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Agricultural and forestry machinery — Knapsack combustion-engine-driven mistblowers — Safety requirements

Matériel agricole et forestier — Nébulisateurs portés à dos à moteur à combustion interne — Exigences de sécurité

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 28139 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 144, *Tractors and machinery for agriculture and forestry*, in collaboration with Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Introduction

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

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.

Agricultural and forestry machinery — Knapsack combustion-engine-driven mistblowers — Safety requirements

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This International Standard specifies safety requirements and their verification for the design and construction of knapsack mistblowers incorporating a combustion engine where the air flow is generated by a fan.

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 does not, however, give any technical requirement for reducing noise or vibration hazards. Indeed, the different means available to reduce these hazards are a matter for the technical aids to which the manufacturer may resort, through specialized books or specified bodies.

This International Standard deals with all significant hazards, hazardous situations and events, excepting those arising from

— electromagnetic compatibility,

— static electricity,

— explosion or fire from chemicals for spraying,

— insufficient structural integrity, and

— noise and vibration.

It is applicable to knapsack combustion-engine-driven mistblowers when they are used as intended and under the conditions foreseen by the manufacturer (see Clause 4).

It is not applicable to knapsack combustion-engine-driven mistblowers manufactured before the date of its publication.

2 Normative references

The following referenced documents are indispensable for the application 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 3767-5:1992, *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 machinery*

ISO 3864-1:2002, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

ISO 8893:1997, *Forestry machinery — Portable brush-cutters and grass-trimmers — Engine performance and fuel consumption*

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

ISO 11684:1995, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety signs and hazard pictorials — General principles*

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

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

ISO 19932-1:2006, *Equipment for crop protection — Knapsack sprayers — Part 1: Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100-1:2003 and the following apply.

3.1
knapsack mistblower
machine with a backpack power unit designed for applying chemicals to crops by means of a hand-held spraying device with the liquid being contacted, nebulized and transported by a high-speed air flow generated by a fan

NOTE An example of this machine is given in Annex C.

3.2
backpack power unit
power source which is designed to be carried on the operator's shoulders by means of a supporting device and harness

3.3
harness
adjustable strap(s) used to suspend the machine from the operator

3.4
silencer
device for directing the exhaust gases

3.5
engine stopping device
control fitted to the machine which stops the engine

3.6
suspension point
device on the machine to which the harness can be attached

3.7
throttle trigger
throttle control
device, usually a lever, activated by the operator's hand or finger, for controlling the engine speed

3.8
throttle lock
device for temporarily setting the throttle in a partially open position

3.9
throttle trigger lockout
device that prevents unintentional activation of the throttle trigger

3.10
chemical pump control device
device, usually a lever, activated by the operator's hand or finger to engage or disengage the pump for filling the chemical tank

3.11
air tube
tube for the air flow between the fan and the nozzle

3.12
normal operation
use of the machine that is reasonably foreseeable and which is consistent with such activities as distribution of chemicals, starting, stopping, fuelling and filling with chemicals

3.13
normal use
normal operation, plus routine maintenance, servicing, cleaning, transporting, attaching or removing accessories, and the making of ordinary adjustments as determined by the manufacturer's instructions

3.14
throttle limiting device
manually activated device allowing different maximum positions of the throttle without preventing the return of the throttle to the idling position, designed to facilitate operation of the engine over a longer working period

4 List of significant hazards

For the purposes of this International Standard, Table 1 gives, for defined danger zones, the significant hazards, the significant hazardous situations and the significant hazardous events covered by this International Standard that have been identified by risk assessment as being significant for this type of machine, and which require specific action to eliminate or to reduce the risk.

Table 1 — List of significant hazards, hazardous situations and events associated with knapsack combustion-engine-driven mistblowers

	Hazard	Subclause
1	Cutting or severing hazards related to the power-driven components	5.9
2	Entanglement hazard related to the power-driven components	5.9
3	Drawing-in or trapping hazards related to the power-driven components	5.9
4	Electrical hazards, created by contact with parts under high voltage (direct contact) or parts which have become under high voltage under faulty conditions (indirect contact)	5.13
5	Thermal hazards resulting in burns, scalds and other injuries, created by possible contact of persons with objects or materials with high temperature, including the radiation of heat sources	5.11, 7.3
6	Hazards resulting from contact with or inhalation of exhaust gases and sprayed products	5.3, 5.4, 5.5, 5.13, 7.3
7	Fire or explosion hazard related to fuel spillage	5.10, 7.3
8	Hazards from neglect of ergonomic principles in machine design, such as hazards from unhealthy postures or excessive efforts and inadequate consideration of human hand-arm anatomy related to handle design	5.1, 5.6, 5.7, 5.8
9	Hazards from failure of the control system related to handle strength, position of controls and marking	5.6, 7.4
10	Hazards from unexpected start-up, unexpected overrun/over-speed from failure/disorder of the control system related to failure in the position of the controls	5.6
11	Hazards from impossibility of stopping the machine in the best possible conditions related to the position of the engine stopping device	5.6
12	Hazards from ejection of fluids related to fuel spillage	5.10
13	Stability when in operation	5.2

5 Safety requirements and/or protective measures

5.1 General

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 International Standard.

It is recommended that the overall mass of the knapsack mistblower at the maximum load, measured with full fuel and chemical tanks, as indicated by the manufacturer, not exceed 30 kg for men and 25 kg for women.

5.2 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 vertical plane passing through the fixation points of the harness at the full gross mass of the machine.

Compliance shall be checked by measurement.

5.3 Exhaust system

The 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.

5.4 Chemical tank and strainer

5.4.1 General

The chemical tank shall be easy to clean both inside and outside. It shall be provided with a strainer having a mesh width not greater than 2 mm whose removal and mounting operations shall be easily carried out with the use of gloves.

The tank shall be equipped with a volumetric scale according to ISO 9357. The volumetric scale shall have a maximum error of ± 7,5 % up to a filling level of 20 % of nominal capacity and ± 5 % for greater filling levels.

During filling and emptying operations, the level of chemicals inside the tank shall be visible. The nominal volume shall be specified in whole litres. Additionally, filling levels and limits shall be visible during the filling operation.

If the mistblower is fitted with an auxiliary pump, the control of the pump shall be positioned so that it can be easily reached by the operator in the normal operating position.

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

5.4.2 Protection against chemical spillage and overflow

The actual overall volume of the tank shall exceed the nominal volume by at least 5 %.

To avoid chemical spillage during filling, the diameter of the filling opening shall be in accordance with ISO 9357.

However, it shall be possible to fill the tank to its nominal capacity within 60 s, without any liquid spillage, using the device described in ISO 19932-1:2006, Annex C.

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

— have a retainer,

— 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 (for example, lids fixed by screwing).

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

5.4.3 Protection against contact with chemicals when draining

It shall be possible to fully empty the chemical tank without overturning the machine.

The operator shall be prevented from coming into contact with the chemicals when emptying the tank. This requirement is met if

— the draining outlet can be opened without the use of a tool (for example, by means of a tap), and

— the flow is directed away from the operator.

Compliance shall be checked by inspection and functional testing.

5.5 Air tube and chemical hoses

The air tube shall be fitted with a handle on which a throttle trigger complying with 5.6.2 and an engine stopping device complying with 5.6.3 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 working position.

The minimum length of the lance from the front of the hand trigger grip to the nozzle shall be 500 mm.

The air tube shall not be detachable without the use of a tool.

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

5.6 Controls

5.6.1 General

All controls shall be designed to be operable by an operator wearing 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. Compliance shall be checked by inspection.

5.6.2 Throttle trigger

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

The throttle trigger shall be positioned so that it can be pressed and released with a gloved hand holding the handle on which the throttle trigger is mounted. The length of the gripping surface of the handle shall be $\geqslant$ 100 mm.

If a throttle lock is provided for starting, it shall be automatically released when the throttle trigger is operated. The throttle lock shall be designed so that two or more independent motions are required to engage the throttle lock.

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.

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

5.6.3 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 used by the operator in the normal operating position.

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.

5.6.4 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.

5.6.5 Chemical pump control device

The control device shall be positioned so that it can be easily reached by the operator in the normal operating position.

Compliance shall be checked by inspection and functional testing.

5.6.6 Liquid line shut-off valve

Spray liquid lines shall be equipped with a shut-off valve, which shall be positioned so that it can be easily reached by the operator in the normal operating position.

Compliance shall be checked by inspection and functional testing.

5.7 Machine support

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

Compliance shall be checked by inspection and functional testing.

5.8 Harness

A suitable harness shall be provided to carry the backpack frame. It shall be adjustable to the size of the operator.

Straps shall be made of non-absorbent material and shall be adjustable in length to meet the needs of the user.

At least one strap shall have a quick coupling and release device, capable of being used with one hand.

The load bearing width of the straps shall be at least 50 mm.

Straps shall not be self-loosened by the force of gravity at the full gross mass of the machine.

The harness shall be designed so as to prevent slipping and allow pressure to be evenly distributed over the operator's back, shoulders and/or waist.

The harness design or the quick-release mechanism shall enable the backpack power unit to be released quickly from the operator in case of emergency. The design of the connection between the harness and those parts of the backpack power unit suspended from it shall be such that separation will only occur as a result of a deliberate action by the operator.

The harness of the knapsack mistblower shall not come into contact with the liquid when the machine is being filled according to provisions given in Annex A.

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

5.9 Power-driven components

The knapsack mistblower 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, e.g. in covers and in 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.

5.10 Fuel tank

The fuel cap shall have a retainer.

The fuel tank opening shall be at least 20 mm in diameter, and the oil tank opening (if any) shall be at least 15 mm in diameter.

The design of the fuel tank assembly shall be such that no leakage occurs.

The fuel tank shall have a ventilation system.

Seepage from any fuel tank ventilation system shall not constitute leakage.

Compliance shall be checked by inspection, functional testing and measurement. Compliance is checked using the following test: bring the machine to its normal operating temperature. Hold the machine in all operating and transport positions. In all these positions, leakage shall not occur.

5.11 Protection against contact with hot parts

The engine cylinder and silencer or parts in direct contact with the cylinder and silencer shall be guarded so that they are not accessible to unintentional contact during normal operation of the machine. If hot parts are accessible, they shall not have a contact area greater than 10 cm^2. They shall be considered accessible if they can be reached by the test cone shown in Figure 1.

NOTE EN 14930 specifies requirements on determination of inadvertent accessibility of hot surfaces of machinery.

The temperature of accessible parts shall not cause a hazard to the operator. For data concerning circumstances under which contact between bare skin and hot surfaces does or can lead to burns, refer especially to the criteria given in Clause 6 and to the measures specified in ISO 13732-1:2006, Annex E.

Compliance shall be checked by functional testing and measurement.

Dimensions in millimetres

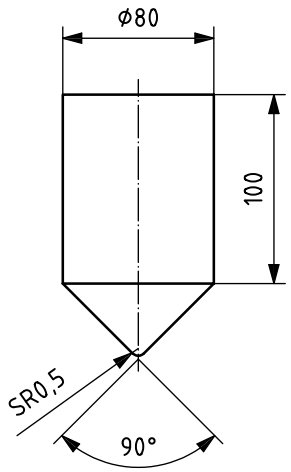

Figure 1 — Test cone

5.12 Protection against contact with chemicals during filling

The frame of the machine shall be designed in a way that allows the machine to be placed in an upright position.

In order to guarantee the stability of the machine during filling operations, the machine shall remain stable on an incline of 8,5° in any direction, irrespective of the amount of liquid in the tank.

Compliance shall be checked by testing in accordance with Annex B.

5.13 Protection against contact with parts under high voltage

All parts of the engine which are under high voltage shall be insulated so that the material under high voltage cannot be touched.

Compliance shall be checked by inspection.

6 Verification of the safety requirements and/or protective measures

Compliance with safety requirements and/or protective measures shall be verified in accordance with Table 2.

Table 2 — Safety requirements and/or protective measures — Verification

Safety requirements and/or protective measures according to subclause		Verification method			
		Inspection [a]	Functional test [b]	Measurement [c]	Reference
5.2	Stability when in operation			X	
5.3	Exhaust system	X	X		
5.4	Chemical tank and strainer	X	X	X	
5.4.2	Protection against chemicals spillage and overflow	X	X	X	ISO 19932-1
5.4.3	Protection against contact with chemicals when draining	X	X		
5.5	Air tube and chemical hoses	X	X	X	
5.6	Controls	X			
5.6.2	Throttle trigger	X	X	X	
5.6.3	Engine stopping device	X	X		
5.6.4	Starting device	X	X		
5.6.5	Chemical pump control device	X	X		
5.6.6	Liquid line shut-off valve	X	X		
5.7	Machine support	X	X		
5.8	Harness	X	X	X	Annex A
5.9	Power-driven components	X		X	ISO 13857
5.10	Fuel tank	X	X	X	
5.11	Protection against contact with hot parts		X	X	
5.12	Protection against contact with chemicals during filling		X		Annex B
5.13	Protection against contact with parts under high voltage	X			

[a] Checking the machine to see that it has all of its components.

[b] Checking the normal operation of the machine/component to ascertain that it performs as specified.

[c] Determining a value using the required devices or instruments.

7 Information for use

7.1 General

The knapsack mistblower shall be supplied with information about the use for which it has been designed or tested, as well as the conditions necessary to ensure that it will remain safe and without risk to health at all times when being used, cleaned or maintained.

7.2 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	kg
b)	Nominal fuel tank capacity	l (litres)
c)	Nominal oil tank capacity (if any)	l
d)	Nominal chemical tank capacity	l
e)	Engine displacement	cm^3
f)	Maximum engine performance (in accordance with ISO 8893)	kW
g)	Engine speed (rotational frequency) at racing	min^{-1}
h)	Maximum rotational frequency of the fan measured at wide open throttle with the inlet/outlet unobstructed	min^{-1}
i)	Flow rate of the fan	m^3/min

7.3 Instruction handbook

Comprehensive instructions and information on all aspects of maintenance and the safe use of the machine, including suitable clothing and personal protective equipment (PPE) requirements and the need for training if necessary, shall be provided by the manufacturer in the instruction handbook. For additional guidance on the drafting of the instruction handbook, see ISO 12100-2:2003, 6.5. The use of photographs and/or diagrams is recommended.

The importance of reading the instruction handbook thoroughly before using the mistblower shall be stressed on the front page of the instruction handbook.

The instruction handbook shall cover information relating to the following:

a) transport, handling and storage of the mistblower, including

— cleaning and maintenance before storage, and

— securing the mistblower during transport to prevent loss of fuel, damage or injury;

b) commissioning of the mistblower, including

- assembly instructions, initial adjustments and checks,
- the consequences of improper maintenance, use of non-conforming components and removal of safety devices,
- filling fuel and oil (if any) tanks, especially concerning fire precautions,
- filling of the chemical tank with regard to environmental pollution, and
- filling and draining operations related to contact with, and inhalation of, chemicals;

c) the mistblower itself, including

- a description, identification and the nomenclature of principal parts, including safety devices and harness, together with an explanation of their functions, and
- the gross mass of the mistblower;

d) the use of the mistblower, including

- operating instructions and information on the use of personal protective equipment (PPE), which shall include the type of PPE to be used with the machine,
- the need for adequate training on safe use,
- a warning against the use of the mistblower while tired, ill or under the influence of alcohol or other drugs or medicaments,
- the chemicals which can be used with the mistblower,
- hazards which can be encountered while using the mistblower and how to avoid them when carrying out typical tasks,
- regular maintenance tasks, pre-operating measures and daily maintenance techniques, including checking for loose fasteners, fuel leaks and damaged parts,
- application of the mistblower and how it is intended to be used, including foreseeable misuse,
- starting and stopping, with particular reference to safety,
- a warning about the emission exhaust gases and the danger of starting and running the engine in a closed room,
- a warning about closing the shut-off valve in the spray liquid line before starting the machine,
- an explanation of symbols and safety signs,
- the operating method to be followed in the event of accidents or blockages that are likely to occur to enable the equipment to be safely unblocked, and
- ways in which experience has shown that the machinery ought not to be used;

e) maintenance instructions, including

— servicing and replacement tasks for the user,

— the specifications of the spare parts to be used, when these affect the health and safety of operators, and

— drawings or diagrams to allow user maintenance and for fault-finding tasks.

7.4 Marking

All mistblowers 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 construction, i.e. the year in which the manufacturing process was completed;

— designation of series or type;

— serial number, if any;

— empty and full masses, in kilograms;

— content of the chemical tank, in litres.

In addition, all mistblowers 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 mistblower and shall resist the anticipated service conditions, such as the effects of temperature, moisture, petrol, oil abrasion and weathering exposure.

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.

7.5 Warnings

All mistblowers shall be marked with the following warnings:

— “Wear eye protection (goggles or face shield)”;

— “Wear ear protection”;

— “Wear respiratory protection and suitable protective clothing”;

— “Read the instruction handbook”;

— “Keep bystanders away when spraying”.

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

Annex A
(normative)

Liquid-retaining test on harness

The purpose of this test is to verify that the liquid does not come into contact with the harness when the chemical tank is being filled. The procedure is as follows.

a) Position the machine over a horizontal surface, then pour a volume of water equal to the nominal volume of the tank in the middle of the tank opening in 2 min.

   The test shall be carried out using the filling device specified in ISO 19932-1:2006, Annex C.

b) Verify visually whether the liquid comes into contact with the harness.

The equipment is considered acceptable if the liquid does not come into contact with the harness.