

## Stray Voltage

Stray voltage is a small voltage (less than 10 V) measured between two points that can be simultaneously contacted by an animal or person. A current will flow between the two points. The amount of current depends on the voltage and the circuit resistance (impedance). Animals or people respond to the resulting current flow and not to the applied voltage. Thus, herds owners suspecting a stray voltage problem have to determine the current level, not just the voltage between the two points.

Although cows and humans may be similarly sensitive to electric current, cows are more susceptible to stray voltage primarily because they have much lower body impedances.

### Symptoms attributed to stray voltage

The symptoms shown by cows subjected to stray voltage vary, depending on the pathway of the current through the animal (impedance and sensitivity of the cow), and the magnitude and duration of the current.

The following are the most common symptoms reported :

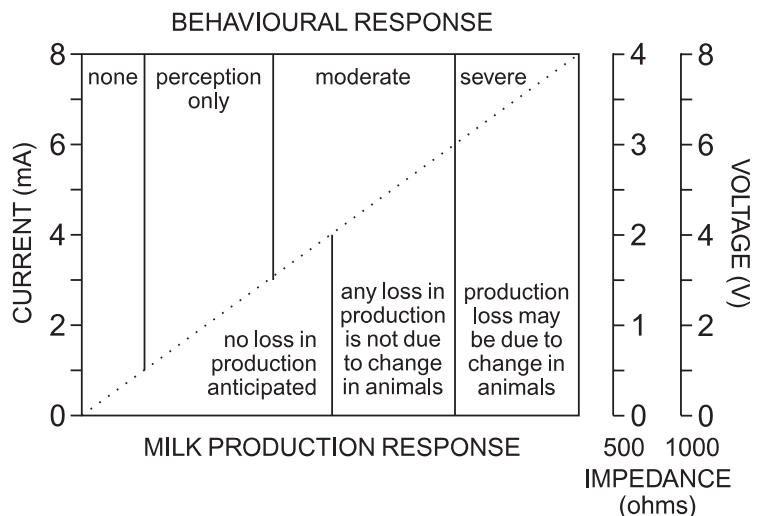
- excessive or unusual nervousness and excessive movement;
- reluctance to enter or eagerness to leave the milking parlour;
- increased frequency of defecation and/or urination in the milking parlour;
- reluctance to consume water (lapping of water from water bowls);
- feed being left in the manger;

- high abortion rate in the herd;
- poor milk let-down and incomplete or uneven milk-out;
- increased milking time;
- lowered milk production;
- increased somatic cell counts and incidence of clinical mastitis.

It must be remembered that many of the above symptoms can be caused by factors other than stray voltage. These factors include management, environmental conditions, poor nutrition, mastitis control programs, sanitation, malfunctioning milking equipment and disease.

Many of the above symptoms are not directly caused by stray voltage. For instance, if the stray voltage/current problem is severe enough to affect a cow's behaviour, such as kicking off the machine, milk-out may be influenced. This problem will result in increased milking time. Mastitis, whether clinical or subclinical, is the result of an infection, but there is more chance of picking up an infection when the machine is being kicked off. Lowered milk production will result when cows drink less water, consume less feed, or develop mastitis. Whether or not milk production will be adversely affected by stray voltage depends on the extent to which the cows' behaviour is altered and how management compensates. On the other hand, improvements in milk production are not always apparent after a stray voltage problem has been corrected.

*Figure 1 : Behavioral and milk production responses to increasing current levels. Voltages (right vertical axis) were estimated using a worst-case circuit impedance (500 ohms) and a more realistic impedance (1000 ohms).*



## Voltage Tolerance Levels

A voltage cannot pose a problem for a cow unless she comes into contact with the voltage. Even then, the source, path, contact, and body impedances have to be such that the voltage will result in a current great enough to affect the animal.

Older recommendations for tolerance levels of cow contact voltages (0.5 V in 1980 and 0.7 V in 1987) were based on the lowest values for perceived currents and low values for body, contact, path and source impedances. Recent research has shown that 1 to 2 mA currents are required to elicit a behavioural response in a dairy cow. These currents correspond to about 0.5 to 2.0 V. Currents up to 4 mA do not appear to inhibit the milk ejection reflex, depress milk production, or increase the incidence of mastitis or other diseases of the cow. Cows must be exposed to at least 4 V on their water bowls before some will start to drink less water. Most cows (more than 90%) adapt within 2 days to constant voltages as high as 6 V on the water bowl. The effects of current (and voltage) on behavioral response and milk production are shown graphically in figure 1.

In a 1992 Cornell study, the effects of long-term voltage exposure on milk yield and composition was assessed. Forty cows in second to fifth lactation were used. Four groups of 10 Holstein cows were exposed to either 0, 1, 2, or 4 V throughout an entire lactation. Each group was housed in a free-stall barn with bunk feed and water provided for ad libitum intake. Voltages were applied between waterers and a metal grid. Milk production (table 1), somatic cell counts, milk fat and protein showed no significant difference between groups exposed and not exposed to voltage. Feed and water intakes were also not affected by voltage.

	Average Actual Voltages	Average 305 day milk	Average Mature Equivalent
0		7312	7802
1		8527	9281
2		6938	7308
4		7725	8911

Table 1 :Average Actual and Mature Equivalent 305 day milk yields for cows exposed to different levels of voltage over a complete lactation.

Based on current research, cow contact voltages from low impedance sources should be kept to less than 2 to 4 V. Contact voltages between 1 and 4 V from low impedance sources may cause some behavioral effects. Once contact voltages reach 1V, a program of routine monitoring should be initiated to ensure that the voltages do not increase significantly.

## Alberta Survey

In the summer of 1984 Alberta Agriculture conducted a survey on the presence of stray voltage on dairy farms in Alberta. The results are shown in table 2.

Voltage Level	% of Farms
0.00 - 0.25	22.8
0.25 - 0.50	23.5
0.50 - 0.75	17.9
0.75 - 1.00	14.8
1.00 - 2.00	19.0
Over 2.00	2.0

Table 2 :Alberta stray voltage survey, 1984.

The survey showed that very few Alberta dairy farms had high stray voltage levels. However, it is noteworthy that 21% of the farms had levels high enough to initiate a program of routine monitoring to insure voltage levels do not increase significantly.

The usual source of stray voltage is faulty wiring (e.g. cracked insulation, corroded connections, improper grounding or overloaded circuits), although new wiring installed incorrectly is also a possible source. In some cases, the stray voltage problem may originate off the farm and be brought in through the power lines.

Many non-electrical conditions can cause symptoms similar to those resulting from the exposure of animals to stray voltage. As well, some current research indicates that stray voltage may be present on a farm without measurable effects on cows, thus making reductions not always cost effective.

prepared by :

Andre W. Visscher  
Dairy Management Consultant  
Calgary : 278-3078