

Parlor analysis – parlor anatomy, basic system tests and how to perform this service

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Abstract

Milk quality on the dairy farm is influenced by the cow environment, the milkers, and the milking machine. A total milk quality program must therefore not overlook the milking system. The milking system can influence milk quality, bulk tank somatic cell counts, and clinical mastitis rates in many ways. Understanding what each part of the milking system does and how to test that it is functioning appropriately is key to providing milking system evaluation and milk quality troubleshooting services at your dairy practice.

Key words: milking system, milk quality, parlor analysis

Goals of Milking

The goal of milking is to efficiently remove milk from the udder while maintaining stable teat end vacuum. We do not want to harm the cow by either causing pain during milking or by causing teat end damage over time. We want to prevent contamination of the milk during milking and to cool the milk as fast as possible after collecting the milk in the bulk tank.

What are the Non-sanitary Components of the Milking System

The non-sanitary portion of a milking system involves all components that do not touch milk. This includes everything from the vacuum pump to the sanitary trap. The vacuum pump is the vacuum source of a milking system. Its main function is to create a vacuum. It can either be a conventional pump that runs continuously at the same vacuum level, or a variable-speed pump that changes speed as the system requires a change in vacuum level. A variable-speed pump saves electricity and is very efficient.

The filter/distribution tank is designed to prevent accidental introduction of items or debris into the pump which would cause damage to the pump. It also serves as a reserve of air to maintain vacuum in the system.

A regulator or vacuum controller allows atmospheric air to be introduced into the system as needed. Systems with a conventional pump require a regulator to let air into the system to maintain system vacuum. Systems with a variable-speed pump do not require a regulator, but do have an electronic vacuum controller component that regulates air administration as the system requires vacuum.

A pulsation system is used during milking to decrease milk slugging and establish consistent milk flow during milking. This system allows for alternating milk and rest phases to be applied to the teat to effectively harvest milk without causing damage to the teat ends.

Automatic take-off units are used to automatically remove the milking cluster from the udder at the end of milking. The goal is to remove the milking units when the teats are still plump with milk but the udder is empty. This involves setting the automatic takeoffs with 2 settings. One is the end of milk flow rate, measured in pounds of milk being extracted per minute. The other is the end of milk delay, which is set at seconds that the milk is flowing at a certain rate. The combination works well to remove milk without applying vacuum to teats that are not plump with milk.

A sanitary trap is the component of a milking system where the sanitary and non-sanitary sides of the system meet. The sanitary trap prevents milk on the sanitary side from getting contaminated.

What are the Sanitary Components of a Milking System

The sanitary components of a milk system are all the components that touch milk during milking. This extends from the milking inflation all the way to the bulk tank.

The inflation is the flexible piece that actually touches the cow. It provides massage to the teat-end through vacuum which causes the milk to be extracted. These can be made of either rubber or silicone. The milk runs through the inflation and into the bowl component of the milking cluster. From the milk bowl it runs through a milk hose into the milking line. The milk line is typically a stainless steel pipe that the milk flows through and leads to the receiving jar. When milk reaches a certain volume in the jar measured by electrodes in the jar, a transfer pump turns on and pumps the milk from the receiver jar to the bulk tank. The purpose of the receiving jar is to prevent slugging of milk in the bulk tank to prevent fat molecules from breaking down, causing milk spoilage. It also eliminates the need to have the bulk tank under vacuum.

As milk is pumped from the receiver jar headed to the bulk tank it goes through a milk filter. This filter removes any dirt, debris, bedding, or manure that happened to contaminate the milk during milking.

Milk is collected in the bulk tank where it stored until a milk company picks it up. The bulk tank has 2 functions, storage of milk and milk cooling. Milk must be chilled to less than

45°F (7.2°C) within 2 hours of being removed from a cow. Bulk tanks have coolant circulated through their tank walls to cool the milk. There is an agitator motor that circulates a paddle at the top of the bulk tank to agitate the milk and keep the fat component of the milk from settling on the top.

Milking System Analysis Overview

Some of the steps of a milking system evaluation can be performed on a static system (not during milking); however, most steps should be performed dynamic (under load, during milking or simulated milking). One of the primary advantages of being able to perform a milking system analysis during milking is that it enables the tester to also observe the milkers. This step should never be overlooked. I have found that if I just stand in the parlor and watch milkers, they know they are being watched and often their behavior is altered by the presence of an observer. However, if the milkers think you are testing the system you will get their normal activities in the parlor.

Equipment you will need to test milking systems includes a digital vacuum gauge, an air flow meter that allows a measured amount of air into the milking system, a pulsator analyzer (Triscan or Digimet), inflation plugs, tubing, timers, strip yield cups, test ports, short pieces of milk hose, lag time and teat end health data logging system (I use apps on an Ipad), Lactocorder milk flow measuring device, and VaDia vacuum evaluators.

Static Testing of a Milking System

The first step in performing a milking system evaluation is to measure system vacuum. This is best done at the receiver jar, pulsator line, regulator, and the vacuum pump. At no point should vacuum vary by more than 0.6 in Hg. I like to compare my measurement to the parlor's vacuum gauge. I find that the gauges in parlors are rarely accurate!

The next step is measuring effective reserve. Effective reserve is defined as the maximal amount of air that can be let into a system and still maintain stable vacuum. I do this by placing an air flow meter near or on the receiver jar. I open air flow meter holes to allow enough air to lower system vacuum by 0.6 in Hg. I record the amount of air in cfm that was admitted. The goal for effective reserve is 1 ½ to 2 cfm per unit + 35 cfm. Example = 10 milking units would need 50 to 55 cfm of effective reserve.

Reasons for low effective reserve include inadequate vacuum pump output, excessive air leaks allowing air to escape, and poor regulator performance.

The next step is measuring manual reserve, which is the amount of air that can be admitted and maintain stable vacuum with the vacuum controller (regulator) disabled. This measurement is for non-variable speed systems only. I perform this by removing the regulator and plugging the pipe it was connected to. I then place an air flow meter on

the receiver jar as I did when measuring the effective reserve. Caution: make sure enough holes are open to accommodate pump capacity or you can collapse the receiver jar. I then close the openings on the air flow meter until the vacuum measurement is 0.6 in Hg below system vacuum. I record the amount of air in cfms.

Reasons for low manual reserve include inadequate vacuum pump output and air leaks in the milking system. In a perfectly functioning system, the effective and manual reserves will be the exact same. The regulator efficiency is the ratio between the effective reserve and the manual reserve. Example - if effective reserve is 50 cfm and manual reserve is 100 cfm, then regulator efficiency is 50%. Goal is to have regulator efficiency over 90%.

The next step in testing a milking system is to measure the vacuum pump capacity. All vacuum pumps are rated at 15 in Hg. You can expect a vacuum pump to produce 10 cfm of air per horse power. This means a 10 HP pump should have a capacity of 100 cfm.

I test vacuum pumps by disconnecting the vacuum pump line from the milking system and use my airflow meter again to measure the amount of air displaced by the pump at 15 in Hg. I record this amount of air. I also use this time to evaluate the belts on a belt driven pump to make sure they are not too loose or worn.

After a milking system passes all the static testing (not during milking), I then will perform the dynamic tests (during milking).

Dynamic Testing of a Milking System

I start the dynamic testing by measuring teat end vacuum at the inflation short milk hose during peak milk flow. Peak milk flow usually occurs at 30 to 45 seconds after unit attachment. The goal for teat end vacuum is 10.5 to 12.5 in Hg with less than 1 to 1.5 in of fluctuation in a low line and less than 2 to 3 in fluctuation in a high line-style parlor.

My observation is that fluctuation is highly variable between different types of milking systems.

During milking, I evaluate for proper unit removal. If units are manually removed, the vacuum should be shut off before removal. I don't want to see any machine stripping! I rely on my VaDia and Lactocorder reports to evaluate whether automatic takeoffs are functioning properly and at an acceptable time. I evaluate strip yields immediately after removal. The strip yield goal is to have over 70 to 100 mL per quarter or 250 to 400 mL per cow. It is difficult to have too high of strip yields! I also like to evaluate teat-ends after unit removal. Teats should not be discolored or have a ring of compression/banding.

I like to evaluate all pulsators with a Triscan machine when the units are under load. Check to see if pulsators are pulsating side-to-side or front-to-back. Proper Triscan graphs should display : A + B phase = milking phase. Should be 50 to 65% of the cycle.

B Phase = time in milk, should be >450 msec. C + D phase = rest phase. Should be 35 to 50% of cycle. C phase should likely be over 100 msec. D phase = time in rest. Should be >200 msec. Rate = number of cycles per minute. Goal = 60. I like to evaluate the ratio of rest to milk phase time as well. I like to make sure all the pulsators match between and within by 5 to 10%.

Lactocorder machine graphing provides a lot of useful information. It can measure startup milk and the presence of bimodality, peak milk flow, average milk flow, total milk time, and end of milk unit removal. I like to see no or minimal bimodality. I want peak milk flow rates of greater than 8 lb (3.6 kg) per minute. With good milking routines, 10 lb (4.5 kg) per minute is attainable. I like to see milking units removed when milk flow rates drop to 2 to 3 lb (0.91 to 1.4 kg) of milk flow rate for 3 to 5 seconds.

VaDia vacuum recordings are also very useful. VaDia units can be plugged into the mouthpiece, short milk tube, and pulsator hoses during milking. Continuous recordings while milking provide very valuable information at several data points.

Mouthpiece vacuum levels should be less than 5 inches during overmilking and less than 4 to 5 inches during peak milk flow. If high mouthpiece vacuum is present, it indicates the teat is not sealed against the inflation. This can be from an inflation that does not match the teat size of the herd, poor stimulation or improper lag time (overmilked at beginning of milking), or overmilking at end of milking (delayed take off, improper ATO settings). I like to see less than 15 seconds of over-milking and less than 5% of VaDia graphs displaying bimodality.

Milker Routine Evaluation

I prefer to evaluate the milkers during milking without them knowing they are being evaluated. I like to see if there is a milking routine? Is it written? Are employees trained and evaluated? The veterinarian is a useful resource for developing and writing a milking routine, as well as training employees along with future evaluations of compliance.

I like to see if the routine is consistent between employees and between cows? What is teat and udder hygiene as cows enter the parlor? Do milkers wear gloves? Is predip applied to adequately cover all teats? Is predip removed in a manner to thoroughly clean teat ends and provide stimula-

tion? Are cows properly forestripped in each quarter = 1 to 2 good squirts of milk? Is lag time appropriate and similar for all cows? Lag time should be 90 to 180 seconds. Teats should be plump with milk when units are attached. Lag time begins with forestripping stimulation, not predipping. Inadequate lag time leads to bimodal milk letdown and poor milk flow rates. Prolonged lag time is often associated with good startup milk without bimodality but poor milk flow rates due to loss of oxytocin effect. I like to see if units are attached in a way to minimize air admission? Are units properly aligned on every cow? Do cows stand nicely for milking and preparation or are they uncomfortable and nervous? I also like to see if teats are covered with a post dip after milking.

Teat End Scoring

I like to score teat-ends on as many cows as possible during milking. I like to score them right before the post milking dip is applied. On small herds, 100% of the teats should be scored. On large herds, a minimum percentage of the cows should be scored in each pen (usually >80%). I use an app on an Ipad to quickly record teat end scores. The goal is to have 85% of teats with a score of 1 to 2, 10% with a score of 3, and <5% with a score of 4. Reasons for poor teat-end condition include unstable teat end vacuum due to inadequate reserve, poor pump capacity, improper regulator function, excess milk hose length, slugging of milk, lifting milk, and inadequate pipeline size for number of units. Also improper teat end vacuum (too low or too high), poorly functioning pulsators, especially inadequate rest phase (D<200 msec), poor pre-milking stimulation ...short lag time, long lag time, improper stimulation, or the action of overmilking cows (improper ATO settings or improper manual removal).

I prefer to compile all the information I gather during the static and dynamic testing and write a detailed report with my findings and my recommendations for the dairy producers. I find that including pictures taken during the dynamic testing are very helpful when dairy producers have team meetings to help train their milking team. I recommend to each of my dairy clients that their milking systems should be evaluated every 12 months, or sooner if milk quality concerns develop.