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Milking machine installations — Mechanical tests

Installations de traite mécanique — Essais mécaniques

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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.

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 6690 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*.

This third edition cancels and replaces the second edition (ISO 6690:1996) which has been technically revised.

Milking machine installations — Mechanical tests

WARNING — Some of the tests specified in this International Standard involve procedures which could lead to a hazardous situation. The attention of any person performing tests in accordance with this International Standard is drawn to the need to be appropriately trained in the type of work to be carried out. It is left to the responsibility of the user to check all national regulatory conditions and health and safety requirements applicable for the relevant country.

1 Scope

This International Standard specifies mechanical tests for milking machine installations in order to verify compliance of an installation or component with the requirements of ISO 5707. It also stipulates the accuracy requirements for the measuring instruments.

This International Standard is applicable for testing new installations and for periodic checking of installations for efficiency of operation. Alternative test methods may be applicable if they can be shown to achieve comparable results.

Test procedures described in Annex A are primarily for testing in the laboratory. An example of a field test procedure which can reduce the time and effort involved in testing is given in Annex C and a corresponding test report in Annex D.

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 3918:2007, *Milking machine installations — Vocabulary*

ISO 5707:2007, *Milking machine installations — Construction and performance*

3 Definitions

For the purposes of this document, the terms and definitions given in ISO 3918 apply.

4 Test equipment

4.1 General

Measurements to be made for the specific milking machine shall be determined before making the tests.

The measuring equipment shall have a precision (maximum error) that, together with the skill of the tester, ensures that the requirements given in ISO 5707 can be recorded with sufficient accuracy. The instruments shall be calibrated regularly to ensure the given specifications.

The measuring points A1, A2, Vm, Vr, Vp and Pe referred to in this International Standard are described in 4.2.2 and 4.2.3 of ISO 5707:2007.

4.2 Measurement of vacuum

The instrument used for measuring vacuum shall be able to measure with an error of less than ± 0,6 kPa and a repeatability within ± 0,2 kPa.

NOTE A vacuum gauge of accuracy class 1,0 will usually meet this requirement if calibrated at a vacuum close to that measured. The accuracy class is defined as the maximum permissible error expressed as a percentage of the pressure range for the gauge.

4.3 Measurement of a vacuum changing over time

The instrument used for measuring a vacuum changing over time shall fulfil the minimum requirements given in Table 1. If the sample rate is much higher than the minimum given in Table 1, then filtering shall be applied. The filtering frequency shall be maximum 50 % of the measuring frequency and approximately the frequency of the expected signal intended to be captured.

NOTE The minimum requirements given in Table 1 ensure that 90 % of the true amplitude and rate of vacuum changes, or 90 % of the resolution of the recording equipment (0,2 kPa), will be measured, whichever is greater.

Table 1 — Minimum sample rate and response rates for vacuum recording systems

No. of test	Type of test	Minimum sample rate Hz	Minimum response rate kPa/s
1	Tests in the receiver and in dry parts of the milking machine.	24	100
2	Test of pulsators	100	1 000
3	Wet or milking-time tests in the milkline.	48	1 000
4	Wet or milking-time tests in the claw.	63	1 000
5	Wet or milking-time tests in the short milk tube.	170	2 500
6	Milking-time test of vacuum changes in the short milk tubes during a liner slip.	1 000	22 000
7	Milking-time test of vacuum changes in the short milk tubes during a liner squawk.	2 500	42 000
NOTE Normal rate of vacuum change in the pulsation chamber in the beginning of phases a and c (see ISO 3918:2006, 5.9 and 5.11) can be about 1 000 kPa/s.			

4.4 Measurement of atmospheric pressure

The instrument used for measuring the atmospheric pressure shall be able to measure with an error of less than ± 1 kPa.

4.5 Measurement of back pressure

The instrument used for measuring back pressure shall be able to measure with an error of less than ± 1 kPa.

4.6 Measurement of airflow

The instrument used for measuring airflow shall be capable of measuring with a maximum error of 5 % of the measured value and a repeatability of 1 % of the measured value or 1 l/min of free air, whichever is the greater, over a vacuum range of 30 kPa to 60 kPa and for atmospheric pressures from 80 kPa to 105 kPa.

Correction curves shall be supplied if they are necessary to achieve this accuracy.

NOTE 1 A fixed orifice flowmeter is suitable for airflows admitted from the atmosphere. Such a meter is an adjustable calibrated valve that allows a set airflow to enter a vacuum system.

NOTE 2 To measure the air admission and leakage in a cluster or teatcup (see 8.3 and 8.4) a flowmeter actually measuring the passing airflow is necessary. A variable area flowmeter is suitable. When inserted in the long milk tube they measure expanded airflow and thus must be calibrated or corrected to the available vacuum or air pressure.

As flowmeters actually measure the flow at the operating vacuum, most meter readings shall be corrected for that vacuum and the ambient atmospheric pressure according to the instructions for the instrument.

An alternative method for measuring air admission and leakage without a flowmeter is given in Annex B.

4.7 Measurement of pulsation characteristics

The instrument, including connection tubes, used for measuring pulsation characteristics shall measure with an error of less than ± 1 pulse/min for the pulsation rate and with an error of less than ± 1 unit of percentage for the pulsation phases and the pulsator ratio (see Figure 6 of ISO 3918:2007). See also Table 1.

The dimensions of the connection tube and T-piece used for attachment to the installation shall be specified with the instrument.

4.8 Measurement of pump rotational frequency

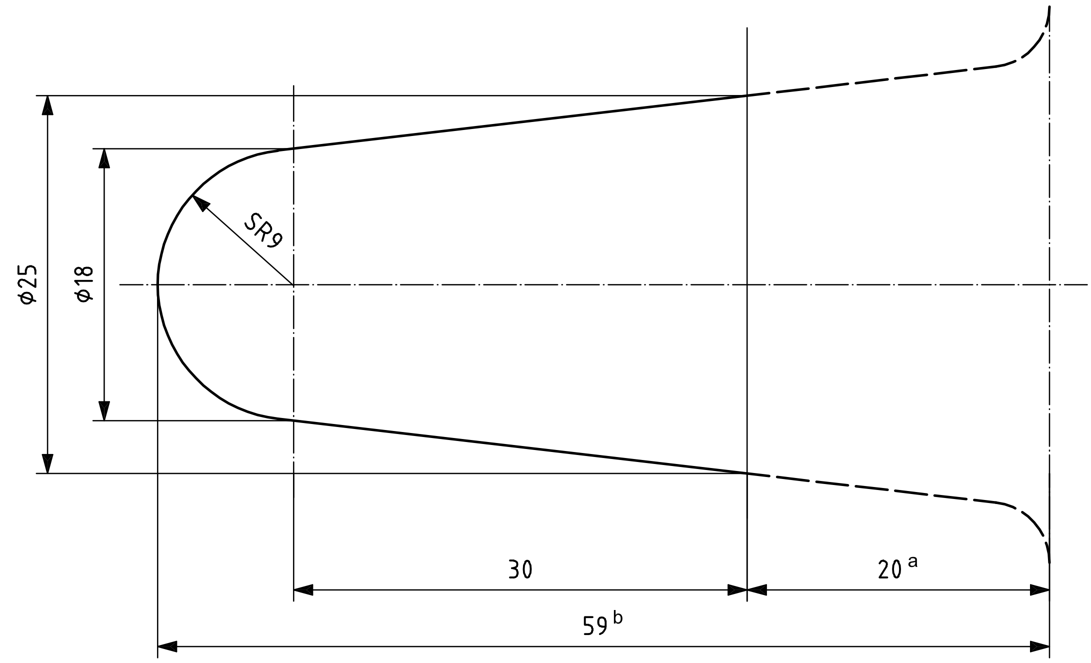
The instrument used for measuring the rotational frequency of the pump shall be able to measure with an error of less than 2 % of the measured value.

4.9 Teatcup plugs

Standard teatcup plugs which are in accordance with Figure 1 shall be used.

The plugs shall withstand cleaning and disinfection. The materials shall comply with the requirements given in 4.4 of ISO 5707:2007 for materials in contact with milk. Some means shall be provided to keep the plug in the liner (e.g. a bead or a cylindrical part).

Dimensions in millimetres
General tolerance ± 1 mm



a The design adopted for this part shall permit complete penetration into the liner.

b Length of protrusion into the liner (9 mm + 30 mm + 20 mm = 59 mm).

Figure 1 — Teatcup plug

5 Vacuum system

5.1 General requirements and preparation

5.1.1 General

5.1.1.1 To keep a milking plant in good condition, periodic checking is recommended. If the effective reserve (see 5.2.5) obtained at the acceptance test has not changed significantly, it is not necessary to perform the tests described in 5.2.4, 5.3.1 and 5.4.

5.1.1.2 For the investigation of particular defects or failures, only those tests that are appropriate to the problem need to be applied.

5.1.2 Preparation before testing

5.1.2.1 Start the vacuum pump and put the milking machine into the milking position with all milking units connected. Portable milking units shall be placed at the most distant milking positions. Teatcup plugs conforming to 4.9 shall be fitted and all controls (e.g. automatic cluster remover systems) shall be in the milking position. All vacuum-operated equipment associated with the installation shall be connected including those not operating during milking.

NOTE It should be observed that, for the measurements specified in 5.6 and 6.2, the place of the units on the milkline can influence the results significantly.

5.1.2.2 Unless otherwise specified in the user's manual, allow the vacuum pump to run for at least 15 min before taking any measurements.

5.1.2.3 Record the atmospheric pressure.

5.2 Vacuum regulation

5.2.1 Test of vacuum regulation deviation

See 5.2.1 of ISO 5707:2006.

With the milking machine running in accordance with 5.1.2, record the working vacuum at the receiver and compare it with the nominal vacuum.

5.2.2 Regulation sensitivity

See 5.2.2 of ISO 5707:2007.

5.2.2.1 With the milking machine operating in accordance with 5.1.2, connect a vacuum meter to the connection point Vm.

5.2.2.2 Record the vacuum as the working vacuum for the milking machine.

5.2.2.3 Shut off all milking units and record the vacuum. The milking machine shall then be in the same state as during milking but with no milking unit in operation.

5.2.2.4 Calculate the regulation sensitivity as the difference between the vacuum measured with no milking units in operation (see 5.2.2.3) and that with all units operating (see 5.2.2.2).

5.2.3 Regulation loss

See 5.2.3 of ISO 5707:2007 and 5.1.1.1 of this document.

NOTE This test is not applicable to bucket and direct-to-can milking machines.

5.2.3.1 With the milking machine operating in accordance with 5.1.2, connect the airflow meter with a full-bore connection to connection point A1 (see Figures 2 and 3 of ISO 3918:2007), with the airflow meter closed. Connect a vacuum meter to the connection point Vm.

5.2.3.2 Record the vacuum as the working vacuum for the milking machine.

5.2.3.3 Open the airflow meter until the vacuum decreases by 2 kPa from the value measured in 5.2.3.2.and record the airflow. For systems with capacity controlled pumps only, check that the pump is running at its maximum speed. If so, there is no regulation loss.

NOTE With multiple receivers it may be necessary to divide the air admission appropriately between connection points A1.

5.2.3.4 Stop any airflow through regulators that admit air and set capacity controlled pumps to their maximum capacity.

5.2.3.5 Decrease the vacuum by opening the airflow meter to the same as in 5.2.3.3 and record the airflow as the manual reserve for the milking machine.

5.2.3.6 Calculate the regulation loss as the difference between the airflows recorded in 5.2.3.5 and 5.2.3.3.

5.2.4 Tests of regulation characteristics

See 5.2.4 of ISO 5707:2007.

5.2.4.1 The regulation characteristics are preferably tested in the fall-off and attachment tests. The presence or absence of an automatic shut-off valve as well as quarter milking will affect the way the tests are carried out. The tests shall therefore be performed as follows.

a) Milking unit with automatic shut-off valve:

   1) use one cluster with shut-off valve enabled (fall-off test);

   2) use one teatcup, with the shut-off valve in attachment position (attachment test).

b) Milking unit without automatic shut-off valve:

   1) use one cluster (fall-off test);

   2) use one teatcup (attachment test).

c) Quarter milking:

   1) use one teatcup (fall-off test);

   2) use one teatcup with the shut-off valve in attachment position (attachment test).

Key

A	undershoot	1	phase 1: no teatcup open
B	vacuum drop	2	phase 2: teatcup(s) are open
C	overshoot	3	phase 3: teatcup(s) open
		4	phase 4: teatcup(s) are closed

Figure 2 — Regulation undershoot, vacuum drop and regulation overshoot for rapid changes in air admission

5.2.4.2 With the milking machine operating in accordance with 5.1.2, connect a vacuum recorder to measuring point Vm.

5.2.4.3 Record the vacuum for 5 s to 15 s: phase 1 of Figure 2.

5.2.4.4 While recording, open one teatcup or one cluster and record for 5 s to 15 s after the vacuum has stabilized: phases 2 and 3 of Figure 2. If 32 or more clusters or teatcups for quarter milking are connected, open one cluster or teatcup per every 32 clusters or teatcups.

If the milking unit is equipped with an automatic shut-off valve, this shall be in operation for the fall-off test, and in or out of operation as during attachment, for the attachment test.

5.2.4.5 While recording, close the teatcup or cluster and record for 5 s to 15 s after the vacuum has stabilized: phase 4 of Figure 2.

5.2.4.6 Calculate the average vacuum during 5 s of phase 1.

5.2.4.7 Find the minimum vacuum of phase 2.

5.2.4.8 Calculate the average vacuum during 5 s of the stable part of phase 3.

5.2.4.9 Find the maximum vacuum of phase 4.

5.2.4.10 Calculate the average vacuum during 5 s of the stable part of phase 4.

5.2.4.11 Calculate the fall-off vacuum drop or the attachment vacuum drop (B in Figure 2) as the average vacuum in 5.2.4.6 (phase 1) minus the average vacuum in 5.2.4.8 (phase 3).

5.2.4.12 Calculate the regulation undershoot (A in Figure 2) as the average in 5.2.4.8 (phase 3) minus the minimum vacuum in 5.2.4.7 (phase 2).

5.2.4.13 Calculate the regulation overshoot (C in Figure 2) as the maximum vacuum in 5.2.4.9 (phase 4) minus the average vacuum in 5.2.4.10 (phase 4).

5.2.5 Effective reserve for milking

See 5.2.4 of ISO 5707:2007 and 5.1.1.1 of this document.

5.2.5.1 With the milking machine operating in accordance with 5.1.2, connect the airflow meter with a full-bore connection to connection point A1 (see Figures 1, 2 and 3 of ISO 3918:2007), with the airflow meter closed. Connect a vacuum meter to the connection point Vm.

5.2.5.2 Record the vacuum as the working vacuum for the milking machine.

5.2.5.3 Open the airflow meter until the vacuum decreases by 2 kPa from the value measured in 5.2.5.2.

NOTE With multiple receivers it may be necessary to divide the air admission appropriately between connection points A1.

5.2.5.4 Record the airflow through the airflow meter.

If the ambient atmospheric pressure at the time of the test differs by more than 3 kPa from the standard atmospheric pressure for the altitude (see Table 3), the corrected airflow shall be calculated from the measured value by the method given in 5.2.6.

5.2.5.5 The airflow recorded in 5.2.5.4 shall be reduced by the air consumption of equipment normally operating during milking but not operating during the test (e.g. diaphragm milk pumps operated by float switch). The resulting airflow is the effective reserve.

5.2.6 Calculation of effective reserve capacity at standard atmospheric pressure

The predicted effective reserve, $q_{\mathrm{R,th}}$, at standard atmospheric pressure can be calculated for positive displacement vacuum pumps by:

$$q_{\mathrm{R,th}} = K_2 \times q - \frac{p_{\mathrm{s}} + p_{\mathrm{a}}}{2 \times p_{\mathrm{s}}} \times (q - q_{\mathrm{R,m}}) \tag{1}$$

where

K_2 is a factor calculated in accordance with 5.3.2.2 or the values given in Table 4;

q is the measured pump capacity, in litres per minute of free air (l/min), at the prevailing atmospheric pressure;