CowContact™

Volume 2001 Issue B
October 2001
www.phasorlabs.com

This one is for farmers and electricians that are new to stray voltage:
(also good for people who think they have all the answers)

Over the past 20 years I have been tracking down stray voltage, working to train others to do the same and staying busy in the pursuit of solutions. A lot of my time is spent trying to prevent people from taking off on tangents with the latest new "solution" for stray voltage when they should be checking the basics first.

When I look back I see a lot of good work that was done to develop "Phase 1 and 2" stray voltage testing guidelines and now we have several stray voltage investigator training classes offered by the University of Wisconsin CAL's section. Through the UW there have also been several training sessions for dairy equipment suppliers, veterinarians and other farm related personnel.

Not enough farm owners and electricians have attended these training sessions. These two groups are the most important people to have involved in the detection and mitigation of stray voltage. I think the reason is simple, they do not have the time to attend seminars and the seminar discussions are probably a bit technical.

Since 1985 I have been involved in amateur radio astronomy. I have worked with others via mail, email and newsletters to educate and assist in the collection of scientific data. The bulk of our group is non-technical but with a little help they have collected a lot of good data.

There are a lot of similarities between collecting stray voltage data and radio astronomy data so I am wondering why it would be so hard to help farm owners and their electricians collect data and help make good decisions based upon the data collected?

The answer is I don't know, but I'm willing to find out. The worst that can happen is farm owners and electricians will learn a little more.

The problem I see today is that there are too many people providing the farmer with totally different theories on stray voltage. If you listen to all the conflicting information, you will be confused. I will go back to the basics, the facts and methods that have been used for the past 20 years. The old methods have not changed much because they are based upon good scientific techniques.

I will try not to give you my opinions but help you develop your own. I will show you how to understand what is happening on your farm and help you make decisions on what to do next.

To understand what is happening on your farm (electrically) you have to make some measurements. If you follow stray voltage discussions you will hear people telling you to measure steady state, RMS, peak, peak to peak, impulses, transients, magnetic fields ….. and on and on and on.

Well all of these items are important but first let's get back to basics. Stray voltage implies a concern for electricity on the farm in places that we do not want electricity to be. If you have a perfect power supply system and perfect wiring on the farm, you still will have some stray voltage. The trick is to keep the level low enough not to be a real concern.

Stray voltage will come from off-farm sources such as utility neutral conductors, telephone shield wires, rural water systems, CATV systems, neighboring homes and farms. It will also come from on-farm sources which include all of your electrical devices and/or wiring in and around the farm and home.

My approach will be to see what is getting to the animal. If you determine the level of voltage at the animal is too high for your personal level of concern, we can discuss what is required to reduce the level later.

Measuring at "Cow Contact" points:

In order to determine what level of stray voltage is getting to the animals you have to make measurements where the animals are located. These are called "Cow Contact" (CC) points. There are quite a few CC points on the average farm, but there are not so many they cannot all be measured. In following CowContact newsletters I will show you one or more methods to measure these multiple CC points.

At each CC point we will measure the voltage across the CC point**. Yes, I said voltage not current.** Your animals respond to current passing through their body. If you could put current sensors on each leg of a cow and sum the currents flowing in all four legs you could measure the current flowing through the cow. This is not a good suggestion because it would be nearly impossible to measure in this manner. If we measure the voltage impressed across the cow from mouth to hoof or hoof to hoof we can estimate the current that flows through the cow.

It's hard to get a cow to stand still and let us hook wires to it. Consider that the average body resistance of a cow varies from about 250 to 1100 ohms. Most people assume an average body resistance of 500 ohms for a cow. If you accept 500 ohms as a reasonable body resistance for the cow, we can place a 500 ohm resistor at each CC point and measure the voltage across the resistor and then calculate the current through the resistor. This value of current would be a reasonable approximation of what current would flow through the body of a cow standing in that location.

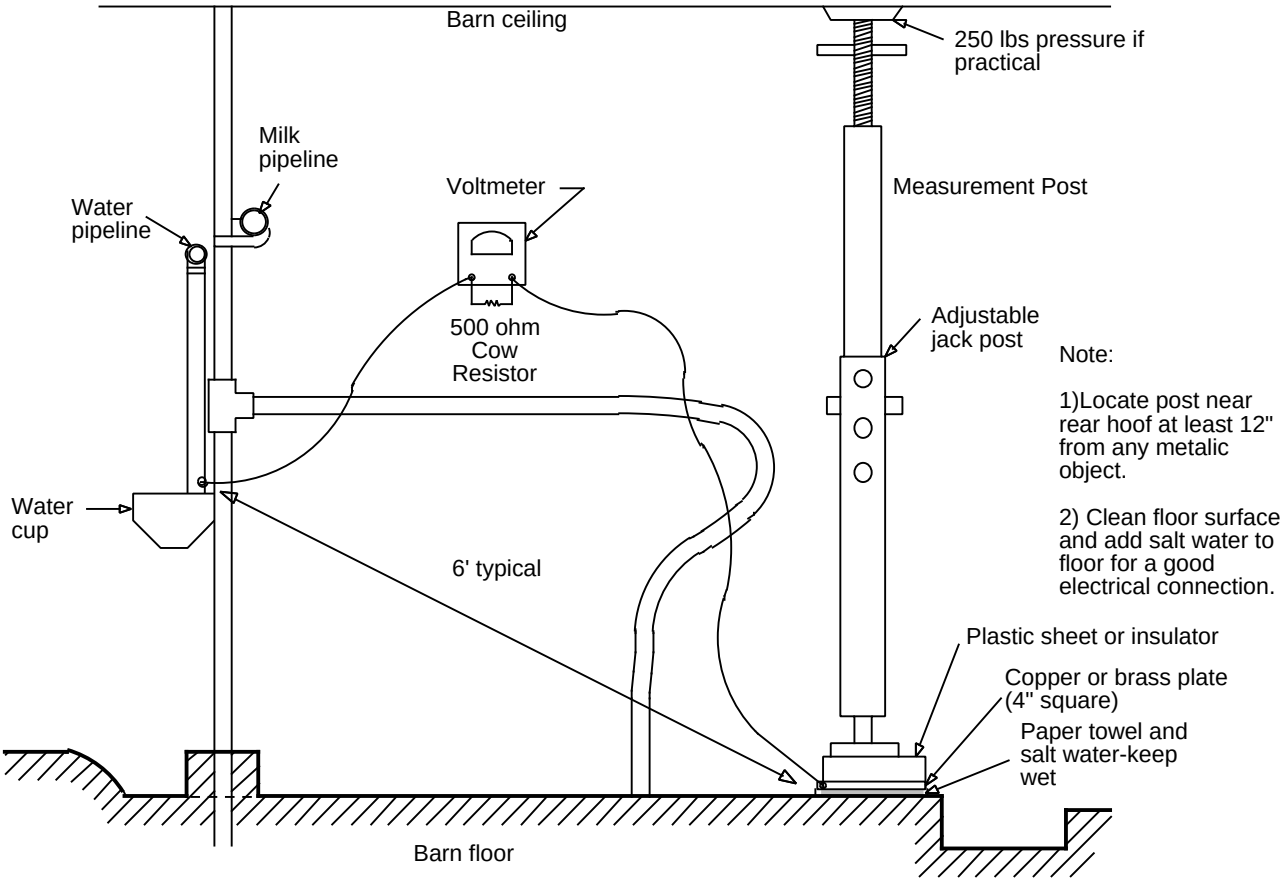
Ohm’s law tells us if we use a 500-ohm Cow Resistor the following relationship exists between current through the resistor (our cow) and voltage measured across the resistor.

Voltage measured (In volts)	Current Flowing (In amperes)	Current Flowing (In milliamperes)
0.0 volts	0.0 amperes	0.0 milliamperes
0.1 volts	0.0002 amperes	0.2 milliamperes
0.2 volts	0.0004 amperes	0.4 milliamperes
0.3 volts	0.0006 amperes	0.6 milliamperes
0.4 volts	0.0008 amperes	0.8 milliamperes
0.5 volts	0.001 amperes	1.0 milliamperes
1.0 volts	0.002 amperes	2.0 milliamperes
2.0 volts	0.004 amperes	4.0 milliamperes

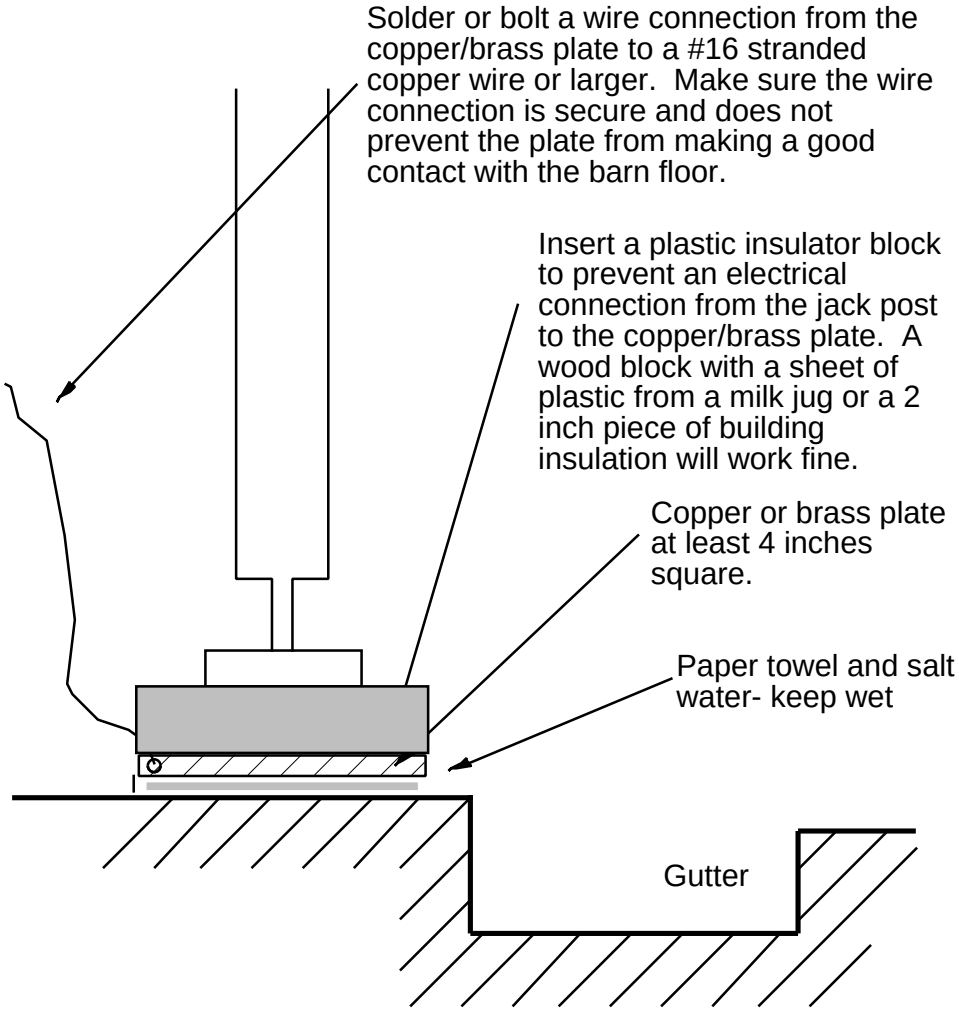
The above conversion holds true for steady state, momentary swells, impulse, transient and all other voltages.

We will discuss where to measure and what level is acceptable later. First we need to discuss how to make the measurement.

You will need a voltmeter, a 500 ohm resistor, a “banana plug”, a brass or copper floor plate, some plastic from a milk jug, a piece of 2” building foam or wood, a jack post, some hose clamps and wire. It will all be connected as shown below. The figure below is for a typical stanchion CC point. A CC point can be any point at which a cow may be located. Normally the drinking water locations for a cow are the areas of great concern.



COW CONTACT AREA MEASUREMENT MOUTH TO REAR HOOVES



JACK POST CONTACT PLATE

The connection to the stanchion or waterline can be made by filing or sanding the corrosion from the metallic pipe and then compressing a copper wire to the pipe using a stainless steel radiator hose clamp. A pipe clamp from the local hardware store made for grounding electrical services will also work fine. Just make sure you have a good electrical connection to the steel pipe. A clean looking pipe may have an oxidation layer that prevents a good electrical connection, so be sure to sand or file the pipe surface before making your wire connection.

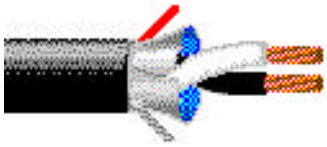
Bring the wires from each of the two cow contact points to the meter and connect to a “banana plug”, then to the meter as shown below. The banana plug can be purchased at Radio Shack. With this connection you will be reading the CC voltage **without** the cow resistor.

Next take a second banana plug and put a 500 ohm resistor between the terminals. Use two 1/2 watt 1,000 ohm resistors in parallel as shown below. Resistors are available from Radio Shack. Use 1/4 watt or 1/2 watt types. This will be your 500 ohm "Cow Resistor".

Then plug the cow resistor into the banana plug on the voltmeter input and the reading will be the CC voltage **with** a cow resistor. The voltage value with the resistor is normally lower than the voltage without the resistor. The voltage without the resistor shows what level of voltage is available to that CC point. The voltage with the resistor shows what voltage would be across a 500 ohm cow that contacted the same two (2) points.

As long as you are to this point, plug ONLY the 500 ohm resistor into the meter, put the meter on the ohms (Ω) scale and measure to make sure your resistor is between 475 and 525 ohms.

If you would like to locate the meter at a point remote from the CC point make the connection using a twisted pair shielded cable such as Belden type 1032A cable. This is a two conductor, twisted pair #18 copper wire cable with a foil shield. If this type of cable is not available, using two of the three wires in an extension cord works just fine. I suggest cutting the plug and receptacle off the cord before you use the wire so someone does not plug one end into the outlet while the meter or CC point is at the other end of the cable.

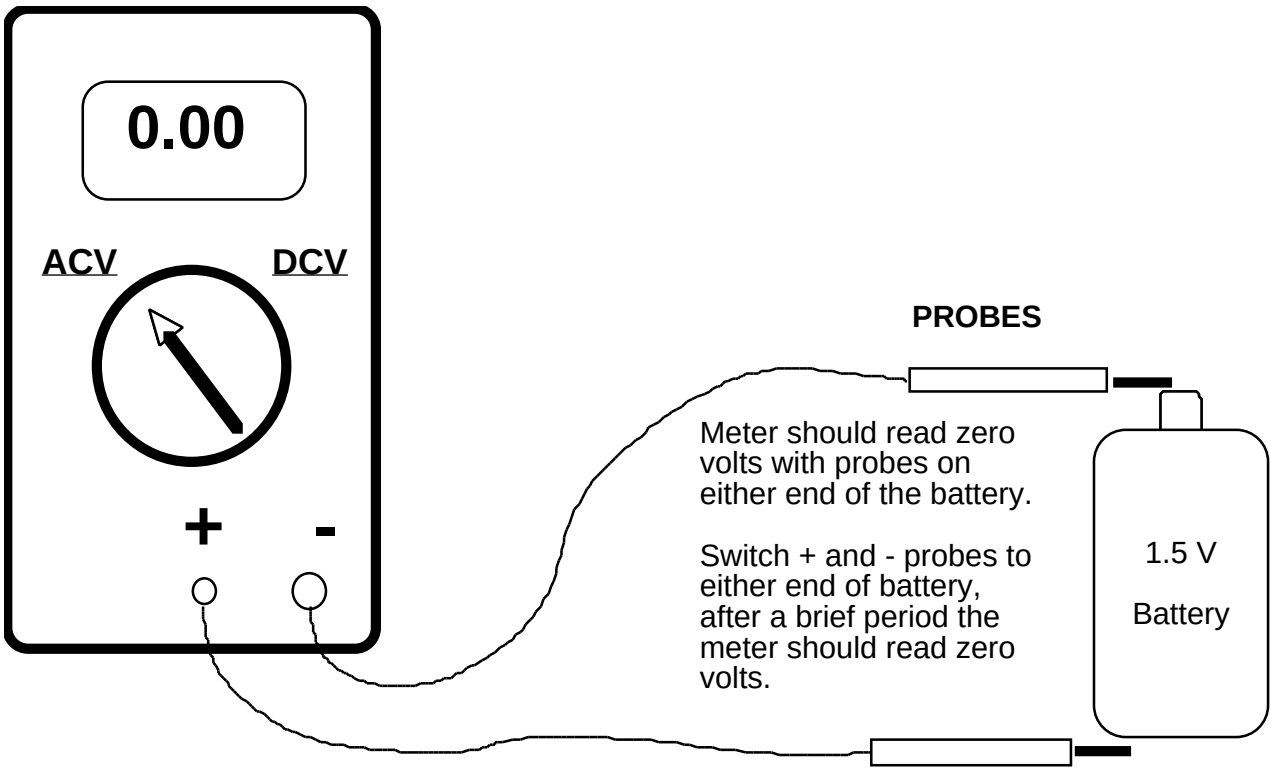


The type of meter you select to use is not critical at this point, but a logging voltmeter will be suggested later .

Below I am showing a Fluke Model 189 digital multi-meter. The meter is in the AC voltage measuring position. If you have a fixed range meter I suggest a full scale of 2 volts AC. This meter records true RMS values in the AC position. The true RMS value will consider all harmonics that are present and give you a reading that is consistent with other true RMS meters. This meter has the advantage of being able to log readings to a computer, a test I will recommend later. If you have any digital meter you can use it for this spot test.


FLUKE 189 TRUE RMS MULTIMETER
0.0039 V AC
AUTO
AutoHold
FAST MIN MAX
LOGGING
HOLD
MIN MAX
REL Δ
CANCEL
SAVE
Hz % ms
RANGE
SETUP
nS
mV
Ω
°F
°C
A
mA
μA
OFF
VIEW MEM
CLEAR MEM
A
mA μA
COM
V

Don’t forget to test your meter to make sure when it is in the AC voltage setting it only reads AC volts and not DC. You do have on-farm sources of DC voltage up to 0.6-0.7 volts even when all the power is shut off. We are looking for on and off farm sources of AC voltage. Some meters mix the AC and DC voltages and report them as only AC, this is not correct and is also very confusing when making measurements.



TESTING YOUR METER FOR DC BLOCKING WHEN SET TO AC RANGE

Performing initial tests on the cow contact point:

We still need to discuss where the best CC points to measure are, but let's discuss how to check out a CC measuring point.

With the meter connected to the cow contact points and no 500 ohm resistor, switch the meter to the AC scale and record the volts AC = _____(Vacw/o).

Plug in the 500 ohm resistor and record the volts AC = _____(Vacw).

Switch the meter to the DC scale and record the volts DC = _____(Vdcw).

Remove the 500 ohm resistor and record the volts DC = _____(Vdcw/o).

If the voltage values are below 0.2 volts you may want to switch to the 200 millivolt (mv) scale. Just be sure to record if you measured in volts or millivolts.

The meter reads AC voltage when the round selector switch is in the position shown above for V~ or V~ mv. The meter reads DC voltage when the round selector switch is in the position shown above for V--- or V--- mv.

Hopefully voltage (Vacw/o) is higher than voltage (Vacw). Voltage (Vdcw/o) should be higher than voltage (Vdcw). Voltages Vacw/o and Vacw have no relationship to Vdcw/o and Vdcw.

The fact that the voltage with the 500 ohm resistor is lower than without the resistor is due to a resistance we call "source resistance". In other words there may be 1.0 volts without a resistor indicating a voltage source of 1.0 is present, but the measurement drops to 0.3 volts when the resistor is applied. The cow will only see 0.3 volts.

You should calculate the AC source resistance of the cow contact measuring point. This is a check to make sure that the test wires are making contact with the remote rods, plates and connections.

If the calculated cow contact source resistance is above 500 ohms check that the floor plate is making as good a connection to the floor or cow contact point as possible. If the cow contact source resistance is below 50 ohms check to make sure the floor plate is not coupling directly to some metallic object above or below the floor.

For this example assume the cow resistor was 500 ohms, the Vacw/o measured 0.8 volts and the Vacw measured 0.2 volts. The source resistance is calculated as follows:

Subtract Vacw from Vacw/o or 0.8 – 0.2 = 0.6
Divide the above answer by Vacw or 0.6 / 0.2 = 3.0
Multiply the cow resistor value by the above answer or 3.0 * 500 = 1,500

The source resistance is calculated at 1,500 ohms which looks high.

Where can you purchase this equipment?

Radio Shack store.
For meters and cables try www.newark.com
For meters and scopes try www.dist-tron.com/

The next issue will discuss selecting the best CC points to measure.

Plain English disclaimer because of some attorneys:

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If you have any questions or find that you are not clear on an item discussed, please send me an email with your questions. I ask that you do not telephone me with questions on these handouts unless you are one of my regular clients.

If you use this information to make a poor decision on your farm, it's your own fault. You have the opportunity to ask for a clarification of any item discussed. If you are not sure about the information you are collecting or the decision you are making, ask me or seek professional assistance.

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