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Milking machine installations — Mechanical tests

Installations de traite mécanique — Essais mécaniques de vérification

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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.

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.

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

This second edition cancels and replaces the first edition (ISO 6690:1983), which has been technically revised taking into account practical experience, technical developments and the requirements of ISO 5707:1996.

Annexes A, B and C form an integral part of this International Standard. Annexes D to E are for information only.

Milking machine installations — Mechanical tests

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.

Test procedures described in annexes A, B and C 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 D and the corresponding test report in annex E.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3918:1996, *Milking machine installations — Vocabulary.*

ISO 5707:1996, *Milking machine installations — Construction and performance.*

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 3918 apply.

4 Test equipment

The measuring equipment shall have a precision that ensures that the requirements given in ISO 5707 can be recorded with the stated accuracy. The instruments shall be checked regularly to ensure the given specifications.

4.1 Measurement of vacuum level

The instrument used for measuring vacuum level shall have an accuracy of at least ± 0,6 kPa and a repeatability of at least ± 0,3 kPa.

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

4.2 Measurement of atmospheric pressure

The instrument used for measuring the atmospheric pressure shall have an accuracy of at least ± 1 kPa.

4.3 Measurement of back pressure

The instrument used for measuring back pressure shall have an accuracy of at least ± 1 kPa.

4.4 Measurement of air flow

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

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

NOTES

1 A fixed orifice flow meter is suitable for air flows admitted in from the atmosphere.

2 A variable area flow meter is suitable for measuring the air admission and leakage to a cluster (see 6.2 and 6.1). The instrument can be inserted in the long milk tube.

As flow meters are actually measuring the flow at the operating vacuum level, most meter readings have to be corrected for that vacuum level and the ambient atmospheric pressure according to the instructions from the manufacturer.

An alternative method for measuring those air flows without a flow meter is given in annex C.

4.5 Measurement of pulsation characteristics

The instrument used for measuring pulsation characteristics, including connection tubes, shall have an accuracy of ± 1 pulse/min for measuring pulsation rate and an accuracy of ± 1 unit of percentage for measuring the pulsation phases and the pulsator ratio (see ISO 3918:1996, figure 7).

NOTE — The dimensions of the connection tube and T-piece used for attachment to the installation should be specified by the instrument manufacturer.

4.6 Measurement of pump rotational frequency

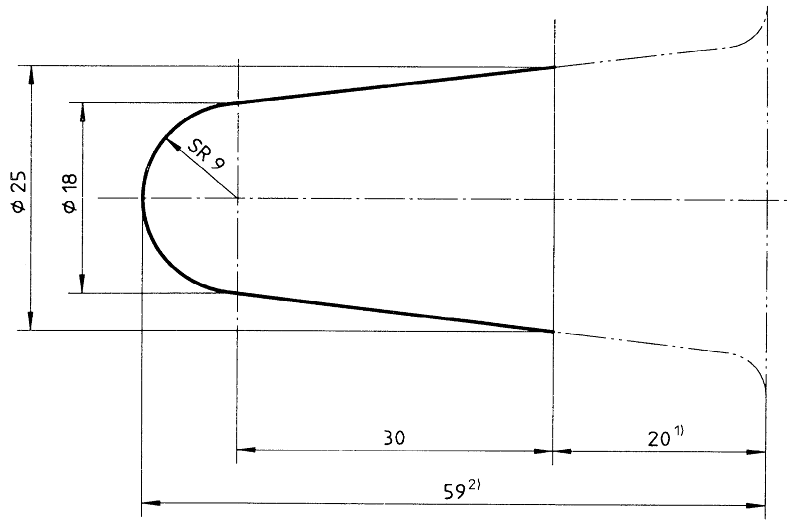
The instrument(s) used for measuring the rotational frequency of the pump, expressed in minutes to the power minus one, shall have a maximum error of 2 % of the measured value.

4.7 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 ISO 5707:1996, subclause 4.5, for materials in contact with milk. Some means shall be provided to keep the plug in the liner (for example, a bead or a cylindrical part).

Dimensions in millimetres
General tolerance ± 1 mm



1) The design adopted for this part shall permit complete penetration into the liner.
2) Length of protrusion into the liner.

Figure 1 — Teatcup plug

5 Installation tests

5.1 General requirements and preparation

5.1.1 General requirements

5.1.1.1 To keep a milking plant in good condition, periodic checking is recommended. If the effective reserve (5.2) obtained at the acceptance test has not changed, it is not necessary to perform the tests described in 5.3, 5.6 and 5.7.

5.1.1.2 For 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 4.7 shall be fitted and all controls (for example automatic cluster remover systems) shall be in the milking position. All vacuum operated equipment associated with the installation shall be connected including that not operating during milking.

NOTE — For all measurements, except those specified in 5.11 and 5.12, the place of the units on the milkline does not influence the results significantly.

5.1.2.2 Allow the vacuum pump to run for at least 15 min before any measurements.

5.1.2.3 Record the atmospheric pressure.

5.2 Effective reserve for milking

cf. 5.1.1.1 and ISO 5707:1996, subclause 5.1.

5.2.1 With the milking machine operating in accordance with 5.1, connect the air-flow meter, with a full-bore connection to connection point A1 (see ISO 3918:1996, figures 1, 2 and 3), as specified in ISO 5707:1996, subclause 4.2.1, with the air-flow meter closed. Connect a vacuum meter to the connection point Vm (see ISO 5707:1996, subclause 4.2.3).

5.2.2 Note the vacuum level as the working vacuum for the milking machine.

5.2.3 Open the air-flow meter until the vacuum level decreases by 2 kPa from the value measured in 5.2.2.

5.2.4 Note the air flow through the air-flow meter.

NOTE — If the ambient atmospheric pressure at the time of the test differs by more than 3 kPa from the normal pressure for the altitude (see table 1), the corrected air flow should be calculated from the measured value by the method given in 7.3.

5.2.5 The air flow noted in 5.2.4 shall be reduced by the air consumption of equipment not included as ancillary, normally operating during milking but not operating during the test (for example diaphragm milkpumps operated by float switch). The resulting air flow is the effective reserve.

5.3 Vacuum-pump capacity

cf. ISO 5707:1996, clause 5.

5.3.1 With the milking machine operating in accordance with 5.1, record the vacuum level at the vacuum pump measuring connection Vp (see ISO 5707:1996, subclause 4.2.3) as the working vacuum for the pump.

5.3.2 Isolate the vacuum pump from all other parts of the installation. Connect the air-flow meter directly to the vacuum pump with a full-bore connection as specified in ISO 5707:1996, subclause 4.2.1.

5.3.3 Note the air-flow meter reading at the same vacuum level as recorded in 5.3.1 as the pump capacity at the working vacuum.

NOTE — To compare the measured vacuum pump capacity with previous values when the atmospheric pressure at the time of the test differs by more than 3 kPa from the normal atmospheric pressure for the altitude (see table 1), the air flow at that altitude should be corrected by the factor K_2, given in 7.2.

5.3.4 Note the air-flow meter reading, q_{50}, in litres per minute, at a vacuum level of 50 kPa.

5.3.5 Note the rotational frequency of the vacuum pump, n, in minutes to the power minus one, at a vacuum level of 50 kPa.

5.3.6 Calculate the nominal vacuum pump capacity, q_{nom}, in litres per minute, from the formula:

$$q_{nom} = \frac{n_{nom}}{n} \times q_{50}$$

where n_{nom} is the nominal rotational frequency of the vacuum pump, in minutes to the power minus one.

NOTE — To compare the measured nominal vacuum pump capacity with the nominal values marked on the pump when the ambient atmospheric pressure differs by more than 3 kPa from the reference atmospheric pressure of 100 kPa, the flow should be corrected by the factor K_1 calculated in accordance with 7.2 or the values given in table 2. To calculate the correction the pump maximum vacuum is needed (see 5.3.7).

5.3.7 Close the air-flow meter totally until the vacuum has stabilized. Record the maximum vacuum, p_{max}, and open the flow meter again to avoid pump damage.

NOTE — This measurement needs only to be made if the pump capacity has to be corrected by calculation. The result is only relevant if the rotational frequency does not decrease by more than 1 %.

5.4 Vacuum pump exhaust back pressure

cf. ISO 5707:1996, subclause 5.6.

With the milking machine operating in accordance with 5.1, record the exhaust back pressure by measurement at the correction point Pe (see ISO 5707:1996, subclause 4.24). The milking machine shall be operating at the vacuum level recorded in 5.2.2.

5.5 Regulation sensitivity

cf. ISO 5707:1996, subclause 6.2.

5.5.1 With the milking machine operating in accordance with 5.1, connect a vacuum meter to the connection point Vm (see ISO 5707:1996, subclause 4.2.3) (same conditions as in 5.2.1).

5.5.2 Note the vacuum level as the working vacuum for the milking machine (same as 5.2.2).

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

5.5.4 Calculate the regulation sensitivity as the difference between the vacuum measured with no milking units in operation (5.5.3) and that with all units operating (5.5.2).

5.6 Regulation loss

cf. 5.1.1.1 and ISO 5707:1996, subclause 6.3.

5.6.1 Follow the procedure in 5.2.1 to 5.2.3.

5.6.2 Stop the air flow through the regulator.

5.6.3 Decrease the vacuum level, by opening the air-flow meter, to the same level as in 5.2.2 and record the air flow as the manual reserve for the milking machine.

5.6.4 Calculate the regulation loss as the difference between the air flows recorded in 5.6.3 and 5.2.3.

5.7 Regulator leakage

cf. 5.1.1.1 and ISO 5707:1996, subclause 6.4.

NOTE — For bucket plants this test is equal to that prescribed in 5.6.

5.7.1 With the milking machine operating in accordance with 5.1, connect the air-flow meter, with a full-bore connection to connection point A1 (see ISO 3918:1996, figures 1, 2 and 3) as specified in ISO 5707:1996, subclause 4.2.1, with no air flow through it. A vacuum meter shall be connected to connection point Vr (see ISO 5707:1996, subclause 4.2.3).

5.7.2 Record the vacuum level as the regulator working vacuum level.

5.7.3 Decrease the vacuum level 2 kPa by opening the air-flow meter and record the air flow.

5.7.4 Stop the air flow through the regulator.

5.7.5 Open the air-flow meter and decrease the vacuum level to the same level as in 5.7.3 and record the air flow.

5.7.6 Calculate the regulator leakage as the difference between the air flow recorded in 5.7.5 and that recorded in 5.7.3.

5.8 Vacuum gauge accuracy

cf. ISO 5707:1996, clause 7.1.

5.8.1 With the milking machine and vacuum regulator operating but with no milking unit operating, and the test vacuum meter connected to connection point (see ISO 3918:1996, figures 1, 2 and 3), as specified in ISO 5707:1996, subclause 4.2.3, or another suitable connection point near the vacuum gauge, record the values on the vacuum gauge of the plant and the test vacuum meter.

5.8.2 Note the difference between these two values as the inaccuracy of the gauge.

5.9 Airline leakage

cf. ISO 5707:1996, clause 8.4.

5.9.1 With the milking machine operating in accordance with 5.1, connect the air-flow meter, with a full-bore connection to connection point, A2 (see ISO 3918:1996, figures 2 and 3), or to the bucket plants connection point A1 (see ISO 3918:1996, figure 1), as specified in ISO 5707:1996, subclauses 4.2.1 and 4.2.2, with no flow through it. Connect a vacuum meter to connection point Vr (see ISO 5707:1996, subclause 4.2.3).

5.9.2 Record the vacuum level as the regulator working vacuum level (same as 5.7.2).

5.9.3 Isolate the vacuum system from the milking system. Stop the air flow through the vacuum regulator, stop or isolate the pulsators and all vacuum operated equipment.

5.9.4 Adjust the air-flow meter until the vacuum level is the same as recorded in 5.9.2. Note the air flow. Note the vacuum level at the vacuum pump connection point Vp (see ISO 5707:1996, subclause 4.2.3).

5.9.5 Isolate the vacuum pump from all other parts of the plant. Connect the air-flow meter directly to the vacuum pump with a full-bore connection.

5.9.6 Open the air-flow meter until the vacuum level at the vacuum pump becomes the same as noted in 5.9.4. Note the air flow.

5.9.7 Calculate the airline leakage as the difference between the air flow recorded without the airline connection (5.9.6) and the air flow with the airline connected (5.9.4).

5.10 Milk system leakage

cf. ISO 5707:1996, clause 11.1.

NOTE — This method implies a good repeatability of the vacuum meter and air flow meter, especially if the leakages are small.

5.10.1 With the milking machine operating in accordance with 5.1, connect the air-flow meter, with a full-bore connection to connection point A2 (see ISO 3918:1996, figures 2 and 3), as specified in ISO 5707:1996, subclause 4.2.2, with no flow through it. Connect vacuum meter to connection point as Vr (see ISO 5707:1996, subclause 4.2.3).

5.10.2 Note the vacuum level as the regulator working vacuum level (same as 5.7.2).

5.10.3 Stop the air flow through the vacuum regulator, stop or isolate the pulsators and all vacuum operated equipment. Plug all air admissions.

5.10.4 Adjust the air-flow meter until the vacuum level is the same as that level noted in 5.10.2. Note the air flow.

5.10.5 Isolate the milk system.

5.10.6 Open the air-flow meter until the vacuum level becomes the same as in 5.10.2. Note the air flow.

5.10.7 Calculate the milk system leakage as the difference between the air flow noted in 5.10.6 and that noted in 5.10.4.

5.11 Pulsation system

cf. ISO 5707:1996, clause 10.

5.11.1 With the milking machine operating in accordance with 5.1, let the pulsator run for at least 3 min.

5.11.2 Connect the instrument specified in 4.5 to the furthest short pulse tube or, for alternate pulsation, the furthest short pulse tube between the shell and the short pulse tube for each side of the pulsator.

5.11.3 Record five consecutive pulsation cycles and analyse the results. Using the pulsation chamber vacuum record, calculate the average pulsation rate, pulsator ratio and the duration of phases a, b, c and d (see ISO 3918:1996, figure 7).

For alternate pulsation these values shall be obtained for both sides of the pulsator and the limping shall be calculated.

Phase b shall be checked to ensure that the vacuum level is not less than the maximum pulsation chamber vacuum minus 4 kPa.

Phase d shall be checked to ensure that the vacuum level does not exceed 4 kPa.

5.12 Vacuum drop in airline

cf. ISO 5707:1996, clause 8.3.

5.12.1 Follow the procedure in 5.2.1 to 5.2.3.

5.12.2 Note the vacuum level at the vacuum pump connection point Vp (see ISO 5707:1996, subclause 4.2.3).

5.12.3 Calculate the vacuum drop to the vacuum pump, as the difference between the vacuum recorded in 5.2.2 (at the receiver) minus 2 kPa, and that recorded in 5.12.4 (at the vacuum pump).

5.12.4 For recorder and pipeline plants record the vacuum level at the regulator connection point Vr (see ISO 5707:1996, subclause 4.2.3).

5.12.5 Calculate the vacuum drop between the receiver and regulator as the difference between the vacuum recorded in 5.2.2 (at the receiver) minus 2 kPa, and that recorded in 5.12.4 (at the regulator).

5.12.6 Calculate vacuum drop in the pulsator air line as the difference between the vacuum recorded in 5.2.2 and the maximum pulsation chamber vacuum as derived in 5.11.3 of the most distant milking unit.

Equipment using vacuum from the pulsator air line during milking, such as automatic cluster removers, has to be considered and should be operated during testing of the maximum pulsation chamber vacuum.

5.13 Air-flow rate at the end of the long milk tube

cf. ISO 5707:1996, subclause 12.1 and clause 15.

5.13.1 Check the length and internal diameter of the long milk tube.

5.13.2 With the milking machine operating in accordance with 5.1, connect a vacuum meter to the connection point Vm (see ISO 5707:1996, subclause 4.2.3) (same as 5.5.1).

5.13.3 Note the vacuum level as the working vacuum for the milking machine (same as 5.2.2 and 5.5.2).

5.13.4 Connect the air-flow meter to the end of the long milk tube instead of the claw. For buckets the pulsator shall run connected to the cluster, but without milking vacuum to the cluster.

5.13.5 Note the vacuum level at this point with the air-flow meter closed and at buckets with an air inlet of 10 l/min.

5.13.6 Open the air-flow meter until the vacuum level at the flow meter is 5 kPa lower than the vacuum measured in 5.13.5.

5.13.7 Note the reading of the air-flow meter as the air-flow rate at the end of the long milk tube.

NOTE — To be relevant, the capacity measured by this method has to be smaller than the effective reserve.

5.14 Leakage in releasers

cf. ISO 5707:1996, subclause 19.1.

In the case of installations with transparent receivers, look for bubbles in the receiver after the releaser milk pump has stopped pumping and while the receiver is still under vacuum. Alternatively, and for non-transparent receivers, follow the procedure in 5.14.1 to 5.14.5.

5.14.1 With a vacuum level in the receiver, immerse the end of the delivery line in a can of water.

5.14.2 Let water into the receiver with a flow similar to the capacity of the releaser.

NOTE — To make it possible to indicate the leakage, it is essential that no air bubbles formed by the incoming water enter the releaser.

5.14.3 Start the releaser and look for bubbles from the delivery line. After the discharge has reached a steady state condition the releaser is considered tight if no bubbles appear from the submerged end of the delivery line.

5.14.4 Stop the releaser and entry of water to the receiver.

5.14.5 Check if water is sucked back to the receiver by controlling any drop in the water level in the can or rise in water level in the receiver.

5.15 Vacuum drop at vacuum taps

cf. ISO 5707:1996, subclause 12.2.

5.15.1 With the milking machine running, connect the air-flow meter to the vacuum tap with a reading of 150 l/min.

5.15.2 Connect a vacuum meter to the vacuum tap upstream of the one with the air-flow meter.

5.15.3 Note the vacuum level at the air-flow meter with an air flow of 150 l/min and at the other tap with no air through it.

5.15.4 Calculate the vacuum drop at the vacuum tap as the difference of the vacuum levels noted in 5.15.3.

6 Component tests

6.1 Leakage through cluster shut-off valves

cf. ISO 5707:1996, subclause 16.2.