Hand Milking

During hand milking of a cow, manual cleaning & massage of the udder stimulates milk let-down. The teat is closed at the base of the udder and then manual pressure is applied to the teat to force the trapped milk out of the teat opening. Hand milking is dependant on increased pressure within the teat to overcome the resistance of the teat sphincter. This is NOT the way milk is removed by nursing calves or milking machines.

Calf

The presence of the calf and its "bunting" of the udder stimulates milk let-down. As a calf nurses a cow, it does not clamp off the base of the teat nor put much pressure on the walls of the teat. But as the calf sucks, a negative pressure is produced in the mouth. The pressure within the udder, created by atmospheric pressure and by milk letdown is greater than the area of negative pressure within the calf's mouth. The resistance of the teat sphincter is overcome and the milk flows rapidly into the calf's mouth (the area of reduced pressure).

How the milking machine works...

A milking machine functions the same as a nursing calf. The reduced pressure within the shell- inflation causes the milk to flow out from the teat and udder and into the milking system.

Pulsation System

The pulsation system allows the inflation (shell liner) to close and apply pressure to the teat end. It does this by allowing atmospheric air to enter between the shell and the inflation. The purpose is to massage the teat end and force tissue fluids back out of the teat end.

If massage fails

If the massage (or rest) phase fails, the tissue fluids begin to collect, swell the teat end and gradually shut off the opening in the teat so little or no milk is removed. This reduces milk harvested and may damage the teat end.

Shell "Creep"

Teat problems are exaggerated if the shell "creeps-up" onto the lower udder and presses the tissues together at the base of the teat. This closes off the opening from the gland cistern to the teat cistern and stops milk flow. It also prevents the outflow of tissue fluids, even with proper massage.

Vacuum Pump

The function of the vacuum pump is to remove or (exhaust) air from a closed system, thereby creating a partial vacuum. Atmospheric air creates a pressure on all surfaces, and when measured with a mercury manometer, will cause mercury to rise in a column to 29.9 inches high at sea level. This is called barometric or atmospheric pressure. Most milking systems will create a partial vacuum of 10.5-12.5 inches of mercury.

Vacuum Gauge

The vacuum pressure may be measured by a vacuum gauge instead of the mercury manometer. It is still measured in inches of mercury (Hg) to indicate the vacuum pressure present. It may also be measured in units called kiloPascals (kPa). One inch of mercury is equal to 3.38 kPa. A vacuum gauge should be located on the vacuum line. It should be observed at each milking to be sure it is working and that it is at the desired vacuum level for milking.

Vacuum Controller (regulator)

The vacuum controller admits air into the milking system to limit the vacuum in the pulsator and milk lines. The CFM rating of the controller must be equal to or greater than the vacuum pump capacity. The controller should be installed in a clean area where moisture and dirt will not affect its proper operation and where it will not freeze in cold weather if condensation accumulates. The preferred site is near the sanitary trap.

Diagram of Controller

The controller allows air to enter the line, as needed. Or, it closes down to exclude excess air in order to maintain a specific vacuum level. A controller that is too small or partially plugged may result in an excessively high vacuum level, which could cause damage to the teats.

Vacuum Balance Tanks

The vacuum balance tank is also referred to as a vacuum reserve, air distribution, or a header tank. It serves as the point of entry for header pipes so serves as a distribution tank. Its content volume has a cushioning effect on the vacuum level when small amounts of air are admitted into the system; so it is a balance or cushion tank.

Teat Cup Shell and Teat Cup Liner (Inflation)

Form a vacuum chamber which allows milk to be removed from the teat and also provides massage of the teat end. The size inflation used should correspond to the shell size. Most companies recommend the use of narrow bore liners (3/4 inch or less in internal diameter). These have less tendency to creep up the teats and shut off milk flow from the udder into the teats

Teat Cup Liner (Inflation)

The inflation (or shell liner) is made of synthetic rubber or silicon and is the only part of the entire milking system which comes in contact with the cow. The surface becomes pitted with use and cleaning and they must be changed on schedule. If not, they are more likely to aid in the spread of infectious bacteria which cause mastitis. They also lose their elasticity, with use, and will not provide proper teat massage.

Twisted Inflation

It is essential that inflations be installed properly and in the correct shell. Twisting will prevent normal function. Some inflations are square, others have ribbed sides or special tops. Some admit air into the tailpiece of the liner and are called a vented inflation. This is done to avoid flooding with milk. Most manufacturers control claw flooding by admitting air into the claw. Vented inflations may cause problems in systems that have inadequate reserve air flow. When vented inflations are used, the air inlet in the claw should be closed (covered or sealed).

Roughened Inflation with Milk Deposits

It is very important that inflations are changed on schedule as recommended by the manufacturer. Otherwise they become worn, allow buildup of milk deposits and bacteria and assist in the spread of contagious forms of mastitis.

Pulsator

The function of the pulsator is to allow intermittent massage of the teat end to prevent swelling. It does this by alternating between a partial vacuum (milking phase) and atmospheric air pressure (massage phase). Some systems require that a specific side of the pulsator be attached to the teat cups for the rear quarters. For these systems, be sure the hoses are connected correctly.

Milking Phase

During the milking phase, the space between the inflation and shell and the space inside the inflation have the same partial vacuum. This causes the inflation to open and milk to flow from the teat because the pressure is lower outside the teat end.

Massage (rest) Phase

During the massage (or rest) phase, air at normal atmospheric pressure enters between the shell and inflation. Due to the partial vacuum inside the inflation, the inflation collapses around the teat. The pressure of the collapsed inflation helps massage the teat end, preventing congestion of blood and body fluids in the teat skin and tissue.

Pulsation Rate

The number of times per minute that the pulsator alternates between the milking and massage phase is called the PULSATION RATE. Rates vary from about 40 to 80 pulsations per minute, depending upon the manufacturer. A rate between 50 to 60 is usually recommended.

Pulsation Ratio

The ratio of time the inflation is in the milking phase compared to the time it is in the massage (rest) phase is called the PULSATION RATIO (or milk to rest ratio). Ratios vary by manufacturer, from 50:50 to about 70:30. Cows will usually milk slightly faster with a wider ratio, such as 70:30. However, the longer milk phase and shorter rest phase may cause teat end trauma and damage if the milking equipment is not working properly and if good milking practices are not followed. Ratios near 60:40 are less likely to contribute to problem situations.

Long Milk Hose

The long milk hose carries milk from the claw to the milk line. Be sure the long milk hose is in good condition, does not leak, is not too long and does not contain a filter. Avoid loops in this line that may cause a "backup" of milk & flood the claw.

Claw Size

The claw should be of adequate size to avoid flooding. Most claws admit air through a small hole in the claw to aid milk flow. Claws should not have filters in them. Be sure the ferrules (tubes where the liners are attached to the claw) are not bent or damaged as this will block milk flow, slow milking and cause teat irritation.

Claw Size

The claw is connected to the milk line by the long milk hose and milk flows from the claw to the milk line through this long milk hose.

Milking Claw

The milking claw connects and supports the four shells and inflations and serves as a collection site for the milk from the four quarters. The "tail piece" of the inflation carries the milk from the teat end into the claw (its also called the short milk tube).

Milk Line

The milk line receives milk through the long milk hose and carries it to the receiver jar. "Low- lines" are located lower than udder level and "high lines" are located higher than udder level. Low-lines result in less claw and hose flooding during peak milk flow and also reduce vacuum fluctuation

Milk Line Function

The milk line must transport milk (allow the milk to flow in it) and also provide room for air to move above the milk.

Milk Line Size

The milk line should be of adequate size for the number of milking units used. Milk lines are made of glass or stainless steel. Stainless steel is preferred because of its durability. Most stainless steel lines

are welded on site and joined at some connections with clamps and gaskets

Milkline slope

Adequate slope in the milkline throughout the system is essential for the proper flow of milk. Flat spots will cause flooding of the line and vacuum fluctuations.

Receiver Jar

Milk flows by gravity through the milk line and into the receiver jar. The receiver jar serves as a small holding reservoir until the milk can be pumped into the bulk tank for cooling and storage. The valve between the receiving jar and the milk pump should not admit air. If a bubbling action occurs in the receiver jar, air is leaking past the valve and it should be corrected or replaced.

Milk Pump

The milk pump turns on when milk reaches a certain level in the receiver jar. It pumps milk through another milk line into the bulk tank. This is a separate small pump which pumps milk and is unrelated to the vacuum pump, which pumps air. Be sure the lines and valves are properly set prior to milking to deliver the milk from the receiver jar to the bulk tank.

Sanitary Trap

The sanitary trap is usually located close to the milk receiver jar. Its purpose is to trap any milk or wash water that goes past the receiver jar, so it doesn't enter the vacuum balance tank or get on into the vacuum pump. The pipes connecting the trap with the balance tank should be the same size as the milkline and should slope toward the trap.