International Standard ISO 6690

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Milking machine installations — Mechanical tests

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6690 was developed by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, and was circulated to the member bodies in April 1981.

It has been approved by the member bodies of the following countries :

Australia	India	Poland
Austria	Iran	Portugal
Belgium	Iraq	Romania
Brazil	Ireland	South Africa, Rep of
China	Italy	Spain
Egypt, Arab Rep. of	Korea, Dem. P. Rep. of	Sweden
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Germany, F. R.	Netherlands	USSR

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Czechoslovakia
Denmark
New Zealand

Milking machine installations — Mechanical tests

0 Introduction

This International Standard describes the tests to be used to determine whether a milking machine installation complies with the requirements of ISO 5707. The full mechanical test procedure, given in clause 6, should be followed for a new installation prior to acceptance by the purchaser, to whom the data obtained should be supplied for future reference.

For periodic checking by investigation of particular defects or failures, only those tests which are appropriate to the problem need be applied.

1 Scope

This International Standard specifies mechanical tests for milking machine installations in order to verify compliance of an installation with the requirements of ISO 5707 and to verify that any claims made in complying with the marking clauses in ISO 5707 are justified. It also stipulates the accuracy requirements for the measuring instruments.

2 Field of application

This International Standard is applicable for testing new installations prior to acceptance by the purchaser and for periodic checking of installations for efficiency of operation.

3 References

ISO 3918, *Milking machine installations — Vocabulary.*

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

4 Definitions

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

5 Test equipment

Usual hand tools and items of small equipment for testing are required, together with instruments for making particular measurements.

The measuring instruments specified in 5.1 to 5.4 shall be checked for accuracy at least once per year.

5.1 Measurement of vacuum level

The instrument used shall be scaled at intervals of not more than 2 kPa[1] and the error with either increasing or decreasing vacuum shall not exceed 1,0 % of the maximum scale value.

5.2 Measurement of air flow

The instrument used shall measure air flow in litres of free air per minute and shall have a maximum error of 5 % of the measured value. It shall be supplied with correction curves for the vacuum range 30 to 60 kPa for levels of barometric pressure from 80 to 105 kPa.

5.3 Measurement of pulsation chamber vacuum cycle

The instrument used for measuring phases *b* and *d* (see ISO 3918, figure 6) and pulsator ratio shall have a maximum error of ± 3 %.

1) 1 Pa = 1 N/m^2

If a vacuum recorder is used, it shall have a paper speed of at least 25 mm/s, constant to within ± 2 %, and a pen deflection of approximately 30 mm for 40 kPa, constant to within ± 3 % (i.e. a maximum error in deflection of ± 1 mm over the scale range).

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

5.4 Measurement of pump speed

The instrument(s) used shall be suitable for measuring the frequency of rotation (min^{-1}) with a maximum error of 2 %.

5.5 Teatcup plugs

Standard teatcup plugs, in accordance with figure 1, shall be used.

The plugs shall withstand cleaning and disinfection.

Dimensions in millimetres

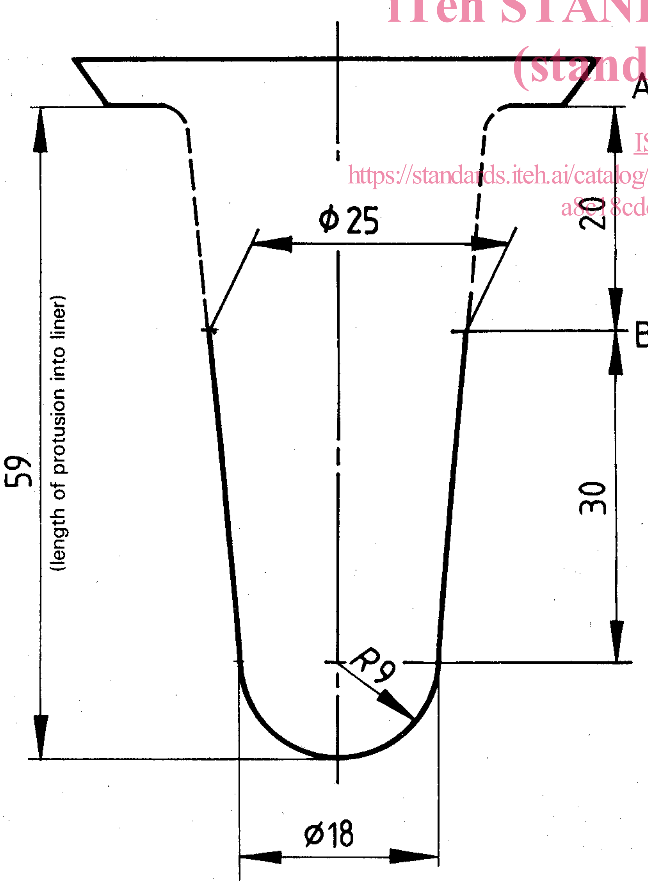

Figure 1 — Teatcup plug

The design adopted for the outer part of the plug (A-B) shall permit complete penetration into the liner.

5.6 Airtight can

An airtight can of capacity approximately 20 l is required.

6 Mechanical tests

In all cases, the vacuum pump shall be allowed to run for at least 15 min before measurement of vacuum level or air flow rate is made, and the installation shall be checked for compliance with the requirements of ISO 5707 relating to construction.

6.1 Effective reserve (see ISO 5707, sub-clause 6.1)

6.1.1 Put the milking machine into the milking position with teatcup plugs (5.5) fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.1.2 Record the vacuum level at, or near to, the vacuum regulator.

6.1.3 Connect the air flow meter with a full bore connection to the T-piece specified in 7.3 of ISO 5707.

Open the air flow meter until the vacuum level decreases by 2 kPa.

6.1.4 Record the air flow through the air flow meter.

NOTE — If the prevailing barometric pressure at the time of the test differs by more than 2 kPa from the standard pressure for the altitude (see 7.1), the true effective reserve at that altitude shall be predicted from the measured value by the method given in 7.3.

6.2 Vacuum pump capacity (see ISO 5707, sub-clauses 6.2 and 6.4)

6.2.1 Put the milking machine into the milking position with the teatcup plugs fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.2.2 Measure the vacuum level at the vacuum pump.

6.2.3 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.

6.2.4 Record the air flow at the vacuum level of 50 kPa.

NOTE — If the prevailing barometric pressure at the time of the test differs by more than 2 kPa from the standard pressure for the altitude (see 7.1), the true vacuum pump capacity at that altitude shall be predicted from the measured value by the method given in 7.2.

6.2.5 Record the air flow meter reading at the vacuum level recorded at the vacuum pump with all units operating.

6.2.6 Record the speed of the vacuum pump, as its frequency of rotation (min^{-1}), at a vacuum level of 50 kPa.

6.3 Regulator sensitivity (see ISO 5707, sub-clause 7.4)

6.3.1 Put the milking machine into the milking position with teatcup plugs (5.5) fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.3.2 Record the vacuum level at, or near to, the vacuum regulator.

6.3.3 Shut off all units except one. Record the vacuum level at the vacuum regulator.

6.3.4 Calculate the vacuum increase from the values recorded in 6.3.2 and 6.3.3.

6.4 Regulator leakage (see ISO 5707, sub-clause 7.5)

6.4.1 Put the milking machine into the milking position with teatcup plugs (5.5) fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.4.2 Record the vacuum level at the vacuum regulator.

6.4.3 Connect the air flow meter with a full bore connection as near to the vacuum regulator as possible.

6.4.4 Record the air flow through the air flow meter at a vacuum level 2 kPa below the vacuum level recorded in 6.4.2.

6.4.5 Plug the vacuum regulator.

6.4.6 Decrease the vacuum level to the same level as in 6.4.4 by opening the air flow meter.

6.4.7 Record the air flow through the air flow meter.

6.4.8 The regulator leakage is the difference between the values recorded in 6.4.7 and 6.4.4.

6.5 Stability of system vacuum (see ISO 5707, clause 8)

6.5.1 Put all units into operation with the teatcups plugged. For bucket, direct-to-can and milking pipeline machines, the units shall be placed at the most distant milking points; if the air pipeline is branched, the test shall be carried out on every branch.

6.5.2 Disconnect the long milk tube of the most distant unit at the claw and connect it to the airtight can (5.6)

6.5.3 Connect a vacuum recorder to the adjacent unit. In the case of a bucket or direct-to-can machine, the connection shall be made through a T-piece inserted in the vacuum tube. In the case of a milking pipeline, recorder or independent air and milk transport machine, the connection shall be made through a T-piece inserted in a short milk tube.

6.5.4 Start the vacuum recorder and rapidly open the connection to the airtight can thereby admitting 10 l of free air to the system.

6.5.5 Record the vacuum drop and duration shown by the record (see figure 2) and calculate the product of these values.

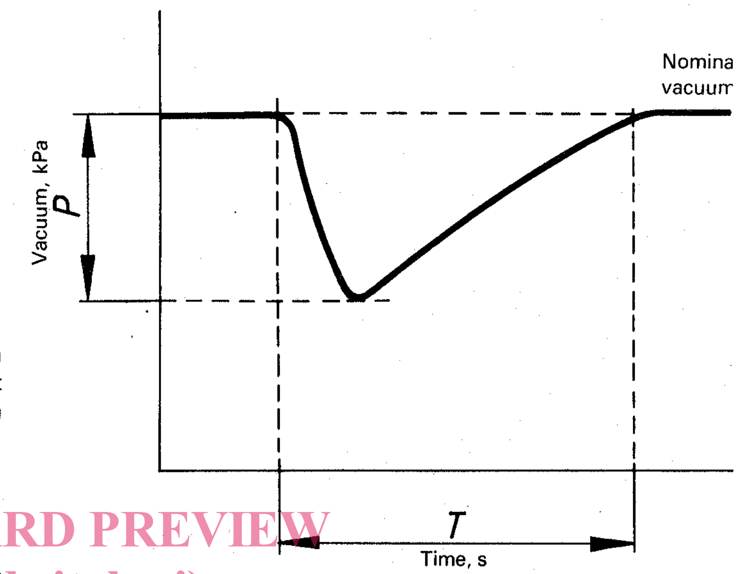

Figure 2 — Trace of system vacuum

6.6 Vacuum drop (see ISO 5707, sub-clause 10.2)

6.6.1 Put the milking machine into the milking position with teatcup plugs (5.5) fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.6.2 Record the vacuum level at the vacuum pump.

6.6.3 Record the vacuum level at the regulator.

6.6.4 Record the vacuum level at the most distant point or points upstream in the air pipeline(s).

6.6.5 The vacuum drop between the vacuum pump and the regulator is the difference between the values recorded in 6.6.3 and 6.6.2.

The vacuum drop between the regulator and any point upstream in the air pipeline(s) is the difference between the values recorded in 6.6.4 and 6.6.3.

6.7 Air pipeline leakage (see ISO 5707, sub-clause 10.4)

6.7.1 Put the milking machine into the milking position with teatcup plugs (5.5) fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.7.2 Record the vacuum level at the vacuum pump.

6.7.3 Record the vacuum level at the regulator.

6.7.4 Connect the air flow meter at the vacuum regulator.

6.7.5 Plug the vacuum regulator.

6.7.6 Isolate the vacuum system from the milk system and the pulsators.

6.7.7 Record the air flow at the vacuum level recorded in 6.7.3.

6.7.8 Record the air flow at the vacuum pump at the same vacuum level as in 6.7.2 with the air pipeline disconnected.

6.7.9 The air pipeline leakage is the difference between the values recorded in 6.7.8 and 6.7.7.

6.8 Vacuum drop across vacuum taps
(see ISO 5707, clause 13)

6.8.1 Connect an air flow meter to the vacuum tap.

6.8.2 Adjust the air flow to 120 litres of free air per minute and record the vacuum level in the air pipeline.

6.8.3 Record the vacuum level between the air flow meter and the vacuum tap.

6.8.4 The vacuum drop is the difference between the values recorded in 6.8.2 and 6.8.3.

6.9 Pulsation system (see ISO 5707, sub-clauses 14.3 and 14.4)

6.9.1 Set the machine in the milking position with all teatcups plugged. Connect the instrument specified in 5.3 to the short pulse tube(s).

6.9.2 If a vacuum recorder is used, record five consecutive pulsation curves and analyse in accordance with the definition given in ISO 3918 to obtain the pulsator ratio and the average percentage duration of phases b and d.

If a digital phase indicator is used, record the mean reading for each phase over at least five pulsations. (See ISO 5707, sub-clause 14.4.)

6.9.3 If a digital instrument is not used, count the number of pulsations over a minimum period of 30 s and calculate the pulsation rate. (See ISO 5707, sub-clause 14.3.)

6.10 Milking system leakage (see ISO 5707, sub-clause 15.3)

6.10.1 Put the milking machine into the milking position with teatcup plugs (5.5) fitted. All vacuum operated equipment associated with the installation shall be connected even though it will not operate during the test.

6.10.2 Record the vacuum level at the regulator.

6.10.3 Connect the air flow meter at the vacuum regulator.

6.10.4 Plug the vacuum regulator.

6.10.5 Record the air flow at the vacuum level recorded in 6.10.2 with the air pipeline and the milk pipeline connected but all units isolated.

6.10.6 Isolate the milking system.

6.10.7 Record the air flow at the same vacuum level as in 6.10.2.

6.10.8 The milking system leakage is the difference between the values recorded in 6.10.7 and 6.10.5.

6.11 Air admission to cluster (see ISO 5707, sub-clause 24.7)

6.11.1 Connect the long milk tube of the cluster under test to the airtight can (5.6), the teatcups being plugged. Connect a vacuum gauge to the airtight can.

6.11.2 Evacuate the can to nominal working vacuum.

6.11.3 Close the vacuum connection and simultaneously start a stopwatch.

6.11.4 Record the time taken for the vacuum level to fall by 10 kPa.

6.11.5 The air admission, q, in litres of free air per minute, is given by the formula

$$q = \frac{6\,V}{t}$$

where

V is the volume, in litres, of the can;

t is the time, in seconds, for the vacuum to fall by 10 kPa from the nominal working vacuum.

NOTE — An alternative method is to insert a variable orifice flow meter in the long milk tube. The meter should be calibrated or a correction applied for the operating condition of 50 kPa vacuum.

7 Prediction of pump capacity and effective reserve at other barometric pressures

Vacuum pump capacity and air demand for a milking machine vary with ambient barometric pressure.

When a milking machine is tested, the measured values shall be multiplied by correction factors which give predicted values under standard conditions.

7.1 Datum levels

For the purpose of this International Standard, the datum levels based on 90 % pump efficiency for atmospheric pressures at various altitudes are given in table 1.

Table 1 — Normal atmospheric pressures at various altitudes

Altitude m	Normal atmospheric pressure (P_{B0}) kPa
Up to 300	100
301 to 699	95
700 to 1 199	90
1 200 to 1 599	85
1 600 and over	80

7.2 Vacuum pump capacity

The factor, K_1, by which the measured vacuum pump capacity should be multiplied to obtain the predicted value at the normal atmospheric pressure for the altitude is given in table 2. This factor is calculated from the formula :

$$K_1 = \frac{\frac{p_{B0}}{p_B} \times p_{max} - p}{p_{max} - p} \times \frac{p_B}{p_{B0}}$$

where

p_B is the prevailing barometric pressure, in kilopascals, during the test;

p_{B0} is the normal atmospheric pressure, in kilopascals;

$p_{max.}$ is the vacuum level, in kilopascals, atthe totally closed pump inlet;

p is the vacuum level, in kilopascals, at the pump inlet.

7.3 Effective reserve

The predicted effective reserve (ER_{pr}) under non-standard conditions of barometric pressure is given in table 2, and calculated from the formula :

$$ER_{pr} = K_1 \cdot C_m - K_2 (C_m - ER_m)$$

where

K_1 is the factor calculated in 7.2;

C_m is the measured pump capacity, in litres/min free air;

ER_m is the measured effective reserve, in litres/min free air;

$$K_2 = \frac{p_{B0} + p_B}{2\, p_{B0}}$$

where

p_B is the prevailing barometric pressure, in kilopascals, during the test;

p_{B0} is the normal atmospheric pressure, in kilopascals.

Table 2 is calculated for $\frac{p_{max.}}{p_B} = 0{,}9$ and $p = 50$ kPa, which gives

$$K_1 = \frac{0{,}9\, p_{B0} - 50}{0{,}9\, p_B - 50} \times \frac{p_B}{p_{B0}}$$

Table 2 — Correction factors for calculating vacuum pump capacity and effective reserve
(based on 90 % pump efficiency)

Prevailing barometric pressure	Normal atmospheric pressure									
	p_{B0} = 100 kPa (altitude up to 300 m)		p_{B0} = 95 kPa (altitude 301 to 699 m)		p_{B0} = 90 kPa (altitude 700 to 1 199 m)		p_{B0} = 85 kPa (altitude 1 200 to 1 599 m)		p_{B0} = 80 kPa (altitude 1 600 m and over)	
p_B kPa	K_1	K_2	K_1	K_2	K_1	K_2	K_1	K_2	K_1	K_2
105	0,94	1,03								
104	0,95	1,02								
103	0,96	1,02								
102	0,98	1,01	0,91	1,04						
101	0,99	1,01	0,92	1,03						
100	1,00	1,00	0,93	1,03						
99	1,01	1,00	0,95	1,02						
98	1,03	0,99	0,96	1,02						
97	1,04	0,99	0,97	1,01	0,90	1,04				
96	1,05	0,98	0,99	1,01	0,91	1,03				
95	1,07	0,98	1,00	1,00	0,92	1,03				
94	1,09	0,97	1,02	0,99	0,94	1,02				
93	1,10	0,97	1,03	0,99	0,95	1,02				
92			1,05	0,98	0,97	1,01	0,87	1,04		
91			1,07	0,98	0,98	1,01	0,89	1,04		
90			1,08	0,97	1,00	1,00	0,91	1,03		
89			1,10	0,97	1,02	0,99	0,92	1,02		
88			1,13	0,96	1,04	0,99	0,94	1,02		
87					1,06	0,98	0,96	1,01	0,85	1,04
86					1,08	0,98	0,98	1,01	0,86	1,04
85					1,10	0,97	1,00	1,00	0,88	1,03
84					1,13	0,97	1,02	0,99	0,90	1,03
83					1,16	0,96	1,05	0,99	0,92	1,02
82							1,07	0,98	0,95	1,01
81							1,10	0,98	0,97	1,01
80							1,13	0,97	1,00	1,00
79							1,17	0,96	1,03	0,99
78							1,20	0,96	1,06	0,99
77									1,10	0,98
76									1,14	0,98
75									1,18	0,97
74									1,23	0,96
73									1,28	0,96

8 Test report

The test report shall be presented in tabular form. The items shown in table 3 shall be included for tests on new installations.

Table 3 — Test report for tests on new installations

Results of checking for compliance with requirements for construction and performance	Clause(s) in ISO 5707
Effective reserve	6.1
Vacuum pump capacity	6.2 and 6.4
Regulator sensitivity	7.4
Regulator leakage	7.5
Stability of system vacuum	8
Vacuum drop	10.2
Air pipeline leakage	10.4
Vacuum drop across vacuum taps	13
Pulsation rate and pulsator ratio	14.3 and 14.4
Milking system leakage	15.3
Air admission to cluster	24.7