INTERNATIONAL STANDARD

ISO 28139

Second edition
2019-12

Equipment for crop protection — Knapsack combustion engine-driven airblast sprayers — Safety and environmental requirements and test methods

Matériel de protection des cultures — Atomiseurs portés à dos motorisés — Exigences de sécurité et environnementales et méthodes d'essai

Reference number
ISO 28139:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*.

This second edition of ISO 28139 cancels and replaces ISO 28139:2009 and ISO 10988:2011, which have been technically revised. The main changes compared to the previous edition are as follows:

— addition of environmental requirements;

— addition of environmental tests;

— exclusion of ergonomics;

— general update to the state of the art.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The structure of safety standards in the field of machinery is as follows:

a) type-A standards (basic standards) giving basic concepts, principles for design, and general aspects that can be applied to machinery;

b) type-B standards (generic safety standards) dealing with one safety aspect or one type of safeguards that can be used across a wide range of machinery:

   — type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise),

   — type-B2 standards on safeguards (e.g. two-hand control devices, interlocking devices, pressure sensitive devices, guards);

c) type-C standards (machinery safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

This document is a type-C standard as stated in ISO 12100.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Equipment for crop protection — Knapsack combustion engine-driven airblast sprayers — Safety and environmental requirements and test methods

1 Scope

This document specifies safety requirements and their verification, environmental requirements and related test methods, and minimum performance limits, for the design and construction of knapsack combustion engine-driven airblast sprayers as defined in 3.9.

It describes methods for the elimination or reduction of hazards arising from their use. In addition, it specifies the type of information on safe working practices to be provided by the manufacturer.

It addresses general operating parameters as well as the potential deposition of spray droplets under specified controlled conditions.

This document deals with all significant hazards, hazardous situations and events, excepting those arising from vibration transmitted to the back of the operator.

It is applicable to knapsack combustion engine-driven airblast sprayers when they are used as intended and under the conditions foreseeable by the manufacturer (see Table A.1).

It is not applicable to:

— hydraulic pressure sprayers;

— thermal sprayers;

— cold foggers;

— sprayers adapted for the application of dry material.

It is not applicable to knapsack combustion engine-driven airblast sprayers manufactured before the date of its publication. The requirements of this document applies to products manufactured 18 months after publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3767-5, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 5: Symbols for manual portable forestry machines*

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 5681, *Equipment for crop protection — Vocabulary*

ISO 9357:1990, *Equipment for crop protection — Agricultural sprayers — Tank nominal volume and filling hole diameter*

ISO 11684, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety signs and hazard pictorials — General principles*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14982:1998, *Agricultural and forestry machinery — Electromagnetic compatibility — Test methods and acceptance criteria*

ISO 19732, *Equipment for crop protection — Sprayer filters — Colour coding for identification*

ISO 19932-1, *Equipment for crop protection — Knapsack sprayers — Part 1: Safety and environmental requirements*

ISO 19932-2:—, *Equipment for crop protection — Knapsack sprayers — Part 2: Test methods*

ISO 22867, *Forestry and gardening machinery — Vibration test code for portable hand-held machines with internal combustion engine — Vibration at the handles*

ISO 22868:2011, *Forestry and gardening machinery — Noise test code for portable hand-held machines with internal combustion engine — Engineering method (Grade 2 accuracy)*

IEC 61032:1997, *Protection of persons and equipment by enclosures — Probes for verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100, ISO 5681, ISO 19932-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
harness
adjustable strap(s) used to suspend the machine from the operator

3.2
engine stopping device
control fitted to the machine which stops the engine

3.3
throttle trigger
throttle control
device, usually a lever, activated by the operator's hand or finger, for controlling the engine speed

3.4
throttle lock
device for temporarily setting the throttle in a partially open position

3.5
throttle trigger lockout
device that prevents unintentional activation of the *throttle trigger* (3.3)

3.6
air tube
tube for the air flow between the fan and the nozzle

3.7
normal operation
use of the machine that is reasonably foreseeable and which is consistent with such activities as distribution of chemicals, starting, stopping, fuelling, filling with chemicals and emptying

3.8
throttle limiting device
manually activated device allowing different maximum positions of the throttle provided to facilitate operation of the engine over a long working period

3.9
knapsack airblast sprayer
self-contained appliance carried on the operator's back by means of shoulder straps in which spray is produced by the action a high velocity air stream on the spray mixture

4 Safety requirements and/or protective measures

4.1 General

The machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this document. (See Annex A for a list of significant hazards and hazardous situations and Annex D for a functional representation of the machine.)

Wearing parts (such as nozzles, filters, anti-drip valves, valves, diaphragms) specified in the instruction handbook shall be changeable without special tools, unless provided with the sprayer, by an operator wearing appropriate PPE (at least protective gloves) and without contamination of the operator and the environment.

Compliance shall be checked by inspection and function test.

4.2 Stability when in operation

The centre of gravity of the upright sprayer shall not be located at a horizontal distance greater than 150 mm from the back support of the harness with fuel and spray tanks filled to their nominal volume and with the equipment ready for use.

Compliance shall be checked by measurement as described in ISO 19932-2:—, 5.3.4.

4.3 Exhaust system

The engine exhaust outlet shall be located so as to direct exhaust emissions away from the operator in the normal operating position.

Compliance shall be checked by inspection and functional testing.

4.4 Air tube and chemical hoses

The air tube shall be fitted with a handle on which a throttle trigger complying with 4.5.3 and an engine stopping device complying with 4.5.4 are mounted.

To adjust the flow of chemicals to the nozzle, an on-off valve shall be fitted such that it can be easily reached by the operator in the working position.

The minimum length of the air tube from the middle of the hand grip to the extremity of the air tube shall be 500 mm as shown in Figure 1.

Dimensions in millimetres

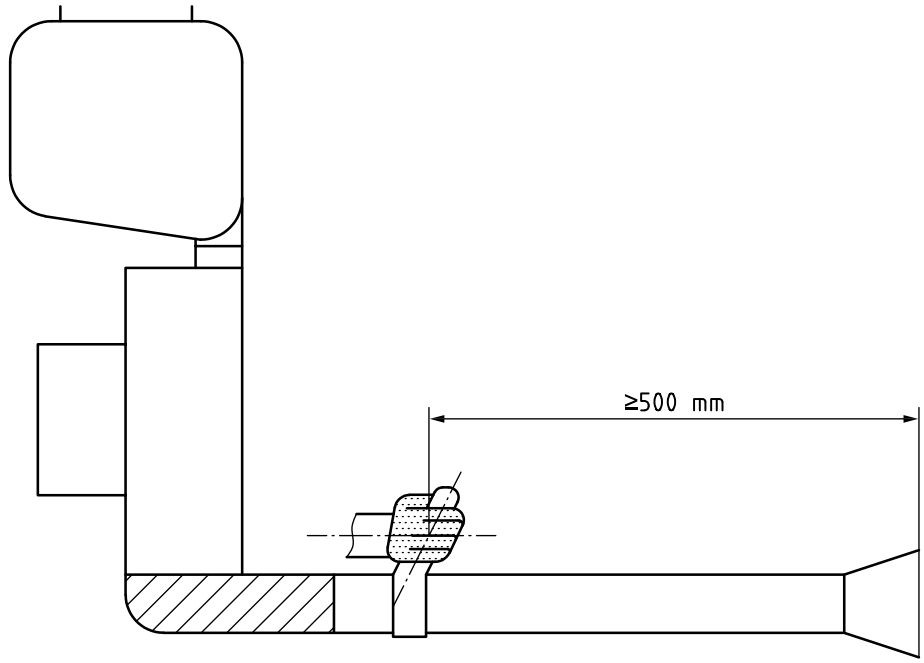


Figure 1 — Length of the air tube

The air tube shall not be detachable without the use of a tool. This requirement does not apply to machines where detached air tube does not allow the moving elements to be reached in accordance with ISO 13857:2008, Table 4.

Compliance shall be checked by inspection, functional testing and measurement.

4.5 Controls

4.5.1 General

All controls shall be designed to be operable by an operator wearing appropriate protective gloves.

Compliance shall be checked by functional testing.

Where the purpose of a control might not be obvious to the user, the control's function, direction and/or method of operation shall be clearly identified by a durable label or mark. Compliance shall be checked by inspection.

Detailed instructions on the operation of the control(s) shall be provided in the instruction handbook.

Operations when applying plant protection products (PPP) shall be possible wearing appropriate personal protective equipment (PPE).

Compliance shall be checked by inspection.

4.5.2 Handle

The length of the gripping surface of the handle shall be at least 100 mm.

Compliance shall be checked by measurement.

4.5.3 Throttle trigger

The machine shall be fitted with a throttle trigger that, when released, automatically reverts to the idling position and is retained in that position by the automatic engagement of a throttle trigger lockout device (see 3.5).

Two or more independent motions are required to engage the throttle lock.

The throttle trigger shall be positioned so that it can be pressed and released with a hand holding the handle on which the throttle trigger is mounted while wearing an appropriate protective glove.

If a throttle lock (see 3.4) is provided for starting the engine, it shall be automatically released when the throttle trigger is operated.

If a throttle limiting device is provided, it shall be positioned so that it can be operated and easily released by a gloved hand holding the handle to which the device is mounted. The throttle limiting device shall not prevent the return of the throttle to the idling position.

Compliance shall be checked by inspection, functional testing and measurement.

4.5.4 Engine stopping device

The machine shall be fitted with an engine stopping device by which the engine can be brought to a full stop and that does not depend on sustained manual effort for its operation. The control for this device shall be attached adjacent to the throttle control so that it can be activated by the operator when holding the gripping area with a hand wearing an appropriate protective glove.

The purpose and method of operation of the device shall be clearly and durably marked. The colour of the control shall clearly contrast with the background.

Compliance shall be checked by inspection and functional testing.

4.5.5 Starting device

A starting device shall be provided to allow starting of the engine without the need for separate, independent auxiliary assistance (for example, belts or cables).

When the machine is fitted with an electric starting device, two or more independent motions shall be required to engage the device.

Compliance shall be checked by inspection and functional testing.

4.5.6 Liquid line shut-off valve

Spray liquid lines shall be equipped with a shut-off device, which shall be positioned so that it can be easily reached by the operator in the normal operating position. No uncontrolled liquid output shall occur at least when the engine is at idling mode. The volume emitted within 5 s after spray shut-off shall not be more than 5 ml.

Compliance shall be checked at idle by inspection and measurement.

4.6 Machine support

The machine shall be supported by a backpack frame designed to distribute the load on the operator's back and shoulders.

Compliance shall be checked by inspection.

4.6.1 Harness

A double shoulder harness shall be provided to support the machine. It shall be adjustable to fit the size of the operator.

A double shoulder harness shall be designed so that pressure is evenly distributed on both shoulders of the operator. The design of the double shoulder harness shall prevent slipping in any direction.

The harness shall be designed and built such that the machine could be quickly released by the operator in case of emergency.

The straps shall be adjustable in length to meet the needs of the operator while on the operator's back. Each shoulder strap shall be adjustable to a length of at least 75 cm, as measured between the fixing points of the same strap.

Each shoulder strap shall have a load bearing part of a length of at least 250 mm and of a minimum comfort width of 50 mm.

Compliance shall be checked by inspection, functional testing and measurement.

4.7 Power-driven components

The knapsack combustion engine-driven airblast sprayers shall be constructed to ensure that access to power-driven components such as pulleys, shafts, gears, flywheels and fan blades, and to drive belts and chains, is prevented.

For openings, such as in covers and guards preventing access to dangerous parts, the safety distances shall be in accordance with ISO 13857:2008, Table 4.

Compliance shall be checked by inspection and measurement.

4.8 Fuel tank

The fuel cap shall have a retainer.

The fuel tank opening shall be at least 20 mm in diameter.

Each opening or cap shall be clearly marked to indicate the function of the tank, and if only the caps are marked, they shall not be interchangeable between tanks.

The design of the fuel tank assembly shall be such that no leakage occurs while the machine is at its normal stable operating temperature, in all working and transport positions according to the information for use. The fuel tank shall have a ventilation system.

The filler openings shall be located so that the action of filling the tanks is not obstructed by other components. It shall be possible to use a funnel.

The cap retainers, opening dimensions and location shall be verified by measurement and inspection. The tightness of the caps shall be verified by inspection while turning the machine in any direction in order to simulate the machine unintentionally falling over to a horizontal position. Seepage from fuel tank ventilation systems is not regarded as leakage.

Compliance shall be checked by inspection, functional testing and measurement.

4.9 Protection against contact with hot parts

The engine cylinder and parts in direct contact with the cylinder or the muffler shall be protected against unintentional contact during normal operation of the machine.

Such hot surfaces shall be considered accessible if the contactable area exceeds 10 cm^2 when probed by the test cone as shown in Figure 2.

The temperature for the accessible parts of the machine defined above, including guards or shields provided to prevent access to such hot surfaces, shall not be more than 80 °C for metallic surfaces or 94 °C for plastic surfaces.

Verification shall be done by determining the accessibility of identified hot surfaces using the test cone shown in Figure 2 and as follows.

Conduct the temperature test in the shade and with a maximum wind speed of 3 m/s. Operate the engine at maximum speed and carry out the test after surface temperatures have stabilized.

Identify the hot surface area or areas. Determine temperatures using temperature-measuring equipment with an accuracy of ±2 °C.

If the test is conducted at an ambient temperature outside of the nominal 20 °C ± 3 °C, the recorded temperatures shall be corrected using Formula (1):

$$T_C = T_O - T_A + 20\ °C \quad (1)$$

where

T_C is the corrected temperature, in degrees Celsius (°C);

T_O is the observed temperature, in degrees Celsius (°C);

T_A is the ambient temperature, in degrees Celsius (°C).

Allow the power source to cool before using the cone. It is not necessary to test the accessibility of hot parts while they are hot.

Apply the test cone shown in Figure 2 in any direction and with a maximum force of $(10^{\ 0}_{-1})$ N. When moving the cone, determine whether there is any contact between the hot surface area or areas and the cone's tip or the conical surface. Neither tip nor conical surface shall come into contact with any hot surface area greater than 10 cm^2.

Dimensions in millimetres

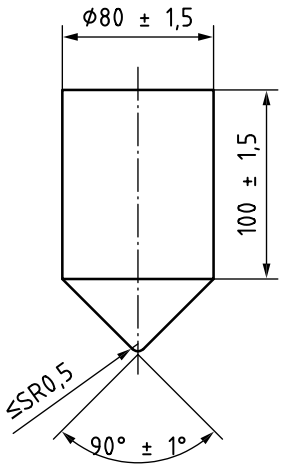


Figure 2 — Test cone

4.10 Electrical requirements

4.10.1 General

Insulated electric wires shall be protected against abrasive contact with metal and hot surfaces and shall be resistant to, or protected against, vibration and contact with lubricant and fuel.

Compliance shall be checked by inspection.

4.10.2 Ignition circuit

4.10.2.1 Requirement

Ignition interruption or short circuiting shall be provided on the low voltage side.

Access to all high voltage parts of the circuit including spark plug terminals shall be prevented in such a manner that the operator cannot make accidental contact with them.

Compliance shall be checked by inspection and by the test of 4.10.2.2.

4.10.2.2 Test method

The requirements shall be checked by inspection and using the test probe B of IEC 61032:1997.

Test acceptance: the test probe shall not make contact with high voltage parts of the circuit including spark plug terminals.

4.11 Vibration

4.11.1 Reduction by design at source and by protective measures

Vibration reduction shall be an integral part of the design process thus specifically taking into account measures at source. The success of the applied vibration reduction measures is assessed on the basis of the actual vibration total values for each handle. The main sources causing and influencing vibration are generally the dynamic forces from engine, unbalanced moving parts, impact in gear sprockets, bearings and other mechanisms, and the interaction between operator and machine.

NOTE CR 1030-1 gives general technical information on widely recognized technical rules and means, and provides guidelines for the design of reduced hand-arm vibration machines.

4.11.2 Vibration measurement

Vibration shall be measured in accordance with ISO 22867 using so far as appropriate the measurement conditions specified by Annex E. The equivalent vibration total value shall be calculated and reported together with the uncertainty of measurement, *k*.

4.12 Noise

4.12.1 Reduction by design at source and by protective measures

Noise reduction shall be an integral part of the design process thus specifically taking into account measures at source. The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values. The main sources causing and influencing noise are the air intake system, engine cooling system, engine exhaust system and vibrating surfaces.

ISO/TR 11688-1 gives general technical information and guidance for the design of low-noise machines. Special care shall be taken in the acoustical design.

NOTE ISO/TR 11688-2 gives useful information on noise generation mechanisms in machinery and ISO 14163 provides guidelines for noise control by silencers. ISO 11691 and ISO 11820 address the testing of the silencer.

4.12.2 Noise measurement

The equivalent A-weighted emission sound pressure level at the operator's position and the A-weighted sound power level shall be measured using the measurement conditions specified by ISO 22868:2011, Annex E and reported.

See ISO 22868:2011, Clause 9 for guidance on declaration and verification.

4.13 Electromagnetic immunity

4.13.1 Requirements

All electronic components of the systems used to control the machine shall meet the acceptance criteria given in ISO 14982:1998, 6.3 and 6.6, concerning the electromagnetic immunity of the machine.

4.13.2 Verification

Electromagnetic immunity shall be verified by testing in accordance with ISO 14982.

5 Environmental requirements

5.1 General

The sprayer shall comply with the following requirements and shall comply with the requirements of ISO 19932-1 and ISO 19932-2 as specified in the following clauses.

The sprayer shall be designed such that the operator shall be able to pick it up, carry it and put it down with the tanks filled at nominal volume in accordance with the instruction handbook and without any spillage.

The sprayer shall be designed such that the filled sprayer can be carried in the upright position.

It shall not be possible to displace any gasket or seal from its seated position by tightening.

Compliance shall be checked by functional test.

5.2 Absorbency of carrying straps

The harness shall be made of non-absorbent material. The increase in mass of the harness having a mass lower than 100 g shall not exceed 35 g after defined immersion in water. Otherwise, the increase in mass shall not exceed 35 % of the dry mass.

Compliance shall be tested according to ISO 19932-2:—, 5.3.8.

5.3 Spray tank

The nominal volume shall be specified in whole litres (l). It shall be possible to determine the spray tank filling level of the sprayer with a minimum resolution of 1 l. If the nominal volume of the sprayer is at least 10 l, a lower resolution is accepted for a filling level below 4 l.

Compliance shall be checked by inspection.

The volumetric contents gauge scale shall have a maximum error of ±10 % of the reading.

Compliance shall be tested according to ISO 19932-2:—, 5.3.5.

It shall be possible to fill the spray tank to its nominal volume within 60 s. The total volume of all liquid spillage during filling shall not exceed 5 ml.

Compliance shall be tested according to 6.7 and ISO 19932-2:—, 5.3.6.

In order to avoid chemical spillage during filling, the diameter of the filling opening shall be in accordance with ISO 9357:1990, Table 1.

Compliance shall be checked by inspection and measurement.

The spray tank shall have a volumetric content gauge scale.

Compliance shall be checked by inspection.

The filling tank opening shall be fitted with a lid, which shall

— be able to be opened and closed without the use of a special tool, and

— be fitted with a holding device ensuring a closed position by means of a positive mechanical action (e.g. lids fixed by screw action).

Compliance shall be checked by functional test.

It shall be possible to empty the tank of the sprayer without the need to invert the sprayer.

Compliance shall be checked by functional test.

The amount of liquid remaining in the spray tank shall not exceed 50 g when tested in accordance with ISO 19932-2:—, 5.3.7.

Drainage opening shall not be directed towards the operator.

Compliance shall be checked by inspection.

The emptying device shall be guarded against unintentional opening.

Compliance shall be checked by inspection and functional test.

The emptying device shall be able to be operated without the use of tools when wearing appropriate protective gloves.

Compliance shall be checked by functional test.

The spray tanks shall have an additional volume of at least 5 % of the nominal volume.

Compliance shall be tested in accordance with 6.6.

5.4 Strainers and filters

The sprayer tank shall have a strainer with a mesh width not greater than 2 mm. Gaps between the spray tank filling opening and strainer, as well as openings within the strainer, shall not exceed 2 mm.

Compliance shall be checked by measurement.

The mesh width of the filters for the liquid going from the tank to the nozzles, if any, shall be less than the narrowest diameter of the smallest size of nozzle to be used.

Filters for the liquid going from the tank to the nozzles, if any, shall be installed at a freely accessible place. They shall be capable of being removed and easily cleaned according to the manufacturer's instructions without any spray liquid leaking out except for that which may be present in the filter

casing and connected lines. The operator shall be capable of removing and cleaning the filter, while wearing appropriate protective gloves, and without being contaminated by spray liquid or causing environmental contamination.

Compliance shall be checked by inspection and function test.

Filters for the spray liquid shall be marked in such a way that they can be identified. Identification can be achieved directly or from information given in the instruction handbook, for example, by marking of filters with:

— the mesh width; or

— colour coding according to ISO 19732.

Compliance shall be checked by inspection.

5.5 Droplet size

Droplet size shall be indicated in the instruction handbook. An example of a method of determining the droplet size is given in Annex I.

5.6 Air hoses and chemical hoses

The radii of the hose bends shall not be less than limits established by the manufacturers of the hoses in normal working positions.

The hoses shall have no bends which hinder the flow of liquid or air.

The distance between the shut-off valve control and the air-outlet section shall be no less than 500 mm.

The air hoses shall be flexible so that their orientation is easily adjustable.

The fan inlet shall be designed such that the ingestion of foreign materials is avoided when the sprayer is on the ground.

Compliance shall be checked by inspection, functional testing and measurement.

5.7 Fan

Fan performance in terms of air velocity shall be indicated in the instruction handbook and shall be measured according to 6.8.

5.8 Mass of total residual liquid

The weight of total residual liquid, i.e. the weight of the spray mixture remaining in the sprayer which cannot be delivered with the intended application rate and/or pressure, shall not exceed 250 g. This requirement does not apply to sprayers fitted with a chemical pump.

Compliance shall be tested in accordance with 6.4.

5.9 Stability

The sprayer shall not fall over when tested in accordance with 6.5.

5.10 Spray liquid flow rate

The spray liquid flow rate, tested in accordance with 6.3 shall not deviate more than 15 % of the nominal flowrate, given by the manufacturer.

Compliance shall be tested in accordance with 6.3.

5.11 Test report

A test report should be completed. An example test report can be found in Annex J.

6 Tests

6.1 Test liquids and equipment

6.1.1 Clean water, free from solids.

6.1.2 Fuel, as indicated by the manufacturer.

6.1.3 Measuring cylinders for measuring volumes up to 1 l with a maximum error of ±10 ml with the scale of 0,01 l.

6.1.4 Weighing devices, able to weigh up to:

a) 25 kg with a maximum error of ±100 g;

b) 2 kg with a maximum error of ±10 g.

6.1.5 Timer (stopwatch), for measuring periods up to 5 min with a maximum error of ±0,5 s.

6.1.6 Environment's temperature measurement device, able to measure temperatures up to 35 °C with a maximum error of ±0,5 °C.

6.1.7 Petri dishes with an internal diameter of ≥150 mm. Other artificial collectors which can ensure the same results may be used, in which case they shall be described in the test report.

6.1.8 Absorbent materials (e.g. sponges 200 mm × 200 mm × 3 mm, or other absorbent materials which can ensure the same results may be used, in which case they shall be described in the test report).

6.1.9 Filling device (for an example, see ISO 19932-2:—, 4.6).

6.1.10 Air velocity measuring device with maximum error of ±0,2 m/s.

6.1.11 Sprayer locking device which enables fixing the sprayer in a defined test position and able to guarantee the locking of the sprayer and its air tube in this position (for an example, see Annex G).

6.1.12 Droplet size analyser, capable of characterizing droplet size spectra (e.g. laser light diffraction particle analyser).

6.1.13 Device for detecting potential vertical deposits, consisting of a frame (2 m × 2 m) with 16 absorbent materials spaced across a length of 400 mm (see Annex H).

6.1.14 Strap test device, see ISO 19932-2:—, 4.4.

6.1.15 Polythene bags, the size of which shall be at least 30 cm × 40 cm.

6.1.16 Polythene sheets, the size of which shall be at least 2 m × 1 m.

6.1.17 Hot surfaces' temperature measurement device, able to measure temperatures up to 100 °C with a maximum error of ±1 °C.

6.2 Test conditions

6.2.1 General

Assemble the sprayer following the instruction handbook. Inspect for tightness of the filling cap and all other operator-controlled couplings.

Before starting each test, ensure that the engine has been properly warmed up.

The tests shall be performed with one new specimen of the sprayer type at an air temperature of 10 °C to 30 °C and a relative air humidity of at least 30 %, without influence of wind or sunlight.

The test site shall be such as to ensure that the natural course of the jet produced by the machine being tested is not altered. The surface on which the tests are carried out shall be horizontal, level and free of obstacles.

6.2.2 Engine speed

If the engine speed cannot be regulated, all tests shall be carried out at the maximum allowable engine speed.

If the engine has an adjustable throttle, tests shall be carried out at the throttle position indicated by the manufacturer in the instruction handbook and corresponding to a determined engine speed.

WARNING — Running the engine in a closed environment can create an inhalation hazard.

6.3 Spray liquid output

Lock the sprayer in the upright position using the sprayer locking device (6.1.11) and with the tank filled to its nominal volume. Measure the spray liquid output in litres per minute (l/min) under each of the following conditions:

— the air delivery tube discharging horizontally with the air tube fully extended;

— at the maximum and minimum inclinations of the air tube discharge specified by the manufacturer, and with the air tube fully extended.

Activate the sprayer with the engine speed in accordance with 6.2.2. Recover the liquid output for a pre-established time. Determine the amount of recovered liquid using a weighing device (6.1.4) or graduated cylinder (6.1.3).

Repeat all test with the tank filled to half its nominal volume.

Alternatively, determine the amount of test liquid sprayed as follows:

a) fill the tank to its nominal volume;

b) activate the sprayer for the time necessary to empty half tank;

c) determine the amount of liquid sprayed by tank re-filling.

The liquid flow from the sprayer output shall be in accordance with the values given in the instruction handbook (see 7.1.1) in all intended working conditions specified by the manufacturer.

6.4 Mass of total residual liquid

This test shall be carried out on a complete, empty sprayer.

Fill the spray tank with water to its nominal volume. Using the sprayer locking device (6.1.11), lock the sprayer in the upright position with its air delivery tube horizontal and operate with the sprayer setting recommended by the manufacturer. Close the shutoff valve when the spray cloud is visibly interrupted.

Determine the amount of total residual liquid as the difference between the mass of the sprayer after the test and the mass measured previously with a completely empty sprayer. The mass of fuel used to run the machine during the test shall be taken into account.

6.5 Stability

Position the empty sprayer on a flat, hard surface with an incline of (8,5 ± 0,2)°, in accordance with Annex C.

Check the stability of the sprayer by rotating it at 90° intervals along its vertical axis to complete a circle.

Fill the spray tank to its nominal volume, then repeat the test with the spray tank filled.

Record any position in which the sprayer does not remain upright without being supported.

6.6 Contents gauge scale and total tank volume

Place the empty sprayer in the upright position and fix it using the sprayer locking device (6.1.11).

Measure and register the volume between the marks when filling the spray tank using a measuring cylinder (6.1.3) or a weighing device [6.1.4 a)]. Continue until the spray tank is filled to its nominal volume.

Determine the scale error, E, for each graduation as a percentage, using Formula (2):

$$E = \frac{V_s - V_m}{V_s} \times 100 \quad (2)$$

where

V_s is the volume according to the spray tank scale, in litres;

V_m is the measured volume of water poured into the tank, in litres.

As a second part to the test, fill the spray tank to the upper edge of the filling opening. Calculate the additional volume, V_A, of the spray tank as a percentage using Formula (3):

$$V_A = \frac{V_t - V_n}{V_n} \times 100 \quad (3)$$

where

V_t is the total volume, in litres;

V_n is the nominal volume, in litres.

6.7 Filling rate

This test shall be carried out on a complete, empty sprayer using the test procedure specified in ISO 19932-2:—, 5.3.6.

Remove the lid while keeping the strainer in position.

Position a filling device (6.1.9) with its outlet placed (100 ± 5) mm above the filling opening. Position the sprayer with its straps opposite the filling device and with the line connecting the upper strap fixing points oriented perpendicularly to the axis of the filling device (see ISO 19932-2:—, Annex E). The impact point of the test liquid shall be the centre of the filling opening.

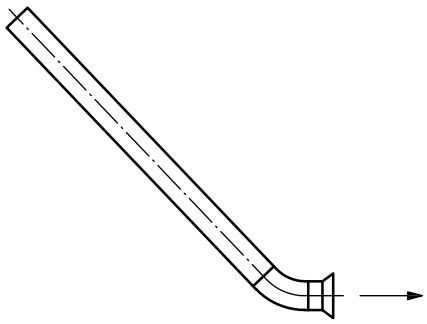
Pour a volume of test liquid equal to the nominal spray tank volume from the filling device into the filling opening of the sprayer.

Determine the volume of the splash liquid according ISO 19932-2:—, 5.3.6.

6.8 Air velocity

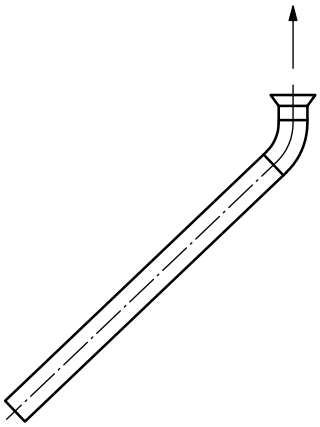
This test provides information about air velocity produced by the sprayer in order to determine the range of effectiveness of the sprayer.

The sprayer shall be locked in the upright position, with its air delivery tube in the horizontal position according to Figure 3 a), using the sprayer locking device (6.1.11) such that the height of the centre of the sprayer spray outlet is (1 000 ± 20) mm from the ground.

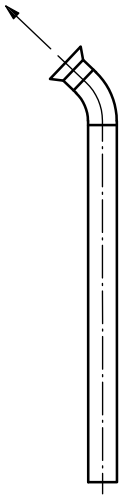


a) Position horizontal — Spray outlet

b) Position horizontal — Main portion of the lance



c) Position vertical — Spray outlet



d) Position vertical — Main portion of the lance

Figure 3 — Positioning of the lance referring to the outlet or to the main portion of the lance

Activate the sprayer with the engine speed in accordance with 6.2.2.

Position the air velocity measuring device (6.1.10) at the centre of the air-outlet section. The device shall be positioned at 3 m distance in a point aligned with the centre of the air-outlet section.

Activate the sprayer and verify that the sprayer positioning is correct.

Measure the air velocity distribution separately at distances of (3 000 ± 20) mm and (6 000 ± 20) mm from the air-outlet at each position on a grid (100 × 100) mm ± 5 mm according to Annex B. Air velocities lower than 2 m/s need not be recorded.

The following data shall be reported in the operator's instruction handbook.

— The mean value of all measured velocities at 3 000 mm at each point of the grid when ≥2 m/s.

— The radius of effectiveness at 3 000 mm, defined as the lowest distance on the grid between the projection of the centre of the nozzle and any point having a measured velocity lower than 2 m/s.

— The mean value of all measured velocities at 6 000 mm at each point of the grid when ≥2 m/s.

— The radius of effectiveness at 6 000 mm, defined as the lowest distance on the grid between the projection of the centre of the nozzle and any point having a measured velocity lower than 2 m/s.

Further data may be reported in the operator's instruction handbook according to manufacturer's evaluation.

7 Information for use

7.1 Instruction handbook

7.1.1 General

The sprayer shall be supplied with information about the use for which it is designed or has been tested and about conditions necessary to ensure that it will minimize any risks to the operator and the environment when it is being filled, adjusted, used, cleaned or maintained.

For the information to be provided to the user the content of this clause together with ISO 12100:2010, 6.4, apply.

It shall be stated that the sprayer shall be used only with plant protection products approved by local/national regulatory authorities for plant protection products for use with combustion engine-driven airblast knapsack sprayers.

Comprehensive instruction and information on all aspects of operator/user maintenance and the safe use for the sprayer, including safety clothing and personal protective equipment (PPE) requirements and the need for training in all operations shall be provided in the instruction handbook.

The importance of reading the instruction handbook thoroughly before using the sprayer shall be stressed on the front page of the instruction handbook. The instructions shall take into account that the sprayer could be used by a first-time inexperienced operator.

In particular, the following information shall be included:

a) business name and full address of the manufacturer and, where applicable, its authorized representative;

b) transport, handling and storage of the sprayer, such as securing the sprayer during transport to prevent loss of fuel, damage or injury;

c) commissioning of the sprayer, such as:

    1) assembling instructions, initial adjustments and checks;

    2) consequences of improper maintenance, use of non-conforming components and removal of safety devices;

    3) explanation of symbols and safety signs;

    4) filling of fuel and oil (if any), especially concerning fire precautions;

    5) charging the battery (if any);

d) the use of the sprayer, such as:

    1) application of the sprayer and how it is intended to be used, including prohibited uses;

2) a description, identification and nomenclature of principal parts, including the safety devices, environmental control devices and harness, together with an explanation of their functions;

3) operating instructions, including the use of personal protection equipment (PPE), which shall include the type of PPE to be used with the sprayer according to label recommendations of the PPP used;

4) the need for adequate training on safe use;

5) a warning against the use of the sprayer while tired, ill or under influence of alcohol or other drugs or medicaments;

6) hazards which may be encountered while using the sprayer and how to avoid them while doing typical tasks including the advice to direct the spray lance downwind from the operator;

7) starting and stopping, with particular reference to safety and environmental control;

8) warning about the emission exhaust gases and the danger of starting and running the engine in a closed room;

9) an explanation of symbols and safety signs;

10) the operating methods to be followed in the event of accidents or blockages that are likely to occur to enable the equipment to be safely unblocked;

11) ways which experience has shown that the sprayer ought not to be used;

12) any position in which the sprayer is not stable;

13) the measured vibration total value to which the hand arm system is subjected or where this value does not exceed 2,5 m/s^2 this needs to be mentioned, and the related uncertainty of measurement;

14) values for equivalent A-weighted emission sound pressure level at the operator position, determined in accordance with 4.12.2, together with the uncertainty of stated values, both in A-weighted dB;

15) values for A-weighted sound power level, determined in accordance with 4.12.2 (if required) together with the uncertainty of stated values, both in A-weighted dB;

16) substances that are known to the sprayer manufacturer that are not compatible with the construction materials of the sprayer and therefore not to be applied;

e) the procedures for wintering and restarting;

f) the procedures to be followed for dealing with blocked nozzles and other breakdowns in the field;

g) recommendations concerning precautions to be taken against contact with and/or inhalation of hazardous chemicals, such as the wearing of personal protective equipment, handling of spray lance or boom at each of the following stages of use:

1) filling of the spray tank with chemicals;

2) spraying;

3) adjustments, including precautions to avoid contamination of environment, operator or bystanders, for instance in case of shortening telescopic spray lances;

4) draining of the spray tank and cleaning;

5) changing of chemicals;

6) servicing and maintenance;

h) maintenance instructions, such as:

1) specifications of the spare parts to be used, when these affect the health and safety of operators and/or the environment, e.g. nozzles, filters, gaskets, handle, hose, couplings and anti-drip device;

2) servicing and replacement tasks for the user;

3) drawings or diagrams to allow user maintenance and for fault finding tasks;

i) additional equipment or attachments for the sprayer according to the intended use;

j) mixing and filling and precautions to be taken to avoid contamination of the environment;

k) conditions of use and the corresponding adjustment of the machine. The droplet size, rotational speed of the engine (or position of the throttle), nominal spray liquid flow rate, shall be specified for all nozzles supplied with the sprayer;

l) range of effectiveness of the sprayer related to target position (e.g. horizontal and vertical) and the method used to determine it (e.g. Annex I or equivalent methods);

m) avoiding drift taking into account different parameters such as nozzles, pressure, boom height, wind speed, etc.;

n) the volume of total residual;

o) emptying and cleaning;

p) checking the volume application rate;

q) the range of types and sizes of nozzles and filters that can be used;

r) intervals for checking the machine;

s) restriction on use of plant protection products;

t) type of nozzles that can be used and for which purpose;

u) necessary preparations for different conditions of use;

v) possibilities of connecting to other equipment and the necessary precautions;

w) checking the sprayer, especially after eventual dropping;

x) spray liquid flow rate for each working position of the air tube defined by the manufacturer;

y) the data related to air velocity as specified in 6.8.

When nozzles can be replaced, advise the user of the correct filters recommended by the nozzle manufacturer.

7.1.2 Technical data

The following technical information shall be made available for each model and/or brand where significant differences occur.

a) Gross mass

— empty [kg]

— full to the nominal volume [kg]

b) Nominal fuel tank capacity [l]

c) Nominal oil tank capacity (if any) [l]

d) Nominal chemical tank capacity [l]

e) Flow rate of the fan [m^3/h]

f) The equivalent A-weighted emission sound pressure level at the operator's position and the A-weighted sound power level

7.2 Marking

All knapsack combustion engine-driven airblast sprayers shall be marked legibly and indelibly with the following minimum information:

— business name and full address of the manufacturer and, where applicable, his authorized representative;

— designation of the machinery;

— year of manufacturing, i.e. the year in which the manufacturing process was completed;

— designation of series or type;

— serial number, if any;

— empty and full masses as specified in 7.1.2, in kilograms;

— volume of the chemical tank, in litres.

In addition, all knapsack combustion engine driven airblast sprayers shall bear identification of the ON/OFF control, fuel and oil (if any) caps and/or openings and choke control.

Marking shall be located in a readily visible position on the Knapsack combustion engine-driven airblast sprayer and shall resist the anticipated service conditions, such as the effects of temperature, moisture, petrol, oil abrasion and weathering exposure.

7.3 Warnings

All controls shall be marked with an appropriate symbol in accordance with ISO 3767-5, as applicable.

Symbols relating to safety shall be in accordance with ISO 11684 and — in respect of their shape and colour — with ISO 3864-1.

All knapsack combustion engine-driven airblast sprayers shall be marked with the following warnings:

— "Wear eye protection (goggles or face shield)";

— "Wear ear protection";

— "Wear suitable respiratory protection and protective clothing";

— "Read the instruction handbook";

— "Keep bystanders away when spraying".

Examples of safety symbols whose meanings shall be explained in the instruction handbook are given in Annex E.

Annex A
(informative)

List of significant hazards

Table A.1 gives the significant hazard(s), the significant hazardous situation(s) and event(s) covered by this document that have been identified by risk assessment as being significant for this type of machine, and which require specific action by the designer or manufacturer to eliminate or to reduce the risk.

Attention is drawn to the necessity to verify that the safety requirements specified in this document apply to each significant hazard presented by a given machine and to validate that the risk assessment is complete.

Table A.1 — List of significant hazards associated with knapsack combustion engine-driven airblast sprayers

No.	Hazard	Hazardous situation and event	Clause/subclause of this document
1 Mechanical hazards	1.1 being run over;	Not relevant	—
	1.2 being thrown;	Not relevant	—
	1.3 crushing;	Not relevant	—
	1.4 cutting or severing;	Contact with power driven components	4.7
	1.5 drawing-in or trapping;	Not relevant	—
	1.6 entanglement;	Contact with power driven components	4.7
	1.7 friction or abrasion;	Not relevant	—
	1.8 impact;	Not relevant	—
	1.9 injection;	Not relevant	—
	1.10 shearing;	Not relevant	—
	1.11 slipping, tripping and falling;	Not relevant	—
	1.12 stabbing or puncture;	Not relevant	—
	1.13 suffocation.	Not relevant	—
2 Electrical hazards	2.1 burn;	Short circuiting	4.10
	2.2 chemical effects;	Not relevant	—
	2.3 effects on medical implants;	Not relevant	—
	2.4 electrocution;	Contact with active parts	4.10
	2.5 falling, being thrown;	Not relevant	—
	2.6 fire;	Short circuiting	4.10
	2.7 projection of molten particles;	Not relevant	—
	2.8 shock.	Contact with active parts	4.10

Table A.1 *(continued)*

No.	Hazard	Hazardous situation and event	Clause/subclause of this document
3 Thermal hazards	3.1 burn;	Contact with hot parts, fire	4.8, 4.9
	3.2 dehydration;	Not relevant	—
	3.3 discomfort;	Not dealt with	—
	3.4 frostbite;	Not relevant	—
	3.5 injuries by the radiation of heat sources;	Not relevant	—
	3.6 scald.	Contact with hot parts	4.9
4 Noise hazards	4.1 discomfort;	Continuous exposure to excessively noisy machine	4.12
	4.2 loss of awareness;	Not relevant	—
	4.3 loss of balance;	Not relevant	—
	4.4 permanent hearing loss;	Not relevant	—
	4.5 stress;	Continuous exposure to excessively noisy machine	4.12
	4.6 tinnitus;	Not significant;	—
	4.7 tiredness;	Continuous exposure to excessively noisy machine	4.12
	4.8 any other (for example, mechanical, electrical) as a consequence of an interference with speech communication or with acoustic signals.	Not relevant	—
5 Vibration hazards	5.1 discomfort;	Transmission of vibration of the machine to the body	4.11
	5.2 low-back morbidity;	Not relevant	—
	5.3 neurological disorder;	Not relevant	—
	5.4 osteo-articular disorder;	Not relevant	—
	5.5 trauma of the spine;	Not relevant	—
	5.6 vascular disorder.	Not relevant	—

Table A.1 *(continued)*

No.	Hazard	Hazardous situation and event	Clause/subclause of this document
6 Radiation hazards	6.1 burn;	Not relevant	—
	6.2 damage to eyes and skin;	Not relevant	—
	6.3 effects on reproductive capability;	Not relevant	—
	6.4 mutation;	Not relevant	—
	6.5 headache, insomnia, etc.	Not relevant	—
7 Material/substance hazards	7.1 breathing difficulties, suffocation;	Potentially linked to product to be distributed	4.3, 4.4, 4.5.3, 4.5.4, 4.5.6
	7.2 cancer;	Potentially linked to product to be distributed	4.3, 4.4, 4.5, 4.6, Clause 5
	7.3 corrosion;	Potentially linked to product to be distributed	4.3, 4.4, 4.5, 4.6, Clause 5
	7.4 effects on reproductive capability;	Potentially linked to product to be distributed	4.3, 4.4, 4.5, 4.6, Clause 5
	7.5 explosion;	Not relevant	—
	7.6 fire;	Leakage of fuel	5.3
	7.7 infection;	Not relevant	—
	7.8 mutation;	Potentially linked to product to be distributed	4.3, 4.4, 4.5, 4.6, Clause 5
	7.9 poisoning;	Potentially linked to product to be distributed	4.3, 4.4, 4.5, 4.6, Clause 5
	7.10 sensitization.	Potentially linked to product to be distributed	4.3, 4.4, 4.5, 4.6, Clause 5
8 Ergonomic hazards	8.1 discomfort;	Too heavy machine; improper design of controls	Not covered; 4.5
	8.2 fatigue;	Too heavy machine; improper design of controls	Not covered; 4.5
	8.3 musculoskeletal disorder;	Too heavy machine	Not covered
	8.4 stress;	Too heavy machine; improper design of controls	Not covered; 4.5
	8.5 any other (for example, mechanical, electrical) as a consequence of a human error.		

Table A.1 *(continued)*

No.	Hazard	Hazardous situation and event	Clause/subclause of this document
9 Hazards associated with the environment in which the machine is used	9.1 burn;	Not relevant	—
	9.2 slight disease;	Not relevant	—
	9.3 slipping, falling;	Not significant	—
	9.4 suffocation;	Not relevant	—
	9.5 interference with signals given by controls of the machine;	Interference with signals given by controls of the machine;	4.13
	9.6 any other hazard as a consequence of the effect caused by the sources of the hazards on the machine or parts of the machine.	Not relevant	—
10 Combination of hazards	—	Not relevant	—
11 Environmental hazards	11.1 Unintended exposure of the environment to plant protection products	Loss of control during spraying	4.2, 4.5
	11.2 Spillages	Filling	5.3
		Emptying	5.3, 5.8
		Deterioration of parts of the machine	5.6
	11.3 Contamination of the water supply	Filling	5.3
		Emptying	5.3, 5.8
	11.4 Leakages	Transport and application	4.5, 5.3, 5.4
	11.5 Overfilling	Filling	5.3
	11.6 Dispersal of spray mixture residues or plant protection products	Drainage	5.3
		Cleaning and rinsing	5.8
	11.7 Accidental leakages	Accidental opening of tank outlet	5.3
	11.8 Over-dosing	Heterogeneous mixing	5.3

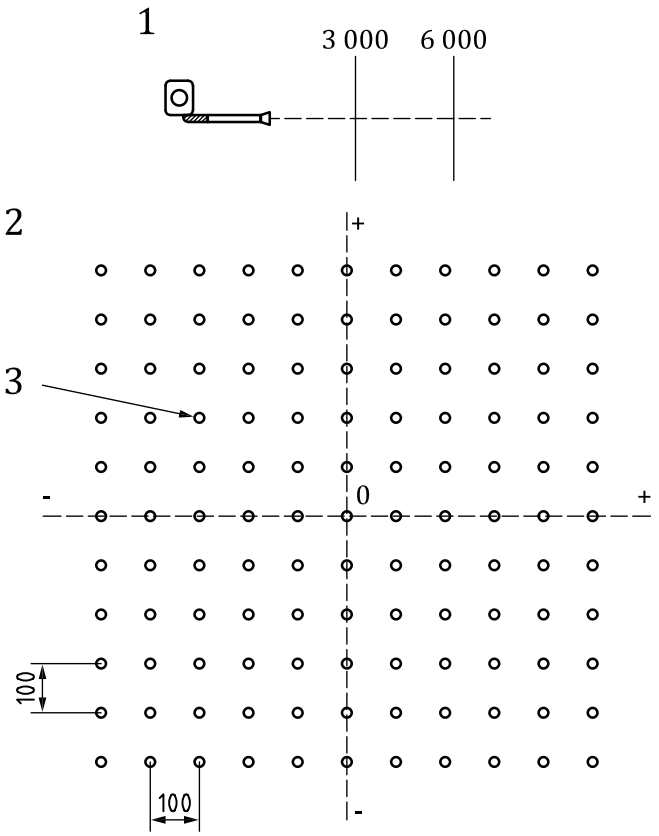
Table A.1 *(continued)*

No.	Hazard	Hazardous situation and event	Clause/subclause of this document
		Sprayer adjustment/ control	5.3
		Sprayer maintenance/ service	Not relevant
		Unintended deposition	5.3, 5.10
	11.9 Unintended spraying outside the target area	Application	5.10
		Spraying stop control	4.5
	11.10 Drift	Spraying	5.5, 5.7, 5.10
	11.11 Discharge of spray mixture	Intervention on the sprayer during application or service	5.3
	11.12 Dripping	Spraying stop control	4.5
	11.13 Contamination during servicing	Change filter	5.4
	11.14 Contamination during cleaning	Emptying	5.3
		Cleaning	Not relevant
	11.15 Wrong application rate	Use	4.5, 5.7

Annex B
(normative)

Sampling grid position for air velocity determination

Dimensions in millimetres



Key

1 air velocity sampling area
2 sampling area
3 air velocity sampling point

Figure B.1 — Sampling grid position for air velocity determination

Annex C
(normative)

Stability test

The sprayer shall be positioned in accordance with Figure C.1.

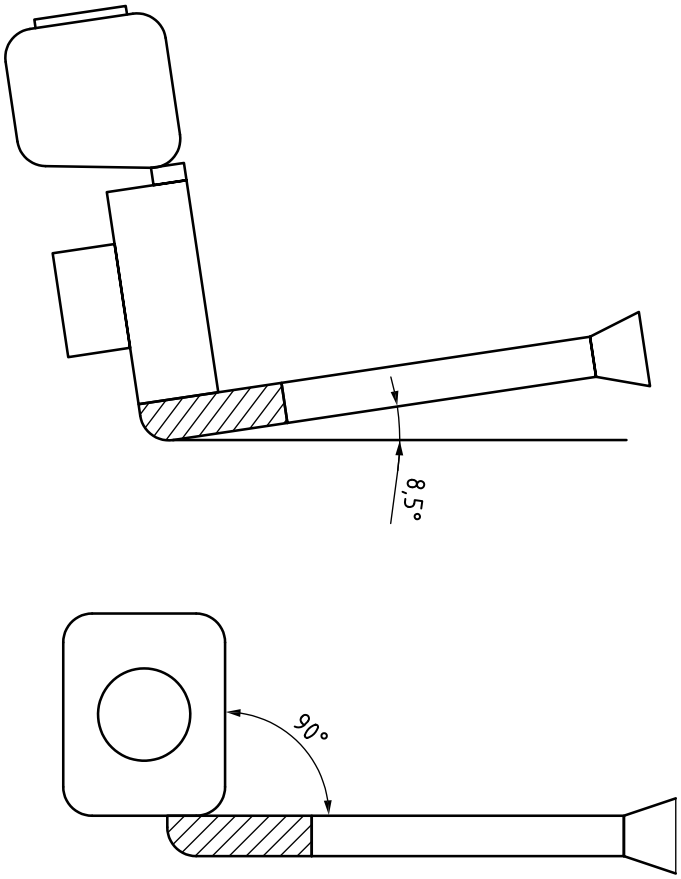


Figure C.1 — Position of sprayer for stability testing

Annex D
(informative)

Example of a knapsack combustion engine-driven airblast sprayer

Figure D.1 shows a functional representation and does not illustrate the safety measures specified in this document.

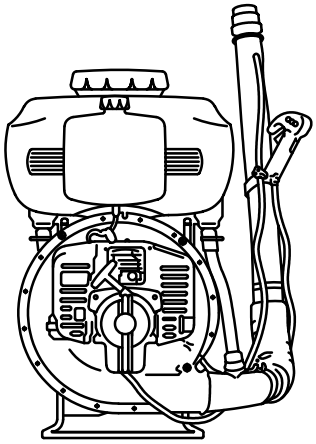


Figure D.1 — Functional representation of a machine

Annex E
(informative)

Safety signs

See Figures E.1 to E.4.

Figure E.1 — Read the instruction handbook — ISO 7010-M002

Figure E.2 — Wear ear protection — ISO 7010-M003

Figure E.3 — Wear respiratory protection — ISO 7010-M017

ISO 7010-M008

ISO 7010-M009

ISO 7010-M010

Figure E.4 — Wear body protection

Annex F
(informative)

Position of sprayer and Petri dishes for potential ground deposit determination

See Figure F.1 for an example.

Dimensions in metres

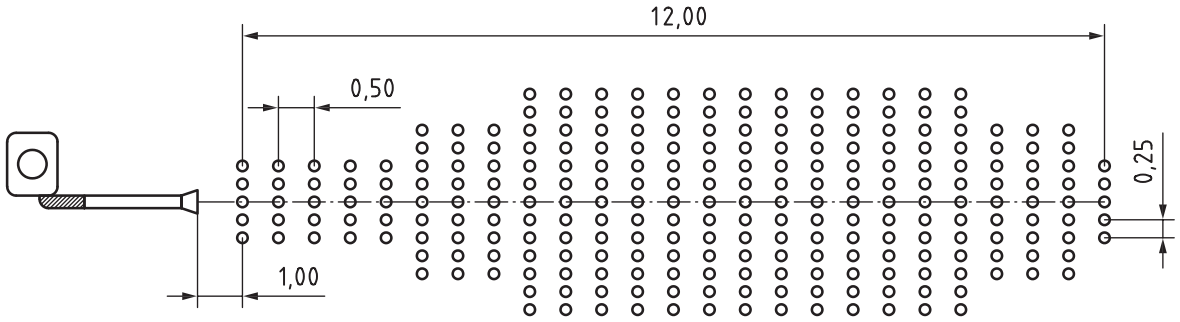


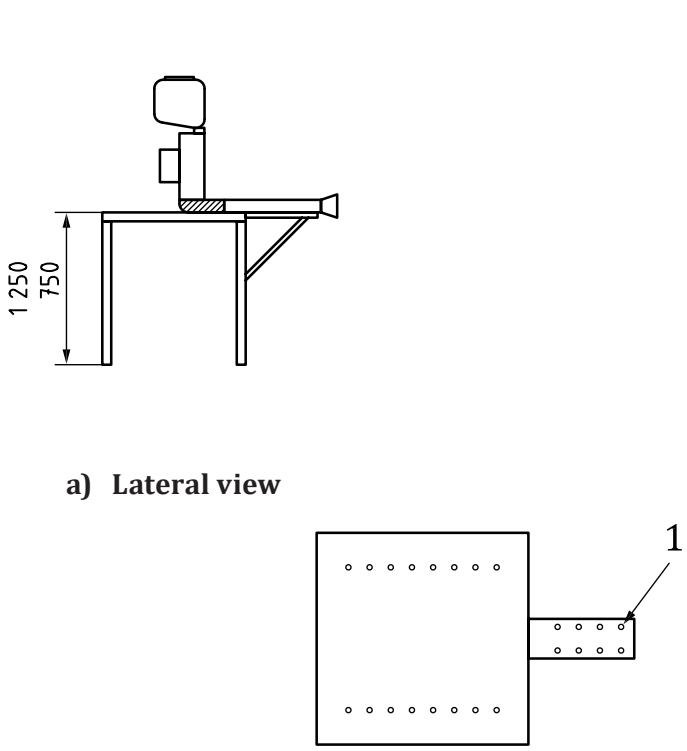
Figure F.1 — Example of sprayer and Petri dish positioning

Annex G
(informative)

Sprayer locking device

See Figure G.1 for an example.

Dimensions in millimetres



a) Lateral view

b) Llateral view

c) Top view

Key

1 holes for locking

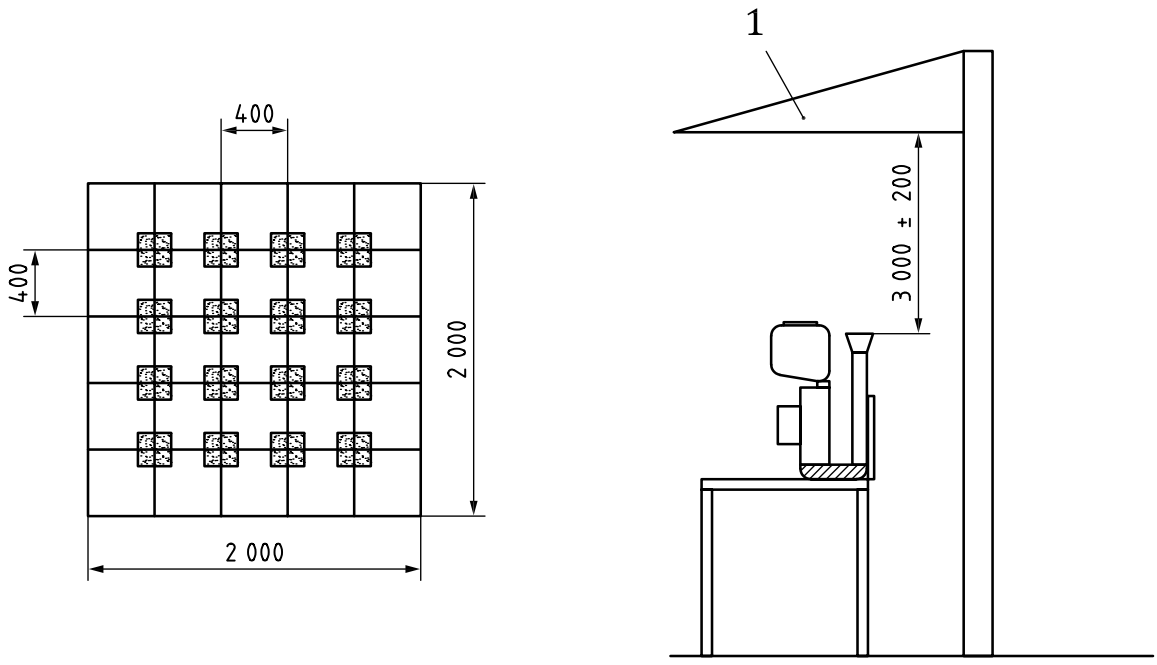
Figure G.1 — Example of sprayer locking device

Annex H
(informative)

Device for detecting potential vertical deposits

See Figure H.1 for an example.

Dimensions in millimetres



Key

1 device with absorbent materials

Figure H.1 — Example of device for detecting potential vertical deposits

Annex I
(informative)

Potential ground deposit, potential vertical deposit and droplet size test

I.1 Potential ground deposit

Precautions may be required when running internal combustion engines indoors.

This test provides information on the spray ground deposit, produced indoors with the sprayer in a static condition and the spray outlet in the horizontal position.

Using the sprayer locking device (6.1.11), lock the sprayer in the upright position with its air delivery tube in the horizontal position according to Figure 3 a) such that the height of the centre of the sprayer spray outlet is (1 000 ± 20) mm from the ground [see Figure G.1 a)].

The test shall be performed indoors. It shall be repeated using the greatest and smallest spray liquid flow rates achievable for the standard sprayer and when configured for ULV (Ultra Low Volume) application, as defined by the manufacturer in the operator's instruction handbook. Each side wall of the indoor enclosure shall be located a minimum of 500 mm from the outermost Petri dishes (6.1.7).

Position a row of Petri dishes on the ground in front of the discharge outlet and symmetrical about the projection of the central horizontal axis of the air outlet, as indicated in Figure F.1. This first row of Petri dishes shall be positioned at a 1 m distance from the spray outlet. The following Petri dishes shall be placed at (500 ± 5) mm intervals up to a distance of 12 m from the sprayer outlet. For each row position one Petri dish on the central axis and at least four additional Petri dishes for each of those mentioned above (two to the left and two to the right) at distances of (250 ± 5) mm from one another. The number of additional Petri dishes (see the example given in Annex F) shall be provided according to the dimension and shape of the surface sprayed.

Verify its correct positioning and run the sprayer.

After operating the sprayer until the tank is empty, determine the amount of liquid in the Petri dishes by mass and express this as a ratio of the amount sprayed.

Other alternative methodologies may be used if they give the same results.

I.2 Potential vertical deposit

This test provides information on the potential vertical (spatial) distribution of the spray cloud.

Using the sprayer locking device (6.1.11), lock the sprayer in the upright position with its air delivery tube 90° above the horizontal [see Figure G.1 b) and Figure 3 c)] or in the position characterized by the highest vertical air velocity measured at the air tube output.

Perform the test indoors, or outdoors in dry weather and in the absence of wind. The test shall be repeated for the greatest and smallest spray liquid flow rates for standard sprayer and when configured for ULV (Ultra Low Volume) application, as defined by the manufacturer in the operator's instruction handbook.

Activate the sprayer and verify that the sprayer positioning is correct.

Using the device for detecting potential vertical deposits (6.1.13), determine such deposits at a distance of (3 000 ± 20) mm vertically above the air tube outlet. Stop the procedure before the absorbent materials (6.1.8) becomes saturated or the spray cloud has collapsed.

Determine the mass of test liquid recovered from each section of the absorbent material. The mass of test liquid collected at each position shall be recorded as a percentage of the total test liquid discharged during the test and these values shall be provided in the operator's instruction handbook.

Other alternative methodologies may be used if they give the same results.

I.3 Droplet size test

This test provides information on the droplet size spectra produced by the sprayer.

Using the sprayer locking device (6.1.11), lock the sprayer in the upright position with its air delivery tube outlet in the horizontal position. Adjust the sprayer setting according to the manufacturer's specifications. If the operator's instruction handbook provides for more than one operating condition, the following measurements shall be carried out and reported for each operating condition.

The droplet size spectrum can be measured with any non-intrusive system appropriate for the range of droplet size and velocity within the spray and the properties of the spraying liquid using measurement systems based on phase Doppler light scatter, laser diffraction or imaging principles. Other non-intrusive measurement systems may also be appropriate if they have a resolution and dynamic measurement range similar to the aforementioned laser instruments. The instrument and measurement system shall enable repeatable measurements for the reference sprays with a maximum deviation of $Dv0,5$ (volume median diameter) between replicate measurements of ±5 % for the same setting and measuring situation.

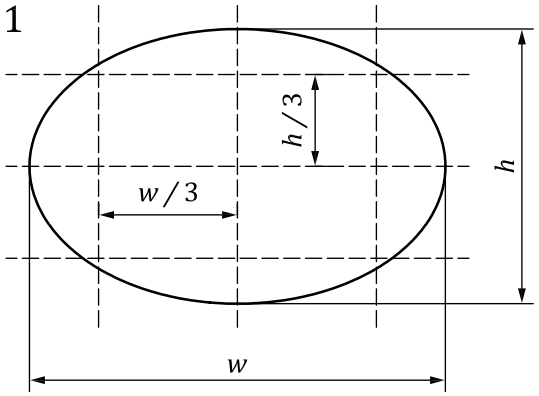
During the measurement of all sprays, the spraying liquid shall have a temperature within ±5 °C of the ambient air temperature. The air and liquid temperatures and humidity shall be recorded at the time of measurement.

A representative cross-section average sample shall be obtained across the entire spray cloud, with droplet size measurement being conducted at a distance of 1 m from the nozzle outlet or at an appropriate distance when measuring a fully atomized spray.

For measuring systems using a point-wise measuring principle, such as phase Doppler devices, continuous or stepwise movement of the point of measurement relative to the spray is required in order to obtain a representative sample of droplets. These relative movements shall follow along one of the central axes of the spray cloud. One additional movement line shall be used at each side of one of the main axes, as shown in Figure I.1. In the case of continuous relative movement, the forward speed shall be constant for all movement lines. For stepwise movement, the measuring time shall be the same at each measuring position. Forward speed, measuring time and/or number of discrete movement lines shall be adjusted to obtain a maximum deviation of $Dv0,5$ between replicate measurements of not more than ±5 % and, where possible and appropriate, to sample at least 10 000 droplets per sprayer.

The height, h, and the width, w, of the spray plume at the measuring distance shall be determined visually or using water-sensitive paper.

The values of $Dv0,1$, $Dv0,5$ and $Dv0,9$ shall be reported.



Key

h height of spray cloud
w width of spray cloud
1 spray cloud section

Figure I.1 — Spray cloud section with lines of relative movement of point of measurement

Annex J
(informative)

Minimum content of test report

An example of a test report is shown in Table J.1.

Table J.1 — Test report example

Report on knapsack combustion engine-driven airblast sprayers Testing organization (name and address):					
Test location:		Date:			
Sprayer					
Type:		Manufacturer:			
Design:					
Nominal tank volume / l:					
Mass of the complete, empty sprayer / kg:					
Total mass of the filled sprayer / kg:					
Wearing parts easy to be changed?		yes		no	
Carrying handle?		yes		no	
Straps					
Number of straps:					
Non-absorbent material?		yes		no	
Length / mm	min:				
	max:				
One with quick coupling device?		yes		no	
Unintentional loosening?		yes		no	
Load bearing width / mm:					
Tank					
Filling limits visible?		yes		no	
Filling opening diameter / mm:					
Filling strainer?	Mesh width / mm:			none	
Volumetric contents gauge:		Range / l:			
		Resolution / l:			
Quick acting shut-off valve?		yes		no	
Closed when released?		yes		no	
Hoses					
With sharp bends?		yes		no	
Filters					
	Mesh width / mm:				
Lance parking device?		yes		no	

Table J.1 *(continued)*

Tests					
Test conditions					
	temperature / °C:				
	rel. humidity / %:				
Damages:			yes		no
Remarks:					
6.3 Spray liquid output					
Stated spray liquid output / l min^{-1}				Measured spray liquid output / l min^{-1}	Deviation / %
6.4 Mass of total residual liquid					
Position:			upright		inclined by [°]
Weight of the sprayer after test / kg:					
Volume of total residual / g:					
Remarks:					
6.5 Stability					
Tank filling level	Sprayer position	Stability			
empty	strap side down the slope		yes		no
	left side down the slope		yes		no
	strap side up the slope		yes		no
	right side down the slope		yes		no
nominal volume	strap side down the slope		yes		no
	left side down the slope		yes		no
	strap side up the slope		yes		no
	right side down the slope		yes		no
Remarks:					

Table J.1 *(continued)*

6.6 Contents gauge			
Level (V_s) / l	Net weight / g (V_m / ml)	Deviation (V_s-V_m) / l	Error (E) / %
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
Remarks:			

6.6 Total tank volume		
Weight of the completely filled sprayer / g:		
Total tank volume / l:		
Additional volume percentage (V_A) / %:		
Remarks:		

6.7 Filling rate		
Pouring flow rate / l min^{-1}:		
Weight of plastic sheet and/or tissue before test (tare) / g:		
Weight of plastic sheet and/or tissue after test / g:		
Volume of splashes (V_S) / ml:		

Table J.1 *(continued)*

Remarks:
6.8 Air velocity
Remarks:

Bibliography

[1] ISO 7010[1)], *Graphical symbols for use on equipment — Index and synopsis*

[2] ISO 10988:2011, *Equipment for crop protection — Knapsack motorized air-assisted sprayers — Test methods and performance limits*

[3] ISO/TR 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning*

[4] ISO/TR 11688-2, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design*

[5] ISO 11691, *Acoustics — Measurement of insertion loss of ducted silencers without flow — Laboratory survey method*

[6] ISO 11820, *Acoustics — Measurements on silencers in situ*

[7] ISO 14163, *Acoustics — Guidelines for noise control by silencers*

[8] CR 1030-1, *Hand-arm vibration — Guidelines for vibration hazards reduction — Engineering methods by design of machinery*

1) The graphical symbol collections of ISO 7000, ISO 7001, ISO 7010 and IEC 60417 can be previewed and purchased on the Online Browsing Platform (OBP), www.iso.org/obp.

ICS 65.060.40

Price based on 39 pages