# Stray Voltages in Dairies [1]

J. A. Watson, R. A. Bucklin, and D. R. Bray[2]

A stray electrical current passing through a cow's body may cause reduced milk production and health problems. The electrical current can be caused by poor or faulty wiring, faulty equipment, or improper grounding. It can also originate off the farm and enter through the grounded neutral wiring network. Stray voltages are usually low, alternating current voltages on the grounded neutral wires of the farm wiring system. Power suppliers may use the terms neutral-to-ground voltage and neutral-to-earth voltage to refer to the problem. Reduced milk production and the costs for treatment of the cow's health problems can lead to substantial economic losses.

## Symptoms

The reaction of animals to stray voltages varies with the amount of the voltage. Cows are more sensitive to small voltages than people and will react to voltages that humans cannot feel. One or more of the following symptoms may indicate that stray voltages exist in a dairy, but similar symptoms can occur due to other problems such as animal mistreatment, milking machine problems, disease, poor sanitation, or nutritional disorders. Common symptoms of stray voltage include the following.

1. Cows often hesitate to enter the parlor. They may stampede or rush out of the parlor when released.

2. Cows dance or step around constantly while in the milking parlor. Nervousness can also be caused by other factors such as malfunctioning milking equipment or rough handling.

3. Normal milk letdown is interrupted, thus requiring more time for milking and machine stripping. This adds more time and money into the production process.

4. Udder irritation can be caused by incomplete milkout, which increases the incidence of mastitis.

5. If cows are exposed to stray voltages while eating, they will be reluctant to eat. Feed intake will be reduced.

6. Stray voltages may enter the parlor through the water supply or metal drinking cups. Animals will hesitate to drink and may lap the water. Each of these symptoms is associated with stress, reduced nutrient intake, or disease. All of these will cause a decline in milk production.

## Causes of Stray Voltage

Electrical power is supplied to dairies over a complex electrical distribution network. This network interconnects with an electrical system that includes grounded primary and secondary neutral wires. The grounded neutral system is connected to earth by grounding rods driven into the soil at various locations along the neutral wire. Any stray voltage between neutral and earth should be monitored. An alternating current (AC) with a stray voltage of 0.5 volts or more between the neutral and earth voltage should be cause for concern. Stray voltages less than 0.5 volts are considered

1. This document is AE55, one of a series of the Department of Agricultural and Biological Engineering, UF/IFAS Extension. Original publication date January 1986. Revised January 1992 and November 2019. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. J. A. Watson, assistant professor; R. A. Bucklin, professor emeritus; and D. R. Bray, professor emeritus, Department of Agricultural and Biological Engineering; UF/IFAS Extension, Gainesville, FL 32611.



Reviewed: 11/2025

normal. Stray voltages vary, depending on the circuits used and the amount of moisture in the soil around the grounding rod (Cloud, Appleman, and Gustafson 1987).

Figure 1 shows an example of how stray voltage can cause current to flow through the cow's body. The animal's feet provide a connection to the ground through wet concrete and the underlying soil. Other parts of the cow's body may be in contact with the grounded neutral system through the drinking cup, stanchion, milking machine, or feeder. The animal is subjected to the neutral-to-earth voltage, as shown by the voltmeter.

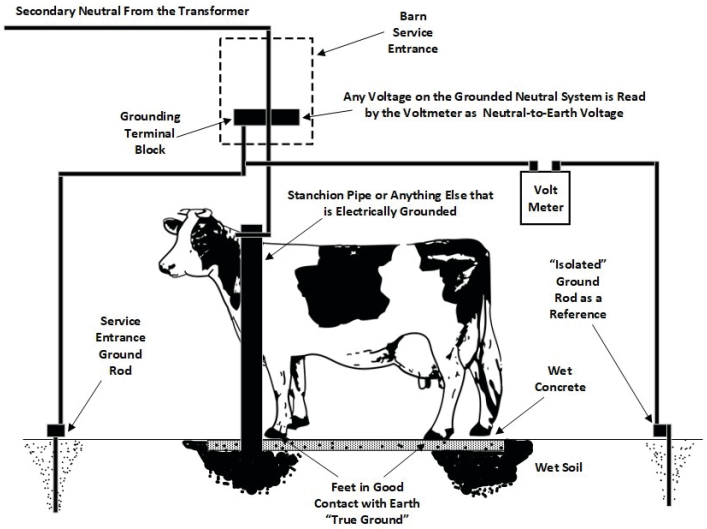


Figure 1. Diagram of current flow from stray voltage through cow's body.
Credits: J. A. Watson, UF/IFAS

## Measuring Stray Voltage

The voltmeter used to check for stray voltage should have a 0 to 5 AC volt scale graduated in 0.1-volt increments. It should have relatively high input impedance of 5,000 to 10,000 ohms, and it should also be battery operated to be independent of an AC power supply. The meter should not read direct current voltage on the AC scale. Test the voltmeter by checking the voltage of a DC battery on the AC scale. If a DC voltage reading is obtained, check the voltmeter instructions.

## Reducing the Effects of Stray Voltage

Voltages between the isolated ground and the system neutral greater than 0.5 AC volts should be reduced. A voltage of 0.5 AC volts or less is within the electrical system's normal operating tolerances. Contact your local power supplier if you suspect a stray voltage problem on your farm. All metal structures or equipment that a cow can touch should be electrically bonded together to prevent any potential difference. A voltage can still exist between the concrete floor and the exposed metal. If this is caused by secondary currents in the farm wiring system, the first step is to reduce the secondary neutral resistance. By improving the neutral wire connection or providing a larger neutral, you will provide a better path for the 115-volt neutral currents.

Another method is to reduce the ground rod resistance at the service entrance to the milking parlor. Voltages between the barn floor and all metallic structures can be eliminated by one of several methods. The concrete floor can be made conductive during construction of the milking parlor by embedding a wire mesh in the floor and bonding all metal structures to the wire mesh.

One effective means to reduce stray voltage is to add 2 x 2-inch square wire mesh made of 10 gauge galvanized welded wire embedded about 2 inches below the floor surface. The mesh should cover both the stall floors and the milking pit area to minimize the chance of a potential difference. Tapering the mesh depth may be necessary to provide gradual transitions between the parlor floor and entrance areas. Welded connections to all reinforcing bars in the floor can also be used, but these may be less effective.

Laying a ground wire in a trench around the milking parlor floor area is another method. Number 4 copper wire should be bonded to all metal structures. In existing floors, slots can be cut, and No. 10 gauge copper wire can be embedded in the floor and grouted over. The grounding conductors should be attached to the common bond between all metal structures in the parlor. The bond between the grounded conductor at the service entrance can be removed, and a separate insulated grounding conductor can be established at the distribution transformer.

Equipment such as isolating transformers and saturating reactors reduce stray voltage problems in some cases. Tests indicate that these electrical devices eliminate stray voltage problems caused primarily by neutral voltages (Appleman and Gustafson 1985; Soderholm 1982). Not all distribution systems can utilize this method because of system constraints such as poor primary grounding, dependence on service grounds, or primary or neutral inadequacies. However, these devices may offer many users experiencing stray voltage problems an inexpensive, code-recognized, reliable way to address these issues.

Experience has shown that cows remember unpleasant experiences such as shocks for an extended period. It also appears that being subjected to shocks may produce an

increased sensitivity to shocks for some animals. Correction of stray voltage problems may not produce immediate improvements in the reaction or production of the herd. Applying these procedures usually reduces stray voltages to acceptable levels. Continuous monitoring of voltages during milking may be necessary to determine the source of the stray voltage problem for difficult cases. Sources of stray voltage can often be identified by noticing stray voltage increases when an electrical appliance is turned on. If this phenomenon is observed, then the appliance must be checked for proper wiring and grounding.

## Conclusion

Careful analysis of the problem and appropriate corrective measures can reduce stray voltages in dairy parlors. Proper measurement techniques, identification of the stray voltage source, and application of recommended techniques in construction and bonding provide the most satisfactory approach to eliminating stray voltage problems.

## References

Appleman, R. D., and R. J. Gustafson. 1985. "Source of stray voltage and effect on cow health and performance." *Journal of Dairy Science* 68(6): 1554–1567. https://doi.org/10.3168/jds.S0022-0302(85)80994-2

Cloud, H. A., R. D. Appleman, and R. J. Gustafson. 1987. "Stray voltage problems with dairy cows." *University of Min-nesota Extension*. Accessed on June 13, 2022. https://hdl.handle.net/11299/205393

Soderholm, L. H. 1982. "Stray-voltage problems in dairy milking parlors." *Transactions of ASAE*: 1763–1768. https://doi.org/10.13031/2013.33803