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# FACTSHEET

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## Title: Understanding the Basics of Milking Machines

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### 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.

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## Function

The milking machine performs two basic functions:

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

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## 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.

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## The Milker Unit

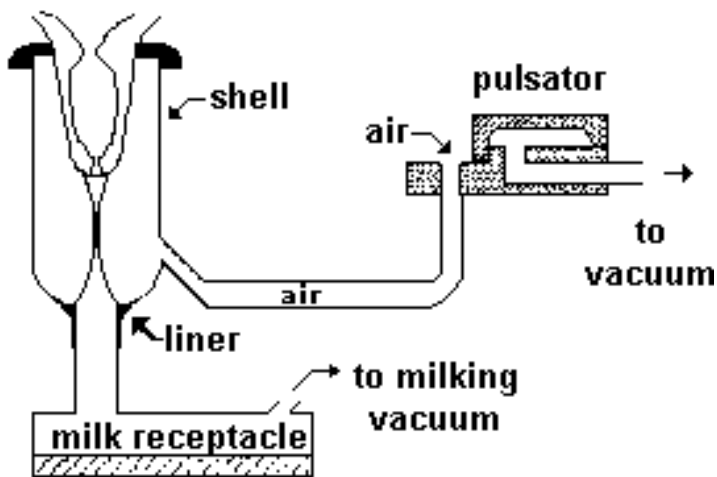
All milker units operate in basically the same way and consist of the following components:

1. Pulsator,
2. Teat cup shells and liners (inflations),
3. Milk receptacle:
  - o bucket
  - o 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*.

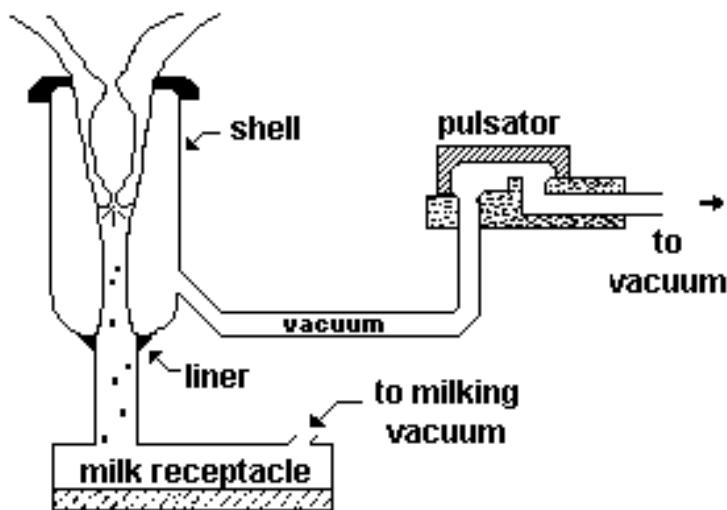
As the pulsator operates, it causes the chamber between the shell and the liner to alternate regularly from vacuum to air source. Keep in mind that the inside of the teat-cup liner is under a milking vacuum at all times. Thus when air is admitted between the shell and liner (*Figure 1A*) the liner collapses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

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## Some Terms Related to the 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.

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## 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.

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## Teat-cup Shells and Liners (Inflations)

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 Liner

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

The general recommendations for changing liners are as follows:

synthetic rubber	1,000 - 1,200 cow milkings
more natural rubber	500 - 700 cow milkings
silicone type	5,000 - 10,000 cow milkings

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## Milk Receptacle

Milker units may be classified either as being the suspension bucket or claw type. The claw-type milker is attached to a floor pail milker or to a milk pipeline system via a hose used to transfer the milk.

Air is needed in the claw to help lift the milk up into the pail milker or into the pipeline. This air is let into the claw through the air admission inlet located in the claw or in the individual teat-cup liners. Care must be taken so that the air admission hole(s) is kept clean but not enlarged to the extent that excessive agitation could cause rancidity problems with the milk. An alternative to air admission is a two vacuum level system within the milker unit which pushes the milk as a column up the hose and into the pipeline.

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## Milk Movement-Pipeline to Bulk Tank

Once in the pipeline, milk flows by gravity into a receiver jar. A milk pump removes the milk from the receiver jar and it passes through a filter as it makes its way to the bulk tank for cooling and storage.

## Other Factsheets Related to Milking Equipment and Milking Techniques

- Installation Recommendations for a Milk Pipeline, *Agdex 410/725*
- Maintenance of Milking and Milk Handling Equipment, *Agdex 410/725*
- Proper Milking Procedures, *Agdex 410/725*

## Related Links

- [Installation Recommendations for a Milk Pipeline](#)
- [Maintenance of Milking and Milk Handling Equipment](#)

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