
**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*

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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*

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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](#).

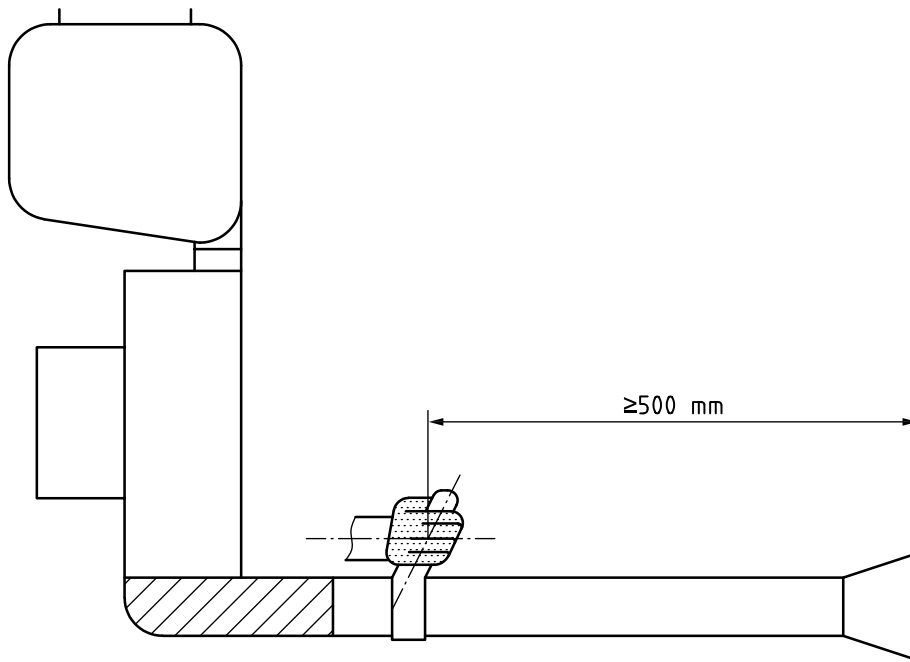


Figure 1 — Length of the air tube

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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.

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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

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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 cm² 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 $20 \text{ °C} \pm 3 \text{ °C}$, the recorded temperatures shall be corrected using [Formula \(1\)](#):

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

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_{-1}^0) 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 cm².

Dimensions in millimetres

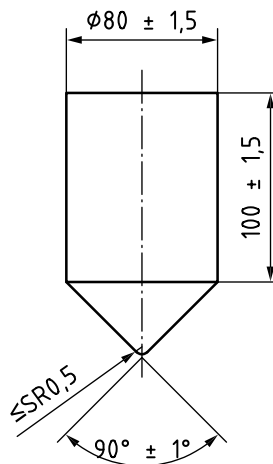


Figure 2 — Test cone