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Crop protection equipment — Reciprocating positive displacement pumps and centrifugal pumps — Test method

Matériel de protection des cultures — Pompes volumétriques alternatives et pompes centrifuges — 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 of 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 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 cancels and replaces the first edition (ISO 12809:2011), which has been technically revised.

The main changes compared to the previous edition are as follows.

— The definitions for the following terms have been modified:

  — 3.1 reciprocating positive displacement pump;

  — 3.2 centrifugal pump;

  — 3.12 air vent line.

— In Clause 4, text has been added to better specify the test on pump installed on the sprayer.

— In Clause 5, more specification about the test liquid has been provided.

— In 7.2, Figure 2 and related text have been added to better specify how to manage test with centrifugal pumps.

— The following subclauses have been improved:

  — 7.3

  — 7.3.1

  — 7.3.2

  — 7.3.3

  — 7.3.3.1

— 7.3.3.2

— 7.3.3.3

— A new Annex B has been added.

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.

Crop protection equipment — Reciprocating positive displacement pumps and centrifugal pumps — Test method

1 Scope

This document specifies test methods and the environmental conditions for evaluating the performance of reciprocating positive displacement pumps and centrifugal pumps designed for crop protection equipment.

This document is applicable when defining the performance of stand-alone pumps or pumps that are installed on a sprayer.

Some of the tests indicated in this document are suited only for specific pump types.

It is not applicable to pesticide metering pumps for injection systems.

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 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.

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
reciprocating positive displacement pump
machine in which liquid is trapped in confined volumes and transported from an inlet connection to an outlet connection by the reciprocating movement of pistons or plungers

3.2
centrifugal pump
non-volumetric pump in which the flow of the liquid is achieved by means of one or more impellers

3.3
suction pressure
pressure at the suction fitting of the pump

3.4
reference suction pressure
value of *suction pressure* (3.3) used for taking into account the pressure drop that is present when the pump is installed on the sprayer

3.5
delivery pressure
pressure at the *delivery fitting* (3.11) of the pump

3.6
rated pressure
maximum pressure at which the pump can be used continuously when installed on the sprayer, as declared by the pump manufacturer

3.7
rotating speed
number of revolutions of the pump shaft in the considered time interval

3.8
flow-rate
volume of liquid that flows through the pump per unit of time

3.9
power consumption
power given to the pump by the power source, measured at the inlet shaft of the pump

3.10
flow-rate adjustment valve
valve for adjusting the liquid flow

3.11
delivery fitting
body of pipelines collecting the liquid coming from the pump and routing it to the delivery pipeline

3.12
air vent line
small hose or tube connected to a *centrifugal pump* (3.2) to bleed off trapped air

Note 1 to entry: For air vent line connection is made from the highest point in the centrifugal pump casing and is routed continually upward to discharge above the highest liquid level in the tank.

4 Accuracy of measurements

Temperatures shall be measured with a maximum error of ±1 °C.

Length shall be measured with a maximum error of ±1 mm.

Suction pressure shall be measured with a maximum error of ±2 kPa.

Delivery pressure shall be measured with a maximum error of ±1 %.

Rotating speed shall be measured with a maximum error of ±1 %.

Flow-rate for stand-alone pumps according to 7.2 shall be measured with a maximum error of ±1,5 %.

Flow-rate for pump installed on a sprayer as in 7.3 shall be measured with a maximum error of ±2 % of the measured value when the flow-rate of the pump is >100 l/min, and ±2 l/min when the flow-rate of the pump is ≤100 l/min.

Load torque shall be measured with a maximum error of ±5 %, at least for values greater than the 25 % of the maximum torque.

The time measurements shall be made to an accuracy of ±1 s, with the exception of measurement indicated in 7.2.7.2 and 7.2.8.2 for which the accuracy shall be of ±0,05 s.

5 Test liquid

5.1 Water, shall be clean and free from solids in suspension with the exception of what might be considered normal for tap water (e.g. lime causing hard water). If an adjuvant or other plant protection products are added, the product identity and properties shall be documented in the test report.

6 General test conditions

6.1 Environmental conditions

The air and testing liquid temperatures shall be not less than +10 °C and not more than +45 °C.

6.2 Suction pressure

The suction pressure, expressed in kilopascals (kPa), shall be measured at the suction fitting, as close as possible to the pump.

6.3 Delivery pressure

The delivery pressure, expressed in kilopascals (kPa), shall be measured at the delivery fitting, before the adjustment valve.

6.4 Rotating speed

The rotating speed shall be expressed in revolutions per minute (r/min).

6.5 Flow-rate

The flow-rate shall be expressed in litres per minute (l/min).

The flow-rate can be determined using a flow meter or alternatively, the liquid flow could be calculated by collecting the liquid in a separate tank, measuring time and mass.

6.6 Power consumption

The power consumption shall be indicated in kilowatts (kW) and can be calculated as the rotating speed multiplied by the load torque measured on the input shaft of the pump, using Formula (1):

$$P = \frac{\pi \times n \times C}{30\,000} \tag{1}$$

where

P is the power, in kilowatts (kW);

n is the rotating speed, in revolutions per minute (r/min);

C is the load torque, in newton metres (N·m), measured on the input shaft of the pump.

Other methods giving the same result can be used when the input shaft of the pump is not accessible.

7 Test methods

7.1 General

Before starting the tests, ensure visually that all connections work properly without leakage at the maximum pressure and without unintended air intake at the maximum depression in the suction line.

If present, set the pressure of the pneumatic pressure pulsation damper as indicated by the manufacturer.

Use the test liquid specified in Clause 5.

7.2 Stand-alone pump

7.2.1 Test bench

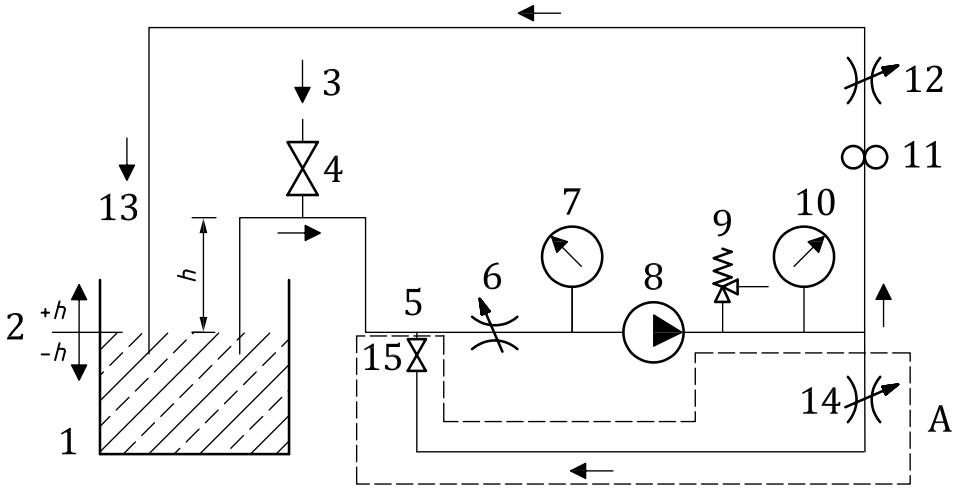
7.2.1.1 The test bench shall have a main circuit containing the devices for flow control and pressure adjustment; see Figure 1 with the scheme of hydraulic circuit for self-priming pump or Figure 2 with the scheme of hydraulic circuit for non-self-priming centrifugal pump. To simulate the installation of positive displacement pump on the sprayer, the test bench shall have an extra circuit (key A in Figure 1) with part of the flow coming back directly to the suction line of the pump.

7.2.1.2 The suction line connects the pump with the tank. It shall be fitted with an air inlet valve (key 4 in Figure 1 or Figure 2), a suction pressure adjustment valve (key 6 in Figure 1 or key 5 in Figure 2) and a suction pressure gauge (key 7 in Figure 1 or key 6 in Figure 2). For self-priming pumps, the h value shall be (400 ± 100) mm (Figure 1). For non-self-priming pumps, the h value shall be (−400 ± 100) mm (Figure 2). The inlet of the suction line shall be free, without non-return valves.

7.2.1.3 The delivery line shall be fitted with a safety valve (key 9 in Figure 1) with appropriate range able to protect the test bench, a pressure gauge (key 10 in Figure 1 or key 8 in Figure 2), a device for flow-rate measurement (key 11 in Figure 1 or key 9 in Figure 2) and a pressure adjustment valve (key 12 in Figure 1 or key 10 in Figure 2). The output of the delivery line shall be connected to the tank in order to guarantee the re-circulation of the test liquid (key 13 in Figure 1 or key 11 in Figure 2). Ensure that the back flow does not create turbulence in the suction line.

7.2.1.4 The extra circuit (key A in Figure 1) shall be fitted with a re-circulation adjustment valve (key 14 in Figure 1) and a shut-off valve (key 15 in Figure 1) able to isolate this part of the circuit.

7.2.1.5 The level of the liquid in the tank (key 2 in Figure 1 or Figure 2) shall be equal (±10 mm) to the top of the pump housing at the beginning of the test. Set the level when all the lines are filled with the test liquid. During the measurement, the level of the liquid in the suction tank shall not change by more than ± 50 mm.

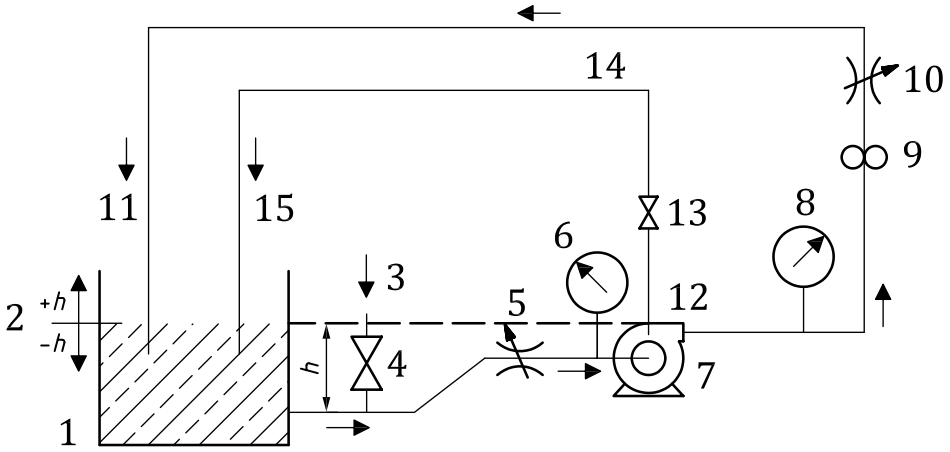


Key

1	tank	9	safety valve
2	water level in the tank	10	delivery pressure gauge
3	air inlet	11	flow-rate measurement
4	air inlet valve	12	delivery pressure adjustment valve / nozzle flow-rate adjustment valve
5	re-circulation input	13	back flow in the tank
6	suction pressure adjustment valve	14	re-circulation adjustment valve
7	suction pressure gauge	15	shut-off valve
8	pump to be tested connected to rpm measuring device		
A	extra circuit to simulate re-circulation for positive displacement pump		
h(±)	height between the water level in the tank and the air inlet valve (see keys 2 and 3)		

NOTE When using centrifugal pump with air vent lines, ensure its proper connection to the hydraulic circuit of the test.

Figure 1 — Scheme of hydraulic circuit for self-priming pump



Key

1	tank	9	flow-rate measurement
2	water level in the tank	10	delivery pressure adjustment valve / nozzle flow-rate adjustment valve
3	air inlet	11	back flow in the tank
4	air inlet valve	12	air vent connection (top plug on the pump housing)
5	suction pressure adjustment valve	13	shut-off valve for air vent line
6	suction pressure gauge	14	air vent line
7	centrifugal pump to be tested connected to rpm measuring device	15	air vent return to tank, above water level in tank
8	delivery pressure gauge	h(±)	height between the water level in the tank and the air inlet valve (see keys 2 and 3)

Figure 2 — Scheme of hydraulic circuit for non-self-priming centrifugal pump

7.2.2 Installation of pump

The pump shall be fixed on the test bench as indicated by the pump manufacturer, especially those concerning the positioning of the pump and the dimension of the fixing device.

The pump shall be connected to the test bench by non-collapsible pipelines, both at the suction and delivery side.

The internal diameter of the suction line shall be as follows:

— for hoses, equal to or greater than (max. +5 %) the internal diameter indicated by the pump manufacturer;

— for fittings, equal to or greater than (max. +5 %) the internal diameter indicated by the pump manufacturer.

The internal diameter of the delivery line shall be equal to or greater than (max. +50 %) that indicated by the pump manufacturer.

7.2.3 Reference suction pressure

The reference suction pressure value shall be (–25 ± 2) kPa.

The suction pressure valve setting shall be set once at the beginning of the test by means of suction pressure adjustment valve (key 6 in Figure 1 or key 5 in Figure 2) at the maximum rotating speed indicated by the pump manufacturer and with the delivery pressure set to (5 ± 1) % of the rated pressure.

