INTERNATIONAL STANDARD

ISO 19932-1

First edition
2006-03-15

Equipment for crop protection — Knapsack sprayers —

Part 1: Requirements and test methods

Matériel de protection des cultures — Pulvérisateurs à dos —

Partie 1: Exigences et méthodes d'essai

Reference number
ISO 19932-1:2006(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 19932-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*.

ISO 19932 consists of the following parts, under the general title *Equipment for crop protection — Knapsack sprayers*:

— *Part 1: Requirements and test methods*

— *Part 2: Performance limits*

Introduction

The application of crop protection chemicals with knapsack sprayers needs to take into consideration biological, economic, environmental and operator issues, as well as the suitability of the sprayer.

The aim of ISO 19932 is to specify requirements, test methods and performance limits for equipment in order to ensure safe use.

Implementation of ISO 19932 should achieve minimal exposure levels to the operator and avoid unnecessary waste of pesticides into the environment.

Equipment for crop protection — Knapsack sprayers —

Part 1:
Requirements and test methods

1 Scope

This part of ISO 19932 specifies the requirements and test methods for manually operated knapsack sprayers with a nominal tank volume of 5 l or more. It is applicable to lever-operated knapsack sprayers and knapsack compression sprayers for their intended use in, for example, agriculture and horticulture.

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 5681, *Equipment for crop protection — Vocabulary*

3 Terms and definitions

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

3.1
nominal volume
volume indicated by the maximum filling level marked on the sprayer tank without any operation of the sprayer

NOTE The maximum filling level can be marked by the upper value of the contents gauge scale or at a lower level by a dedicated mark.

4 Test liquids and equipment

4.1 **Water**, clean and free from solids.

4.2 **Test liquid**, consisting of water with a known concentration of tracer.

Both colorimetric and fluorimetric tracers can be used to simulate pesticide solutions for the purpose of quantifying spray liquid leaks and deposits. The concentration of such solutions, instrumentation used and removal techniques shall be appropriate to the tracer selected for these measurements.

4.3 **Colorimeter or fluorimeter**, able to determine the concentration of the tracer.

4.4 **Preconditioning device**, permitting the sprayer to be fixed and the sprayer pump lever to operate continuously. The stroke and frequency shall be adjustable.

4.5 Shut-off valve test device, consisting of a frame for fixing the hand-held part of the valve and a unit for moving the valve lever in order to open it periodically with an induced flow at the prescribed rate and pressure. The stroke shall be adjustable.

4.6 Strap test device, capable of dropping the sprayer, vertically guided, onto each strap from a height of 200 mm using a horizontal restraining bar 75 mm in diameter. The device is to be capable of testing sprayers with one or two upper and/or lower fixing points.

An example is given in Annex A. Other devices with equivalent performance may be used.

4.7 Impact test device, used to drop the upright sprayer, vertically guided, onto a flat, level surface, 50 mm thick × 800 mm × 800 mm and made of high density polythene (PEHD), placed on a flat, level floor.

The device shall not affect the impact force of the dropped sprayer.

An example is given in Annex B. Other devices with equivalent performance may be used.

4.8 Filling device, by which the volume and flow of water or test liquid can be controlled and adjusted.

An example is given in Annex C. Other devices with equivalent performance may be used.

4.9 Weighing devices:

a) device with the ability to weigh up to 25 kg with a maximum error of ± 1 g;

b) device with the ability to weigh up to 2 kg with a maximum error of ± 0,1 g.

4.10 Measuring cylinders, permitting measurement of volumes of up to 1 l with a maximum error of ± 10 ml.

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

4.12 Pressure supply device, used to set the sprayer under pressure using air or water. The pressure shall be adjustable up to 1 MPa (10 bar) with a maximum error of ± 5 % of the measured value.

4.13 Pressure gauge, used to measure between 0 MPa and 2 MPa (20 bar) with a maximum error of ± 0,12 kPa (0,12 bar).

4.14 Polythene bags, of size 30 cm × 40 cm.

4.15 Polythene sheets, of size 2 m × 1 m.

5 Tests

5.1 General

The tests shall be performed on one new specimen of the sprayer type at an air temperature of 10 °C to 30 °C and relative air humidity of at least 50 %, with no influence of wind or sunlight and, for lever-operated sprayers, after preconditioning according to 5.2.

Assemble the knapsack sprayer in accordance with the instruction handbook. Inspect for tightness the filling cap, gland nut and other operator-controlled couplings. Weigh the complete empty sprayer using a device according to 4.9 a) and register the mass in grams (g).

5.2 Preconditioning of lever-operated sprayers

Attach the lever-operated sprayer by its straps to a device according to 4.4. Fill the spray tank with water to at least 75 % of its nominal volume.

Activate the lever with a frequency of maximum of 35 strokes/min such that a spray is provided that corresponds to the optimum spray pressure specified in the instruction handbook. If no such information is given in the instruction handbook, perform the preconditioning at (300 ± 20) kPa [(3 ± 0,2) bar]. Refill the spray tank when the water level has dropped to about 5 % of the nominal tank volume. Continue this procedure for 25 h.

5.3 Functional tests

5.3.1 Shut-off valve reliability

Detach the shut-off valve assembly with the spray lance from the sprayer and mount it on a device in accordance with 4.5. Connect the shut-off valve to a pressurised water supply of (300 ± 20) kPa [(3 ± 0,2) bar]. Fully activate the shut-off valve using a frequency of (15 ± 5) cycles/min for a total duration of 25 000 cycles. Inspect and record any leakage.

5.3.2 Sprayer output

The output rate of the sprayer for each type/number(s) of nozzles supplied shall be measured with a maximum error of 1 % at the optimum spray pressure or setting specified in the instruction handbook. If there is no such information in the instruction handbook then the test shall be done at (300 ± 20) kPa [(3 ± 0,2) bar]. Record the sprayer output rates and calculate the percentage deviation, expressed in percent, from the values specified in the instruction handbook as

$$\text{Deviation} = \frac{\text{measured output rate}}{\text{specified output rate}} \times 100$$

5.3.3 Straps and their fixation points

WARNING — This test has some element of risk. All personnel shall either be kept out of the test area or otherwise protected from hazards such as thrown objects.

Fill the spray tank with water so that the total mass of the sprayer is 7 kg ± 10 g. Attach the sprayer to a device conforming with 4.6, so that each load-carrying strap can be tested individually. From the position at which the sprayer is carried by a strap on the device, lift the sprayer vertically 200 mm and let it drop. Repeat this 10 times for each load-carrying strap.

Inspect for damage.

NOTE The test with a 7 kg sprayer mass represents a safety factor of 5 in respect of the maximum load expected to be applied on a strap by operator handling of the sprayer.

5.3.4 Volume of external surface deposit

5.3.4.1 General

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

Wash all external surfaces of the sprayer with a non-ionic surfactant aqueous solution of 0,5 % and then dry the sprayer.

Put the lever and spray lance in the parked position. Remove the lid or the air pump. Place the filter basket in a polythene bag and fit it into the filling orifice so that the bag follows the shape of the basket.

For compression sprayers, fit a rubber bung into the filling orifice or, where an integral filling funnel is provided, seal this funnel's opening by stretching plastic film across it.

Set the sprayer over a container which can handle a volume at least equal to the nominal spray tank volume.

Position a filling device according to 4.8 with its outlet placed 100 mm above the filling opening such that it simulates overfilling. The sprayer shall be positioned with its straps opposite the filling device and with the line connecting the upper strap fixing points orientated perpendicularly to the axis of the filling device (see Annex C). The impact point of the test liquid shall be the middle of the filling opening.

Fill the filling device with a volume of test liquid or water to its maximum volume without overspill and continue according to 5.3.4.2 or 5.3.4.3.

5.3.4.2 Determination using test liquid

Pour a volume of test liquid that equates to the nominal spray tank volume from the filling device onto the closed filling opening of the sprayer such that it simulates overfilling. The flow rate shall be such that the nominal tank volume will be poured within 60 s with a maximum deviation of 10 %.

Remove the filling device and replace the container with collected test liquid with a dry container free from any tracer. This second container shall have the capacity which is at least equal to the volume of water selected to be used in the washing of the sprayer.

Wash the external surface of the sprayer with water until all deposits of tracer have been removed. Determine the amount of collected washing water using a device according to 4.9 a). Determine the tracer concentration in the washing water using a device according to 4.3.

Calculate the external surface deposit, V_D, using the following equation:

$$V_D = V_W \times \frac{C_W}{C_T}$$

where

V_W is the collected washing water in millilitres (ml);

C_T is the selected concentration of tracer in the test liquid;

C_W is the concentration of the tracer in the washing water.

The concentration of the tracer in the test liquid and the amount of washing water shall be chosen such that the external surface deposit can be determined with a maximum error of ± 1 ml.

5.3.4.3 Determination using water

Pour a volume of water that equates to the nominal spray tank volume from the filling device onto the closed filling opening of the sprayer such that it simulates overfilling. The flow rate shall be such that the nominal tank volume will be poured within 60 s with a maximum deviation of 10 %.

Remove the polythene bag and the rubber bung immediately after pouring the water and weigh the sprayer together with the lid or the air pump, using a device according to 4.9 a).

Determine the amount of external surface deposit as the difference in mass between the sprayer after water has been poured over it and the mass registered in 5.1.

5.3.5 Volume 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 and fix it to a structure in operating position. For lever-operated sprayers, a device according to 4.4 may be used.

Sprayers carried with two straps shall normally be fixed vertically, while single-strap sprayers shall be inclined according to the strap–sprayer configuration.

The lance with hose shall be fixed in a horizontal position at the same level as the lowest part of the sprayer. Spray with the biggest nozzle supplied, at the optimum spray pressure specified in the instruction handbook. If no such information is provided in the instruction handbook, perform the test at (300 ± 20) kPa [(3 ± 0,2) bar].

For compression sprayers, close the shut-off valve when the spray fan collapses even if there is at least 100 kPa (1 bar) working pressure in the tank.

For lever operated sprayers, give five additional full pump lever strokes immediately after the spray fan collapses or the spray pressure drops below 100 kPa (1 bar) and then close the shut-off valve

Weigh the sprayer using a device according to 4.9 a).

Determine the amount of total residual liquid as the difference between the mass of the sprayer after test and the mass registered in 5.1.

5.3.6 Stability

Position the empty knapsack sprayer on a flat hard surface with an incline of 10° (= 5,7 %) so that the load-carrying straps are facing down the slope. Set the lever and lance in parked position. If there is no parked position, set the lever in its highest position and the lance down the slope.

Check the stability of the knapsack sprayer by rotating it by 90°.

Repeat the test with the spray tank filled to nominal volume.

Register any tendency to instability.

5.3.7 Contents gauge scale and total volume

Place the empty knapsack sprayer in upright position on a flat, horizontal surface with the lever in the parked position.

Measure and register the volume between the marks filling the spray tank using a measuring cylinder according to 4.10 or using a device according to 4.9 a). Continue until the spray tank is filled to its nominal volume.

Determine the scale error, E, as a percentage, using the following equation:

$$E = \frac{V_S - V_m}{V_S} \times 100$$

where

V_S is the volume according to spray tank scale, in millilitres (ml);

V_m is the measured volume of water filled into the tank, in millilitres (ml).

As a second part of the test, fill the spray tank up to the upper edge of the filling opening.

For lever-operated sprayers, insert the filter basket and close the lid.

For compression sprayers, insert and tighten the air pump and, where an integral filling funnel is provided, remove all liquid from this funnel. If the filling opening is situated below any parts of the tank, such that air cushions are formed, remove the hose and fill the sprayer through the tank outlet opening with the air pump mounted.

Weigh the sprayer using a device according to 4.9 a).

Determine the total water volume by the difference between the mass of the completely filled sprayer and the mass registered in 5.1.

Calculate the additional volume, V_A, of the spray tank in percent using the following equation:

$$V_A = \frac{\text{Total volume} - \text{Nominal volume}}{\text{Nominal volume}} \times 100$$

5.3.8 Filling rate

5.3.8.1 General

This test shall be done on a complete, empty sprayer.

Wash all external surfaces of the sprayer with a non-ionic surfactant aqueous solution of 0,5 % and then dry the sprayer.

Put the lever and spray lance in the parked position. Remove the lid or the air pump, but maintain the filling filter in position.

Position the sprayer over a container which can handle a volume at least equal to the volume of water selected to be used in the washing of the sprayer for the test according to 5.3.8.2, or position the sprayer in the centre of a plastic sheet according to 4.15 for the test according to 5.3.8.3.

Position a filling device according to 4.8 with its outlet placed 100 mm above the filling opening such that it simulates overfilling. The sprayer shall be positioned with its straps opposite to the filling device, with the line connecting the upper strap fixing points orientated perpendicularly to the axis of the filling device (see Annex C). The impact point of the test liquid shall be the middle of the filling opening.

Fill the filling device with a volume of test liquid or water, to its maximum volume without overspill and continue according to 5.3.8.2 or 5.3.8.3.

5.3.8.2 Determination using test liquid

Pour a volume of test liquid that equates to the nominal spray tank volume from the filling device into the filling opening of the sprayer. The flow rate shall be such that the nominal tank volume will be poured within 60 s with a maximum deviation of 10 %.

Wash the external surface of the sprayer with water until all deposits of tracer have been removed. Determine the amount of collected washing water using a device according to 4.9 a). Determine the tracer concentration in the washing water using a device in accordance with 4.3.

Calculate the volume of splashes, V_S, using the following equation:

$$V_S = V_W \times \frac{C_W}{C_T}$$

where

V_W is the collected washing water in millilitres (ml);

C_T is the selected concentration of tracer in the test liquid;

C_W is the concentration of tracer in the washing water.

The concentration of the tracer in the test liquid and the amount of washing water shall be chosen so that the external surface deposit can be determined with a maximum error of ± 1 ml.

5.3.8.3 Determination using water

Pour a volume of water that equates to the nominal spray tank volume from the filling device into the filling opening of the sprayer such that it simulates overfilling. The flow rate shall be such that the nominal tank volume will be poured within 60 s with a maximum deviation of 10 %.

Wipe off any external residues on the sprayer with a tissue.

Determine the amount of splashes as the mass of the collected splashes on the plastic sheet and the tissue, considering their tare, using a device according to 4.9 b).

5.3.9 Emptying

This test shall be done on a complete, empty sprayer.

Fill the sprayer with water to its nominal volume. Drain the sprayer in accordance with the instruction handbook and then weigh it using a device according to 4.9 a).

Determine the amount of liquid remaining in the sprayer as the difference between the mass of the drained sprayer and the mass registered in 5.1.

5.4 Impact test

WARNING — This test has some element of risk. All personnel shall either be kept out of the test area or otherwise protected from hazards such as thrown objects.

This test shall be carried out on a complete, empty sprayer as a preparation for the tests specified in 5.5 and 5.6.

Fill the spray tank to its nominal volume with water. Set compression sprayers to their maximum nominal pressure, as specified in the instruction handbook.

Attach the sprayer to the impact test device according to 4.7. Drop the sprayer once from a height of 600 mm.

5.5 Pressure test

WARNING — This test has some element of risk. All personnel shall either be kept out of the test area or otherwise protected from hazards such as thrown objects.

The sprayer to be tested shall first be subjected to the impact test in accordance with 5.4.

Fill the spray tank with water to its nominal volume. Connect the outlet of the shut-off valve to an external pressure supply device according to 4.12.

Raise the pressure until the pressure relief valve opens or the pressure level is twice the specified maximum pressure and maintain that pressure for 30 s.

Record the result of the test and the relief valve opening pressure, if applicable.

5.6 Leakage test

5.6.1 General

This test shall be carried out on a complete, empty sprayer. The sprayer shall first be subjected to the pressure test in accordance with 5.5.

Fill the spray tank with test liquid or water to its nominal volume, close the tank opening with the lid or the air pump and remove all external residues of the liquid.

Pressurise the spray tank to the maximum pressure specified in the instruction handbook and spray for (10 ± 1) s, ensuring that no spray liquid will contaminate the sprayer surface. Replace the spray nozzle with a blank and remove all external residues of the liquid.

Place the sprayer in the upright position: on a bench, over a container, if test liquid is used; on a plastic sheet according to 4.15 if water is used. Allow the lance assembly with hose and closed shut-off valve to freely hang.

The container shall be able to handle the volume of the sprayer, and the water used in the washing and needed to completely cover the immersed sprayer.

Leave the sprayer for (300 ± 5) s and depressurise the tank immediately ensuring no new leakage.

Repeat the above test twice: first with the sprayer inclined at 45° (strap-side down) for (60 ± 1) s; then with the sprayer in a horizontal position (strap-side down) for (60 ± 1) s.

Examine for leakage for each test separately according to 5.6.2 or 5.6.3, depending on whether test liquid or water has been used.

5.6.2 Determination using test liquid

Collect escaped test liquid in a suitable container holding a volume of tap water and immerse the complete sprayer to remove any less obvious leaks. Remove the sprayer from the container and determine the amount of washing water using a device according to 4.9 a). Determine the tracer concentration using a device according to 4.3.

Calculate the volume leakage, V_L, using the following equation:

$$V_L = V_W \times \frac{C_W}{C_T}$$

where

V_W is the collected washing water in millilitres (ml);

C_T is the selected concentration of tracer in the test liquid;

C_W is the concentration of tracer in the washing water.

The concentration of the tracer in the test liquid and the amount of washing water shall be chosen so that the external surface deposit can be determined with a maximum error of ± 1 ml.

5.6.3 Determination using water

Wipe off any external residues on the sprayer with a tissue.

Determine the amount of leakage as the mass of the collected water on the plastic sheet and the tissue, considering their tare, using a device according to 4.9 b).

6 Test report

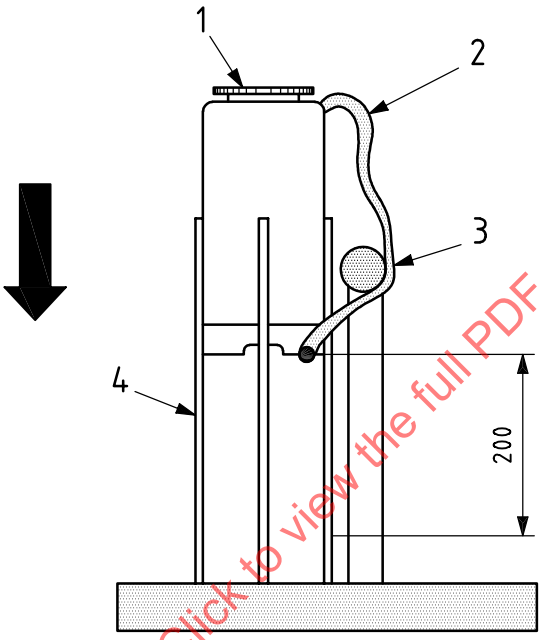
The results of the test shall be stated in a test report. An example is given in Annex D.

Annex A
(informative)

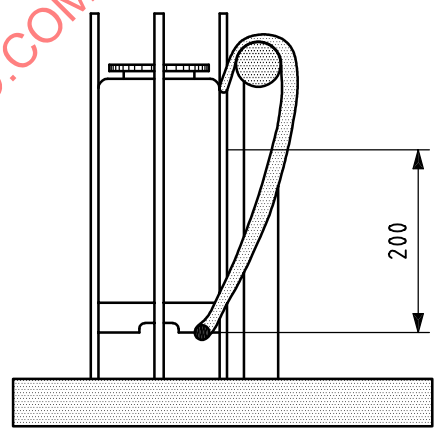
Example of strap test device

A suitable strap test device one capable of applying a controlled and reproducible force to the straps, as shown in Figure A.1.

Dimensions in millimetres



a) **Release position**



b) **Impact position**

Key

1 sprayer
2 straps
3 restraining bar
4 guides

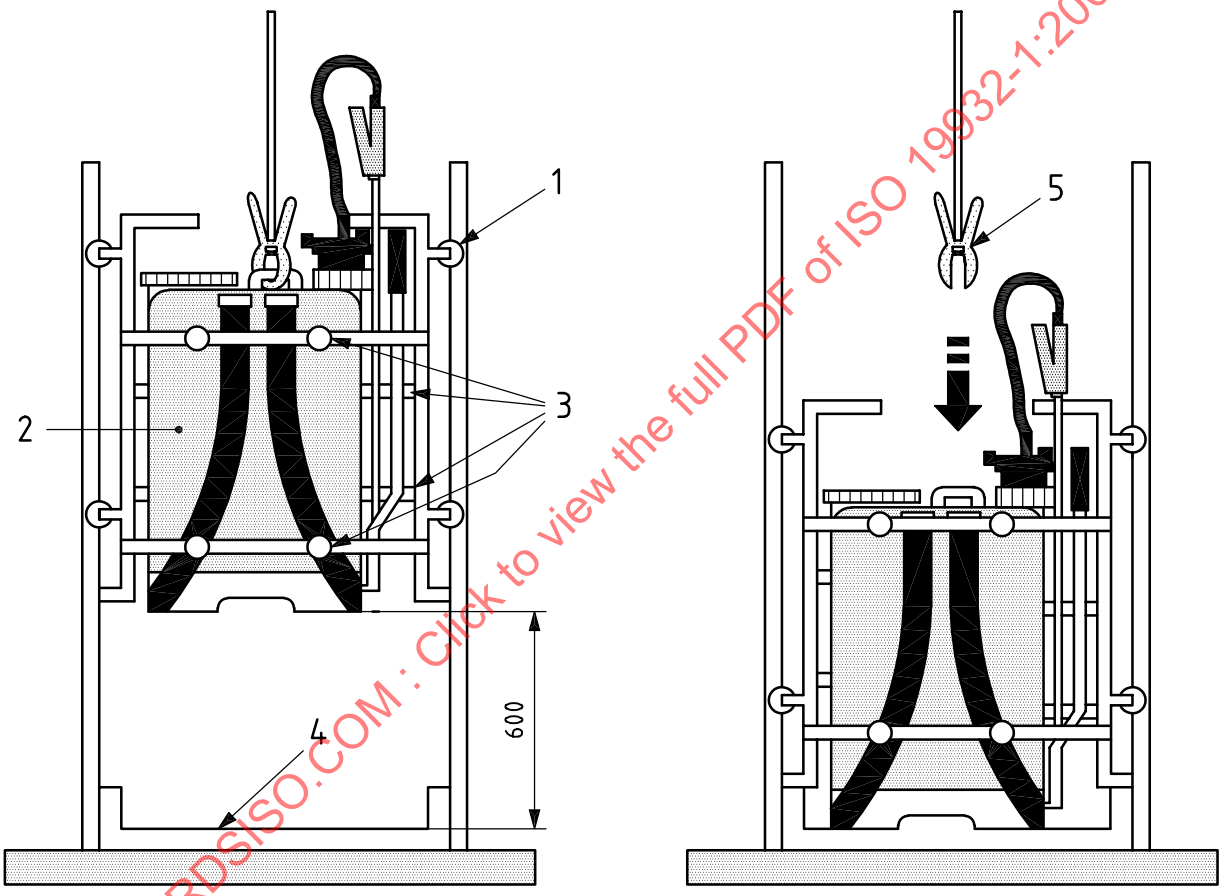
Figure A.1 — Force applied to straps

Annex B
(informative)

Example of impact test device

An suitable impact test device is one capable of making a controlled and reproducible impact to the base of the sprayer, as shown in Figure B.1.

Dimensions in millimetres



a) **Release position** b) **Impact position**

Key

1 roller
2 sprayer
3 adjustable guides
4 defined surface
5 pincers

Figure B.1 — Impact to base of sprayer

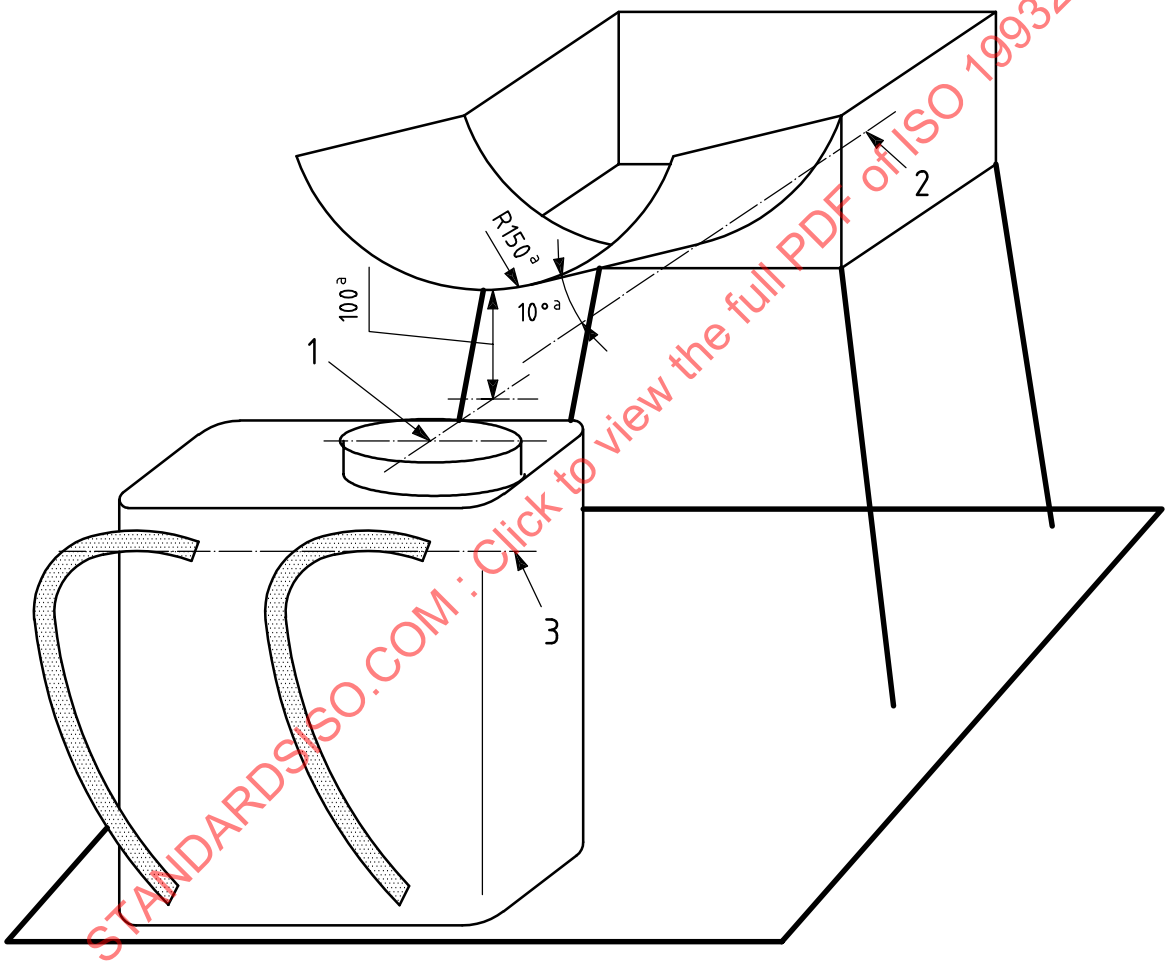
Annex C
(informative)

Example of filling device

The filling device is a stationary device simulating the filling of a sprayer with an unprofiled bucket.

The device (see Figure C.1) consists of a liquid supply system (not drawn) capable to deliver a volume equal to the nominal volume of the sprayer under test within 1 min with a controlled and adjustable flow rate with a maximum deviation of 10 %.

Dimensions in millimetres



Key

1 impact point of the test liquid
2 axis of the filling device
3 line connecting the upper strap fixation points

a Recommended dimensions.

Figure C.1 — Configuration of filling device

Annex D
(informative)

Example of a test report

Report on knapsack sprayer tests according to ISO 19932-1

Testing organization (name and address):	
Test location:	Date:

Sprayer			
Sprayer type:		Manufacturer:	
Design:	lever-operated ☐	compression ☐	
Nominal tank volume (l):		Number of straps: 1 ☐	2 ☐
Mass of complete, empty sprayer (g):			
Nozzle type		Adjustment	Optimum spray pressure (kPa)
Remarks:			
Test conditions			
Minimum temperature (°C):		Minimum rel. humidity (%):	
Maximum temperature (°C):		Maximum rel. humidity (%):	
Preconditioning			
Spray pressure (kPa):		Pump frequency (min^{-1}):	
Duration (h):			
Damage:	**Yes** ☐	**No** ☐	
Remarks:			