges.

3.2.1 F

If nozzles are used on a boom to form a uniform spray the cross volume distribution will be measured on a 10 cm groove patternator and for a given pressure and nozzle height the coefficient of variation must not exceed 7 %, for other specified ranges of pressure and height it must not exceed 9 %. The range of height must be at least 20 cm. The maximum tolerable height is 90 cm.

Explanation: The coefficient of variation is calculated by the formula:

$$C_v = \frac{\sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}}}{\bar{X}} \cdot 100\% \quad \text{with} \quad \bar{X} = \frac{\sum X_i}{n}$$

With nozzles with overlapping spray patterns, this requirement holds only for the fully overlapped areas.

Supplementary requirement under 2.

F

The uniformity of cross distribution is measured by a 10 cm groove patternator. Measured values may not deviate by more than $\pm 15\%$ from the mean in the pressure range specified by the applicant. With overlapping nozzles, this requirement holds only for the fully overlapped area.

Explanation: If the variation coefficient V_k is used in evaluating the uniformity of cross distribution, V_k must be $\leq 7\%$.

3.4.1 F

The output of adjacent nozzles of the same type on spray booms must not deviate more than 5 % from their mean output.

3.4.2 R

The output of adjacent nozzles of the same type on spray booms must not deviate more than 10 % from their mean output.

Supplementary requirement under 2.

R

The output of nozzles of the same size must not deviate by more than 10 %.

4.1.1 F

The 10 % volumetric droplet diameter of nozzles mounted in a spray boom must not be smaller than 115 μm if there are no drift reducing equipment in use like for example air-assistance.

Explanation: For the measurement follow Guideline 1-1.2.4 of Part VII of the Guidelines for Plant Protection Equipment Tests of the Federal Biological Research Centre (BBA). For comparable measurements nozzles of the size 02 with a 10 % volumetric droplet diameter of 115 μm at 2.5 bar are deposited at the BBA. These nozzles can be used for comparable measurements with different droplet size analysing systems as e. g. image analysing and Malvern. These nozzles are available at the BBA.

19.1.1 F + R

The flow rate of the nozzles must not deviate more than 10 % from the data of the dosing tables.

Explanation: The maximum tolerable error for measuring the flow rate is 2.5 %.

21.0.0 F + R

On atomisers data as type, size and important data for spraying must be indicated.

Explanation: Identification must be performed by codes (e.g. type number, symbols, colours etc.) which can be decoded by the aid of tables to supply the information required.

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Guidelines
for the Official Examination
of Plant Protection Products**

**Part VII
(Plant Protection Equipment)**

January 1988

1-1.2.1

**Guideline for the
Test of Tank Agitators**

by
Dirk Rautmann
Siegfried Rietz

issued by the Department for Plant Protection Products and
Application Techniques of the Federal Biological Research
Centre Braunschweig

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German version available by:

Saphir-Verlag
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English version available by:

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Guideline for the test of tank agitators

Agitators are tested with the help of a one-per cent suspension of OB-21 (Cupravit). One suspension can be used for testing several devices to save OB-21 and reduce the problem of disposal. When filling the next tank, the deposit in the first is flushed with the original spray liquid.

Containers shall be closed because of water evaporation. A suspension can be used for at least six weeks, according to studies by the BBA division for application techniques.

At the beginning of a test, fill tank up to nominal capacity while the agitators are running. Stir the one-per cent suspension until it is homogeneous. At the same time take two basis samples (≥ 30 ml) each at three points (5 cm below the liquid level, middle of the liquid column, 5 cm above the tank ground). Then stop agitation and allow the suspension to stand still in the tank for 15 hours. Switch on agitators again and stir the tank content at maximum intensity. After ten minutes agitating take two samples each at three different levels as for the basis samples, with the agitators running.

Next, simulate empty-spraying of the tank by opening one of the spray boom feeders and connecting it to a valve which lets out the same amount of liquid as is applied by all nozzles together during normal spraying. Close all other feeders. Set pressure at three bar overpressure for flat fan nozzles and at the middle between minimum and maximum operating pressure for vineyard and orchard sprayers. If there are several nozzle sets, use the one which applies the greatest amount of spray liquid.

At the outlet of the opened nozzle feeder, take two samples each at the beginning of spraying and after every 50 l with sprayers of up to 400 l of nominal tank capacity, after every 100 l with sprayers of nominal tank volume between 400 and 1,000 l, and after every 200 l with sprayers of more than 1,000 l nominal tank volume, until spraying is finished. The last sample is to be taken from the residue of the tank content.

The concentration of the samples is stated by determining their contents of solid matter. Shake samples and fill 20 ml of each into evaporating pans. Weigh empty and filled pans accurately to 1 mg. Dry samples in the pans at 105° to 110°C in a hot air cabinet, suck off the air. Cool samples down in the desiccator and weigh them again accurately to 1 mg.

Take the mean of each pair of samples. The three mean values of the basis samples must be between 0.950 and 1.050 %. If they are, their average is the reference value, if not the basis sampling has to be repeated. Calculate the relative deviations of the mean values of the other samples from the reference value.

Standard Report

Effect of agitators with OB-21 suspension

1. Concentration in the tank after filling (basis sample):

top:..... % middle:..... % bottom:..... %

reference value:..... %
(mean of top/middle/bottom values)

2. Concentration in the tank after 15 hours standstill and 10 minutes agitation

top:..... % middle:..... % bottom:..... %

relative deviation from the reference value:

top:..... % middle:..... % bottom:..... %

3. Effect of agitators after 15 h standstill and 10 min agitation
(measured at spray boom section feeder)

type of nozzle: type of valve/strainer:

overpressure: bar

sampling at filling level of the tank: [l]	relative deviation of the OB-21 concentration with reference to the basis sample [%]

Notes on sediment of OB-21 after emptying of tank:

**Federal Biological Research Centre for Agriculture and Forestry
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**Guidelines
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**Part VII
(Plant Protection Equipment)**

January 1988

1-1.2.2

**Determination of the
Rest Volume of Liquid**

by
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issued by the Department for Plant Protection Products and
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Guideline for the determination of the rest volume of liquid

1. Field crop and orchard sprayers

a) Technical rest volume

The equipment shall run in a fixed and horizontally position at the nominal speed of the pump.

The field spray boom or nozzle carrier must be switched on.

Pressure is set so as to achieve

- a single nozzle output of 2 l/min for field crop and vineyard sprayers,
- a single nozzle output of 4 l/min for orchard sprayers,
- a single nozzle output of 6 l/min for hop sprayers.

The single nozzle output must be adjusted with an accuracy of 0.1 l/min. The machine is to be stopped immediately when the gauge shows the first significant pressure drop.

The volume of spray liquid which is left in the equipment at that point of time is determined accurately to 0.1 % of the nominal tank volume.

b) Rest volume of liquid on slope

In correspondence to its purpose - which is provided by the instruction manual - the machine is put into a slope position towards the left, right, front and back. In these positions, the rest volumes on slope are determined in the same way as the technical rest volume of liquid.

2. Pedestrian sprayers

Technical rest volume

The equipment is operated as usual but in a fixed position.

The equipment is switched off immediately when the nozzle begins to put out spray liquid mixed with air. The volume of liquid left in the equipment is determined accurately to 0.1 % of the nominal tank capacity.

All measurements are to be repeated twice, and an average is calculated from the results.

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Guidelines
for the Official Examination
of Plant Protection Products**

**Part VII
(Plant Protection Equipment)**

January 1988

1-1.2.3

**Examination of Flow Control
Devices on Field Crop and
Orchard Sprayers**

by
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1 - 1.2.3

All measurements of the flow rate (or application rate) are carried out at the spray boom or nozzle carrier. The results are recorded. Measuring and recording continues until a state of inertia is reached again. At a nominal p.t.o. shaft speed of 1,000 RPM, for instance, the speeds analogous to 540 RPM are valid.

The measurements under points 1 to 3 are made under the following test conditions:

The driving speed is 2 m/s, the p.t.o. shaft speed 400 RPM and the standard application rate 300 l/ha.

1 Changing of spray condition by switching on and off the nozzle feeders

- 1.1 Switch off - switch on, measure simultaneously.
- 1.2 Switch off at 2 m/s -- lower speed to 1.5 m/s, slow down p.t.o to 300 RPM -- switch on, measure simultaneously.
- 1.3 Switch off at 2 m/s -- raise speed to 2.5 m/s, raise p.t.o. to 500 RPM -- switch on, measure simultaneously.

2 Changes in speed

- 2.1 within one gear:
Change p.t.o. shaft speed from at least 300 RPM to 400 RPM and 500 RPM and then from 500 RPM to 400 RPM and 300 RPM for five seconds each, carrying out measurements simultaneously.
- 2.2 Changing gears at p.t.o. 400 RPM
Set speed to at least 1.5 m/s; 2; 2.5; 2; 1.5 m/s, measure simultaneously.

3 Switching off/on boom sections

Successively switch off boom sections except one, then switch them on again. Measure simultaneously.

4 Setting the same flow rate anew

The equipment is operated at p.t.o. 500 RPM and a driving speed of 2 m/s. Two rows of measurements are repeated seven times ($n=7$). For the measuring rows, set and operate the equipment at a flow rate of 100 (or the nearest possible value), then successively set it to 200, 300 and 400 l/ha (1st measuring row: ascending) and to 500 l/ha (or the nearest possible value), then set it to 400, 300 and 200 l/ha (2nd row: descending). Measure at flow rates 200, 300 and 400 and 400, 300 and 200 l/ha, respectively. When setting the flow rates, be careful not to exceed the value to be set (and to have to turn down the flow rate later). If tables, diagrams or the directions of use, for a driving speed of 2 m/s, provide for a flow rate of more than 50 l/ha below 200 or above 400, the two series of measurements have to be extended accordingly, the first settings (100 l/ha and 500 l/ha, resp.) being shifted accordingly.

1 - 1.2.3

To establish the time during which the equipment exceeds the flow rate tolerance of $\pm 10\%$, add up the individual times during which that tolerance is exceeded.

Evaluation

The coefficient of variation V_k is calculated as follows:

$$\bar{x} = \frac{\sum x_i}{n}; \quad s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

$$i = 1, 2, \dots, 7 \quad V_k = \frac{s}{\bar{x}} \cdot 100[\%]$$

The largest deviations δ are calculated:

$$\delta_{\max} = \frac{x_{\max} - \bar{x}}{\bar{x}} \cdot 100[\%]; \quad \delta_{\min} = \frac{x_{\min} - \bar{x}}{\bar{x}} \cdot 100[\%]$$

The mean deviation between mean flow rate \bar{x} and standard flow rate \tilde{x} is calculated:

$$\Delta = \frac{\bar{x} - \tilde{x}}{\tilde{x}} \cdot 100[\%]$$

SECTION III

INSPECTION OF PLANT PROTECTION EQUIPMENT - already in use

Preliminary Remarks to the Testing of plant protection equipment already in use (inspection)

Voluntary testing of field sprayers has been offered in the Federal Republic of Germany since the end of the sixties and for air assisted sprayers for orchards, vineyards and hops since the mid-eighties. As a result this country has gathered plenty of experience with the testing of plant protection equipment. Since not all crop protection equipment is accessible with voluntary programmes, compulsory testing for field sprayers was introduced in mid-1993 by way of a statutory regulation. The same will obtain for air assisted sprayers for orchards, vineyards and hops in the coming years.

Insufficient participation by farmers, and certainly the high percentage of faulty field sprayers as well, occasioned the Federal Minister of Nutrition, Agriculture and Forestry to initiate compulsory testing for in-use plant protection equipment for field crops (field sprayers). The amending order of 11 June 1992 states that the above-mentioned equipment must be tested by official authorities or officially licensed testing stations once every two calendar years. The obligation to have these tests done went into effect on 30 June 1993. It applies for crop protection equipment in-use and new sprayers after their first use.

The order also stipulates that the equipment owner must indicate the section of the calendar year in which the crop protection equipment in question must be tested by a certification label on the equipment issued by the responsible authority. The labels are also issued if the equipment has only minor faults which the owner is obligated to eliminate without delay.

According to the order, field sprayers in use as of 1 January 1994 must bear a valid certification label. Following this date, the office stipulated by state law is required to prohibit use of field sprayers until they bear such a certification label. Fines are defined for contravention.

The federal order also contains a devolution of power upon the states to undertake further action as may be required to check compliance with the compulsory regulations by means of state orders or administrative regulations.

On the basis of BBA drafts aiming at the greatest possible level of national uniformity in this testing system, the states have issued licensing and testing orders referring to the two BBA guidelines defining in detail the requirements governing the test equipment (1-3.1.1) and the requirements/features for in-use field sprayers (1 – 3.2.1). In spite of many years of experience in the field of equipment testing, well-established testing procedures and mature testing technology, many regulations had to be set out in more detail for reasons of legal security. For instance, requirements for testing equipment have been more stringently defined and specified. Alterations were also required in the requirements/features for in-use field sprayers in relation to determination of horizontal distribution quality. The former practice of visual reading of the levels in the collectors and determination of compliance with the $\pm 15\%$ deviation clause no longer seems appropriate within the framework of the updated requirements. Plans have therefore been made to evaluate horizontal distribution according to the coefficient of variation only as of 1 January 1998. This will likely lead to sole use of test stands with electronic filling gauges. Two new items of test equipment which extend step by step beneath the spray booms, are now on the market. Both products already have BBA approval. Conventional test stands can still be used if retrofitted with an automatic filling level measuring device. Such devices are in preparation and will probably be ready for operation when required.

Another new requirement stipulates that the water used in testing be collected and pumped back into the crop protection device to prevent water contamination.

Proposal for Uniform Enforcement of Plant Protection Equipment Inspections in the Federal States (Laender)

(Draft)

Regulation under Article 30 (2) of the Plant Protection Act of 15 September 1986 (BGBl¹ I p. 1505) on the approval of inspection workshops

Article 1 Approval

Upon application, commercial enterprises are approved by <the authority competent at the seat of the enterprise>² as inspection workshops for inspections of crop protection equipment if

1. the enterprise guarantees to accurately and reliably carry out the inspections and acknowledges the inspection regulation,
2. the enterprise employs sufficient personnel who are especially qualified for inspection of crop protection equipment,
3. the enterprise has the necessary facilities to carry out the inspections, and
4. the enterprise guarantees readiness for inspection together with <the competent authority>.

Details on the conditions for approval are given in Appendix 1.

Inspections under this regulation are tests according to Article 7 (2) or (3) of the Regulation Plant Protection Products of 28 July 1987 (BGBl. I p. 1754) amended by Article 1 (1) of the regulation of 11 June 1992 (BGBl. I p. 1049).

Article 2 Powers of the Inspection Workshops

Approved inspection workshops are entitled to

1. carry out inspections according to the document of approval,
2. award inspection stickers as shown in Appendix 2,
3. use a plaque of approval as shown in Appendix 3.

Article 3 Obligations of the Inspection Workshops

The inspection workshops undertake to

1. allow officials of <the competent authority> access to the inspection facilities and ongoing work during customary business hours,
2. give information, upon request, concerning the inspection procedure,
3. treat the inspection reports confidentially,
4. notify <the competent authority> of changes in the inspection personnel, and

¹ BGBl.: Bundesgesetzblatt - Federal Law Gazette

² The administrative procedural laws of the respective land are valid.

5. notify the respective competent authority, before inspections, if inspections are to be carried out in another land.

Article 4
Termination of Approval

Apart from cases as under Article 49 (2) sentence 1 of the Administrative Procedural Law³, approval of an inspection workshop may be withdrawn if this is sought by the inspection workshop.

Article 5
Fees

A fee is raised on the approval of an inspection workshop⁴.

³ The administrative procedural laws of the respective land are valid.

⁴ The fee regulations of the respective land are valid.

Conditions for Approval as Inspection Workshop

1. Inspection personnel

For the inspection of plant protection equipment, the inspection workshop must employ personnel who have completed relevant vocational training, who are reliable and who have proved the necessary technical knowledge and skills regarding the technical requirements of crop protection equipment, its operation and calibration, and who have a minimum of job experience.

2. Place of inspection

A suitable shed or test field is required. Suitable in particular means providing protection from weather influences. It is to be ensured that only clean equipment, filled with clean water, is allowed for inspection, and that the water used is collected and returned. The provisions of the Water Balance Law must be observed; liquid residues must be legally disposed of.

3. Inspection equipment

Facilities according to Article 1 (3) include, as far as necessary for the inspection work that may be carried out according to the document of approval,

- a patternator to measure the horizontal distribution according to BBA Guideline 1-3.1.1 of Part VII of the BBA Guidelines for Testing Plant Protection Equipment,
- devices to measure the pump volume flow rate and to test flowmeters according to Guideline 1-3.1.1 of Part VII of the BBA Guidelines for the Testing of Plant Protection Equipment,
- a pressure testing device according to Guideline 1-3.1.1 of Part VII of the BBA Guidelines for Testing Plant Protection Equipment,
- at least two gauging cylinders according to Guideline 1-3.1.1 of Part VII of the BBA Guidelines for Testing Plant Protection Equipment,
- a revolution counter,
- a stopwatch,
- technical aids to check nozzle spacing and angles, and
- a computer.

To ensure the necessary accuracy of measurement, the inspection equipment must be checked by experts at least every two years. The measuring instruments used for these checks must have an even greater accuracy than the inspection equipment. Check results are recorded in an instrument book. [Inspection equipment which has undergone the check should be labelled with a sticker.]

Sample of inspection sticker:

Cf. Appendix 4 of the Regulation on Plant Protection Products of 28 July 1987 (BGBI. I p. 1754) amended by Article 1 (5) of the regulation of 11 June 1992 (BGBI. I p. 1049).

Material: self-adhesive foil
Size: 75 mm in diameter
Colours:

Year	Colour	RAL (Standardized) No.
1995	Orange	2000
1996	Blue	5015
1997	Yellow	1012
1998	Brown	8004
1999	Pink	3015
2000	Green	6018

In the following years, the colours are returning in the same order. The writing is any time black. Size of the inspection workshop's address field: 60 mm wide, 25 mm high. The address of the inspection workshop, written in black, may be either directly printed on the sticker or is stuck separately on the address field in the inspection sticker with self-adhesive transparent foil.

[Appendix 3
(to Article 2 (3))]

Plaque of approval:
Approved Workshop for Inspection of Plant Protection Equipment



**Proposal for Administrative Regulations in the Federal States (Bundesländer)
(Inspection Regulation for crop protection equipment)**

(Draft)

Administrative rule according to Article 30 (2) of the Plant Protection Act of 15 September 1986 (BGBl.⁵ I p. 1505) for an inspection regulation and for adequate training of the inspecting personnel.

Contents

I. Definitions of terms

II. Inspection regulation for plant protection equipment for field crops

1. Inspection procedure
2. Inspection report
3. Procurement of inspection stickers
4. Inspection fee

III. Regulations regarding the training of inspection personnel

I. Definition of terms

1. Inspection:

Testing according to Article 7 (1) to (3) of the Regulation on Plant Protection Products of 28 July 1987 (BGBl. I p. 1754), amended by regulation of 11 June 1992 (BGBl. I p. 1049).

2. Appropriate vocational training:

Vocational training in the field of farm machinery, such as agricultural mechanic /*to be supplemented by the Land authorities*/.

3. Plant protection equipment for field crops:

Plant protection equipment according to Article 7 (2) sentence 2 of the Regulation on Plant Protection Products of 28 July 1987 (BGBl. I p. 1754), amended by regulation of 11 June 1992 (BGBl. I p. 1049).

⁵ BGBl. Bundesgesetzblatt -- Federal Law Gazette

II. Inspection regulation for plant protection equipment for field crops

1. Procedure of inspections

Inspections shall be carried out according to Guideline 1-3.2.1 of Part VII of the BBA Guidelines for the Testing of Plant Protection Equipment.

2. Inspection report

The result of inspection is to be reported for every item of plant protection equipment in writing, in at least three copies, following Guideline 1-3.2.1 of Part VII of the BBA Guidelines for the Testing of Plant Protection Equipment. Calibration values such as nozzle throughput and spray pressure should be checked and recorded.

One copy of the inspection report is sent to the owner of the equipment and one to the competent Land's crop protection service. The inspection workshops keep their own copies for ten years.

3. Procurement of inspection stickers

The crop protection service and other authorities empowered by it are entitled to procure inspection stickers. These authorities keep records about the stickers they have issued. The inspection workshops obtain the stickers at their expense from the crop protection service or an authority empowered by it. They keep records about the use of the stickers. These records have to be submitted to the crop protection service upon request.

4. Inspection fee

A fee is raised on the inspection.

III. Training of inspection personnel

Following is a list of subjects to be treated during special training of inspection personnel. The subjects are based on the Plant Protection Act, the Regulation on Plant Protection Products, the Regulation on the Approval of Inspection Workshops, and sections I and II of the present regulation.

1. Introduction

- Importance and necessity of the inspection

2. Legal bases of the inspection

- Plant Protection Act
- Regulation on Plant Protection Products
- Regulation on the Approval of Inspection Workshops
- Administrative Regulations

3. Regulation of the inspection of plant protection equipment

- Conditions for approval of the inspection workshop:
 - inspection personnel
 - place of inspection

- testing devices
- Powers of the inspection workshop
- Duties of the inspection workshop

4. General notes regarding the inspection

- Requirements to be met by crop protection equipment
- Criteria to assess fulfilment of the requirements
- Identification of the equipment type and version
- Correct operation of the item of equipment
- Correct operation of the testing devices
- Procurement of inspection reports (forms) and stickers
- Records about the use of the stickers

5. Execution of inspection

- Mechanic prepares equipment for inspection
- Inspector clears equipment for inspection
- Fitting of testing devices
- Execution of measurements
- Location and elimination of faults
- Writing of inspection report
- Assessment of the equipment
- Decision on award of sticker

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Guidelines
for Testing Plant Protection Products
and Plant Protection Equipment**

Part VII

December 1996

1-3.1.1

**Requirements for
Facilities to Test
Plant Protection
Equipment Already in Use**

issued by the Department for Plant Protection Products and
Application Techniques of the Federal Biological Research
Centre Braunschweig

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German version available by:

Saphir-Verlag
Gutsstrasse 15,
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English version available by:

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1 - 3.1.1

Preliminary remark: Facilities used by official or officially recognized stations to test plant protection equipment already in use shall meet the requirements listed in the present Guideline.

For the approval by the BBA these requirements are taken as a basis for the tests.

1. Test facility to measure the uniformity of the cross distribution of plant protection equipment for field crops

A test stand with 100-mm-wide and at least 80-mm-deep grooves measured between the upper edge and the bottom end shall be used to measure the uniformity of the cross distribution. The test of a 12-m-wide spray boom must be possible in one passage.

- Groove test stands shall be at least 1.5 m deep. The groove width shall be adhered to with a tolerance of + 2.5 mm. Prior to the start of the control, the grooves being ready for use shall be checked by suitable means such as a pattern to see whether the above tolerance limits are adhered to. The graduated cylinders shall be of the same type and size and have a capacity of at least 500 ml. Scale graduation should be 10 ml at a maximum. The error should not be greater than 10 ml or 2 % of the measured value.
- The groove width of test stands working with groove scanners and electronic data sampling shall be adhered to with a tolerance of ± 1 mm. The positioning of the single steps of the scanner shall be adhered to with an accuracy of ± 20 mm. The measuring error of the flow volume of the single grooves at a flow volume of 300 ml/min shall be less than 4 %. The instruction manual shall give information how to adjust the test stand.
- Test stands of different design can be used if they reach at least the same measuring accuracy.

2. Test facility to measure liquid flows

The measuring range shall be appropriate for the measuring task. The display must be adjustable. Connecting pieces for various makes of plant protection equipment shall be on hand.

2.1 Test facility to measure pump capacities

For pump testing, the error of flowmeters should not exceed 2 % of the measured value or 2 l/min.

2.2 Test facility to check flowmeters

The error of measuring instruments for testing flowmeters, which are in use for accurate dosing, should not be greater than 1.5 % of the measured value.

3. Facilities for testing manometers

Manometers used for testing shall have a minimum diameter of 100 mm and they shall be officially calibrated. If, for measuring purposes, they are directly connected to the plant protection equipment, they will have to be damped and be provided with a pressure-relief device.

Measuring range, scale graduation and accuracy depend on the range of the spraying pressure for which the pressure gauge to be tested normally is in use and can be gathered from the following table:

Range of spraying pressure [bar]	Minimum requirements for manometers used for testing			
	Scale graduation max. [bar]	Accuracy [bar]	Grade required following DIN 16005	With a measuring range of up to [bar]
0 - 6	0.1	0.1	1.6	6
			1.0	10
			0.6	16
6 - 16	0.2	0.25	1.6	16
			1.0	25
> 16	1.0	1.0	2.5	40
			1.6	60
			1.0	100

4. Test facilities to measure the single nozzle output of sprayers and air-assisted sprayers for high crops

For the loss-free collection of the liquid output of all nozzles, measuring cylinders, having a measuring range of up to 2 l, a scale graduation of 20 ml at a maximum and an error of 20 ml at a maximum shall be used.

The number of measuring cylinders shall depend upon the plant protection equipment to be tested. For air-assisted vineyard sprayers, ten cylinders often suffice; for sprayers in hops, twenty cylinders can be required.

Test stands of different design can be used if they reach at least the same measuring accuracy.

5. Measuring cylinders for calibration

For the testing and calibration of volume measuring instruments measuring cylinders shall have a certification of accuracy and their specification can be gathered from the following table:

Volume	Scale graduation	error at a maximum
2000 ml	20 ml	± 10 ml
1000 ml	10 ml	± 5 ml
500 ml	5 ml	± 2.5 ml
100 ml	1 ml	± 0.5 ml

Explanation: If measuring cylinders with a certification of accuracy are kept ready for calibration it is not necessary to use officially calibrated or accuracy certificated measuring cylinders with the test stands No. 1 and No. 4 of this guideline.

6. Auxiliary devices for testing the preset spray angle of nozzles used for sprayers and air-assisted sprayers for field crops, having an accuracy of at least 2°.

7. Auxiliary devices for testing the nozzle inclination for sprayers and air-assisted sprayers for high crops, having an accuracy of at least 2°.

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Guidelines
for Testing Plant Protection Products
and Plant Protection Equipment**

Part VII

December 1996

1-3.2.1

**Features for Testing Field
Sprayers and Air-Assisted
Sprayers Already in Use**

issued by the Department for Plant Protection Products and
Application Techniques of the Federal Biological Research
Centre Braunschweig

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German version available by:

Saphir-Verlag
Gutsstrasse 15,
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English version available by:

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1 - 3.2.1

Preliminary remark

During the test of equipment already in use the fulfilling of requirements according to § 24 of the Plant Protection Act is checked on the basis of the following features.

These features are arranged by design groups of plant protection equipment and are numbered correspondingly. Following each feature instructions and/or examples pertaining to minor failures are given. The listing of minor failures need not necessarily be complete but it provides a framework for discretionary powers. The statement "Minor failures: none" means that no minor failures exist for this feature.

If the failures are of minor importance, a control badge (sticker) may be issued if the owner engages himself to remedy the failures **immediately**.

For testing used equipment (within six months from its putting into use) according to § 7, section 3, of the Ordinance for Plant Protection Products and Plant Protection Equipment, only the features pertaining to

- 2. pump
- 6. pipe system
- 9. nozzles

shall be applied. However, for new equipment with a spray boom which has been approved by the BBA as a single part or which is part of a complete approved equipment (nozzles may also have been exchanged by other ones approved by the BBA according to the equipment matrix) and if the manufacturer also supplies a certificate showing all the important data of the equipment, the measuring of the cross distribution according to feature K.9.3 can be dropped.

The result of the test shall be described in a control report to be written according to the sample in Appendix 1. If the above prerequisites are met and if the testing is done according to § 7, section 3, of the Ordinance for Plant Protection Products and Plant Protection Equipment without measuring the cross distribution, then the result of the test shall be stated in the control report which is an integral part of the equipment certificate according to the sample given in Appendix 2.

1. Drive

K.1.1 The drive shall not be affected in its function by wear or any other defect.

Explanation: Drive elements such as p.t.o. shaft, chain, sprocket wheels, V-belt, gear, etc. are to be tested.

Minor failures: slight wear of the drive elements, poor chain greasing, slight damaging of V-belt, too low V-belt tension.

2. Pump

K.2.1 The volume flow of those pumps, which supply the nozzles with liquid, should be adapted to the needs of the equipment.

Explanation: The measurement is to be done with a measuring device according to Guideline 1-3.1.1 of Part VII of the Guidelines for Testing Plant Protection Products and Plant Protection Equipment of the Federal Biological Research Centre. The needs of the equipment can be taken from the maximum nozzle output and an additional volume flow for the hydraulic agitator if existing. The additional volume flow is to take from the following table:

nominal tank capacity	additional flow rate
up to 1000 l	5 % of the nominal tank capacity
between 1000 and 2000 l	60 l/min
more than 2000 l	3 % of the nominal tank capacity

Minor failures: none

K.2.2 Pulsation caused by the pump must be damped.

Minor failures: none

K.2.3 The pressure-relief device shall work reliably.

Explanation: The functioning of the pressure-relief device must also be granted if a subsequent installed pressure-filter is plugged up with foreign particles.

Minor failures: none

K.2.4 The pump shall not leak.

Explanation: She may not drip.

Minor failures: none

3. Agitator

K.3.1 A clearly visible agitation inside the tank should be reached during spraying, with half filling and at the rated p.t.o. shaft speed.

Explanation: Attention should be paid to the correct insertion of the parts of the agitator. If the latter is hydraulic, there should be an additional volume flow according to feature K.2.1.

Minor failures: none

4. Spray liquid tank

K.4.1 The tank and the screw-caps must not leak.

Minor failures: none

K.4.2 If the filling is done at the tank dome, there should be a filler sieve available.

Minor failures: none

K.4.3 Pressure compensation must be ensured.

Minor failures: none

K.4.4 A clearly readable liquid level gauge has to be available.

Minor failures: The hose used to determine the tank level is opaque and only little transparent, the float is hardly visible, the scale is partly hid by the hoses.

K.4.5 It must be possible to collect the spray liquid properly when the drainage is done.

Minor failures: The drain-cock is difficult to operate, the collection of liquid is hindered by a badly positioned hose.

K.4.6 As far as tank filling devices are concerned, it must be ensured that the spray liquid cannot flow back.

Minor failures: none

K.4.7 Gate-type fillers of sprayers made after 1 January 1989 shall have a protective grating with a maximum mesh width of 2 cm.

Minor failures: none

K.4.8 Gate-type fillers must work reliably.

Minor failures: none

K.4.9 Container cleaning device must work reliably.

Minor failures: none

5. Controls

K.5.1 All devices for measuring, switching and adjusting pressure shall not leak and function well.

Minor failures: All switching or adjustment devices are lacking ease but are not impaired in their functions.

K.5.2 All devices for adjusting pressure have to keep the working pressure at a normal constant speed.

Explanation: This includes also that they reach the same working pressure after the equipment has been switched off and on again.

Minor failures: Changes of the working pressure by up to 5 %.

1 - 3.2.1

K.5.3 The controls required for a perfect dosing as well as the switching devices have to be mounted such that the operator can read and operate them without difficulty during work; it is still considered reasonable that the operator turns his head or his upper body in doing so.

Minor failures: Switches for boom sections are unfavourably positioned and cannot be easily reached, minor vibrations of the manometer indicator.

K.5.4 As to their scale range, pressure gauges shall correspond to their purpose.

Minor failures: none

K.5.5 In the range of spraying pressure the pressure gauges shall at least meet the requirements of grade 2.5 (DIN 16005).

Explanation: The accuracy of the pressure gauges shall be tested by means of the test facility for manometers according to Guideline 1-3.1.1 of Part VII of the Guidelines for Testing Plant Protection Products and Plant Protection Equipment of the Federal Biological Research Centre. Grade 2.5 (DIN 16005) corresponds to the following error limits:

range of spraying pressure up to [bar]	Max. error [bar]
5	0.125
6	0.15
10	0.25
16	0.4

Minor failures: Indication errors up to 3 % of the end of the range of spraying pressure.

K.5.6 The manometer casing shall have a minimum diameter of 60 mm.

Minor failures: none

K.5.7 The scale graduation of the pressure gauges, up to 5 bar, shall be 0.2 bar at the maximum.

Minor failures: none

K.5.8 Other measuring devices, especially flowmeters used for dosing, can deviate from the measured value by 5 % at the maximum within the customary measuring range.

Explanation: Flowmeters, if any, shall be tested when being fitted already by means of a test equipment according to those described in Guideline 1-3.1.1 of Part VII of the Guidelines for Testing Plant Protection Products and Plant Protection Equipment of the Federal Biological Research Centre. In doing so, controls connected before in series, consisting of separate return flow, a feed line leading to the controls of the plant protection equipment, a valve for adjusting pressure, a manometer, a flowmeter and a pressure-relief device can be useful.

Minor failures: indication errors up to 7.5 % at range limits.

K.5.9 There shall be a main control valve which works reliable.

Minor failures: none

6. Pipe system

K.6.1 The pipe system must not leak and be designed such that all nozzles are uniformly and sufficiently provided with liquid.

Explanation: Pipelines and connections shall be tested at the maximum possible working pressure however with 10 bar at the most. They shall not drip.

Minor failures: none

K.6.2 Hoses should not have any marks of kinking or abrasion.

Minor failures: negligible abrasion having not yet reached the woven fabric of the hose.

K.6.3 Hoses in working condition must not be suspended in the range of the jet.

Minor failures: none

7. Filtering

K.7.1 At least one filter each has to be inserted into the suction and pressure pipelines. It shall be possible - also with a full tank - to clean the filter without wasting more liquid than the volume in the filter housing and in the sucking hose respectively.

Explanation: Nozzle filters, if any are in this case not regarded as filters in pressure pipelines. The filter elements shall be checked as to their state of sealing and damages.

Minor failures: minor damage to the sealing though no dropping.

K.7.2 The filter elements have to be replaceable.

Minor failures: none

8. Spray boom

K.8.1 In all directions it must be of stable design, i.e. during spraying there should be no major unwanted bouncing, no mechanical deformation or deflection in its joints.

Minor failures: negligible deformations of the boom which do not affect the direction of nozzles.

K.8.2 There have to be obstacle-avoiding devices with an automatic resetting.

Minor failures: Slow automatic resetting because of poor greasing, for example.

K.8.3 Nozzles must have uniform spacing between each other and from the target area.

Explanation: During the folding of the boom, the nozzle heads should not be twisted or shifted. The distances of nozzles from the target area may vary up to 10 cm.

Minor failures: none

K.8.4 Parts of equipment shall not be sprayed.

Minor failures: none

K.8.5 In case of working widths equal 10 m or more, the atomizers at the boom ends have to be protected from being damaged because of soil contact, e.g. by spacers.

Minor failures: Spacer is deformed.

K.8.6 For spray booms with more than 6 m working width, it must be possible to switch the spray boom on or off in at least two sections.

Minor failures: none

K.8.7 Height adjustment devices must be in working order.

Minor failures: none

K.8.8 Devices to compensate bouncing and slope positions must be in working order.

Minor failures: none

9. Nozzles

K.9.1 Types and sizes of all nozzles used at the same time, including the relevant drop stop valves and filters, if any, have to be alike.

Explanation: Nozzles should be used which are approved by the BBA. With multiple-nozzle-bodies each nozzle type is to be tested.

Minor failures: none

K.9.2 Nozzles should not drip after being switched off.

Explanation: It shall be checked, by repeatedly operating the on/off switches, whether the nozzles do not drip for more than five seconds after the spray jet collapsed.

Minor failures: none

K.9.3 The cross distribution, within the fully overlapping range, shall be uniform. The cross distribution will be evaluated on the basis of the coefficient of variation which shall not exceed 10 %. Until 31 December 1997 an equal criterion is, that not more than 8 % of the measured values, within the fully overlapping range, shall deviate more than 15 % from the total mean value.

Explanation: The cross distribution test is to be done by means of the test equipment described in Guideline 1-3.1.1 of Part VII of the Guidelines for Testing Plant Protection Products and Plant Protection Equipment of the Federal Biological Research Centre. Prior to the start of the cross distribution measurement, attention should be given to the perfect functioning of the spraying and correct adjustment of all nozzles. The measurement of the fitted sets of nozzles shall be made at the working pressure indicated by the owner of the sprayer. The distance from the measuring area should be the one normally used in practice; for nozzles with a spray angle of 110°/120°, the distance, as a rule, is 50 cm. If for remedying failures new nozzle tips approved by the BBA are installed no additional cross distribution test is to be done provided that at least one cross distribution test has been done before.

Minor failures: Up to 12 % of the measured values deviate more than 15 % from the mean value.

Control test station

Control Report No.

for plant protection equipment for field crops

- Test acc. to § 7, sect. 2 of PflSchMVO* Test acc. to § 7, sect. 3 of PflSchMVO Recheck
 Safety regulation test

Owner's address

Make or manufacturer acc. to BBA code list:

Type:

Year of manu. 19 Machine No.:

- rear mounted surface mounted trailed self-propelled
 private hired jointly used

Remarks, recommendations, replaced parts, repairs

Test result yes no Date and signature of the inspector

	Equipment		minor failure *if any	failure or missing	O.K. or failure remedied	minor failure *if any	failure or missing	O.K. or failure remedied
1. Drive		K.1.1 Function	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
2. Pump	<input type="checkbox"/> piston <input type="checkbox"/> diaphragm <input type="checkbox"/> <input type="text"/> <input type="text"/> l/min at <input type="text"/> bar	K.2.1 flow volume K.2.3 pressure relief device		<input type="checkbox"/>	<input type="checkbox"/>	K.2.2 pulsations K.2.4 no leakage	<input type="checkbox"/>	<input type="checkbox"/>
3. Agitator	<input type="checkbox"/> mechanic <input type="checkbox"/> hydraulic	K.3.1 recirculation		<input type="checkbox"/>	<input type="checkbox"/>			
4. Tank	nominal capacity <input type="text"/> l	K.4.1 no leakage K.4.3 pressure compens. K.4.5 drainage K.4.7 filter sluice K.4.9 cont. cleaning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	K.4.2 filter sieve K.4.4 scale K.4.6 filter device K.4.8 gate-type filter	<input type="checkbox"/>	<input type="checkbox"/>
5. Controls		K.5.1 function K.5.3 operation K.5.5 accuracy K.5.7 spacing K.5.9 switch off dev.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	K.5.2 pressure K.5.4 measur. range K.5.6 casing K.5.8 flowmeter	<input type="checkbox"/>	<input type="checkbox"/>
6. Pipe system		K.6.1 no leakage K.6.3 suspension		<input type="checkbox"/>	<input type="checkbox"/>	K.6.2 no kinking	<input type="checkbox"/>	<input type="checkbox"/>
7. Filtering		K.7.1 installed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	K.7.2 inserts	<input type="checkbox"/>	<input type="checkbox"/>
8. Spray boom	working width <input type="text"/> m nozzle distance <input type="text"/> cm no. of sections <input type="text"/>	K.8.1 stability K.8.3 distance K.8.5 spacer K.8.7 height adjustm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	K.8.2 evading K.8.4 in spray jet K.8.6 sections K.8.8 anti-swing	<input type="checkbox"/>	<input type="checkbox"/>
9. Nozzles	no. of pieces <input type="text"/> marking <input type="text"/> manufacturer <input type="text"/> no. of measured data with > 15% deviation or coefficient of variation <input type="text"/>	K.9.1 type, size K.9.3 cross distribution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	K.9.2 anti drip	<input type="checkbox"/>	<input type="checkbox"/>

Land / competent office

Location of control (area code, town)

Sample Equipment Certificate

To be completed by the manufacturer

Manufacturer

Type: D-No.:

Designs (Matrx) Machine-Nr.:

Year of manuf. 19 Approved (BBA), Test No. G-

rear-mounted
 surface-mounted
 trailed
 self-propelled
 private
 hired
 jointly used

Additional accessories:

Nominal tank capacity l

Type of pump

Pump design

Type of controls

No. of sections

possible spray booms

To be completed by the control test station

Control test station

Control Report No.

for plant protection equipment for field crops
Test according to § 7, sect. 3 of the PflSchMVO

Remarks, subsequent changes

Owner's address

Test result sticker	Equipment	Date and signature of the inspector	minor failure	failure or missing	O.K. or failure remedied
<input type="checkbox"/> yes <input type="checkbox"/> no	2. Pump Capacity: <input style="width: 50px;" type="text"/> l/min at <input style="width: 50px;" type="text"/> bar	K.2.1 flow volume K.2.3 pressure relief device	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	6. Pipe system	K.6.1 no leakage K.6.3 suspension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	8. Spray boom marking <input style="width: 50px;" type="text"/> working width <input style="width: 50px;" type="text"/> m nozzle spacing <input style="width: 50px;" type="text"/> cm				
	9. Nozzles No. of pieces <input style="width: 50px;" type="text"/> nozzle marking <input style="width: 100px;" type="text"/> manufacturer <input style="width: 100px;" type="text"/> * no. of measured data with > 15% deviation or coefficient of variation <input style="width: 50px;" type="text"/>	K.9.1 type, size K.9.3 * cross distributor * if not approved by the BBA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Land / competent office

Location of control (area code, town)

Non-official translation



**FEDERAL BIOLOGICAL RESEARCH CENTRE
FOR AGRICULTURE AND FORESTRY**

FEDERAL REPUBLIC OF GERMANY

3rd edition

July 1990

**Features for Testing
Air-Assisted Sprayers for
Orchards, Vineyards and Hops.**
(Chapter IV of BBA-Instructional Leaflet No.44)

**Issued by the Department for Plant Protection Products and
Application Techniques of the Federal Biological Research
Centre Braunschweig.**

IV Features for testing air-assisted sprayers for orchards, vineyards and hops

Note: a) = requirement, b) = explanation

1 Drive

- a) The drive shall not be affected in its function by wear or any other defect.
- b) Drive elements such as p.t.o. shaft, chain, sprocket wheels, V-belt, gear, etc. shall be tested.

2 Pump

- a) The volume flow of the pump should be adapted to the needs of the equipment. In case of hydraulic mixing additional sufficient volume flow shall be provided⁶. The volume flow of the pump is defined by the outfit of the sprayer corresponding to its intended use (see, operator's manual). Pulsation caused by the pump shall be damped and the device to avoid overpressure shall be working.
- b) Check the output with the flowmeter at the nominal pump speed and in the normal pressure range. Check the pulsation damping.

3 Mixing

- a) A clearly visible agitation inside the tank should be reached during spraying, with the half filled tank and at the nominal p.t.o. shaft speed.
- b) Attention should be paid to the correct insertion of the parts of the mixing system. If the latter is hydraulic, there should be an additional volume flow according to 2 a).

4 Tank

- a) The tank and the screw-caps shall not leak. If the filling is done at the tank dome, there should be a filler sieve available. Pressure compensation shall be ensured. A clearly readable liquid level gauge has to be available. It shall be possible to collect the spray liquid properly when draining.

As far as tank filling devices are concerned, it shall be ensured that the spray liquid cannot flow back. Gate-type fillers of sprayers shall have a protective grating with a maximum mesh width of 2 cm.

- b) Check the sprayer whether the requirements given in a) are fulfilled.

⁶ min. 5 % of the nominal tank volume in l/minute in case of sprayers with nominal tank volumes up to 1.000 l. In case of injector mixing systems minor volume flows may be sufficient.

5 Controls

- a) All devices for measuring, switching and adjusting pressure shall function well. The controls required for a perfect dosing as well as the switching devices have to be mounted such that the operator can read and operate them without difficulty during work; it is still considered reasonable that the operator turns his head or his upper body is doing so.

As to their scale range, manometers shall correspond to their purpose and it shall be possible to read them clearly. The manometers shall at least meet the requirements of grade 2.5 (DIN 16 005) and the casing shall have a minimum diameter of 60 mm. The scale graduation of the manometer shall be 1 bar max. for spraying pressures up to 20 bar, 2 bar for pressures between 20 and 40 bar and 5 bar for pressures above 40 bar.

Other measuring devices, especially flowmeters used for dosing, may deviate from the measured value by 5 % max. within the customary measuring range.

Devices for constant application rate should be tested for their normal behaviour. In doing so, changes of state, e.g. by switching on and off the lines leading to the nozzles, changes in speed including also such ones occurring between the opening and closing of lines leading to the nozzles, and switching off partial widths should - over 5 seconds at the maximum - result in a change of the application rate in the state of inertia by ± 10 % max..

- b) Check the functions and the correct positioning of the controls and devices mentioned under a). Devices for adjusting pressure shall keep the working pressure at a normal constant working speed. This includes also that they reach the same working pressure after the equipment has been switched off and on again. Check the accuracy of the manometer with the manometer test instrument. Check the flowmeter, if any, with the suitable test instrument.

6 Hoses and pipes

- a) The hoses and pipes system shall not leak and be designed such that all nozzles are uniformly and sufficiently provided with liquid. Hoses should not have any marks of kinking or abrasion and shall not be suspended in the range of the spray jet in working condition.
- b) Check hoses, pipes and connections at the permissible maximum pressure of the sprayer.

7 Filtering

- a) The spray liquid shall be filtered sufficiently. At least one filter each has to be inserted into the suction and pressure lines. The filter elements shall correspond to the nozzle size and shall be replaceable.
Note: Filter in lines should be positioned such that plugging is indicated by pressure drop at the manometer.
- b) The filter elements shall be checked as to their state of sealing and damages, if any. On the pressure side, the mesh width of the filter shall be smaller than the nozzle diameter.

8 Blower

- a) If the equipment can be used as field crop and air-assisted sprayer, it shall be possible to make the blower ineffectual. The design and the accessories shall correspond to the manual. The nominal speed (see manual) shall be reached at the nominal speed of the drive. If there are recommendations of the official plant protection service for special adjustments of the air deflecting devices, these recommendations should be used for testing.
- b) Check whether the requirements mentioned under a) are fulfilled. Check the rotor of the blower and the casing whether there are damages. Check the state of the air deflecting devices and the possibility to adjust and to lock them.

Measurements of the air output and the air velocity are not made.

To reach the intended airflow the mechanical part of the blower shall be faultless and the rotor shall reach the speed given in the manual at the nominal speed of the drive.

9 Nozzles and distribution of the spray liquid

- a) The sprayer shall be provided with nozzles which make possible the application rates given in Annex 1 and in the dosing tables of the equipment. Different types of nozzles shall be positioned symmetrically on the right and left side. The adjustment of the nozzles (output, spray jet angle and direction) shall be reproducible. It shall be possible to switch off each nozzle. The nozzles shall produce uniform spray jets.

Measuring the output the deviation of the output of each nozzle of the same type shall be $\pm 10 \%$ max. of the mean output of all nozzles. If there are special recommendations of the official plant protection service for the adjustment of the nozzles, these recommendations should be used for testing.

- b) Check the sprayer whether the requirements mentioned under a) are fulfilled.

Before measuring the output of each nozzle, check whether the nozzles are working well and are adjusted correctly and whether the anti-drip devices are functioning. If different sets of nozzles are used, each set shall be tested.

Note: For the adjustment of the nozzles suitable aids shall be provided.

The adjustments shall be made in accordance with the recommendations⁷ and tested. For doing that, the same adjustment of the sprayer shall be used as when developing the dosing tables.

10 Safety

- b) In case of arrangement with the accident prevention organisation ((Berufgenossenschaft)) the sprayer shall be checked corresponding to Annex 2.

⁷ Recommendations mean statement about sizes, positioning and angle / direction of nozzles and positioning of air deflecting devices of the blower.

11 Dosing tables

- b) The dosing table (see Annex 3 to 5) should include customary amount of spray liquid. Additional demands of the equipment owner should be observed.

The liquid output of the sprayer shall be measured within the spray pressure range. Define dosing data with the help of the tables of Annex 6 and additional tables⁸ and write them into the dosing table. Do not leave the optimum pressure range of the nozzles.

⁸ e.g. of the manufacturer or of the official plant protection service.

SECTION IV

APPENDICES

Appendix A

Measuring direct drift when applying liquid plant protection products outdoors
(Guideline VII, 2-1.1)

Appendix B

Guidelines for the application of plant protection products with the use of aircraft.

Appendix C

A historical survey of the development of plant protection testing in the
Federal Republic of Germany

Description of test facilities used in the Application Techniques Division

Non-official translation

German text is legally binding

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Guidelines
for Plant Protection
Equipment Tests**

Part VII

September 1992

2-1.1

**Measuring direct Drift
when applying
liquid Plant Protection Products
outdoors**

issued by the Department for Plant Protection Products and
Application Techniques of the Federal Biological Research
Centre Braunschweig

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Introduction

The present Guidelines help to assess plant protection equipment in view of direct drift problems to make a high comparability of outdoor drift values possible. Many outdoor trial parameters cannot freely be chosen as it is possible with a test stand and do not remain constant throughout the trial. In keeping with the limits stipulated in these Guidelines, different research workers, for some parameters, have shown to reach highly identical results. For the evaluation of the drift trials, various possible ways have been discussed. The method described in paragraph 6 of these Guidelines has already been used for other evaluations (e.g. residue trials) and has stood the test.

As far as the clarification of details is concerned, deviations from the Guidelines are permitted. However, it should be taken into consideration that these results do not always lend themselves for absolute statements as they only permit relative comparisons.

1. Definition

A direct drift is that part of the amount of active ingredient applied which, during the application process, due to atmospheric currents, is borne beyond the treated area. Whatever amount gets lost due to evaporation or leaching cannot be considered as a direct drift.

2. Trial area

The trial area is part of a larger location. In wind direction, next to the trial area, there should be a free site serving as an area for drift measurements. The size of the trial area cannot be fixed. Its width depends upon crop, growth stage, kind of equipment, etc. and it should be so that the tour which is farthest away from the area for drift measurements does not contribute to the direct drift.

(Pragmatical values: crop areas 20 m; orchards 5 rows; vineyards 10 rows). The length of the trial area is best chosen if direct drifts can still reach the neighbouring area of measurement even if winds, within the permissible values, will change direction.

3. Carrying out of trials

The entire trial area is treated with a liquid. For demonstration purposes this liquid can contain both a plant protection product (copper preparation) or a colouring agent. Each trial shall be repeated at least three times. During the trial the following weather data shall be constantly recorded (see annex 1):

- wind direction
- wind speed
- air temperature
- relative atmospheric humidity
- amounts of cloud

Weather data shall be recorded in the centre of the measuring area, within five metres from the trial area, at the following heights (see annex 2): in

- fields 1 m
- vineyards 3 m
- orchards 4 m
- hop-growing areas 10 m

Air temperature, throughout the entire trial, must not exceed 25 °C and wind speed not 5 m/s.

The mean wind direction shall not deviate more than 30° from the main one. The main wind direction is the average one ascertained over the whole duration of trials carried out on one trial site and one trial day and should be at right angles to the direction of the tour. All the trial parameters shall be completely recorded according to annex 1.

4. Method of measurement

Direct drifts are measured

– in suspension:

passive, ball-shaped drift collectors (see annex 3) are fixed onto poles;

– as ground sediments:

object carriers with a surface area of at least 100 cm² (see annex 3) are horizontally placed on the ground.

The amount of collected product is measured by fluorimetric or atomic absorption spectrometric methods.

5. Points of measurement

The suspended part of the direct drift is measured by drift collectors at a vertical distance of 1 m; further subdivisions are possible. The distance from the trial area is

– 5 m in fields;

– 10 m in fruit-, vine- and hop-growing areas.

In fields, measurements shall be carried out up to a height of 4 m while for the other crop heights it must be adapted to the crop height and the equipment.

The drift collectors are placed at least at three different times.

It depends upon the task of the trial how the object carriers for measuring the ground sediment will be arranged.

From the following distances at least five must be selected in order to grant the comparability of trials:

1; 2; 3; 4; 5; 7.5; 10; 15; 20; 30; 40; 50; 75 and 100 m.

The object carriers are placed at distances of 2 – 3 m and measurements are carried out five times.

Starting points for fixing the distances from the trial area are

– in fields: 1 nozzle distance from the outermost nozzle

– in fruit-, vine- and hop-growing areas:

- - the centre of the equipment if the spraying is done only from one outer side;
- - the width of half a lane from the outermost row if the first tour is carried out in the first lane.

All arrangements are depicted in annex 2.

6. Evaluation and representation of results

The measured amounts of drifted product are indicated according to annexes 4 and 5. In addition the mean values are to be calculated for each distance.

As the normal distribution of results from drift trials is not very likely, a distribution-free index is used for quantification. A quantile of 95 of the individual values is chosen as an index to take, in the evaluation, the optimum values into account.

The following calculating method is suggested:

$A(0.95)$	$= (1 - G) * A(J) + G * A(J+1)$
with	
$(n + 1) * P$	$= J + G$
n	$=$ Number of values
P	$= T/100$, here 0.95
T	$=$ percentile value, here 95 %
J	$=$ integral part of $(n + 1) * P$
G	$=$ fraction of $(n + 1) * P$
$A(J)$	$=$ drift value in place J
$A(J + 1)$	$=$ drift value in place $J + 1$
$A(0.95)$	$=$ required quantile value
$A(n)$	$=$ drift values arranged according to their size

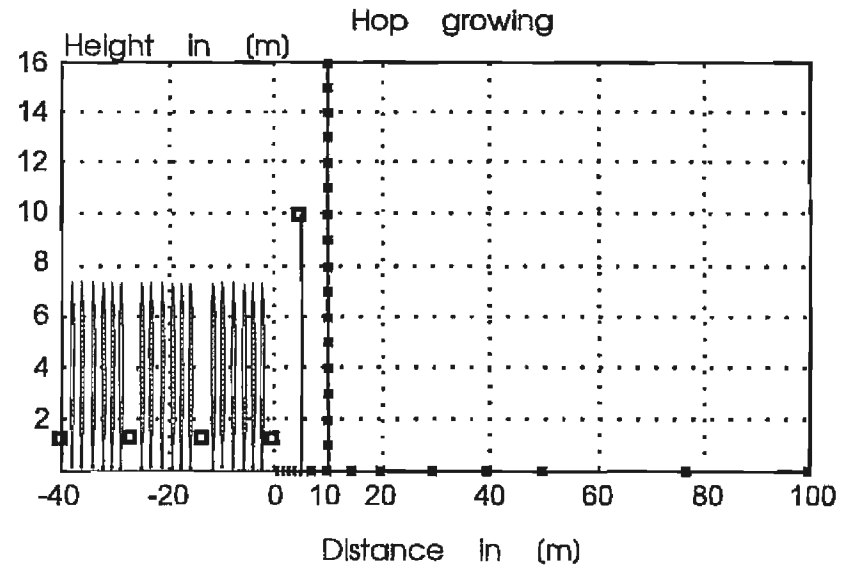
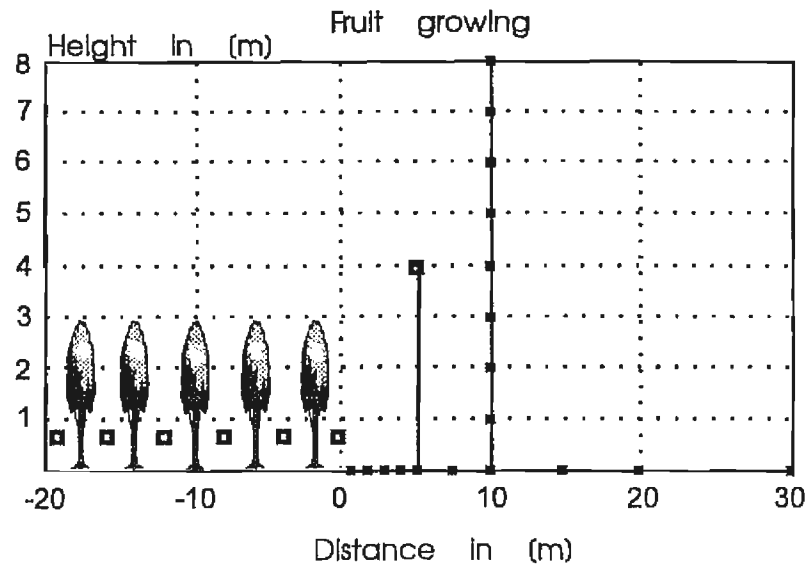
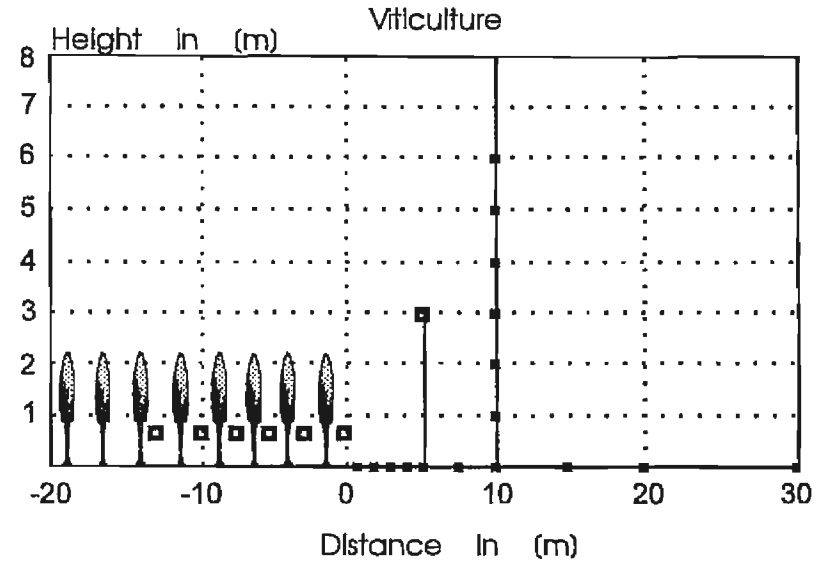
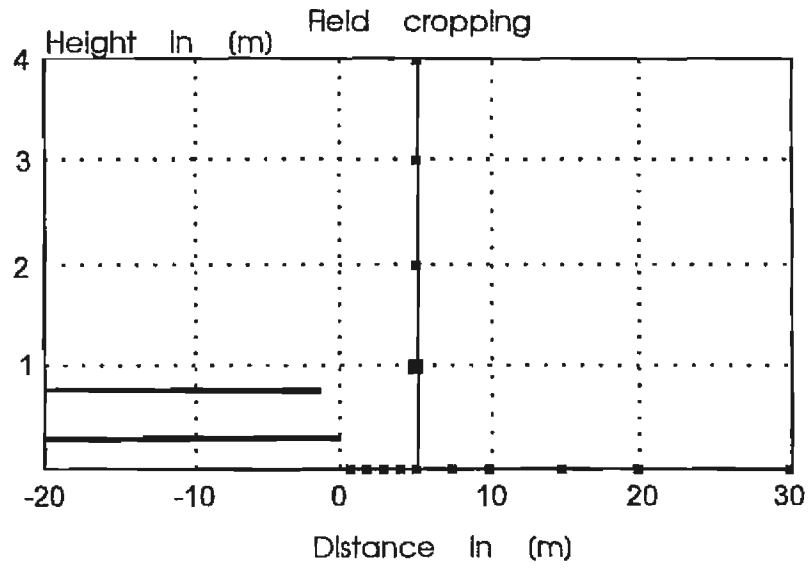
Trial carried out by				Trial No.:		
Trial area:		Farm:		Trial date:		
Where:		Where:				
Detailed location:		Street:				
Slope:						
Crop				Crop:		
Variety:		Root stock:				
Age:		Site:				
Form of crapping:		Density of stand:				
Growth stage:		Vigour:				
Height of stand: cm		Upper limit: cm				
		Lower limit: cm				
Liquid of treatment				Remarks:		
Amount of liquid: l		Liquid application rate: l/ha				
Substance used:		Concentration: %				
Amount of substance: g		Substance application rate: g/ha				
Auxiliary substances:		Concentration: %				
Amount of aux. substances: g		Appl. rate of aux. substances: g/ha				
Plant protection equipment				Remarks:		
Manufacturer:		Typ:				
Attached equipment: () Trailed: ()		Mounted: () Self-drive: ()				
Working width: m		Speed: km/h				
Height of connecting rod: cm		Distance of first nozzle from the ground: cm				
Type of nozzles:		Spraying pressure: bar				
Spraying angle: () forwards () backwards						
Nozzle position:		Left		Right		
		No	Size	Angle	Size	Angle
		10				
		9				
		8				
		7				
		6				
		5				
		4				
		3				
		2				
1						
Position of guide vanes:						
left below: right below: left top: right top:						
All angles measured from the horizontal; marked upwards with (+) and downwards with (-)						
Type of fan:		Sense of rotation:				
Step:		Speed in rpm:				

Appendix A

Annex 1

Trial arrangement						Remarks:		
Standard arrangement:								
Field cropping: ()		Viticulture: ()		Fruit growing: ()			Hop growing: ()	
Changes:								
Ground sediment measurement:			Kind of collector:					
Collector size:			Number per distance:					
Measur _____ 0)								
Suspended part measurement:			Kind of collector:					
Height bottom:			Number per height:					
Height top:			Vertical distance:					
Carrying out of trail						Remarks:		
Description/sketch:								
Weather data								
Row/tour	Time	Temp. (°C)	Rel. humidity (%)	Wind direction	Wind speed (m/s)	Clouds		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Miscellaneous:



□ Weather data ● S

■ G

Annex 3

Materials for drift measurement

Ground sediment

Filter paper M&N No. 615
Width 30 mm, rolls of 100 m each
Art. No. 100 615 003

Manufacturer:
Macherey & Nagel
Postfach 307
5160 Düren

Petri dishes
145 cm²
Order No. 639 160

Manufacturer:
Grteiner & Söhne
Postfach 1320
72622 Nuertingen
(Tel. 07022/5010)

Suspended parts:

"Drift collectors"
(ball shaped plastic detergents)

Specifications:
Art. No. 0140
Diameter: 80 mm
Colour: white
Weight: 15 g
Knitted fabric width: 110 mm
Thread size: 0.38 mm
(pressed)

Manufacturer:
Siral A. Siebauer
Postfach 29
Niedermauker Str. 8-10
91187 Roettenbach
(Tel. 09172/454)

washable glasses
Boiling glasses 230 ml
with neutral screw-on lid
Art. No. 17 016

Manufacturer:
SLA Handels GmbH
Am Bahnhof
Postfach 31 11 74
38239 Salzgitter
(Tel. 09172/454)

Ground sediment measurement

Trial number:

Distance [m]	Replication	Deposited drift material	
		[$\mu\text{g}/\text{cm}^2$]	rel. to application rate [%]

Appendix A

Annex 5

Suspended part measurement

Trial number:

Distance from the trial area:m

Height [m]	Replication	Deposited drift material	
		per collector [μ g]	rel. to application rate [%]

Non-official translation

German text is legally binding

**Federal Biological Research Centre for Agriculture and Forestry
Federal Republic of Germany**



**Guidelines
for the application of
Plant Protection Products
with the use of aircraft.**

2nd edition

April 1991

Issued by the Division for Plant Protection Products and
Application Techniques of the Federal Biological Research
Centre Braunschweig.

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At the time of up-dating the version accepted by the Legislative Authority and editorially revised from the guidelines of December 1972, and from the leaflet „Setting up the applications groups“ to these Guidelines from January 1973. A „special issue“ leaflet no longer existing.

1. Introduction

The guidelines for the application of plant protection products with the use of aircraft should help in reducing and avoiding the various harmful effects threatening the environment and should be used as basis for the official measures.

The air-traffic rules and the other relevant regulations remain untouched.

The competent Agricultural Government Authorities of the federal districts can derive diverging regulations from these guidelines.

2. Compulsory Announcement

Each intended output of plant protection products with use of aircraft must be notified by the contractor a minimum of 14 days before the beginning of the operation to the relevant Agricultural Government Authority of the federal districts. The form presented as enclosure 1. should be used for this purpose. When a danger suddenly occurs a shorter period of time can also apply.

Additionally, it is necessary to inform at least per telephone in due time, the relevant Agricultural Authority of the federal districts and this no later than 48 hours before the beginning of the operation.

3. Conditions of Contract

A written contract has to be made between the contractor and the flying enterprise.

The guidelines for the output of plant protection products have to be made as part of the contract.

The contractor and the flying enterprise have the obligation to conclude the necessary adequate liability on third-party insurance. Further particulars are to be agreed-upon in the contract.

4. Aeronautical Map for Operation

It is necessary that the competent Agricultural Government Authorities, that every pilot and that the operation manager have a map established at the minimum scale of 1:25000 or at a bigger scale (for example 1:10000) on which the following items have to be marked :

- a) the fields to be treated
- b) the operating airfields (take-off and landing runways as well as the refilling place for the plant protection products).
- c) all the properties running a risk, for example : blocks of flats and gardens, water surfaces, protected water areas from the zones I and II, and other protected areas.
- d) certain neighbouring cultivated grounds.

e) all flight obstacles on the fields to be treated.

A specimen of the aeronautical map has to be presented together with the Notification Form number 2 to the competent agricultural federal district authorities. Any change occurring in the registration of the beginning of the operation has to be notified to the relevant Agricultural Authority in due time and no later than 48 hours before.

5. Requirements for the Personnel and the Equipment of the Task Groups

5.1 Pilots only can be employed who can show evidence of their required reliability and the required specialised professional knowledge and dexterity according to Paragraph 10 from the Code of Protection for Cultivated Plants brought into effect on 15th September 1986 (PflSchG).

5.2 The instruments set up on the flying equipment for bringing out the plant protection products as well as the refuelling installation on the ground (vehicles, mixing installation, scald container, measuring instruments for liquid measurements, hose lines) have to meet the requirements specified in Article 4 under Section 1 from the Regulations for Plant Protection Products and Plant Protection Equipment brought out on 28th July 1987. In particular, results from it :

5.2.1 Minimum requirements for the aircraft

- 5.2.1.1 To control the pre-adjusted working pressure, a fluid dampened (Glycerine) gauge has to be fitted in the spray system. The range of this gauge should be within the limits of the working pressure.
- 5.2.1.2 Front end mounting of the spray system is to be preferred, if the kind of application and the liquid distribution allows it.
- 5.2.1.3 It must be made sure that the nozzles do not drip after being switched-off.
- 5.2.1.4 The spray tank is to be equipped with an agitator.
- 5.2.1.5 In case of an hydraulic agitator in the spray tank, the main pump has to have sufficient output to ensure adequate spray mixing effect with fully opened spray nozzles. (ground level testing with water).
- 5.2.1.6 The pump's suction line has to be properly installed to secure the in-flight emptying of the tank.
- 5.2.1.7 To completely drain the spray tank a drainage valve has to be installed in such a manner, that the spray fluid can be safely recovered without endangering operating personnel or any other part of the machinery getting in contact with it, for example struts.
- 5.2.1.8 The filling hole of the spray container must be provided with a leak proof closing lid. The container must have a pressure compensator through which the spray liquid cannot overflow.
- 5.2.1.9 The spray tank as well as suction or pressure piping have to be equipped with non reverse safety valves (couplers) which allow removal of same without loss of fluid.

5.2.1.10 Within the range of the pilots visibility the following read-out devices are to be installed:

- a) Pressure Gauge for the working pressure if possible for the pump end and the spray boom ends.
- b) Control lights indicating the position of the valve, either open or closed.
- c) Fluid volume indicator.

5.2.2 Minimum requirements for ground level refilling installations.

5.2.2.1 To ensure the proper composition of the spray fluid the tank vehicle has to be equipped with the proper balance, calibrated measuring devices, etc...

5.2.2.2 The mixing unit's chemical tank, used to refill the aircraft's spray tank, has to have an accurate and clearly visible calibrating device. To be accurate, the mixing unit has to be levelled out properly.

5.2.2.3 The design of this mixing tank has to be so that no leakage or swapping over can occur while mixing.

5.2.2.4 The mixing tank's volume should not exceed approx. 1500 litres and be equipped with a mixer capable of reconditioning a suspension which has been settled over a period of time⁹.

5.2.2.5 The spray tank also has to have a draining device, which allows a total draining of the fluid without spilling over personnel or equipment.

5.2.2.6 Further more the tank has to have a pressure compensator and a tight, leak proof, filling cap which avoid spilling while moving.

5.2.2.7 All individual valves of the mixing unit, like the tank, hoses, etc. have to be provided with a leak proof shut-off device.

5.3 All airfields, used as filling stations, are to be equipped with a wind sock and operational measuring devices for wind speed, temperature and humidity.

5.4 To operate and maintain the spraying - and the mixing/filling equipment, a qualified operator, especially trained on crop spraying equipment, has to stand by at the location being used.

6. Location of airfields and their restricted use.

Airfields, in use for crop spraying operations, are not to be located within restricted areas where drinking water is withdrawn from. Airfields can only be set up with the permission of the landowner.

⁹ The efficiency of the agitator must not exceed $\pm 15\%$ deviation of concentration of a one percentage OB 21 suspension (copperoxychloride) within the tank. Explanation : Follow BBA guidelines VII, 1-1.2.1.

Plant grown for animal feed in areas set up as refilling sites are to be harvested prior to the site being used. These areas have to be left idle for a minimum of 6 weeks.

Soil, which has been contaminated by a major chemical spill are to be left unused until regenerated.

The owner or user of the area concerned is to be informed accordingly.

7. Public Information

The contractor has to make a public notice at the latest 48 hours before the crop spraying starts. He is to stipulate the beginning and the end of the operations.

8. Restriction of Access and Marking

The contractor has to restrict the access to the area to be treated and, if necessary, mark the areas to be treated. Human being, domestic animals and endangered objects should not come into contact with the plant protection product.

9. Plant Protection Products

Only approved plant protection products in legalised amounts are to be used. The use of reduced amounts is also possible.

Additional regulations according to Paragraph 8 from the Plant Protection Act made by the regional authorities remain unchanged.

10. Operating Flight Conditions

10.1 Plant protection products shall not be sprayed from aircraft if:

- a) horizontal wind speed exceeds 5m/sec. and if strong gusts of wind do not allow proper spraying operation.
- b) thermal winds exist or if the air temperature is above +25°C in shaded areas.
- c) within a safe range of 50 m from endangered objects. In order to operate within the 50 m area a written approval from the persons concerned is required. In case of wind drifts the safety range has to be increased.
- d) derived from c) plant protection products dangerous to bees are not allowed to be used inside a circle of 60 m from the beehives without permission from the bee-keeper and then outside their daily time of flying-swarmering. (Paragraph 2 Division 3 from the Bees' Protection Regulations against Plant Protection Products from 19.12.1972).

10.2. A flight log book is to be kept according to attachment No. 2.

11. Wind Drift

Should, in spite of all precautionary measures, the plant protection products drift onto endangered objects, the persons concerned must immediately be informed and begin counter measures. The same applies if other unmarked objects were directly hit by the plant protection products.

12. Handling and Storage of Plant Protection Products as well as empty packing Material.

The contractor is liable for the safe storage of plant protection products, of the rests of these products and for the legal disposal of packing material.

Legal Basic laws are :

- Regulations on waste reduction and waste disposal from 27.08.1986 („Abfallgesetz - AfG) which are the basis for the
- Decree on waste regulations according to Paragraph 2 Division 2 („Abfallbestimmungs Verordnung - AbfBestV“) from 03.04.1990 (Plant Protection Products see under Waste classification 53103, Page 623) ; according to Paragraph 4 Division 5 Waste Regulations is the
- 2nd general administrative regulations for Waste Decree („TA-Abfall“) from 10.04.1990. Here are the regulations for waste disposal (Plant Protection Products - see Attachment C, Page 32).

13. Precautions when dealing with Plant Protection Products

Please consult the leaflet AID No. 1042 „Vorsicht beim Umgang mit Pflanzenschutz- und Schädlingsbekämpfungsmitteln“ = Precautions when dealing with plant protection products and fighting it's harmful effects, 1991 (or new version).

Attachment No. 1

Announcement of intended Application of Plant Protection Products with Use of Aircraft¹⁰

1. Company respectively Name and address of orderer:
2. Company respectively Name and address of flying service:
3. Operational area (District respectively County):
4. Type of plants, type of pest (infection) and number of treatments:
5. Type of plant protection product and amount of in kg/ha or l/ha:
6. Proposed additives in kg/ha or l/ha:
7. Proposed mixtures with other additives (i.e. fertilisers) in kg/ha or l/ha:
8. Amount of water or other soluble (i.e. oil) in l/ha:
9. Type of aircraft, models and identifications:
10. Name of provided pilots:
11. Description of installation and type of equipment used on aircraft (crop spraying equipment):
12. Description of the filling equipment:
13. Proposed dates of treatment (beginning and end):
14. Remarks :

.....the ..(date)... 19..

..... the .. (date)... 19..

Flying Services

Contractor/Company

Note to the contractor :

With this announcement please enclose the aeronautical map made according to Point 4 of the Guidelines for the Plant Protection equipment with the use of aircraft.

¹⁰ according to regulations.....(Indication of the applied laws).

Appendix C

**A historical survey of the development of plant protection testing in the
Federal Republic of Germany**

Description of test facilities used in the Application Techniques Division

A historical survey of the development of plant protection testing in the Federal Republic of Germany

The Plant Protection Act of 1937 specified the testing of plant protection products and plant protection equipment. Until 1945, such equipment was examined under technical and practical aspects by the "Biologische Reichsanstalt". Another office involved was the Technology Branch of the Potato Beetle Control Service. With the end of World War Two, that service ceased to exist as so many others in the public sector, and a new beginning had to be made in the official testing of plant protection equipment in the following years.

In February 1946, a working group for the official examination of plant protection equipment was set up, with the head of the Plant Protection Products Examination Office of the "Biologische Zentralanstalt" in Braunschweig as chairman. An Institute for the Examination of Plant Protection Equipment was built up in Darmstadt and was moved to Braunschweig, now seat of the "Biologische Bundesanstalt für Land- und Forstwirtschaft"-BBA- (Federal Biological Research Centre for Agriculture and Forestry), in 1950. A testing hall was built there in 1964, and most of the testing activities moved indoors.

As plant protection equipment became ever larger and technical demands on test facilities increased, a new, much larger testing hall was soon planned. In autumn 1988, the Application Techniques Division of the Braunschweig Department for Plant Protection Products and Application Techniques moved into a modern testing hall with offices and laboratories of its own (figure 1). The new hall is currently being equipped with new facilities, such as an air-conditioned wind channel and test benches to test oscillation, cross distribution and fans. For a description of the test facilities used in the Application Techniques Division see section III, appendix C.

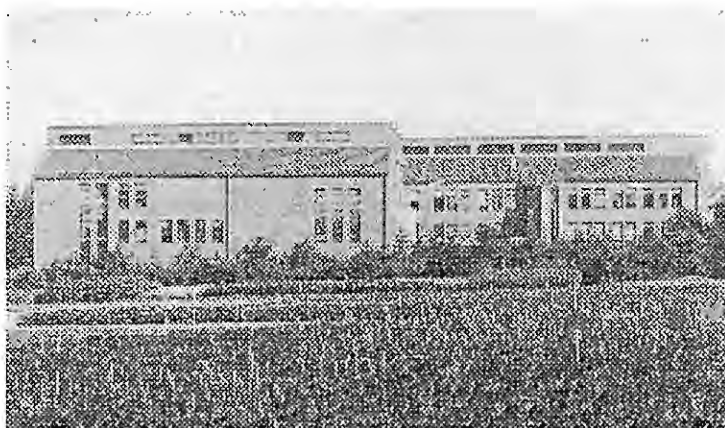


Figure 1: Southern aspect of the new test hall with offices and laboratories of the Division for Application Techniques in Braunschweig; the hall was built in 1988

The Act on the Protection of Crop Plants (Plant Protection Act) of 15th September 1986 significantly widened the official testing of plant protection equipment. From 1st July 1988, a procedure of declaration which regulates the placing of plant protection equipment on the market became legally binding. Voluntary tests of plant protection equipment for suitability continue. The Act also regulates the examination (monitoring) of used equipment.

AIR-CONDITIONED WIND CHANNEL

Task/Purpose

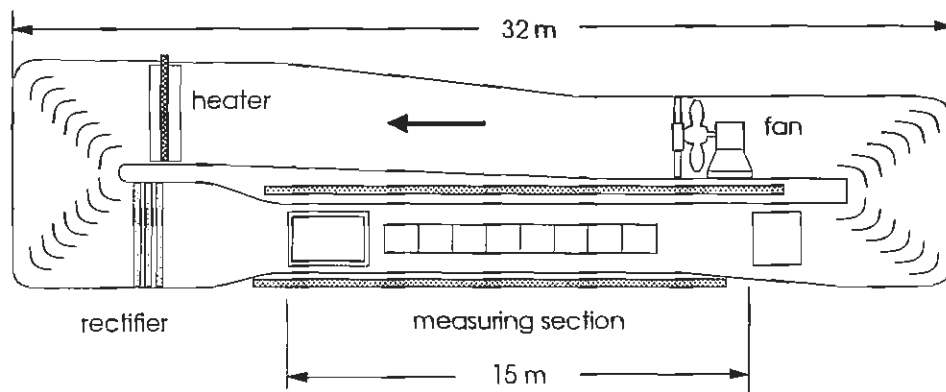
Evaluation of the direct drift of nozzles and plant protection equipment with the aspect to find application techniques which are more convenient for the environment.

The advantage of this wind channel is that tests can be carried out under constant and reproducible climatic conditions.

Arrangement and Function

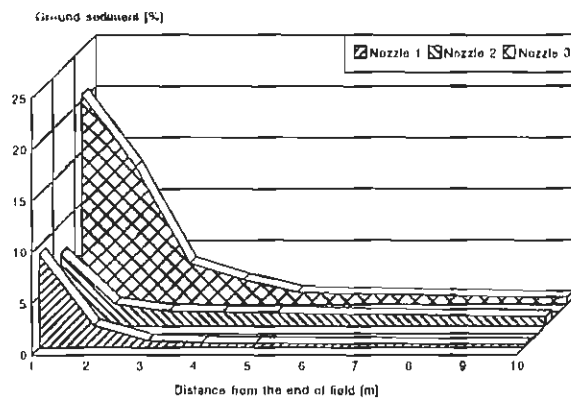
Closed wind channel (Goettingen design). Measuring section made of stainless steel (length up to 15 m; width up to 2.4 m; height 1.6 m). Continuously adjustment of air speed up to 15 m/s; of temperature from 10 to 30°C; and of relative humidity from 40 to 80%.

At the beginning of the measuring section individual atomizers or sprayer boom segments are installed. Research on drift can be done by using tracers or plant protection products. The ground sediment in wind direction is determined by using glass plates. For determining the air carried drift different collectors are used which are arranged inside the measuring section wherever it may be suitable.



Results

Ground sediment in relation to the distance
Ditch measurements in crops



AIR DISTRIBUTION TEST STAND

Task/Purpose

Determination of the air velocity and direction of fans attached to air-assisted sprayers at several fixed points from the fan centre.

Evaluation of the air distribution as to the fulfilling of requirements and features.

- The air speed shall not exceed the values of the following table:

Crops	Air velocity	Measuring point
vineyards	30 m/s	0.60 m from the fan centre
orchards	40 m/s	0.75 m from the fan centre
Hops	40 m/s	1.00 m from the fan centre

-The air flow produced by the device must be symmetrical on the right and left side as to their maximum speeds. At comparable measuring points deviations shall not exceed 10 % from the mean value .

Arrangement and Function

The air-assisted sprayer is correctly positioned and operated at a rated p.t.o. speed while standing. The measuring probe (five-hole ball-shaped impact tube) passes vertically through the air currents, with levels of distances being 0.6 m (vineyards), 0.75 m (orchards) or 1.0 m (hops) from the fan centre and the maximum spacing in height being 0.25 cm starting with 0.25 cm and finishing with the maximum working height of the device.

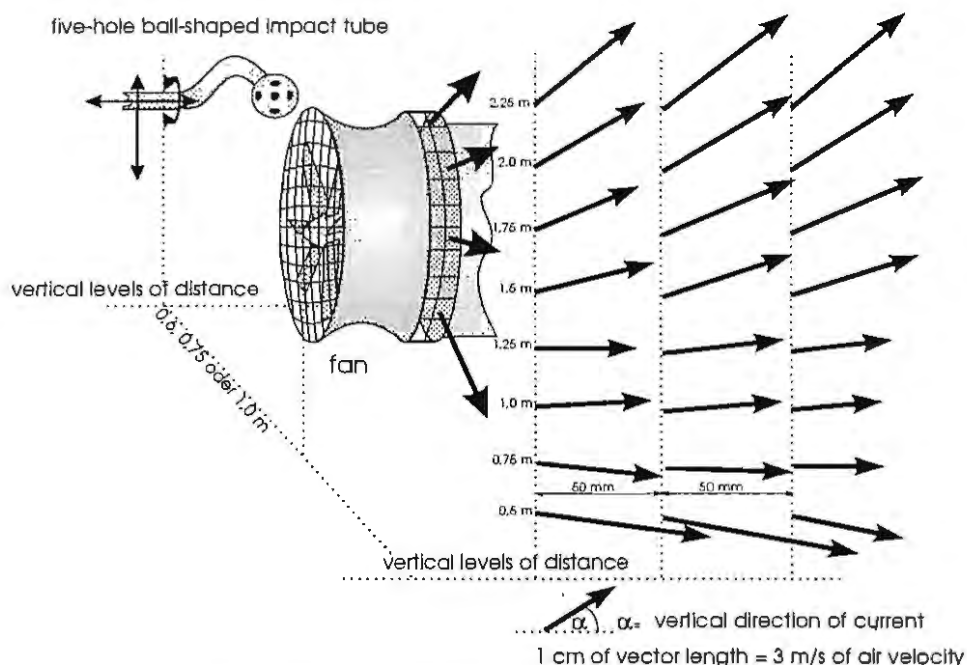
The probe is constantly set into the direction of the air current by a servo motor; this action is computer-assisted.

Thus it becomes possible to measure the air speed as well as the direction of the air on the horizontal and vertical levels.

The measured values thus obtained are stored by a PC and composed to form an air speed profile chart.

The test stand because of its probe which can be continuously moved in three directions has a measuring range of 1.6 m (length) by 3.84 m (height) and 2.0 m (width).

Results



APPLICATION LABORATORY

Task/Purpose

Laboratory for application tests with plant protection products.
 Research on the penetration and application behaviours of droplets in crops under reproducible conditions.

Measurement of droplet sizes of nozzles at different pressures and with different plant protection products.
 Measurements of the uniformity of distribution of granules applicators.

All tests are done at speeds normally used in practice and serve, on the one hand, to evaluate the fulfilling of legal requirements during equipment tests and, on the other hand, to gain basic knowledge in order to optimize the distribution and deposition of plant protection products.

Arrangement and Function

Laboratory with waste air treatment by air wash and activated carbon filter. Soil drainage in collecting tanks.
 Computer-controlled trolley-car on a rail for application tests.

The rail is fastened to hinged brackets. If the room has to be used for other purposes, the rail with the trolley-car can be moved to the wall. It can be suspended at an optional height of 2.2 or 3.2 m above ground. The car is servo-motor driven and has a vertically adjustable adapter, e.g. for the spray booms, individual nozzles or granule applicators. The lower end of the adapter is adjustable to a height between 30 cm and 290 cm above ground. The rail is eight metres long (at least 3 m thereof for constant velocity). The velocity is continuously adjustable up to 4.3 m/s (15 km/h). The maximum spraying pressure at the nozzles is 10 bar. Digital displays and data outputs are available at the switchboard panel for spraying pressure, velocity, sprayer position, room temperature and humidity as well as barometric pressure.

Results

Example of a droplet size distribution

Häufigkeitsverteilung Volumen			Akkum. Bkt(er)		
Klassenzahl: 36			Dichte = 1.0000 g/cm **3		
Durchmesser	Sammen	Verteilung	Volumen	Anteil	Dif.
mm			mm ³ * 3	sum. %	norm. %
0.100	020	*	0.000000	0.00	-1.5
0.200	040	*	.003184	.01	-.38
0.400	080	*	.019378	.04	-.62
0.600	090	*	.036079	.15	-.58
0.800	100	*	.126350	.34	-1.37
1.000	120	*x	.254483	.68	-1.84
1.200	140	*x	.401897	1.11	-2.34
1.400	150	*x	.573794	1.72	-2.63
1.600	160	*xx	1.458487	3.21	-2.81
1.800	200	*xx+	2.217811	5.90	-2.55
2.000	220	*xxx	3.456844	9.11	-2.21
2.200	240	*xxx*	4.851380	12.78	-1.89
2.400	260	*xxxx*	8.890497	17.40	-1.51
2.600	280	*xxxxx*	8.771854	22.52	.88
2.800	300	*xxxxxx*	10.424084	27.24	-.75
3.000	320	*xxxxxxx*	12.48357	32.02	-1.54
3.200	340	*xxxxxxx*	14.839284	38.77	-1.63
3.400	360	*xxxxxxx*	18.521433	43.96	-1.54
3.600	380	*xxxxxxx*	18.398854	48.08	.03
3.800	400	*xxxxxxx*	20.287198	53.07	-.81
4.000	420	*xxxxxxx*	21.838481	57.06	-1.47
4.200	440	*xxxxxxx*	24.091021	62.87	-2.18
4.400	460	*xxxxxxx*	25.824880	68.96	-3.23
4.600	480	*xxxxxxx*	27.571544	72.05	-3.10
4.800	500	*xxxxxxx*	28.863114	75.12	-1.15
5.000	520	*xxxxxxx*	30.401585	79.44	-1.07
5.200	540	*xxxxxxx*	32.571819	84.29	-2.86
5.400	560	*xxxxxxx*	33.745712	88.18	-1.17
5.600	580	*xxxxxxx*	34.231422	92.45	-2.81
5.800	600	*xxxxxxx*	36.805027	92.78	-1.81
6.000	620	*xxxxxxx*	30.110428	94.30	-1.86
6.200	640	*xxxxxxx*	35.759048	98.05	-1.26
6.400	660	*xxxxxxx*	32.040651	96.42	-1.88
6.600	680	*xxxxxxx*	37.532738	98.07	-.97
6.800	700	*xxxxxxx*	37.701862	98.52	-1.08
7.000	720	*xxxxxxx*	38.289510	100.00	0.00

To produce an image of the droplet sedimentation the spray boom will be moved across silicon oil filled petri dishes.
 Droplet size will be measured with an automatically image analysing system.

For measuring sizes of droplets in flight a "Phase Doppler Particle Analyser" (PDPA) is used.

CROSS DISTRIBUTION TEST STAND

Task/Purpose

1. Determination of the uniformity of cross distribution of field sprayers.
2. Determination of the flow rate of the individual nozzles of a field sprayer boom.

Evaluation of the cross distribution and the output of the individual nozzles as to the fulfilling of requirements and features.

Ref.to 1:

For one pressure and distance indicated for the atomizer by the declarer, the coefficient of variation should not exceed 7% while for all other indicated pressures and distances it should not exceed 9%.

Ref.to 2:

Deviations of the flow rate of each individual nozzle from the common mean should not exceed 5%.

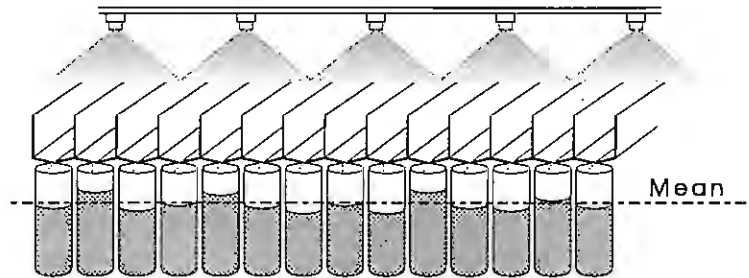
Arrangement and Function

The tests are made with the sprayers in standing position as follows:

Collecting the liquid from the boom into 100-mm-wide grooves, passing on the liquid from the grooves into collecting cylinders for a certain time, determining the liquid in the cylinders by ultrasonic sensor measurements followed by electronic processing of the data obtained. The whole process is program-controlled from the PC.

For data evaluation purposes, the PC calculates the average value, the individual deviations therefrom and the coefficient of variation on the basis of all the levels of spray liquid measured in the cylinders.

The test stand has a working width of 12 m and can be moved horizontally in such a way that field sprayer booms up to a working width of 24 m can be tested within two measuring steps.



The distance of the nozzles from the collecting level can be continuously adapted to heights between 0.30 and 1.50 m.

Results

Protocol prints

of a horizontal distribution

of the single nozzle output

TEST STAND FOR SINGLE NOZZLES

Task/Purpose

Measuring the liquid distribution of single nozzles to evaluate and compare the quality of distribution. Measuring the spray angle.

For band spraying nozzles, if possible, the distribution profile should be rectangular, i.e. it should have a sharply defined spray pattern, and the cross distribution should meet the requirement that the measured values do not deviate more than 30 % from the average of all values measured between the lateral edges of the spray pattern.

In all nozzle tests, the geometry of the nozzle tip is documented by means of its distribution profile. In case of repeated tests, it may be concluded from comparisons of distribution profiles that the geometry of the nozzle tip must have changed.

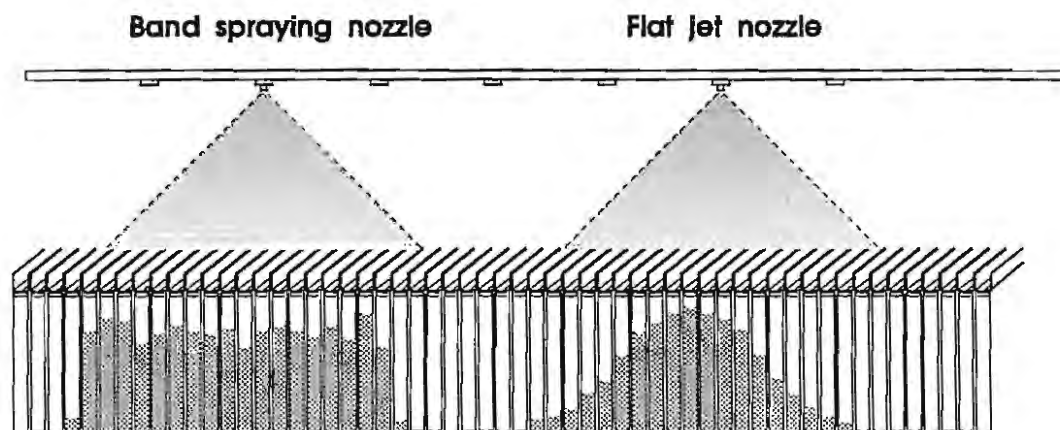
Arrangement and Function

The liquid distributed by a nozzle is collected in 25-mm-wide grooves, passed on to collecting cylinders for a certain time followed by a determination of the liquid volumes by ultrasonic sensor and the input of the measured values into an EDP system. The whole process is program-controlled by a PC. The tests are made in standstill.

A graphic representation is made from the measured values by support of electronic data evaluation.

The test stand has a working width of 2475 mm (99 grooves) and a groove length of 2500 mm. Spraying pressures up to 10 bar can be continuously adjusted. The spray boom is movable both vertically and horizontally. The distance between nozzles and collecting level can be continuously adapted between 0.10 m and 1.10 m of height.

Results



FAN TEST STAND

Task/Purpose

Measurement of air flow rate of air-assisted sprayers for use in orchards, vineyards and hops.

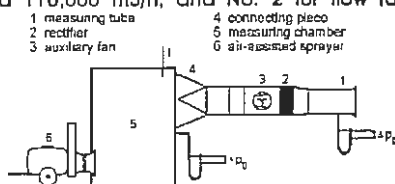
Evaluation of fan output: The nominal air flow rates should not deviate more than 10 % from the actual ones.

Arrangement and Function

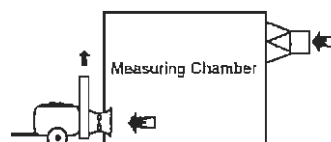
The air-assisted sprayer sucks the air from the measuring chamber (5). To prevent any differential pressure in the measuring chamber, the same amount of air has to be fed to it through a set of measuring and control units consisting of measuring tube (1), rectifier (2), controllable auxiliary fan (3) and connecting piece (4). As the characteristic line of the measuring tube was determined by the manufacturer before it was fitted into the test stand, the air flow rate can easily be determined by measuring the differential pressure within the measuring tube.

The various options for installing the air-assisted sprayers do not only permit to measure the total air flow rate of the fan but also to measure partial streams, e.g. on the left and right hand side of the fan. The fitted wall of the the measuring chamber has such dimensions that measurements are possible at a maximum differential pressure of 200 Pa.

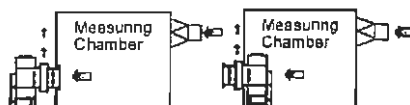
The test stand has two different measuring and control sets. No. 1 is for measurements of flow rate between 20,000 and 110,000 m³/h, and No. 2 for flow rates between 2,000 and 20,000 m³/h.



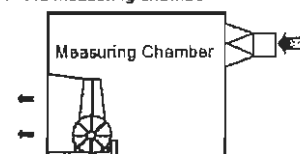
Basic arrangement of the chamber test stand



Arrangement for an one way sucking air-assisted sprayer in the measuring chamber



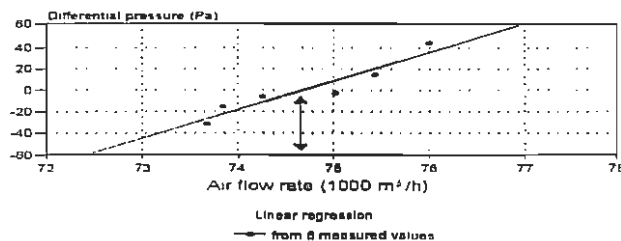
Arrangement for a two way sucking air-assisted sprayer in the measuring chamber



Arrangement to measure the half side air flow rate of an air-assisted sprayer

Results

Measurement of air flow rates Air-assisted sprayer in hops



Result: 74650 m³/h at 0 pascal

FAN TEST STAND

Task/Purpose

Air flow-rate measurements on engine-driven pedestrian sprayers.

Evaluation of fan output: the air flow rate of the fan has to be at least 400 m³/h.

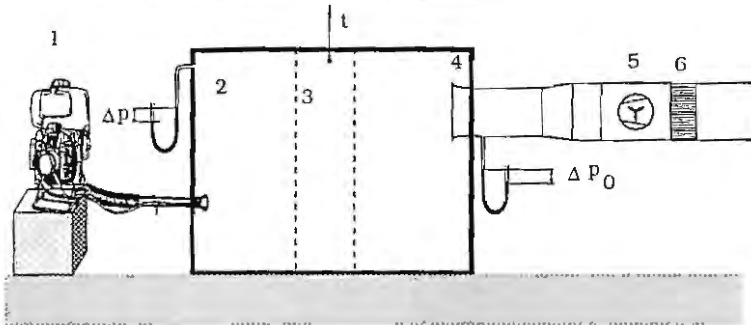
Arrangement and Function

As far as engine-driven pedestrian sprayers are concerned, a separate measurement of the air flow rate on the intake side is not possible because of the fan providing the engine with cooling air. It is no solution either to put the sprayer inside the measuring chamber, so that the air flow cooling the engine is not measured; firstly, due to the exhaust gases, the result would be falsified and secondly the engine would peter out for lack of oxygen. Therefore, the air flow rate must be measured on the pressure side. To this end, the sprayer (1) is put outside the measuring chamber (2) and the spray lance is led into the measuring chamber. The measuring chamber is provided with stabilizing screens (3) to prevent the jet of air from directly hitting the intake measuring nozzle(4). The auxiliary fan is controlled such that inside the measuring chamber there will be no differential pressure.

The air flow rate of the fan can be determined by help of the characteristic line of the measuring tube and the differential pressure measured in it.

The test stand corresponds to DIN standard 24163 and is suited for measuring air flow rates between 200 and 2000 m³/h by various optional measuring tubes.

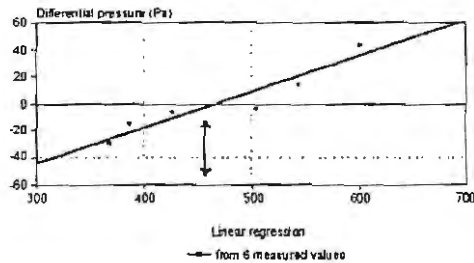
- | | |
|----------------------|------------------|
| 1 pedestrian sprayer | 4 measuring tube |
| 2 measuring chamber | 5 auxiliary fan |
| 3 calming sieves | 6 rectifier |



General arrangement of the test stand

Results

Air flow-rate measurements (engine-driven pedestrian sprayer)



Result: 455 m³/h at 0 Pascal

PUMP TEST STAND

Task/Purpose

1. Determination of the characteristic lines of pumps for plant protection equipment.
2. Testing of control devices for plant protection equipment.

Judgement on the fulfilling of requirements and features. Determination of the present state of the art on the basis of comparative investigations of, for example, electronic control devices. To this end, measurements shall be made according to the Guideline 1-1.2.3, part VII, of the Guidelines for the official testing of plant protection products.

Elaboration of test specifications and features.

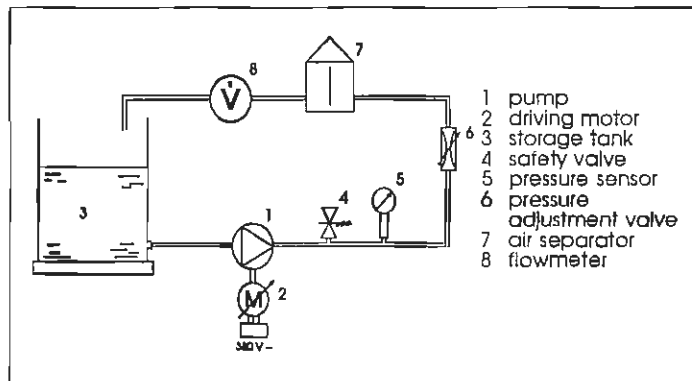
The flow rate of the pump must be adapted to the liquid-consuming parts of the equipment (for field sprayers, e.g. 5 l/min per metre of working width plus, if required, the necessary flow rate for the hydraulic agitator).

Arrangement and Function

The pumps to be tested are installed into the fluid circuit of the test stand and their flow rates are determined as a function of the working pressure.

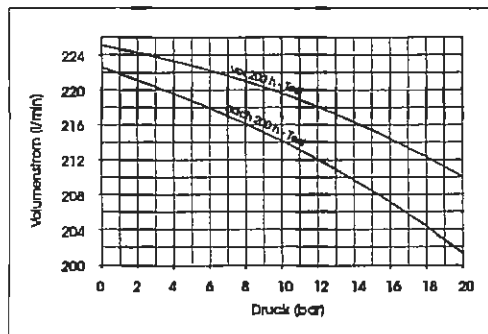
Characteristic values of the test stand:

Driving speed:	continuously adjustable up to 1,000 1/min
Maximum working pressure:	60 bar
Maximum flow rate:	300 l/min
Acceptance of measuring signals:	by XY recorder or EDP



Results

Characteristic line of a six-chamber diaphragm pump



PUMP TEST STAND (DURABILITY TEST)

Task/Purpose

Tests to determine the wear of pumps and nozzles.

Evaluation of the reliability of function and wear resistance. The flow rate should not be changed considerably by the durability test.

Arrangement and Function

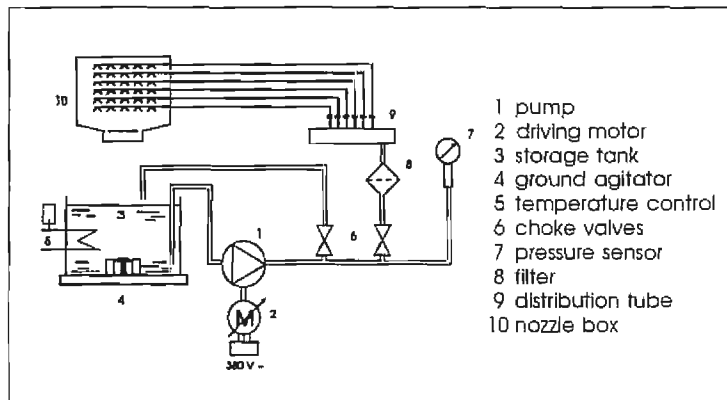
The parts to be tested are installed into the fluid circuit of the test stand and operated throughout the duration of the test under load.

Conditions of testing:

Duration of test: 200 h for pumps, 1,000 h for nozzles.
 Pressure during test: 50 % of the nominal pressure for pumps, medium spraying pressure for nozzles.
 Driving speed: Nominal rotational speed (540 min⁻¹)
 Test liquid: OB21, 0.5%
 Test temperature: 20°C ±2°C

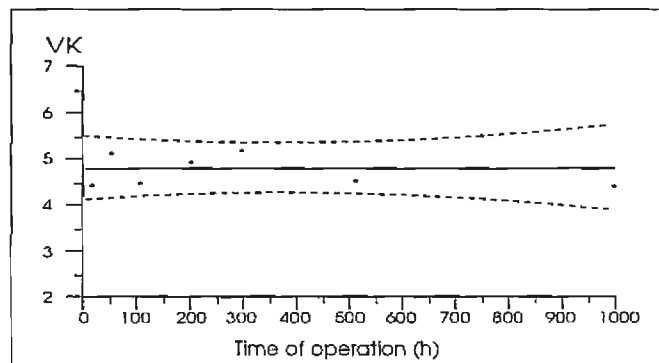
Storage tank: 1,000 l

For nozzles, at the beginning of the test and after 15, 50, 100, 200, 500, 750 and 1,000 hours, the coefficient of variation for the cross distribution and the individual nozzle output are determined.



Results

Coefficients of variation of the cross distribution of a stainless steel nozzle during a 1,000 h wear test



SPRAY BOOM TEST STAND

Task/Purpose

Determination of the uniformity of distribution of field sprayers taking into account their boom movements as they occur in practice.

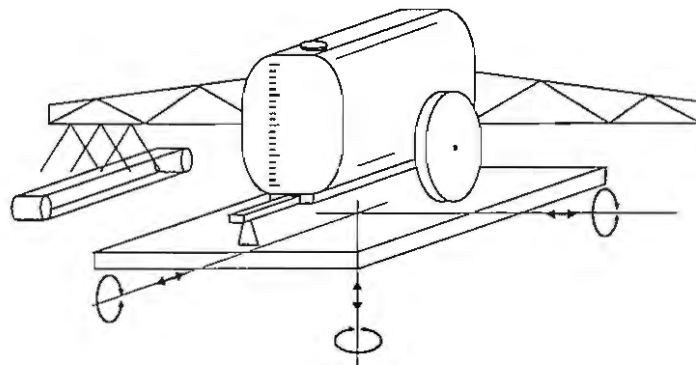
The oscillation test stand allows a simulation of field sprayer movements with 6 degrees of freedom under standardized reproducible conditions.

Elaboration of requirements and features to evaluate the movement behaviour of the boom and the quality of distribution.

Arrangement and Function

The vibrating table of the test stand (3.5 by 2.5 m) is moved by hydraulic cylinders. At a maximum stroke of 200 mm, its maximum acceleration is up to 2 g. This corresponds to a nominal load of 1.5 t at a stroke frequency of about 2 Hz. Thus it is possible to simulate, at a high rate of accuracy, the movements of a field sprayer which were measured before during field application. The use of standardized "test areas" permits to ensure reproducible test conditions at the test stand.

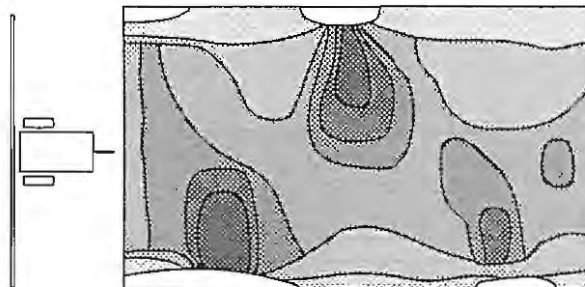
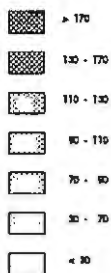
While the field sprayer is moving at the test stand, the spray distribution and the respective deposition is measured under the boom. Water is given onto an endless moving band and the spray quantity applied in each vertical section is measured capacitywise. Vertical distribution can repeatedly be measured in different sections of the boom thus permitting a judgement of the spray distribution.



Results

Example for spray distribution when moving over uneven field

Belagweite / %



Fahrrichtung →

TECHNICAL REST VOLUME

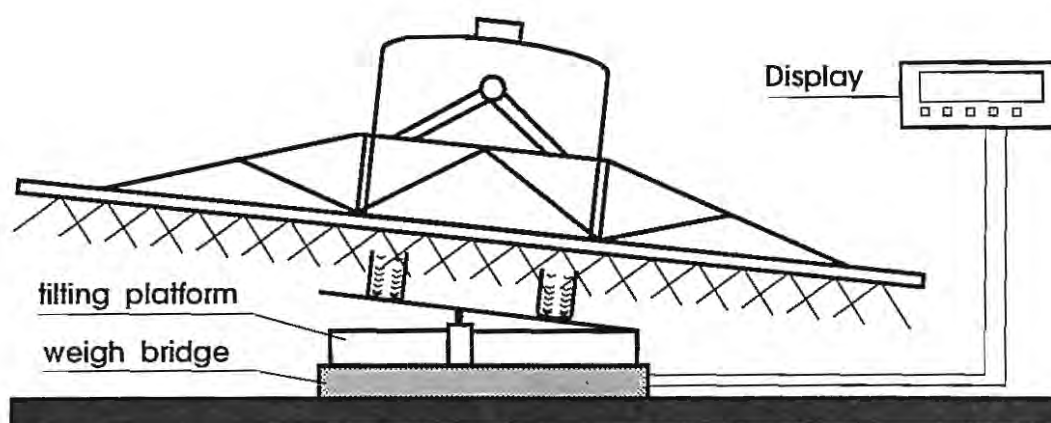
Task/Purpose

Measurements of the technical rest volume and the rest volume on slopes. Technical rest volumes are any spray liquids which cannot be applied according to the defined use.

For tanks up to 400 l the technical rest volume and the rest volume on the maximum slope according to the defined use must not exceed 4 % and for bigger tanks it must not exceed 3 %. Measurements shall be made according to guide-line 1-1.2.2. of part VII of the guide-lines issued for the testing of plant protection equipment.

Arrangement and Function

The plant protection equipment is mounted on a tilting platform. Both is positioned on a weigh-bridge. The dry weight of the equipment is determined before filling. Then the liquid is filled in and the equipment operated according to the above guide-line. When air is sucked in for the first time, the equipment is switched off and a second weighing follows. The difference between the two weighings presents the rest volume. In the case of air-assisted sprayers for high-growing crops, the measurement shall be made horizontally and, in the case of slopes, left and right side down. For field sprayers on slopes, an additional measurement shall be made up- and downwards.



Results

Nominal Tank capacity (l)	Field Sprayers			Air assisted Sprayers		
	Minimum Rest Volume (l)	Maximum Rest Volume (l)	Number of Variations	Minimum Rest Volume (l)	Maximum Rest Volume (l)	Number of Variations
400	2	15	525	2	9,3	98
600	2	21,8	1005	1	12,4	88
800	2,6	27	1196	0,4	16	36
1000	2,6	33	1176	1	21,1	96
1200	9,5	23,2	252			
1400	14,6	40	210	10,2	10,2	8
1500	5,6	45	522	1	25	26
2000	5	46,5	894	2,2	40	25
2800	5,5	29,5	288			
3000	25	63	168	2,3	60	10
3500	19,9	35	33			
4000	33,5	80	83			

Table indicating rest volumes originating from the procedure of declaration for plant protection equipment. For every class of litres, the minimum and maximum rest volumes as well as the number of variations of types are indicated.

TESTSTAND FOR ELECTRONIC CONTROL UNITS

Test/Purpose

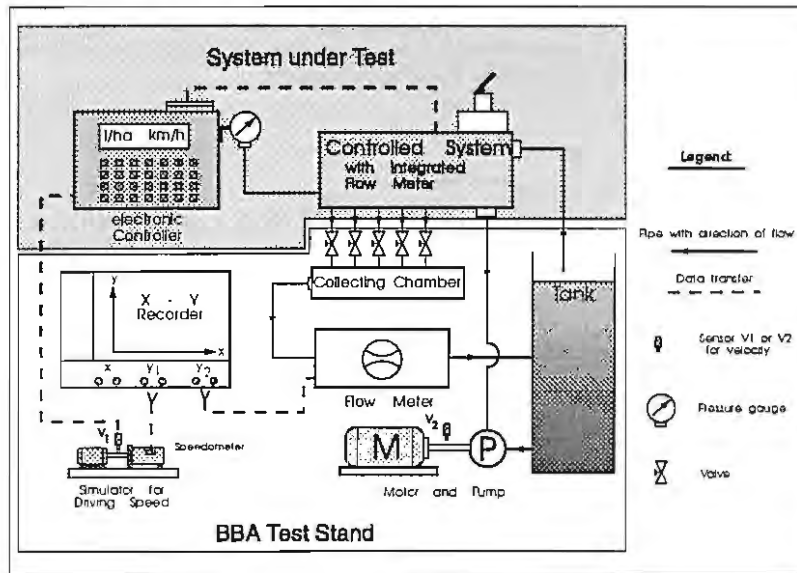
Test of equipment for controlling the output of sprayers and air blast sprayers for field crops, orchards, vineyards and hops.

Judgement on the fulfilling of requirements and features.

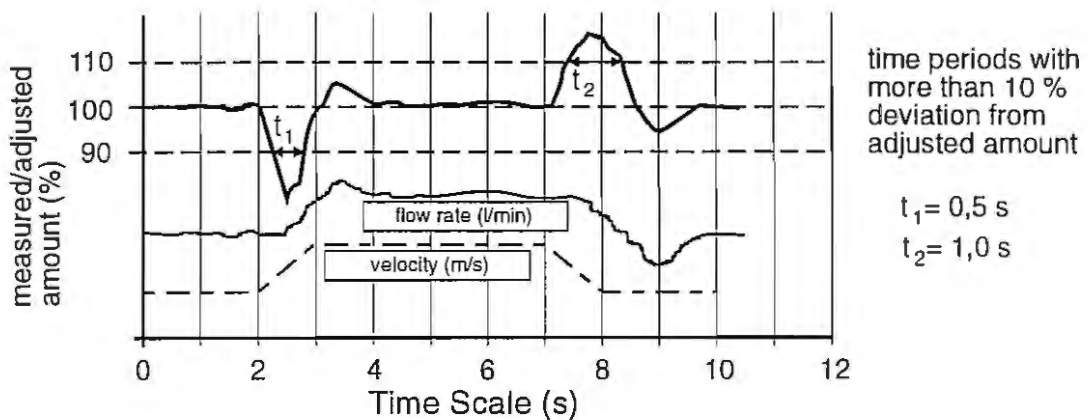
Arrangement and Function

The system under test consists of the electronic controller and the controlled system, both together will be integrated in the test stand.

When simulating working conditions -as variation of velocity, switching of boom sections, variation of output or switching on and off the spray boom- the nozzle flow rate and the velocity are recorded and from this will be calculated the momentary deviation from the adjusted amount (l/ha).



Results



VERTICAL DISTRIBUTION TEST STAND

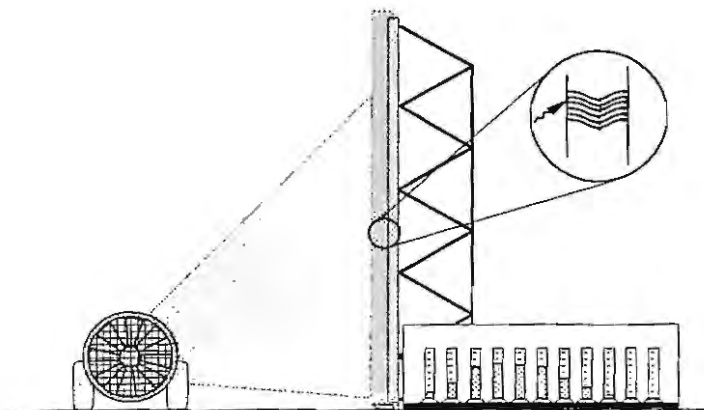
Task/Purpose

Determination of the liquid distribution of air-assisted orchard and vineyard sprayers.

Elaboration of requirements as to the distribution characteristics of air-assisted sprayers, with results of measurement from field tests being included. Testing of the sprayer settings indicated by the manufacturer to ensure favourable vertical distributions, low drift and low soil contamination.

Arrangement and Function

Collecting the droplets produced by the nozzles in separating elements (200 cm long, 25 cm high, distance between the laminae 25 to 35 mm). The water separated from the carrier air stream in 18 separating elements is collected sectionwise and flows into graduated cylinders through plastic tubes. The constant determination by an ultrasonic sensor of the contents of the graduated cylinders guarantees a permanent control of the momentary liquid flow rate per sector. As soon as the stationary working condition is reached, the measured values are taken over by an EDP system. This data collecting is program-controlled by PC. The tests are carried out while the sprayer is standing. The test stand has a height of 4.5 m and a width of 2.0 m permitting vertical distribution measurements for fruit tree heights of up to 4.0 m. The distance between the central axis of the air-assisted sprayers and the test stand is half the width of the lane, generally 2m.



Results

Air assisted sprayer:

Hersteller: Nicolas
 Gerät: BCR 1000
 Type: Anhängersprayer
 G-Fl: 8
 Grad. Seite: Rechts
 Abstand: 2,0 m

Fan:

Type: Axial
 Rotordurchmesser: 700 mm
 Drehzahl: 540 U/min
 Gang: 8
 Drehricht: links
 Druck: 10,0 bar

Drainage und Wasser

Linie	Wasser		Wasser		
Nr.	Grad.	Wasser	Nr.	Grad.	Wasser
8	3	62	8	3	64
7	3	52	7	3	53
6	3	48	6	3	45
5	3	28	5	3	29
4	3	26	4	3	27
3	3	13	3	3	9
2	3	1	2	3	5
1	3	21	1	3	13

Vertical Distribution

