The Dutch Quality System for milking machine maintenance

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Without doubt, the milking machine is one of the most intensively used machines on a dairy farm. A well functioning milking machine is a prerequisite for good udder health and excellent milk quality. As a consequence, each milking system should be serviced and checked at least once a year.

Summary

In the eighties and nineties ISO standards were developed for milking machines. In the Netherlands these standards were implemented in a quality system for the maintenance of milking machines and the accuracy check on milk meters and jars. These checks are conducted by certified technicians of the milking machine dealers. An independent organisation KOM, established as result of an agreement between the National Farmers Union, Milking machine manufacturers union and the National Breeding and milk recording organisation, is responsible for the quality control. The system guarantees the farmer that the maintenance of his milking machine and the necessary accuracy checks of milk meters and jars are performed well against minimal costs. The system has been incorporated in the quality system for dairy producers by the Dutch dairy industry.

Key words*: Quality system, maintenance, milking machines, milk meters, recorder jars, accuracy, calibration.*

Introduction

With the introduction of milking parlours in the early seventies, it became clear that milking machines need regular testing and maintenance for good milking. Testing was done by advisors from the dairy industry, animal health services or governmental extension services on request of the farmer or when problems with milk quality or udder health occurred on the farm.

In the case of malfunctioning, a technician of the milking machine dealer was asked to perform the necessary repairs, and the milking machine was checked again by the dairy advisor or extension officer.

In the early eighties the Dutch farmers union, governmental extension service and the milking machine manufacturers developed a national maintenance system. The basic idea behind this system was that all regular testing and maintenance should be integrated and performed by the technicians employed by dealers of the manufacturers to reduce the costs for the farmer and to improve the quality of maintenance. The national extension service became responsible for the training and evaluation of the technicians to guarantee their quality of work. The testing method was described in a national guideline for technicians. From that time on, all manufacturers used the same testing method, an uniform Maintenance and Advice Report (MAR) and farmers paid a fixed price for the yearly test. At the end of the eighties over 80% of the Dutch farmers participated in this maintenance system. Today about 100% of the farmers participate in the system.

International standards

In the seventies and early eighties manufacturers and experts from various countries, prepared the first international standards for milking machines which were more or less based on the Dutch system. The most recent ISO standards are from 1996. ISO 3918 describes the vocabulary, ISO 5707 describes the standards for construction and performance of milking machines and ISO 6690 deals with the testing methods. At this moment a new revision is considered. The standards apply to both new installations, and machines in use, to check the performance of operation periodically. In the same time ICAR developed guide lines for the approval and the use of milk meters and jars for milk recording purposes (ICAR, 1995).

Quality system

In the mid nineties the national extension service was reorganised and had to end these activities. Together with the Dutch farmers union and the Dutch organisation of milking machine manufacturers, plans were developed to start a quality system for milking machine maintenance (KOM). This was a logical step in the further development of the preventive maintenance system. The quality system was expanded with certification of the technicians, calibration of test equipment and by special courses for machine on time testing. The ultimate goal of course was to guarantee the farmer that the milking machine is working properly, without having a negative effect on milk quality or udder health. Another prerequisite was that the KOM system should fit in to the total quality management system for dairy farms (KKM, 1998) as developed by the Dutch dairy industry and the national farmers union. The KKM system is permissive to the national and EU legislation aspects, and obligatory for all Dutch dairy farmers since 2000. Farmers who want to deliver milk to one of the dairies, have to meet the requirements of the six modules of KKM. These modules

are Medicines, Animal health and welfare, Foodstuff and water, Milking and milk storage, Cleaning and disinfection and Environment and waste products. The module Milking specifies that the milking machine should be tested yearly by a KOM-certified technician.

Institution KOM

In 1998 the project KOM was transformed from a project into an independent institution, because quality systems should be independent from the parties involved. The KOM organisation is responsible for the entire quality system. The Dutch breeding and milk recording organisation decided to incorporate the routine accuracy check of electronic milk meters and recorder jars into the KOM responsibilities. This check is necessary for meters used for the official milk recording system as stated by the ICAR rules. The technicians from the manufacturers combine the yearly service on the milking machine and the routine tests on the functioning and accuracy of electronic milk meters and jars. The reason to do so was to reduce the costs for the farmer by combining control systems and maintenance.

The KOM quality system

KOM has developed several activities to control the quality system. These activities and the procedures are recorded in the KOM guide lines (KOM, 1999):

- Registration and evaluation of all test reports made by the technicians including reports on the accuracy of milk meters and jars;
- Yearly control and calibration of the test equipment used by technicians;
- Performing random checks on the 'quality of work' of the technician including milk meters and jars;
- Certification of (new) technicians;
- Development of standard reports (MAR) and tests (based on ISO);
- Studies on the relation between milking machines and milk quality;
- Development of guide lines for new areas, like automatic milking systems.

Registration of all test reports

During the yearly check on the milking machine, all components are checked and tested. If necessary, repairs are made or devices like pulsators are adjusted to the right value. Vacuum level, reserve capacity, air inlet, air consumption, air leakage and pulsation curves, are measured by using test equipment like airflow meters, vacuum testers and pulsation testers. The test results are recorded in a standard test report, which is equal for all manufacturers. The technician can also write down his comments. A copy of the report is handed over to the farmer, another copy is sent to KOM. The reports are registered per technician and evaluated at random using an evaluation protocol. The evaluation report is discussed with each technician once a year.

Control and calibration of the test equipment in use

At Waiboerhoeve experimental station, the research facility of the Institute for Animal Husbandry, a training and test centre was established. This centre has a special test installation suited to test and calibrate vacuum gauges, air flow meters and pulsator test devices. The test installation (Figure 1) has two test rigs, one with a high pipe line (stanchion barn type) and one with a low pipe line (milking parlour type), both with a vacuum pump. The vacuum pumps can be connected such that the vacuum pump capacity can be varied from 1 000 to 2 500 litres per minute. The low pipe line is also equipped with several types of milk meters to perform the routine tests for milk meters.

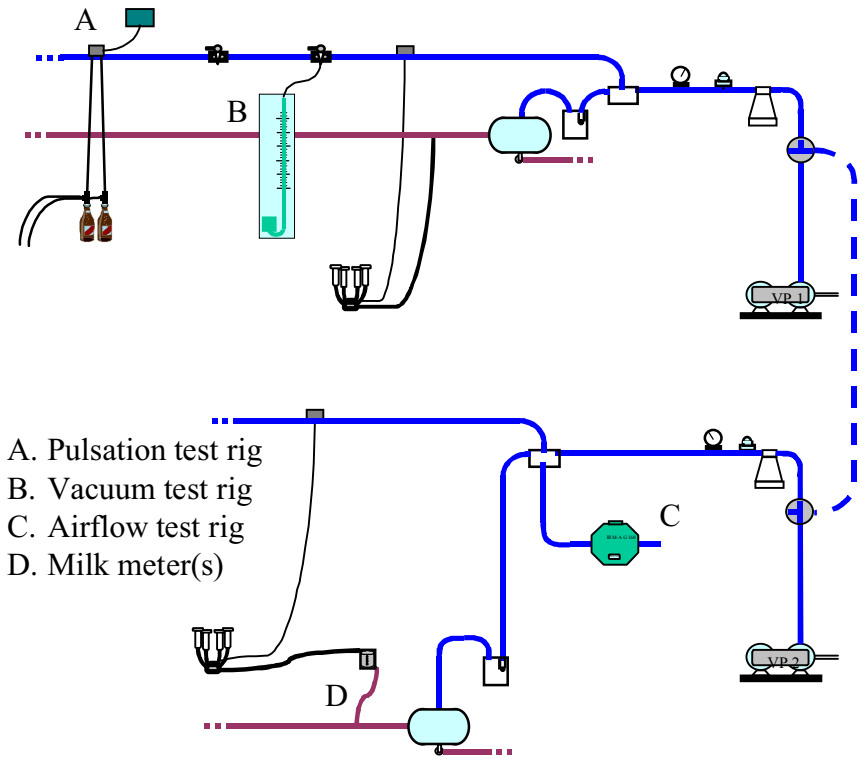

Figure 1. Scheme of the test installation for testing equipment.

The test rig is equipped with the following components: a vacuum regulator, an IRM-A G 160 gas meter (Instromet), a mercury vacuum meter, a digital vacuum meter (Digitron), an electronic relay pulsator controlled by an electronic pulsation controller with variable pulsation ratios and pulsation rates, connection points for vacuum gauges and valves to (dis)connect vacuum lines. The IRM-A G 160 gas meter has a maximum capacity of 4166 l/ min to calibrate the air flow meters. Air flow is measured by reading the number of pulses produced by the meter when air is passing the meter. The meter is connected to a PC system with an airflow control program (AFC) to control the flow settings and the test program.

The pulsation controller has simultaneous, alternating and cascade features. Pulsation rates and ratios can be adjusted continuously. To simulate the air consumption of a milking cluster during milking, two half litre bottles are used for both channels. In this way, results will not differ due to the temperature and the ageing of liners.

The centre has also equipment to test temperature meters, balances and other equipment. The milking parlour side is equipped with almost every approved electronic milk meters available. They are used for training courses, to explain and practise the routine test for milk meters.

Random checks

Since 1998 the KOM institution also performs random checks on farms to evaluate the quality of work by the technicians, both for milking machine maintenance and for the routine test of milk meters. Each technician will get at least one random check per year by one of the KOM-officers. This re-test is carried out at soon as possible after the technician has done the yearly test. It consists of a check on vacuum level, reserve capacity, regulator leakage, the pulsation system partially, cleaning temperature and the presence of the test report. If necessary the whole test will be performed. If the technician is not doing a good job, KOM may decide to withdraw his certificate, so that he is not allowed to do any testing anymore.

Certification of the technicians

According to the requirements of KOM and KKM, all technicians should be well qualified. Because there is no general education for this type of work, KOM together with the Research Institute for Animal Husbandry, has set up a special education program for milking machine technicians. The course consists of several modules varying from udder physiology, milking routines, milk quality, Mastitis, machine milking and testing, milk meter routine testing to dialogue techniques with the farmer. For the already more skilled technicians a modified course was developed. Over 350 technicians joined these courses and approximately 85% succeeded and obtained a certificate, so they are allowed to test milking machines within the KOM system. A special course was designed for those technicians who do regular maintenance of automatic milking systems.

Other activities

Due to the growing number of farmers using an automatic milking system, there was a need for standards for these machines. So on request of KOM, a new testing method was developed for automatic milking systems by the Research Institute for Animal Husbandry. This system is largely based on the current ISO standards for milking machines, but completed with some special requirements for the reserve capacity and air inlet for teat cups. Also a new test report for AM-systems was developed.

Results of evaluation and test equipment calibration

One of the first activities of the KOM -project was to evaluate the technicians by reviewing an at random selection of ten maintenance and advice reports for each technician. The reports were evaluated on several aspects, like completeness of the report, measurements, interpretations and remarks and advises. A final score from 0 to 10 was given to the technician. Figure 2 shows the results of this evaluation from 1995 to 1997. The average results improved clearly over these years. In 1998 it was decided to change the way of evaluation. Now the MAR reports have to fulfil the KOM requirements and the evaluation is incorporated into the random check system.

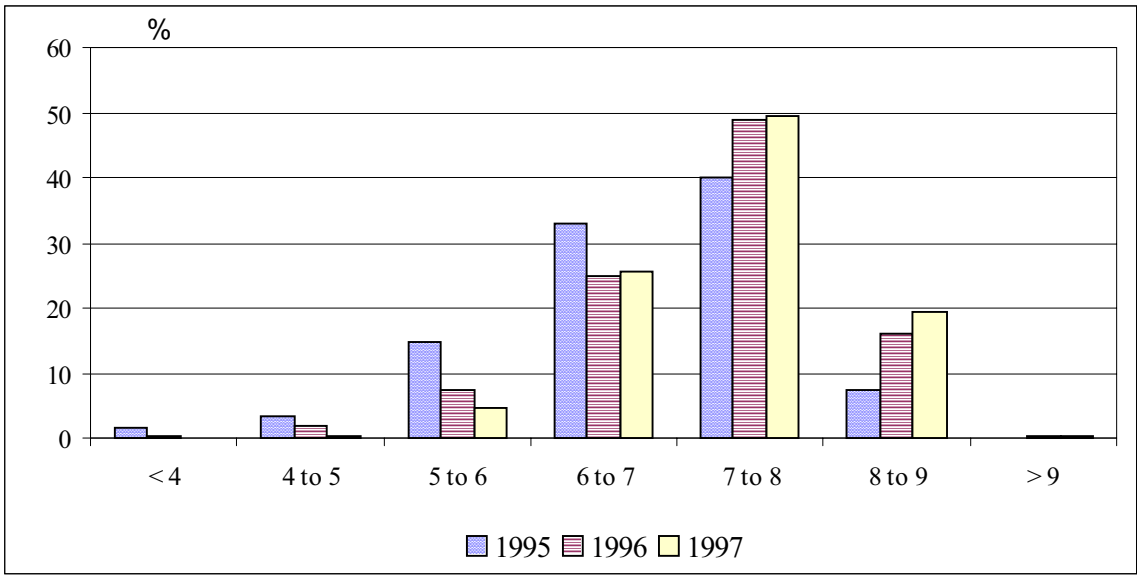

Figure 2. Frequency distribution of the rating of technicians (n=205).

Accuracy requirements

Technicians use different types of test instruments. Bourdon gauges and digital vacuum meters are used to check the vacuum level. Because of health risks, it is forbidden to use mercury vacuum meters when testing on a farm. Vacuum meters shall have an accuracy of at least ± 0.6 kPa and a repeatability of at least 0.3 kPa (ISO 6690). Vacuum gauges of class I usually will meet these requirements. Air flow meters shall have a maximum error of less than 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 to 60 kPa and for levels of atmospheric pressure from 80 to 105 kPa (ISO 6690). Different types of air flow meters are used by technicians, like air flow meters with a metering tube and a floating device, orifice air flow meters and electronic air flow devices. Pulsation testers including connection tubes shall have an accuracy of 1 pulse/ min for measuring the pulsation rate and an accuracy of 1% (10 ms) for measuring the pulsation phases and pulsation ratio.

Balances which are used for milk meter tests shall have an accuracy of 20 grams. Angle measurement instruments are used to check the position of recorder jars. Recorder jars are calibrated with water to ensure an accurate reading, but this procedure is quite time consuming. After calibration with water the position of the recorder jar is measured with the angle measurement instrument and the data are stored. Next time the routine test will be done with this instrument and the same values should be measured again. The instrument shall have an accuracy of 0.1 degrees.

Results

The test results are shown in figure 3. In the year 2000 85% of the vacuum meters, air flow meters and pulsation testers was approved immediately, compared to 83% according to De Koning (1994). About 14% was approved after adjustment and 1% was rejected. For the other test devices like balances and temperature meters, the results were very well within the acceptable limits. The angle measurement instruments however were tested for the first time and 34% needed adjustments to get approved. This was mainly caused by improper calibration methods by the technicians concerned.

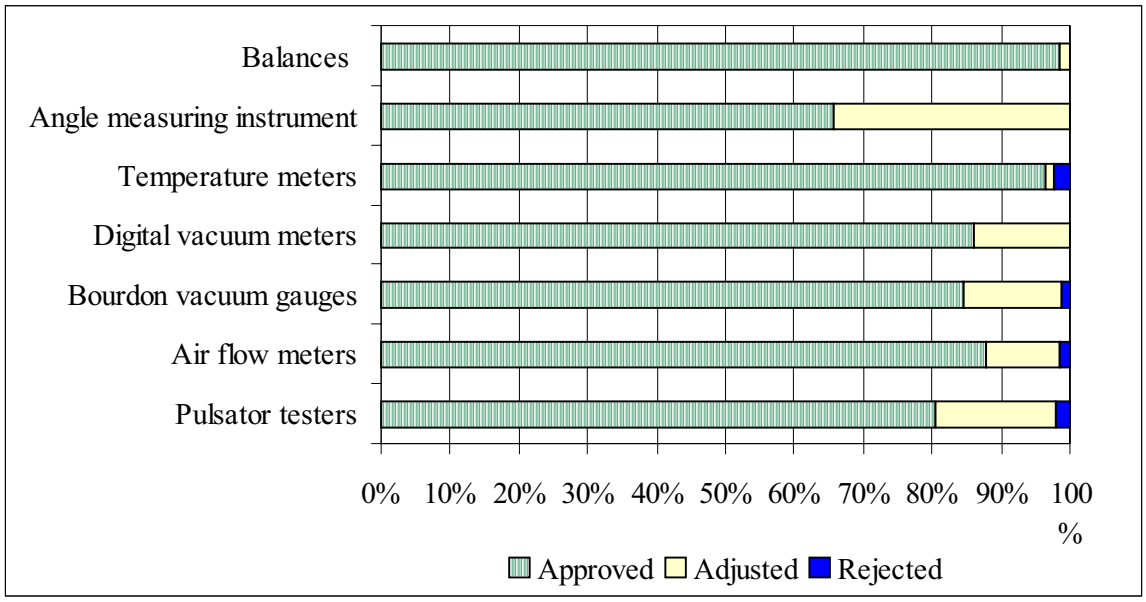

Figure 3. Results of the calibration test in 2000 for different devices.

The results clearly show that calibration is necessary to guarantee accurate testing in practice to prevent wrong interpretations on the functioning of milking machines and or milk meter devices. Therefore it was decided to calibrate the test equipment of the technicians at least once a year. Each approved device will get an approval sticker of KOM, so farmers can see whether the technician is using calibrated equipment.

Random checks

Table 1 presents the results for the random checks performed by KOM in 2000. Almost 13% of the random checks resulted in a remark concerning one or more aspects. The majority of the remarks was on the data entry up on the test report and the maintenance. In a few cases the technician was ordered to repair some things, like pulsation system or repair of air leakage's. About 18% of the farms had a deviation on the accuracy of the recorder jars. In 2001 extra attention will be paid to this aspect.

Table 1. The number of random checks (farms and meters) in 2000.

	Milking parlours	Milk meters		Recorder Jars	
		Farms	Meters	Farms	Meters
Total number	410	162	1 590	56	497
Number with comments[1)]	53	20	35	10	33
% deviation with comments	12.9%	12.3%	2.2%	17.8%	6.6%

[1)] There has been a comment due to deviation in the test results, or over the procedure used, or on the report itself.

Future developments

The fast development and introduction of portable PC's, e-mail services and Internet offer interesting perspectives to improve the quality system. A big step further can be made by improving the speed, for example by sending the MAR reports electronically to KOM. Another interesting aspect is the expected integration of test equipment, so one device is able to measure the different functions and to complete the data into a digital MAR report. New data could be checked for mistakes but could also be compared automatically with the historical data.

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