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MILKING MACHINE OPERATION AND MAINTENANCE

1. Introduction

The milking machine plays an important role on the dairy farm as an efficient means of milking cows; however, it must be remembered that this machine is one of the few devices which has direct contact with living animal tissue. A milking operation which results in discomfort to the cow and is caused by faulty milking equipment or techniques may lead to injury or mastitis.

Consequently, before a person attempts to milk cows he/she should thoroughly understand the basic operation of the milking equipment and fully realize the significance of maintaining the equipment in good condition at all times and of employing good milking techniques. This factsheet describes the basic operations involved to help give a better understanding of milking machines.

2. Function

The milking machine performs two basic functions:

- It causes milk to flow from a teat by exposing the teat end to a partial vacuum.
- It massages the teat in an effort to relieve the effects of a continuous milking vacuum.

2.1 Vacuum

Milking machines depend upon a partial vacuum for their operation. A partial vacuum is created when part of the air is removed from a confined space, such as the various pipes in a milking system. The amount of air removed from the system will determine the vacuum level.

The vacuum level indicated on a vacuum gauge is measured in Kilopascals (metric) or in inches of mercury vacuum (imperial). For example, if approximately one-half of the air is removed from the system a vacuum gauge would indicate 50 kilopascals or 15 inches of mercury vacuum.

2.2 Milker units

All milker units operate in basically the same way and consist of the following components:

a) Pulsator
b) Teat cup shells and liners (inflations)

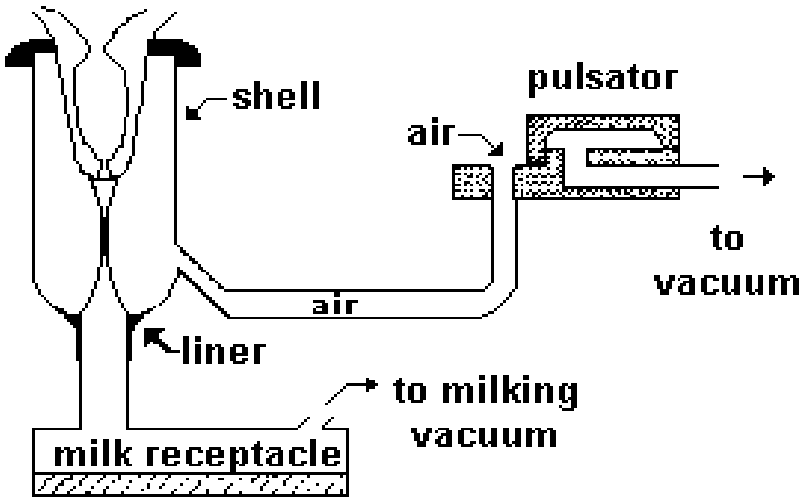
c) Milk receptacle:
   - bucket
   - teat-cup claw (attached to a floor pail milker or to a pipeline).

The basic operation of the milker unit is shown in *figures 1A* and *1B*.

As the pulsator operates, it causes the chamber between the shell and the liner to alternate regularly from vacuum to air source. Keep in mind that the inside of the teat-cup liner is under a milking vacuum at all times. Thus when air is admitted between the shell and liner (*Figure 1A*) the line collapses around the cow's teat.

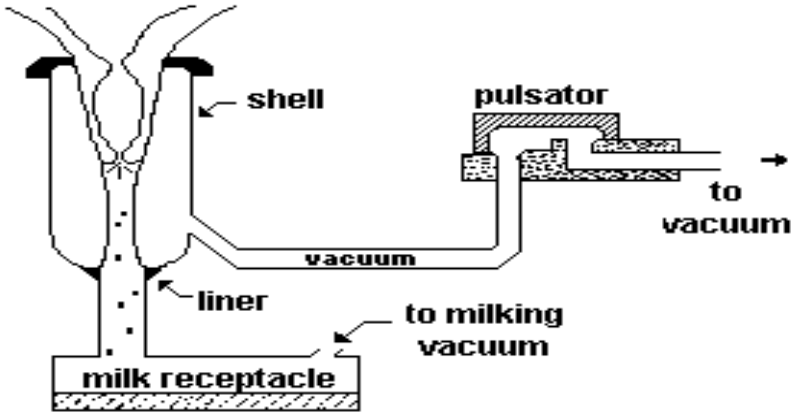
The pressure of the collapse liner is applied to the teat giving a massaging action. This is called the **rest** or **massage** phase. Milk does NOT flow from the teat during this phase.

Figure 1A. Massage Phase



During the **milk** phase (*Figure 1B*), the space between the liner and the shell is exposed to the vacuum by way of the pulsator. The fact that there is now equal pressure on both sides of the liner causes it to open. The end of the cow's teat exposed to the vacuum and the influence of internal milk pressure within the cow's udder causes the milk to be drawn out through the teat opening.

Figure 1B. Milking Phase



The milking process then consists of opening (milk phase) and closing (massage phase) the teat-cup liner over and over again.

Terms related to Pulsator

Pulsator cycle

A cycle refers to the total time in seconds that a pulsator takes to complete one milk phase and one massage phase.

Pulsator Rate

The pulsation rate refers to the number of cycles that the pulsator makes in one minute. Pulsators on the market have pulsation rates ranging from 40 to 60 cycles per minute.

Pulsation Ratio

The pulsation ratio is the length of time in each cycle that the pulsator is in its milk phase compared to its massage phase. The pulsation ratio may be expressed as a simple ratio or it can be expressed as a percentage. Examples of pulsation ratios are as follows:

1:1 or 50:50
1 1/2:1 or 60:40
2 1/2:1 or 70:30

Therefore, a 60:40 pulsator means that within any given cycle the teat-cup liner will be open and milking 60% of the time and closed or massaging the teat 40% of the time.

Pulsation Phase

The pulsation phase refers to the method of pulsation known as simultaneous (4 x 0) or alternating pulsation (2 x 2).

Simultaneous Pulsation

Some milking machines are designed to operate with all four teat cups simultaneously milking and then all four teat cups massaging.

Alternating Pulsation

Some milking machine units are designed to operate with an alternating action; that is, while two teat-cup liners are milking the other two liners are massaging. Depending on the manufacturer, the alternating action may be from the left side to the right side or it can be from front quarters to back on an individual cow.

How Pulsators are activated

Pulsators can either be vacuum or electrically operated. The vacuum-operated pulsator uses air to move the plunger or slide valve which covers or uncovers the air passages to produce the pulsating action. The plunger or slide valve may be housed in oil for smoother action. The rate of pulsation is controlled by a needle valve which may be factory set or may be manually adjustable. Temperature changes tend to affect the pulsation rate of vacuum-operated pulsators; so be conscious of this factor and maintain the pulsator at normal operating temperatures to help reduce rate variations.

The electric pulsator may be operated by a master control which sends, via an electric current, the proper command to the pulsator to perform a preset pulsation rate and ratio. The electric pulsator is unaffected by temperature and therefore, has the advantage of producing a constant pulsation rate.

Some electronic pulsators have a computer chip internally mounted. These pulsators function to a preset rate and ratio once they are inserted into a stall cock electrical-vacuum source.

Some pulsators have variable pulsation rates and ratios. This feature allows the individual farmer to better choose the pulsation rate and ratio that suits the dairy herd's needs. However, a word of caution: DO NOT experiment unless you fully understand the technical aspects of pulsation rates and ratios and know how they influence the cow's milking; otherwise, severe injury could result.

Teat cups shells and liners

Many types of teat-cup shell and liner combinations are available. Make sure that the shell and liner are compatible. For instance, make sure that the liner has enough room inside the shell so that it can fully collapse without hitting the inside walls.

Choose a liner that has a mouth piece which helps prevent downward slippage or riding-up action on the base of the udder. To reduce teat and udder irritation, the use of narrow to intermediate bore liners is recommended. If a herd is presently being milked with a wide-bore style liner and one wishes to change to a narrow-bore liner, be conscious of the following facts:

1. Many drop-offs may be experienced at first until you relearn how to handle the milker units, such as putting less tension on the units, etc.
2. Slower milking may be experienced on some cows at first.
3. Some long, flabby teated cows may never be able to adapt to the narrow-bore style.

Softness of Liners

The liners (inflations) should be replaced as recommended by the manufacturer. A liner should be replaced immediately if it becomes damaged.

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Technical specification

Two Bucket two cluster Fixed Type Milking Machine

This milking machine comprises of one vacuum generation system (fixed type), one set of milk can assembly and PVC pipes and fittings. Detailed description of the whole system is as follows:

(i) Vacuum System:-The vacuum system assembly comprises of three components :-

A) Vacuum Pump (One No.):-The capacity of vacuum pump is 350 liters per minute at 50kpa vacuum suitable for milking two cattle at time.

B) Vacuum Tank (One No.):-Vacuum tank is made of thick PVC sheet with a suitable capacity to store the vacuum.

C) Motor (One No.):- Our vacuum pump will be driven by 2H.P, single phase 1440 R.P.M motor with MCB for protection as well as on off switch.

(ii) Milk Can Assembly (One no.):-One milk can assembly comprises of following Components:-

A) Pulsator:-Our pulsator is adjustable in the range of 50 to 180 pulse per minute (P.P.M) over an operating vacuum range of 30 to 50kpa.The pulsator is also available for connection to filtered air-line ,there by further improving internal cleanliness and long term reliability.

Technical Data:-

Pulsation Type	Alternate
Rate	Adjustable from50 to 180 P.P.M
Operating System	Pneumatic
Working Principle	Diaphragms
Body Material	Thermoplastic resin

B) Milk Claw:-Milk claw is the part of milk can assembly where the milk the milk is collected from the liner (connected to cattle teats) and transferred to milk can through milk tubes .Milk claw capacity is 180c.c.

C) Liner: - Each milk can assembly consist four numbers of food grade, FDA approved milking liners suitable for cattle teats.

D) S.S Teat Cup:-The teat cup is made of S.S 304 material suitable to liner .Liners are fitted in teat cup assembly.

E) Short Pulsation Tube:- With every teat cup short pulsation tube for pulsation of the liners shall be provided.

F) Milk Tube:-1.25 meters of food grade P.V.C transparent milk tube for milk transfer from milk claw to milk can shall be provided.

G) Double Pulsation Tube:-1.25 meter of double pulsation tube attached to pulsator and milk claw shall be provided.

H) Pulsator Adopter: - One pulsator adopter for every pulsator for every pulsator to attach the milk can pulsator shall be provided.

I) Milk can:-Milk can of S.S 304 make with capacity of 25 lits and thickness shall be provided.

- P.V.C Fittings:- P.V.C fittings with following components shall be provided.

A) Vacuum Gauge:-One number vacuum gauge of dial size four inches with marks from 0 to 100KPA.

B) Vacuum Regulator:-For the regulation of vacuum at constant rate one spring type vacuum regulator shall be provided.

C) Vacuum Valve :- Vacuum Ball valves and necessary components shall be provided to make connection with P.V.C pipe and milk cans.

Type of Machine

Type of Machine	Cow milking at a time	Trolley type	Fixed type
One cluster, one bucket	One	√	√
Two cluster, one bucket	Two	√	X
Two clusters, two bucket trolley type	Two	√	√
Four clusters, four bucket fixed type	Four	X	√

Equipment Installation and Commissioning

Before any new milking machine is used, it should be thoroughly tested for both milking and cleaning performance. This is the responsibility of the milking machine supplier. The milking machine dealer should provide the dairy operator with instructions for operation of the milking machine in both the milking and cleaning mode. The results of a commission test should also be presented documenting that the milking machine is functional and with measurements of:

- Vacuum level at the regulator or vacuum gauge
- Milking vacuum level (average vacuum in the claw at peak milk flow)
- Pulsator rate and ratio with a commissioning check of each pulsator
- Effective and Manual Reserve airflow
- Air injector timing
- Water flow rate through each milking unit during the wash cycle.
- Recommended cycles for cleaning
- Recommended chemical concentrations for each cycle

Operation

Milking cows is a highly qualified job that will benefit from a persistent use of correct routines.

- Before starting milking make sure all equipment and tools are at hand and in proper condition. Use clean suitable clothing and wash your hands thoroughly before starting milking.
- Always handle animals with care and in a calm and considerate way. No yelling or beating if you want them to give you all their milk.
- Clean and massage the cow's udder. Use dry cleaning if the udder is clean. If it is so dirty that wet cleaning is required make sure you wipe the teat dry after cleaning. Use disposable cloths for each cow or individual cloths that are cleaned in a washing machine between every milking.
- Premilk by hand in a test cup. Take a few squirts from each teat and check for flocculation or blood.

- In some countries a special pre dip is used to disinfect the outside of the teat. This will eliminate infections to spread from the outside of the teat to the inside of the same or other teats milked with the same unit.
- Put on the milking unit within one minute after preparation.
- A persistent routine is very important for this action as the cows will develop a let down reflex that is adjusted to such a routine.
- Monitor the milking and adjust the unit if it starts squeaking or if the cow appears uncomfortable.
- Take off the unit when the milk flow has ceased or is very low. Check that the udder is empty before you remove the unit. Avoid developing habits were all the cows expect you to aftermilk with machine before taking off. If you use automatic take off units do some random checks that the cows are properly milked.
- Teats dip the cows within one minute after takeoff. This will safeguard disinfection and protection of the teat canal while it still is open. Register the observations you do on the individual cows during milking. In many production systems milking is the only time of the day when you are close to all the individual lactating cows.
- Treated and sick cows shall always be milked separately and after all the healthy cows.
- Cows develop habits. If you establish and maintain a persistent milking routine for every milking the cows will feel comfortable and respond positively with an even production.

Maintenance of Milking machines

Vacuum

1. Check oil level weekly.
   - Fill with correct type of oil recommended by manufacturer. Some 0ils contain additives which form a sludge when mixed with water and detergent. Do not overfill - excess oil will blow out exhaust.

2. Check type and tension of belts. Spin pump by hand to see if vanes fall freely, or to detect unusual drag loose pulleys or rough bearings. Check that pulleys are in line.
   - With v-belts care must be taken that the belt section used matches the the correct section pulley, for example, B section belting should not be use on A section pulleys. Tighten drive belts so there is a slight sag on the slack side while running. Repair or replace worn vanes, bearings and drive belts.

3. Check cleanliness of vacuum pump.
   - Once every six months, or when the pump becomes fouled by milk, it should be cleaned using diesel fuel or a 4:1 kerosene-oil mixture. Approximately two pints of mixture are fed into the suction port while the pump is running. If extensive cleaning is required, the pump can be filled with this mixture and allowed to soak. After the pump is cleaned half a pint of oil should be added through the suction port to ensure thorough lubrication.
4. Check exhaust pipes.
   - The exhaust pipe must never be smaller than the outlet from the pump, otherwise pressure will seriously limit the performance of the pump. Elbow bends should not be used as they are too restrictive. Bends with large radii are better. A non-return valve should prevent reverse rotation when pump is switched off.
5. Check capacity of pump with a flow meter.
   - Every six months have vacuum pump capacity checked by service man to help detect wear, leaks or stoppage in the system.

Vacuum Control Valves or regulators

1. Check the location of regulator.
   - In bucket systems the regulator should be placed in a clean spot on the vacuum line between the reserve tanks and the first stall cock. In milk pipeline systems the regulator should be placed:
     - between the vacuum reserve tank and the sanitary-trap near the milk receiver, or
     - on the vacuum reserve tank.
2. Check the capacity of the regulator.
   - The regulator must be capable of admitting air at least equal to the capacity of the vacuum pump. All milking systems should be equipped with a vacuum relief valve set 2 or 3 inches higher than normal line vacuum, for safety in event of regulator failure.
3. Check valve, screen and filters.
   - Regulator valves, valve seats, screens and filters should be dismantled and thoroughly cleaned at least twice a year unless regulators are unavoidable in a dusty location then they should be cleaned more often. Do not oil valves or moving parts since this will only collect dust and dirt and make the valve stick.

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Pulsator

1. Check the pulsation ratio. The pulsation ratio refers to the length of time the inflaction or liner is in the "milking" phase compared to the "rest" phase. This can only be checked by special test instruments.
   - Example pulsation ratios are 50:50 and 60:40. Know what is recommended for your equipment and report any malfunctions to the service man.

2. Check pulsation rate. The pulsation rate refers to the number of cycles ("milking" phase + "rest" phase = 1 cycle) the pulsator makes in one minute. You can check this with a watch by inserting your thumb inside an inflation when system is operating and counting the number of squeezes per minute.
   - The recommended rate is in the range of 50 to 60 pulsations per minute. This depends on such things as pulsation ratio, vacuum level and type of inflation. Know and follow manufacturer's recommendations to keep these factors in balance. **Do not experiment**on your own.

3. Check cleanliness of pulsators. Check pulsator filters and diaphragms.
   - Older type pulsators need frequent cleaning of air inlets and occasional replacement of valve rubber seals. Some can be wahed out regularly, but check manufacturer's recommendations before bringing in contact with water.

4. Check voltage, look for loose connections and electric shorts on electric pulsators.
   - Report problems to a service man.

Vacuum Pipelines

1. Check stall cocks for leaks.
   - Tighten or replace faulty stall cocks.
2. Check drain cocks for leaks.
   - Adjust or replace.
3. Check line for buildup of residue.
   - Flush vacuum pipeline with hot water and a non-foaming detergent.
4. Check gasket on sanitary traps for leaks.
   - Adjust or replace.

Rubberware

1. Check short air tubes on milker units.
   - Never milk with holes in pulsator air tubes.

2. Check inflation or liners.
    - Discard any inflation of liner with holes or cracks. Discard any liner than has passed the number of cow milkings recommended by the manufacturer: for example 1000 cow milkings.
3. Check storage of rubberware.
    - It is recommended that two sets of liners be kept on hand. One set stored in a lye solution and used on alternate weeks.

Milk Claw

1. Check air admission hole ("air vent").
    - Clean air vents thoroughly. Slow milking and/or flooding of claw could be caused by blocked air vents. Do not increase vent size.
2. Check valve, float, claw gaskets and air manifold.
    - Clean and replace any defective claw parts.
3. Check for vacuum stability during milking with all units in operation.
        - This test will determine if a constant, steady vacuum exists at the teat cup at all times during milking.

Milk Pipelines

1. Check for proper slope.
    - Maintain slope of 40 mm per 3 m (1 1/2 in. per 10 ft) downward, towards the milk receiver jar from the high point in the line.
2. Check milk inlets for location and leaks.
    - Maintain inlets in the top third of the pipeline to prevent vacuum fluctuations. Make sure valves close properly to prevent vacuum losses.
3. Check for leaky couplings.
    - To prevent vacuum losses tighten couplings; clean and/or replace gaskets.

Milk Receiving Jar

1. Check gaskets, fittings and non-return valve for leaks.
    - Clean and/or replace gaskets. Tighten couplings.
2. Check electrical probes for corrosion and wear.
    - Report "unexplained" buildups to service man.

Milk Pump

Check bushings, seals and diaphragms.

- To assure proper performance and sanitation make necessary adjustments or replacements.

Cleaning and Sanitation of Milking Machines

Special care must be exercised in cleaning milking machines. As milking machines become more complex the task of assuring adequate mechanical cleaning action in all parts of the milking machine becomes increasingly complex. The proper cleaning of milking equipment is very much necessary to maintain the quality of raw milk by avoiding contamination from it. The following methods can be employed to get better cleaning efficiency.

I. Manual Cleaning:

Washing by hand is appropriate for bucket milking machines and clusters, and for ancillary equipment's. The daily cleaning routine consists of three stages: a rinse with cold or tepid water (38-55°C), a warm detergent wash and a final rinse with clean water. The cold or tepid water rinses remove residues of milk which would otherwise partially inactivate the disinfectant in the next stage. Tepid water is particularly beneficial for rinsing the clusters, as this is more effective than cold water in removing fat and milk residues.

Procedure:

1. After milking, the outside of the milking unit is cleaned by wiping and rinsing. Each unit should be rinsed by connecting the vacuum tube to a vacuum tap and drawing clean water through the teat cups. If the clusters are not cleaned immediately, they should be left immersed in water.
2. The warm detergent-disinfectant wash, is the most important of the three. Unless the solution reaches all milk-contact surfaces, milk residues may remain which will protect bacteria from the disinfectant. Care must be taken to avoid air-locks in the clusters.
3. Clusters should be washed first by full immersion for two minutes; teat cups, milk tubes and claws are scrubbed, and the cluster is re-assembled and transferred to the rinsing trough.
4. The final clean water rinse, the addition of 50 ppm of hypochlorite significantly improves results. The clusters should be rinsed and hung up to drain.

In case of deposits on the milk-contact surfaces or high bacteriological counts, extra steps are required, as detailed below.

i. De-scaling with acid

Phosphoric acid is used to remove milk stone (milk and hard water residues). After cleaning, the metal components of the milking unit are dismounted and soaked in the de-scaling solution, in accordance with the instructions of the manufacturer. All parts should be brushed with detergent-disinfectant solution and finally rinsed.

ii. Heat Treatment

If detergent-disinfectant solution is unavailable, heat treatment is necessary. The temperature of hot water should be more than 85°C, should be rinsed through the clusters. After treatment, the equipment is hung up to dry.

iii. Wet storage of clusters

Clusters are suspended in a rack in such a way that they can be filled with a suitable detergent-disinfectant solution between milking. If milk has poor microbial quality, immediate attention to be given to following points

1. Old and worn rubber parts should be replaced, together with metal or plastic equipment which is rusty, corroded or has open seams.
2. Metal components should be de-scaled and rubber ware soaked in hot detergent disinfectant solution.
3. Daily cleaning and disinfectant methods should be checked and any faults corrected.

II. In place cleaning

This method used in the milking equipment is connected with the pipelines and cooling tank. This has circulation and acidified boiling water cleaning methods, latter method is less commonly used in cleaning.

a. Circulation cleaning

Circulation cleaning is a three-stage process consisting of a pre-rinse with water, a recirculated hot wash with detergent-disinfectant solutions and a final cold water rinse. The efficiency of circulation cleaning depends on the temperature of the water used for the detergent-disinfectant wash, the optimum initial temperature being at least 85°C. Parlours with large-bore pipeline systems have air-injectors to develop turbulence of the cleaning solution and thus improve surface contact and disinfection efficiency.

Procedures for circulation cleaning are usually indicated by the milking machine manufacturer. Although some differences exist between the various types of milking installations, the generally-accepted procedures are as follows:

1. After milking, rinse the machine thoroughly with warm water, and brush the clusters to remove external dirt.

2. Attach the jetters to the cluster.
3. Check the water temperature (85°C).
4. Drain the milk from the receiver and milk pump.
5. Remove the filter sock (interior) and clean the filter as recommended by the manufacturer.
6. Connect the air pipeline directly to the water heater and set the three-way valve to the washing position so that the hot rinse water is drawn into the machine.
7. Set the releaser milk pump to run continuously and adjust the spreader on the receiver lid to the washing position.
8. Allow hot water to pass through the machine and discharge to waste until the temperature of the water leaving the machine exceeds 50°C.
9. Add approved detergent-disinfectant solution to the measured volume of hot water, in accordance with the specifications of the manufacturer. Set the three-way valve to draw solution from the wash through the installation and continue circulation for 5-10 min. No advantage is gained by prolonging circulation, as the temperature of the solution progressively falls.
10. Discharge the detergent-disinfectant solution by deflecting the delivery pipeline.
11. Run clean cold water into the machine. Sodium hypochlorite may be added at a concentration of 50 ppm to avoid risk of contamination from supply lines.
12. Switch off the releaser and vacuum pumps; drain and prepare the machine for milking.

An acid rinse cycle may be performed to remove mineral deposits from water and milk. This may be a cold or warm rinse. The required frequency of acid rinse depends on the quality of the water used for cleaning. If a hypochlorite rinse is given for two minutes immediately before milking, it is not necessary to add hypochlorite to the final rinse.

b. Acidified boiling water cleaning

This method relies on heat for bacterial sanitation. The wash solution makes a single pass through the system and is not circulated. In the first 2-3 min of cleaning, acid (nitric, sulphuric or citric) is added to the water to prevent hard-water salt deposits on internal surfaces. All components should reach 77°C and be kept at this temperature throughout the cleaning process, for approximately 5 min. A recommended routine for acidified boiling water cleaning at the end of each milking (or alternatively once a day or once a week) is as follows:

1. Brush clean the outside of the clusters and jetters with a detergent-disinfectant solution and fit the teat cups into the jetters.
2. Check the water temperature.
3. Remove the milk delivery pipe from the bulk tank.
4. Add the stock acid solution to the acid container.
5. Turn the three-way valve to the wash position and open the wheel valve controlling the flow from the water boiler.
6. Adjust the spreader on the receiver lid to the washing position.
7. Set the releaser milk pump to run continuously, to discharge return water to waste.
8. When water flow ceases, stop the vacuum and releaser pumps and drain the machine.

The total flow time should be 5-6 min. All parts of the machine should reach 77°C after 2-3 min.

c. The procedure for the lye bath is as follows:

Place a rack in the bottom of a pan, put all the rubber parts on the rack, and cover them with water. Add 4 teaspoonsful of lye for each quart of water, bring the lye-water to a boil, then remove the pan from the heat. When the water has cooled, remove the rubber parts from the pan, rinse them thoroughly, and store them in a clean dark place until they are to be used. Sanitize the parts just before they are used. Boiling the rubber parts in a lye solution removes the milk fat from the pores of the rubber, restores its resiliency, and prolongs its life.

After assembling the machine for the next milking, draw some sanitizing solution by vacuum through the whole machine. Be sure to empty the sanitizer out of the milk pails before milking.

Cleaning assessment methods

a. Visual inspection

Cleaning failures usually result in a visual build up or residual film on some part of the milk harvesting or storage equipment. These residual films having characteristic appearance, which can help to find out the cause of cleaning failure. Films formed by the milk solids viz fat and protein has brownish slimy appearance and mineral deposits caused by using hard water has rough porous texture and are visible when wet. Discoloration may also occur due to corrosion and/or pitting of surfaces. Biofilms can be diagnosed by scrubbing a small area with concentrated acid and/or detergent solutions.

b. Rinse/Swab method

To avoid contamination from the utensils and maintain the quality of raw milk dairy has to create awareness among farmers for clean milk production, good

hygiene practices etc., at farm level. It's recommended to verify the cleaning efficiency of utensils used for milking. Rinse method for cans/pails and Swab method shall be used for testing Cleaning efficiency of milking equipment and its accessories.

The following table shows the limit for efficiency of cleaning based on the residual microorganisms in cans/pails.

Standard plate count/litre of holding capacity	
Satisfactory	Not more than 1000
Fairly Satisfactory	Over 1000 up to 5000
Un satisfactory	Over 5000

c. Bioluminescence method

All of these bacterial tests rely on culture media and incubation from two to three days. Recent developments of ATP detection methods using a bioluminescence have been proposed as a rapid method for assessing the effectiveness of sanitation in the dairy industry. ATP bioluminescence is a rapid detection method suited for on-site sampling and takes less than five minutes to perform. Plate count methods also detect the presence of bacterial contamination on equipment surfaces, whereas ATP bioluminescence can detect both bacterial contamination and nonmicrobial contamination such as milk soil. ATP bioluminescence has the potential to be a useful tool to evaluate the effectiveness of cleaning procedures used on the milking machines.