PROPER MILKING MANAGEMENT
FOREWORD

Proper Milking Management is the eighth in a series of management manuals published by Veeapro Holland. Through these manuals Veeapro Holland aims at providing you with useful management information. Dairy cattle worldwide have to be managed well to utilise their genetic potential to full extent. No single booklet can cover every subject as diverse and complex as dairying. Nor will probably everyone associated with dairying agree on all points covered in one publication. But we of Veeapro Holland believe the combination of this manual and other publications on the subject may broaden your knowledge about proper milking practice and will subsequently contribute to a healthy and highly productive herd.

Veeapro Holland is indebted to those who contributed to this manual, particularly Ing. Kees de Koning and Ing. Roelof Westerbeek of the National Reference Centre for Livestock Production (IKC) of the Ministry of Agriculture, Nature Management and Fisheries at Lelystad for their constructive criticism.

We would like to thank the IPC-Livestock/Dairy Training Centre 'Friesland' at Oenkerk for their valuable assistance in the preparation of this manual.

Many thanks also to those associations and publishers who permitted us to use various data and illustrations.

VEEPRO HOLLAND
INTRODUCTION

In dairy farming it is important to note the direct link between the well-being of the cows and the profitability of the dairy farm. Among others, a good milking technique is of utmost importance. No single duty in the dairy operation carries as much responsibility as does the actual job of cow milking. The continuous use of a proper milking routine results in higher milk yields of good quality, fewer problems with udder health, longer cow life expectancy and reduced milking time. All these factors contribute to a higher profit margin per cow.

Good milking is a skill that can be learned through practical experience. Harmonious interaction between milker and cow is of utmost importance with regard to the amount of milk a cow produces and hence to the farm’s profitability. A good milker develops a routine that is followed during each milking. It cannot be stressed enough that if milking habits are good, results will be good. The conditions at the dairy farm in question determine the choice of hand or machine milking. Whichever system in use, the milker should be familiar with basic milk secretion and udder conformation of the dairy cow. Full understanding of how the cow produces milk and how a milking machine functions to remove that milk is essential.

The milking machine, its testing and the storage and cooling of milk are discussed in more detail in Milking Machine Management, volumes 1 & 2. Additionally described in this manual are the cleaning, disinfection, and maintenance of the milking equipment.

Cow milking is the most important job in the dairy herd.
The main characteristics of good hand and machine milking are:

- a regular and good milking routine under optimal conditions will result in high milk yields;
- the quality of the milk produced must be up to the highest hygienic standards;
- the risk of udder infection must be reduced to an absolute minimum;
- the physical and mental effort required from the milker or operator should be acceptable and he should perform his duties within an appropriate environment.

THE MAMMARY SYSTEM

The udder conformation
The udder is the most important part of the cow. Ideally, the udder should be symmetrically shaped with a level floor and carried well above the hocks. It should be strongly attached, well-balanced with adequate capacity and express good milk production for a long period of time. The fore udder should be of sufficient length with a firm and smooth attachment to the body wall. The rear udder should be attached high and be of sufficient uniform width from top to floor. The quarters must be evenly balanced. Furthermore the udder must have strong median and lateral suspensory ligaments for good support and attachment to the pelvis.

The teats should be uniform, of medium length and diameter, cylindrical, squarely placed, plumb, and be well-placed from side and rear views. The udder texture should be soft and pliable, and the udder should collapse well after milking.

The udder structure
The suspensory ligament divides the udder into two halves and each half is again divided into two separate quarters: two fore and two rear quarters (see figure 1). There is no clearly visible separation between the two quarters of one side, but the fact that one quarter can produce abnormal milk proves that they are independent. Although the fore teats are usually a bit longer than the rear ones, the capacity of the rear quarters is larger; the rear-to-front quarters ratio is about 55:45 in adult Holstein Friesian cows. The teats have a rich supply of blood and they may vary in shape from cylindrical to conical. The lengths of the teats can be variable.

The size and shape of the udder and teats may have an effect on the efficiency of machine milking. When teats are spaced too widely or face outward on poorly shaped udders, it is rather difficult to handmilk or attach the milking machine cluster unit to each quarter. The same applies to pendulous udders that hang too close to the surface, causing problems owing to lack of working space for milking.

At the lower end of the teat is the teat or streak canal. The streak canal is about 1 cm long and is encircled by a strong teat-closing muscle; the sphincter. The strength of this muscle determines the ease of milking and milking speed.

A nearly flat teat bottom and a well-closed teat canal largely prevent the penetration of bacteria into the quarter. A frayed or swollen appearance is often attributable to damaged teats.

Inside the teat is a cavity, the teat cistern, that is connected to the gland cistern. The walls of the cistern are very sensitive
and they can easily be damaged through incorrect milking. About 20 to 25 large milk ducts empty into the gland cistern. This cistern has a capacity of about 1 litre. These ducts branch out, away from the cistern, becoming narrower and narrower, until they end in alveoli lined with glandular cells. Milk is formed within the alveoli and in a well-developed udder there are about 2 billion of such alveoli, grouped in clusters. Normally, their number decreases during the latter half of the lactation period. Incorrect milking makes the decrease come about more rapidly, resulting in lower milk production.

Sound udders; a pleasure to milk!

The majority of the milk is stored in the alveoli and in the finer milk ducts; the milk is held up by a muscular system surrounding these milk ducts. As the pressure within the alveoli and finer ducts increases, most of the milk is let down into the wider ducts and the cisterns.

The milk ejection reflex
The duct system itself is opened by direct nerve impulses generated by the massage of the teats and the udder. The milk is said to be 'let down'. The hormone 'oxytocin' actuates the milk let-down mechanism. The secretion of this hormone into the blood stream, together with the cow’s willingness to co-operate, requires a harmonious and undisturbed interaction among the cow, the milker and the milking machine. Oxytocin production lasts about 5 - 7 minutes; from this it follows that the cow must be milked within this period. An adequate 'let-down' of milk is an absolute necessity for complete milk removal. Without the desired milk-release reflex no milking machine can completely remove milk still remaining in the udder.

The release of oxytocin from the hypophyses in the brain is initiated not only by udder preparation (unconditioned reflex), but sometimes also by signals like the noise of the milking machine (conditioned reflex). This reflex applies also to the sucking of a calf. The physiological mechanism involved in milk let-down explains why the milking routine should always be regular, carried out correctly and with minimum disturbance.

In order to support the milk let-down as well as possible and to improve the working efficiency, the CPA method (Concentrates/Preparation/Attachment) is practiced in the Netherlands. The CPA method is practiced for each cow individually and can be divided into the following steps:
1. the provision of concentrates;
2. the preparation of the udder;
3. the attachment of the milking clusters.

Provision of concentrates
Feeding concentrates appears to result in a strong conditioned reflex in milk let-down. In the Netherlands it is sometimes recommended to shut off feeder boxes about one hour before actual milking with a view to fully utilising the milk release reflex.
Udder preparation (stimulation)
Before milking, the cow must be ‘prepared’. Proper udder preparation stimulates the cow to let down her milk. It removes microorganisms from the udder and teat skin, thereby reducing the risk of udder infection. The main actions in udder preparation are:

- cleaning the teats and the udder itself, so that the milk cannot be contaminated with dirt during the milking process;
- checking the foremilk for abnormalities.

Cleaning of udder and teats
These actions should induce the cow to let down her milk. In hand milking, the emphasis is on udder cleaning, whereas in machine milking the let-down reflex is conditioned. In hand milking the risk of dirt, hairs or skin particles falling into the bucket during milking is greater than in machine milking when handstripping is omitted. In practice, the clipping of the udder and flanks of the cow is recommended to avoid dirt contamination.

In machine milking, dry cleaning of the udder and teats may be sufficient, in particular when the cows are kept in a pasture or in a loose housing system with clean free stalls. Dry cleaning takes little time and reduces the risk of transfer of udder pathogens from one cow to another. Disposable paper towels are preferred to minimize spreading of udder infections from one cow to another.

Significantly dirty udders should be washed with lukewarm water from a bucket or a spray-jet and be dried thereafter with a single-service paper towel. The water kept in buckets should be regularly replenished to reduce contamination, especially in case of herds with dirty udders. Udders that have not been properly dried after washing can be a source of contamination. Water may drain into the liner during milking and consequently increase the risk of spreading pathogens through the milking machine. Never milk cows with wet udders or dirty teats.

Checking the foremilk
An important part of udder preparation is checking the foremilk with a strip cup. Remove at least two squirts of milk from each quarter whilst taking care to avoid splashing milk on one’s hands, other teats and the floor. If the milk is flaky, slimy or bloody, suspect mastitis. Also inspect the udder and teats, looking for injuries, swelling and redness. Exercise caution when dealing with contaminated milk.

Attaching the milking machine unit
Time lost between stimulation and actual attaching of the clusters can be costly. This timing of attachment should always coincide with the ‘let-down’ process and be performed as a routine action. It will facilitate more complete milking within a shorter period of time. The teat cups should be gently attached in a correct manner and with minimal loss of vacuum. The cluster unit must be applied correctly to the teats, usually within 30 seconds from the end of stimulation or as soon as the teats are full of milk. With cows accustomed to proper milking practice this time can be reduced following stimulation.
Teat cups should be removed gently after shutting off the vacuum supply to the cluster unit. The removal of the cluster unit has top priority over all other operations. A little over-milking with a properly functioning milking machine does not have any major effect on udder health. However, the risk of adverse effects on udder health are great during over-milking, if the milking machine does not function properly. A milk flow indicator or an automatic cluster removal (ACR) system can be of great help.

Disinfect teats
When the clusters are removed, there is a minimal amount of milk on the teat end. If left there to dry, it may act as a culture medium for bacteria and may attract disease-carrying flies. To prevent this, it is recommended that teats should be dipped or sprayed with a disinfectant, such as chlorine hexidine or organic iodine solution as soon as possible after milking. Field trials have shown that post-milking teat dipping reduces the spread of mastitis pathogens.

Examination of the foremilk for mastitis

Attentiveness during milking
At all times close attention must be given to the functioning of each cluster unit of the milking machine to achieve optimal milkout. Milk only as many cows as you can handle efficiently. Correct attachment of the teatcups, without suction of 'free air' is essential to avoid the spread of mastitis pathogens or the sucking in of dirt. The milker should ensure that the cow has been milked out properly. Handstripping is undesirable.

Never indulge in bad milking habits with machine and hand milking since this may result in injury to the delicate tissue lining of the teat, the udder cistern or the teat end. It is extremely important that slipping of teatcups be minimized because such occurrences probably contribute to more machine-induced infections than any other single factor.

Remove clusters units
It is good practice to remove the cluster unit soon after the milk flow has stopped.
Feed cows after milking

The cows should stand for at least 1 hour after milking to allow the teat sphincter to close tightly and the teat dip to act as an efficient barrier against environmental infections. Providing fresh feed at the feedracks will keep cows standing. Research has demonstrated that this practice has a positive influence on udder health.

The above-mentioned points should be practiced with the daily milking routine. The more routine put into the daily milking operation, the calmer the cows will get and the more milk they will produce. Whenever possible, milking should consistently be done by the same person or people. It should be remembered that it is easier for cows to get used to good practices than to bad ones and that good habits will give a much better return in the long run.

Feeding of cows just after milking reduces the chance of bacteria entrance significantly.

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CLEANING, DISINFECTION AND MAINTENANCE OF MILKING EQUIPMENT

Although proper milking techniques are essential, the routine cleaning and disinfection of the milking equipment is even more important. Milk is sterile when secreted from healthy udders by the milk cells, but it can easily be contaminated, even before it has left the udder. The risk of contamination is particularly great once the milk has been removed from the udder and becomes exposed to a wide range of bacteria and other impurities.

Milking machine design

Milking equipment and utensils should be made from materials which are durable and of hard-wearing quality. They should be designed especially for use in the dairy industry. The construction should be such that all surfaces that come into contact with milk can be thoroughly cleaned and disinfected after each milking. Faults in design, such as undersized or oversized pipeline diameters, dead ends and too many bends, will make the cleaning procedure more difficult and will consequently encourage milk deposits and the growth of bacteria.

Milk pipelines should always be properly supported with brackets and have the right slope for draining off the cleaning liquids and water. The teat cup liners should be checked regularly for tiny cracks, bulges, and loss of elasticity. They should be replaced when signs of wear are beginning to show, which applies equally to the short and long milking tubes. Tiny cracks in liners and milking tubes are an ideal niche for bacterial growth. The formation of milkstone or other deposits must be prevented at all times. As a rule of thumb, liners should be replaced after 2,500 milkings. Some types of liner should even be replaced earlier. Ask your supplier.

Cleaning products

There are several cleaning chemicals on the market that are essential for proper cleaning of milking equipment. Milk producers should be sure to use only recommended cleaning and disinfectant products of appropriate strength for their milking equipment. The following products are available:

Detergents are cleaning agents whose main purpose is to remove impurities and
Hygienic milk production starts with clean milking equipment.

Dirt from the equipment. It is essential to use the recommended solution for the water hardness in question.

Disinfectants are sterilizing agents and are used to eliminate bacteria which may have remained in the equipment after washing.

Detergents/disinfectants are a combination of cleaning and sterilizing agents.

Milkstone removers are acid solutions used for the removal of deposits within the equipment. The frequency of use depends mainly on the detergents used and hardness of the water.

Important factors with regard to cleaning

- **Water**: the potable water should be clean and of minimal hardness.
- **Time**: the detergent/disinfectant should be in contact with a solid surface for about 5 - 10 minutes with the emphasis on temperature; it should never be below 40°C.
- **Temperature**: chemical reactions are accelerated by increasing the temperature and cleaning at higher temperature is usually more effective.
- **Mechanical action**: using a brush considerably contributes to the cleaning efficiency.
- **Chemical action**: cleaning chemicals remove dirt, disinfect, and soften the water, thus preventing the formation of milkstone.

Daily routine cleaning

There are various ways of keeping milking equipment clean. As milking takes place twice a day, semi-automation and/or cleaning-in-place (CIP) operation are rather attractive. The automatic washing unit ensures reliability throughout the cleaning process. Whatever method is used, the following routine should always be practiced since it has proved suitable for large as well as for small milking systems.

Immediately after milking

- Drain all milk which is still in the milk pipeline between the receiver and the milk tank.
- Disconnect the milk pipeline from the tank (no water must be mixed with milk).
- Remove and dispose of the filter (never use it twice).
- Clean the outer surfaces of all milking equipment.

Pre-rinsing

- Connect the cleaning circuit to the wash basin filled with luke-warm water. Let the water flow through the entire milk pipeline until it is clear and then drain from the circuit. Do not circulate!

Actual cleaning and disinfection

- Fill wash basin with the desired amount of hot water (80°C).
- Add the detergent or a combined detergent/disinfectant to the water in
accordance with the manufacturers’ label instructions.

- Place milking units or the cleaning circuit in a way ensuring proper circulation.
- Let the solution circulate for about 10 minutes. At the end of the cleaning process the temperature of the water solution should still be above 40° C.
- After circulation, drain the solution from the circuit.

**Post-rinsing**

- After cleaning, circulate some cold water through the cleaning circuit. A liquid milkstone remover (acid) may be added (again read label instructions for the desired strength), which eliminates the accumulation of milkstone and improves the rubber life.

**Water draining**

- After the milking machine engine has stopped running, open the drain valves so that all the water can run off.

**Post to the next milking**

- Just before the next milking, rinse the entire milk pipeline with clean luke-warm water and drain before milking; be sure that there is no water in the milk receiver. Fit a new milkfilter.

If cleaning and disinfection of the milking machine has been automated, the washing equipment must be programmed in such a way that the working order is in accordance with that described above. The most important advantage of automated cleaning-in-place is that the cleaning is always carried out according to a fixed schedule.

**Check before milking**

- the vacuum level
- the vacuum recovery time of your system by opening a milk valve for 5 seconds and convince yourself that there is a vacuum recovery within 3 seconds
- the oil level of the vacuum pump oilers
- the condition of pulse and milk tubes, liners and valves
- the cleanliness of cluster units

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**Periodical cleaning and maintenance**

The milking machine is used twice a day the year round, so it must always be kept in perfect working order. Therefore, periodical cleaning and maintenance is a must to avoid any major breakdown during milking. The dairy farmer should be fully acquainted with its functioning and also understand malfunctioning, and should know how to maintain the equipment in optimal working order.

All milking machines must be regularly serviced and tested on a routine basis at least twice every year. Most milking machine companies provide a service manual and a handbook with equipment specifications. They also offer service contracts for regular testing of the equipment.

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The milk pump should be regularly checked for optimal working order.
The following items should be routinely checked once a month:

**Vacuum pump**
- top up oil reservoir or change oil in piston-type pumps every 500 hours
- check bearings and check for unusual drag or loose pulleys
- check V-belt tension and replace belts, if necessary
- clean the exhaust pipe

**Vacuum regulator**
- clean the dust-cap or filter, valves and seats
- check capacity and adjust with a calibrated vacuum meter

**Pulsator**
- check frequency of pneumatic and electric pulsators
- check and/or replace diaphragm, and clean air vent holes
- grease selectors, if necessary
- check all pipeline fittings

**Milk taps**
- check general condition and change, if necessary

**Vacuum taps**
- exchange defective taps
- grease, if necessary

**Milk pump**
- check and adjust switching system
- check and/or fit new seals
- install a new non-return valve, if necessary
- install a new rubber ring in joint near milk filter, if necessary

**Cluster unit**
- dismantle claws and clean, if necessary
- replace liners at recommended time

**Automatic cluster removing equipment**
- override time control and re-adjust (about 1½ minute)
- check time delay (about 15 seconds)
- grease the piston and ram

Periodical maintenance of the vacuum pump is essential.
Full understanding of how the cow produces milk and the proper milking practices are essential. Thorough cleaning of milking equipment after each milking is absolutely necessary for the production of high-quality milk. Practice your cleaning routine as instructed and you will be rewarded with high-quality milk proceeds. Avoid short cuts at all costs. The same applies to the periodical maintenance of your milking installation. Altogether it means a better labour climate and higher profits for every dairy farmer.

The general guidelines for good milking machine management are:

1. understanding the function of the udder and the secretion of milk by the let-down reflex;
2. maintaining a regular and proper milking technique on a routine basis;
3. creating a good working environment for your milkers;
4. practicing high hygienic standards during milking;
5. rewarding your employees with a bonus for outstanding performance;
6. using the right strength of cleaning and disinfection products;
7. ensuring that milking is done at the desired vacuum level;
8. checking routinely the vacuum regulator;
9. keeping your pulsators in optimal working order;
10. testing your milking machine system twice yearly for optimal maintenance.
FURTHER REFERENCES

• Milking; lecture notes by IPC-Livestock/Dairy Training Centre ‘Friesland’
• Machine Milking and Lactation by Bramley, Dodd, Mein and Bramley (1991).
• Milk Formation and Removal & Clean Milk Production, Dairy Handbook of Zimbabwe (1987).
• Physiology of Lactation by Smith (1969).
• Biology of Lactation by Schmidt (1971).

Earlier publications:

• Reproduction Management
• Young Stock Management
• Foot Care Management

• Feeding Management, Volume 1
• Feeding Management, Volume 2
• Milking Machine Management, Volume 1
• Milking Machine Management, Volume 2
Dairy Training Centre Friesland (DTC-Friesland) is part of IPC Livestock. It is established by various Dutch farmers’ organisations and controlled by the Ministry of Agriculture, Nature Management and Fisheries. The Centre conducts a variety of international training programmes and courses. We also provide consultancy and management services.

All courses have a strong practice-oriented character based on the training concept of **learning by doing**. The practical training is very intensive; one instructor deals with groups of six students and for subjects like milking even with three students only. DTC-Friesland offers training in the following subjects:

- **Dairy Husbandry**
  - machine- and handmilking, milking machines, milk hygiene
  - feeding, ration calculation, feedplans, quality of feedstuffs
  - fertility management, heat detection
  - breeding, use of A.I., culling, body conformation
  - housing, tying/cubicle systems, hygiene
  - health, mastitis control, hoofcare
  - calfrearing
  - farm economics
  - farm administration

- **Forage production**
  - pasture management
  - fodder crops
  - silage making
  - farm machinery

- **Milk processing**
  - manufacture of cheese, butter, yoghurt, ice-cream, etc.
  - milk collection and payment systems
  - marketing
  - management of a dairy unit

- **Sheep husbandry**
- **Dairy goat husbandry**
- **Intensive beef production**
- **Horse keeping and animal traction**
- **Teaching methodology**

Visits to farmers’ organisations, A.I.-stations, Health and Extension service etc. are integrated in the courses to provide a good picture of the dairy sector in the Netherlands.

**AD HOC COURSES**

Our major activity is the organisation of ad hoc courses on request. These training programmes are tailor-made and completely designed according to the requirements
of the client. The courses deal with one or more of the earlier mentioned subjects. Duration of the courses varies from 1 week to several months. The courses are conducted in English. For some special subjects training can be provided in French, Spanish or German. If facilities are available locally, our staff is prepared to conduct courses abroad as well.

**SIX-WEEKS COURSE: MODERN DAIRY FARM MANAGEMENT**

This course is especially designed for persons in charge of a large-scale dairy enterprise, and includes all aspects involved in managing a dairy herd. The course offers a good opportunity to refresh one’s knowledge and learn about recent developments in dairy farm management.

**SIX-WEEKS COURSE: MILK PROCESSING**

The course is designed for (assistant) managers of small to medium-sized dairy plants and future staff of new dairy enterprises; i.e. on-farm milk processing. Both six-weeks courses are conducted annually in September. However, for groups of at least six persons it can be organised at any time during the year.

**TRAINING FACILITIES AND STAFF**

The centre has three farms, each with a different management system. One farm is especially equipped for international courses. The total stock at the three farms includes 240 dairy cows, 50 fattening-bulls, 45 dairy goats, 85 sheep and 12 Friesian horses. Additionally, the centre maintains close relations with twenty neighbouring farms which are used for practical training. Our staff consists of fifty dedicated and well-qualified trainers. All have up-to-date knowledge of modern dairy farm management, and over 70 man-years experience is present in various dairy development projects throughout the world.

**ACCOMMODATION**

A modern hostel provides full board and lodging in single or double bedrooms. An international kitchen and many recreational facilities are present. Social excursions are organised during the weekends to enable the students to get acquainted with the Dutch culture.

For more detailed information on our activities, please contact:

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