INTERNATIONAL STANDARD

ISO 5707

Third edition
2007-02-15

Milking machine installations — Construction and performance

Installations de traite mécanique — Construction et performances

Reference number
ISO 5707:2007(E)

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Published in Switzerland

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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 5707 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 5707:1996) as well as ISO 5707:1996/Cor.1:1997, which have been technically revised.

Introduction

This International Standard has been developed in response to worldwide demand for minimum specifications for milking machine installations. The basic requirements for the construction and performance of milking machines for animals are determined by the physiology of the animal and the need for a standard of high hygiene and milk quality.

Milking machine installations — Construction and performance

1 Scope

This International Standard specifies the minimum performance and information requirements and certain dimensional requirements for satisfactory functioning of milking machines for milking and cleaning. It also specifies minimum requirements for materials, design, manufacture and installation.

This International Standard is applicable to milking machines for milking cows, water buffaloes, sheep and goats where animals are milked with pulsation created by vacuum, and where milk is, at least partly, transported with the help of airflow. Some clauses are not applicable to all types of milking machines. The qualitative requirements also apply to installations for milking other mammals used for milk production.

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 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 6690:2007, *Milking machine installations — Mechanical tests*

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

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

ISO 14159, *Safety of machinery — Hygiene requirements for the design of machinery*

IEC 60335-2-70, *Household and similar electrical appliances — Safety — Part 2-70: Particular requirements for milking machines*

3 Terms and definitions

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

4 General

4.1 Tests for compliance

The methods for performance testing referred to in this document are specified in ISO 6690.

These testing methods may not be sufficient to test the performance of an installation incorporating special design features. In order to avoid limitation of development, other systems than those described in this International Standard can be used if the same result can be achieved. Such systems and other special performance characteristics that are not covered by the requirements in this International Standard should also be described and specified in the user's manual.

4.2 Access for measurements

4.2.1 General

The connection points specified in 4.2.2 and 4.2.3 shall be provided to test the function of the installation. Dismantling parts of the milking machine is acceptable to access these connection points. All connection points and their location shall be described in the user's manual.

4.2.2 Airflow measuring connections

The following connection points shall be provided for an airflow meter:

— A1: to enable measurement of effective reserve, manual reserve and regulator leakage:

  — in bucket or direct-to-can milking machines, between the regulator sensing point and the first vacuum tap;

  — in pipeline milking machines, at or near the receiver(s), upstream of the sanitary trap(s);

  — in recorder milking machines, at every sanitary trap, or near the sanitary trap(s) on the milking vacuum line(s);

— A2: to enable measurement of leakage into the vacuum and milk systems, between the vacuum pump(s) and the sanitary trap(s) or the first vacuum tap.

See connection points A1 and A2 in Figures 1, 2 and 3 of ISO 3918:2007.

NOTE In bucket and direct-to-can milking machines, the connection point A2 is the same as A1.

When closed, e.g. not in use, these connection points shall not form any trap for liquids. The connection point shall have the same internal diameter as the air line or (48,5 ± 2) mm, whichever is smaller.

4.2.3 Vacuum measuring connections

The following connection points shall be provided for a vacuum meter:

— Vm at or upstream of the measuring point A1;

— Vr near each regulator sensing point;

— Vp near each vacuum pump inlet.

To enable measurement of exhaust backpressure, a suitable connection point Pe shall be provided to measure exhaust backpressure on each exhaust line at the vacuum pump outlet.

See measuring connections Vm, Vr, Vp and Pe in Figures 1, 2 and 3 of ISO 3918:2007.

NOTE In a pipeline milking machine, Vm can be any point in the milking system in, or upstream of, the receiver. In a recorder milking machine, Vm can be in the milking vacuum line or in the nearest convenient recorder jar. In a bucket milking machine, Vm = Vr and can be combined with the nearest convenient vacuum tap.

These connection points should be located at least five pipe diameters from any elbows, air inlet points or other fittings creating air turbulence.

If the regulator sensing point is on a branch, there shall be two measuring points Vr, one to measure the vacuum drop in the air line upstream of this branch and the other one to determine the regulator leakage near the regulator sensing point.

4.2.4 Other necessary measures

Means shall be provided to isolate the vacuum pump from the installation to make it possible to measure the vacuum pump capacity.

To enable measurement of leakage into the vacuum system and of the air used to produce pulsation, it is necessary that the pulsators can be stopped or disconnected in all types of installation.

4.3 Safety and hygiene

Installations shall comply with the relevant safety requirements given in ISO 12100-1 and ISO 12100-2. The electrical components shall comply with the relevant safety requirements given in IEC 60335-2-70.

NOTE The significant hazards which require action to reduce risk are: crushing, shearing and slipping, tripping and falling hazards; electrostatic phenomena and external influences on electrical equipment, noise; unhealthy postures, inadequate local lighting and hazards caused by failure of the energy supply or disorder of the control system.

The hygiene requirements given in ISO 14159 apply.

The equipment has to be effective, easy and safe to use and test.

Since most milking machines depend on a public electricity supply that fails occasionally, alternate means for operating the machine in such emergencies should be installed. It is important to design and install the equipment so that noise levels in the cowshed or parlour and in the vicinity are as low as practicable and comply with requirements in national legislation.

Milking equipment and connection to milk storage facilities on the farm should be designed and maintained to minimize turbulence, frothing, foaming or agitation of the milk, thereby reducing physical damage to the milk fat and the development of free fatty acids.

Further safety and hygiene requirements will be covered by legislation that will be the subject of other International Standards.

4.4 Materials

All components that are subjected to a vacuum shall be designed and constructed to withstand a minimum vacuum of 90 kPa without permanent distortion.

Materials that may involve danger if damaged, such as glass, shall be designed using a safety factor of 5 against external pressure (i.e. 5 × 90 kPa).

Materials in contact with milk shall meet requirements for food contact surfaces. All materials in contact with milk or cleaning solutions, whether used for rigid components (e.g. buckets, pipelines or recorder jars) or flexible components (e.g. joint rings, teatcup liners), shall be constructed to withstand the maximum temperature used in the plant as specified in the user's manual. In addition, such materials, when used in accordance with the recommendations in the user's manual, shall not impart taint to the milk.

All milk contact surfaces shall be free from engraving or embossing. All metal milk contact surfaces, except for welded seams, shall have a surface roughness, Ra, less than or equal to 2,5 µm when tested in accordance with ISO 4288. Surface roughness, Ra, on welded seams shall not exceed 16 µm.

Copper or copper alloys shall not be used in any part of the installation that may come into contact with milk or cleaning and disinfecting fluids other than water.

Materials that come into contact with cleaning and disinfecting fluids at concentrations of normal use shall be suitable for such contact. Materials that also come into contact with milk shall be resistant to both milk fat and cleaning and disinfecting solutions.

4.5 User's manual

4.5.1 General

The user's manual shall specify a system of measures that ensure that the function, safety and hygiene of the milking machine are maintained during its intended lifetime. This includes instructions for routine servicing and replacement of individual parts. An indication shall be given as to whether particular actions should be performed by the user or if other suitably qualified personnel are needed.

If it is intended that the user shall make adjustments, instructions for such adjustments shall be included. If special tools are required, these shall be supplied with the installation.

The user's manual shall be written in at least one of the country's official languages that is relevant for the user.

Besides the instructions stated in this clause, data given in other clauses in this document shall also be specified in the user's manual.

4.5.2 Installation details

At least the following details shall be provided:

— mounting dimensions, space requirements and critical building dimensions;

— recommended ambient conditions for the different parts of the milking machine;

— minimum electrical power supply and earthing requirements;

— minimum water supply and drainage requirements;

— nominal working pressure and capacity of a compressed air system;

— amount of airflow and vacuum for cleaning;

— the minimum required airflow use of vacuum-driven ancillary equipment.

4.5.3 Instructions for use

At least the following instructions shall be provided:

— start up, operating and shut down procedures;

— the effective reserve, as calculated and as measured;

— recommended cleaning and disinfecting procedures, including temperatures and chemicals, and components requiring manual cleaning;

— the maximum temperature at which the installation can be cleaned and disinfected;

— definition of any manual intervention, such as manual actuation of valves or replacement of single use items such as filters, along with the appropriate time interval;

— procedures necessary to avoid contamination of the milk from cleaning solutions, withheld, abnormal and undesirable milk;

— the maximum number of units or maximum milk flow per slope of the milkline;

— procedures for introducing animals new to the milking installation.

5 Vacuum system

5.1 General

The ultimate goal of vacuum regulation is to maintain vacuum conditions at the teat end within the intended range. In order to meet this requirement the machine shall be capable of adequate vacuum control and the operators shall use the machine with reasonable care and in accordance with the user's manual.

5.2 Vacuum regulation

5.2.1 Vacuum deviation

The regulation system shall, together with the vacuum pump capacity, be such that the working vacuum, after a specified start-up period, at measuring point Vm, is maintained within ± 2 kPa of the nominal vacuum when tested in accordance with 5.2.1 of ISO 6690:2007. The minimum start-up time shall be specified in the user's manual.

5.2.2 Regulation sensitivity

The regulator(s) shall control the working vacuum such that, when tested in accordance with 5.2.2 of ISO 6690:2007, the regulation sensitivity does not exceed 1 kPa.

5.2.3 Regulation loss

In order to use the installed vacuum pump capacity efficiently, the regulation loss, when tested in accordance with 5.2.3 of ISO 6690:2007, shall not exceed 35 l/min of free air or 10 % of the manual reserve, whichever is the greater.

NOTE Regulation loss and effective reserve depend on the vacuum pump capacity, the regulation characteristics and the vacuum drop between Vm and the regulator sensing point. See 5.6.2 and Figure 6 of ISO 3918:2007.

5.2.4 Regulation characteristics and effective reserve

The regulation characteristic overshoot shall be less than 2 kPa when the regulation characteristic tests are conducted in accordance with 5.2.4 of ISO 6690:2007.

One of the following requirements shall be fulfilled:

— the regulation characteristic vacuum drop and undershoot shall be less than 2 kPa when the regulation characteristic test is conducted in accordance with 5.2.4 of ISO 6690:2007

or

— at least the minimum effective reserve at standard atmospheric pressure shall be that given in A.1 for cows and buffaloes and in D.1 for sheep and goats.

The calculation of the effective reserve in accordance with A.1 and D.1 is considered to be sufficient for small milking systems and where the operator(s) take reasonable care to avoid air inlet in the cluster during normal milking, whereas the vacuum drop and undershoot tests are more appropriate for large milking systems and where the operators are less careful during attachment. Under such circumstances, there should be sufficient effective reserve to maintain the working vacuum within ± 2 kPa at measuring point Vm during the course of normal milking, including teatcup attachment and removal, liner slip or teatcup/cluster fall, for most of the milking time.

The effective reserve shall be measured in accordance with 5.2.5 of ISO 6690:2007. Standard atmospheric pressures are given in Table A.4.

5.3 Vacuum pumps

5.3.1 General

The vacuum pump shall have adequate airflow capacity to meet the requirements for milking and cleaning, including the air used by all ancillary equipment operating during milking and cleaning, whether continuously or intermittently.

For calculation of airflow capacity of the vacuum pump see the examples in Annex A. The airflow shall be measured in accordance with 5.3.1 of ISO 6690:2007.

If more than one vacuum pump is installed, it shall be possible to isolate the pump(s) not in use.

5.3.2 Influence of altitude

Vacuum pump capacity decreases with altitude. This shall be taken into account when determining vacuum pump capacity. See A.5.

5.3.3 Exhaust

The exhaust shall not obstruct the passage of the exhaust air by sharp bends, T-pieces or unsuitably designed silencers.

Means shall be provided to minimize oil discharge from oil-lubricated vacuum pumps into the environment, for example with an oil separator, collection or recirculation system fitted in the exhaust pipe.

Moisture from the exhaust pipe shall be prevented from entering the vacuum pump, for example by fitting a moisture trap or having an exhaust pipe with a continuous slope away from the vacuum pump.

The exhaust pipe should not discharge into a closed room where foodstuffs are stored or processed, or where persons or animals are present.

5.3.4 Prevention of reverse flow through vacuum pump

Automatic means shall be provided to prevent reverse flow of air from the exhaust, which may contaminate the milk system.

5.3.5 Location

The vacuum pump shall be located so that the air line vacuum drop recommendation in 5.6.2 can be achieved using air lines with reasonable diameter. The vacuum pump shall be installed so that its capacity, vacuum and, where applicable, speed can be easily measured.

NOTE The vacuum pump should be placed in a well-ventilated and non-freezing area isolated from the milking parlour and milk room.

5.3.6 Marking and specifications

The vacuum pump shall be indelibly marked with the following information:

— the name of the manufacturer;

— the type and identification, e.g. model number or code;

— the direction of rotation;

— the recommended operating speed(s), corresponding capacity at 50 kPa, expressed as free air at an atmospheric pressure of 100 kPa, and power consumption in kW;

— when applicable, the maximum permissible exhaust backpressure, measured in accordance with 5.3.3 of ISO 6690:2007.

The user's manual shall also state:

— the oil consumption, if appropriate;

— the recommended lubricant, if used;

— mounting points and dimensions;

— how a capacity-controlled vacuum pump can be run with its maximum and/or constant capacity.

5.4 Vacuum regulator

5.4.1 Regulator leakage

The regulator leakage, when tested in accordance with 5.4 of ISO 6690:2007, shall not exceed 35 l/min of free air or 5 % of the manual reserve, whichever is the greater.

5.4.2 Mounting

The vacuum regulator shall be mounted in a readily accessible location and protected from moisture from the milking machine and installed in a place and manner in which it is protected from excessive dust.

Examples of location of the sensing point are:

a) in pipeline and automatic milking machines, either between the interceptor and the sanitary trap or in the sanitary trap or in the receiver;

b) in recorder milking machines, either between the interceptor and the sanitary trap or in the sanitary trap or in the milking vacuum line;

c) in bucket milking machines, either between the interceptor and the first connection to the air line or on the interceptor.

Vacuum sensors not fulfilling the hygiene requirements shall be located in the vacuum system as near to the sanitary trap as practical.

The regulator should be installed in a place and manner so as to minimize noise for the operator(s).

5.4.3 Marking and specification

The vacuum regulator shall be marked indelibly with the following information:

— the name of the manufacturer;

— the type and identification, e.g. model number or code;

— the designed working vacuum range;

— the airflow capacity range at 50 kPa working vacuum, expressed as free air at an atmospheric pressure of 100 kPa.

The user's manual shall also state the airflow capacity at the upper and lower end of the designed working vacuum range.

5.5 Vacuum gauge

5.5.1 General

Over the vacuum range from 20 kPa to 80 kPa, the vacuum gauge shall indicate intervals of 2 kPa or less. When mounted and calibrated, the error measured in accordance with 5.5 of ISO 6690:2007 shall not exceed 1 kPa at the working vacuum.

NOTE 1 A vacuum gauge of accuracy class 1,6 that is calibrated and adjusted in place will meet this requirement.

NOTE 2 The accuracy class is the maximum permissible error expressed as a percentage of the pressure range for the gauge.

5.5.2 Mounting

A vacuum gauge shall be mounted where it is readable while milking.

NOTE More than one vacuum gauge may be needed.

5.6 Air lines

5.6.1 General

Air lines shall be installed so that they are sloped to a readily accessible drain valve and are self-draining when the vacuum is shut off. Provision shall also be made for cleaning and inspection of these lines.

5.6.2 Internal diameter and airflow

The internal diameter of the air lines shall be of large enough dimensions that the vacuum drop does not seriously affect the functioning of the milking machine. The vacuum drop between Vm and Vr reduces the regulating range of the regulator and may increase the regulation loss. The vacuum drop between Vr and Vm shall therefore not exceed 1 kPa when tested in accordance with 5.6 of ISO 6690:2007.

The vacuum drop between Vm and Vp leads to higher vacuum at Vp, increases power consumption and decreases the vacuum pump capacity. Therefore the vacuum drop between Vm and Vp should preferably not exceed 3 kPa.

Annex B gives guidelines for the required internal diameter of the air lines based on the specified vacuum drop and the effective length of the pipe system at a given average airflow.

5.7 Interceptor

An interceptor shall be fitted near the vacuum pump, between the vacuum pump and the regulator.

There shall not be any intermediate connections into the air line between the interceptor and the vacuum pump, except as required for test purposes or connection of a safety valve.

NOTE The safety valve may be fitted to protect the pump from effects of high vacuum caused by the activation of any vacuum shut-off valve in the interceptor.

Means shall be provided to prevent liquids trapped in the interceptor from entering the vacuum pump. It shall also be provided with automatic drainage facilities and it shall be possible to inspect and clean the inside of the interceptor.

The effective volume of the interceptor shall be given in the user's manual, as measured in accordance with 5.7 of ISO 6690:2007.

The effective volume should be adequate to facilitate washing of the air lines and should be determined by the air line sizes.

5.8 Sanitary trap

A sanitary trap shall be fitted between the milk system and the vacuum system in pipeline and recorder milking machines, between the receiver vessel and the vacuum system, except where the vacuum and pulsation systems form part of the routine circulation cleaning and disinfection system.

The sanitary trap shall have provision for drainage and shall have means to minimize liquid entry into the vacuum system

The effective volume of the sanitary trap shall be stated in the user's manual, measured in accordance with 5.8 of ISO 6690:2007.

It shall be possible for the operator to detect the presence of milk and/or cleaning solutions in the sanitary trap when the machine is running, for example by use of transparent sections.

NOTE It is an advantage to the operator if the trap is situated adjacent to the receiver and within sight during milking.

Where there is no provision for circulation cleaning of the sanitary trap(s), the receiver(s) and the receiver air line, this line shall be designed to drain towards the sanitary trap(s).

5.9 Leakage into the vacuum system

When determined in accordance with 5.9 of ISO 6690:2007, leakage into the vacuum system shall not exceed 5 % of the vacuum pump capacity at the working vacuum and for capacity-controlled vacuum pumps at the pump's maximum capacity.

5.10 Vacuum taps for bucket milking units

The vacuum drop across the tap shall not exceed 5 kPa with an airflow of 150 l/min of free air through the tap, measured in accordance with 5.10 of ISO 6690:2007.

The taps shall have stops at the fully open and fully closed positions. The taps shall be fixed to the air pipeline to prevent displacement in relation to the pipeline orifices. Gaskets shall not obstruct the tap aperture. The taps shall be connected to the upper part of the pipe.

For taps connected by means of a special adapter, the adapter shall be considered as part of the tap.