Technical Note - Milking Machine Testing

The milking parlour is one of the most important pieces of machinery on a dairy farm, and the only equipment in direct contact with the cow. However, the function, maintenance and effects on milk quality of the milking parlour are poorly understood by many dairy farmers. As a result, milking equipment is neglected and poorly maintained on many farms.

The impact of the milking parlour on milk quality is well documented. Milking equipment can be a vector of infection and spread pathogens between cows and udder quarters or alternatively the parlour can adversely affect the condition of the cows' teats, which in turn impairs the udder's defence mechanisms. Therefore, a parlour not functioning to its optimum can increase the risk of mastitis, damage teats and also increase overall milking time.

Testing Parlour Performance

Regular testing, service and maintenance of milking equipment are essential to maintain good mechanical performance, and reduce negative impacts on the cows' udder. Most milk producers will have a static machine test carried out annually, to comply with farm assurance guidelines. A static test is carried out with the machine running, but not milking and measures vacuum levels, effective vacuum reserve, pulsation characteristics and air leakage. However, a static test is only a small part of an effective assessment of milking machine performance, a full assessment can be divided into the following four categories:

i. A static test – carried out between milkings to measure vacuum levels, effective vacuum reserve, pulsation characteristics and air leakage.
ii. A dynamic test – carried out during milking to measure vacuum levels and stability, milk flows, ACR take off settings, cow behaviour and post milking teat condition.
iii. Plant cleaning – carried out post milking and measures wash temperatures, flow rates, solution distribution and chemical concentrations.
iv. Operator assessment – carried out during milking to assess operator technique and effectiveness of milking practices.

Most dairy farmers fulfil the requirements of farm assurance and have the milking equipment static tested annually; however few go beyond this level until a serious problem is

encountered. Dynamic milking machine testing which encompasses plant cleaning and operator assessment provides useful additional information which can be used to pre-empt parlour maintenance, and ensure minimal damage to the udder by the milking process.

The Kingshay Farming Trust (2005) describes the best guides to machine function as:

1. Teat condition at the end of milking
2. The frequency of liner slips
3. The average milking time per cow
4. The completeness of milk extraction.

All of these guides to function are part of a dynamic milking machine test.

Teat Condition

The skin of the teat is the first line of udder defence from the invasion of mastitis causing pathogens. Many studies have suggested that changes in the teat tissue due to milking may reduce the effectiveness of this barrier against infection. Short term changes induced by the milking machine can include colour changes, swelling, and dermal effects, while long term damage can include hyterkeratosis of the teat end. Hyperkeratosis results in thickening of the skin giving roughness and callus formation at the teat end. A high proportion of the herd showing teat damage, and the severity of the damage can be indicative of impaired milking machine function. This can be the result of excessive vacuum, over milking or hard liners.

Liner Slippage

A dynamic milking machine test will identify the level of liner slip, and check the condition of the liners. Liner slip, when the liner loses contact with the teat skin and permits entry of air into the milking system, causes fluctuations in claw vacuum level, and can result in extracted milk being forced back through the liners causing teat end impacts, forcing bacteria in the liners inside of the udder. Research shows that this has been associated with mastitis occurrence. Liner slippage is a problem when 5 – 10% of cows have slippage during milk extraction. Flooding of the claw piece can cause liner slippage at the beginning of milking, while poor liner design or uneven weight distribution within the claw are the most common causes later in milking.

Liners should be changed every 2500 milkings or 6 months, whichever is the sooner, as the liners are made of a synthetic rubber which deteriorates with usage and contact with detergents. The surface eventually becomes cracked and disinfection of the surface area is impaired. The correct size of liner is around 22mm for most Holstein-Friesians (~ 1-2 mm less than the average diameter of the teat after milking). Cows teats will be extended by some 20% during milking, and so minimum liner length should be 135mm.

Milking Time per Cow

Milking time per cow is highly related to yield and is similar across all parlour types. Shorter or longer milking times may indicate problems with milking routine or machine function. Table 1 gives typical milking out times for a range of milk yields.

Table 1: Typical Milking Time

Milk Yield (litres)	Typical Milking Time (minutes/cow)
10	5
15	6
20	7
25	8
30	9

Source: (Kingshay, 2005)

Milk Extraction

When a milking parlour is properly set up and milking routine optimal, the milk remaining in the udder post milking should be between 150 – 250 ml, with the higher levels for higher yielding cows on 3 x milking It is important to check the strip yield of cows regularly as it is a primary indicator of parlour function. If cows in the herd have very little milk remaining in the udder, the automatic cluster removal settings should be checked, and if too much milk is remaining, undermilking has occurred which can also lead to mastitis problems.

Routine Maintenance

Having the milking parlour tested annually is not sufficient to ensure that it is maintained in good working order. There are several key areas that should be checked regularly:

(1) Liners: As was mentioned earlier liners need to be checked, and changed regularly. It is also important that the liners are suitable for the claw, and should fit correctly so that they cannot twist.

(2) Vacuum: Vacuum levels should be checked on the parlour daily. High level equipment should run at 45 – 48kPa and low level equipment should run at 40 -44kPa. However, the key requirement is that the liner vacuum at peak milk flow is around 36 KPa irrespective of whether the milk pipe is high or low level. This can only be measured during a dynamic test. The vacuum regulator is a key piece of equipment and requires regular cleaning between services. To check if it is working effectively, listen to the regulator operating with all cluster vacuum shut off. Then open the vacuum shut off button on one or two units. If the regulator is working there should be a reduction in the air intake 'hissing' noise.

(3) Air Bleeds: All air bleeds should be free from dirt. Milk on the floor of the parlour when the units are removed is indicative of blocked air bleeds.

(4) Pulsation: The majority of pulsation faults results from splits in the pulse tubes, or grit under the pulsator valve seats. Pulsation can be checked by blocking three teat cups and sticking your thumb in the fourth. After 20 seconds the vacuum level will be equivalent to that on the cow's teats. If you find it uncomfortable on the thumb, the pulsation ratios need to be altered to improve teat conditions and milking out speed.

Summary

The milking parlour provides the interface between the teat and the bulk tank. Short term malfunction of milking equipment can have significant effects on cow performance. Long term malfunction such as excessive liner slippage or fluctuating vacuum levels can lead to irreversible teat damage and increased levels of mastitis. To minimise any disruptions to work schedules and cow performance the milking equipment must be thoroughly tested and maintained in good working order.