



Project Set 128 B
**128.004 – Elevated Neutral-to-Earth
Voltages and Urban Stray Voltage
Concerns in Distribution Systems**

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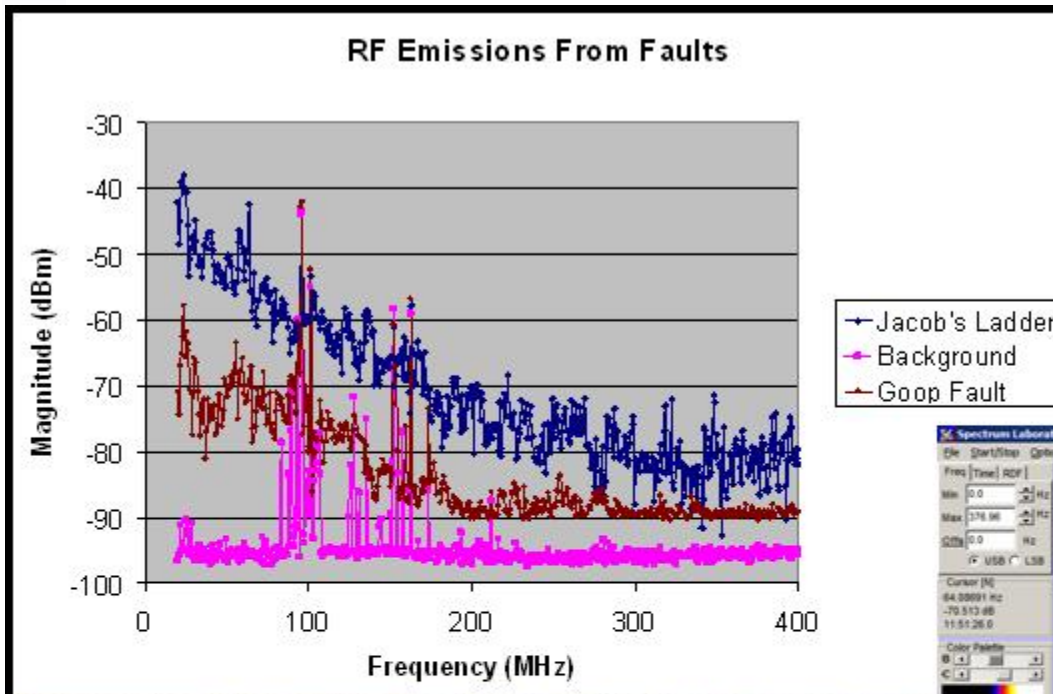
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July 2008 Lenox Task Force Mtg

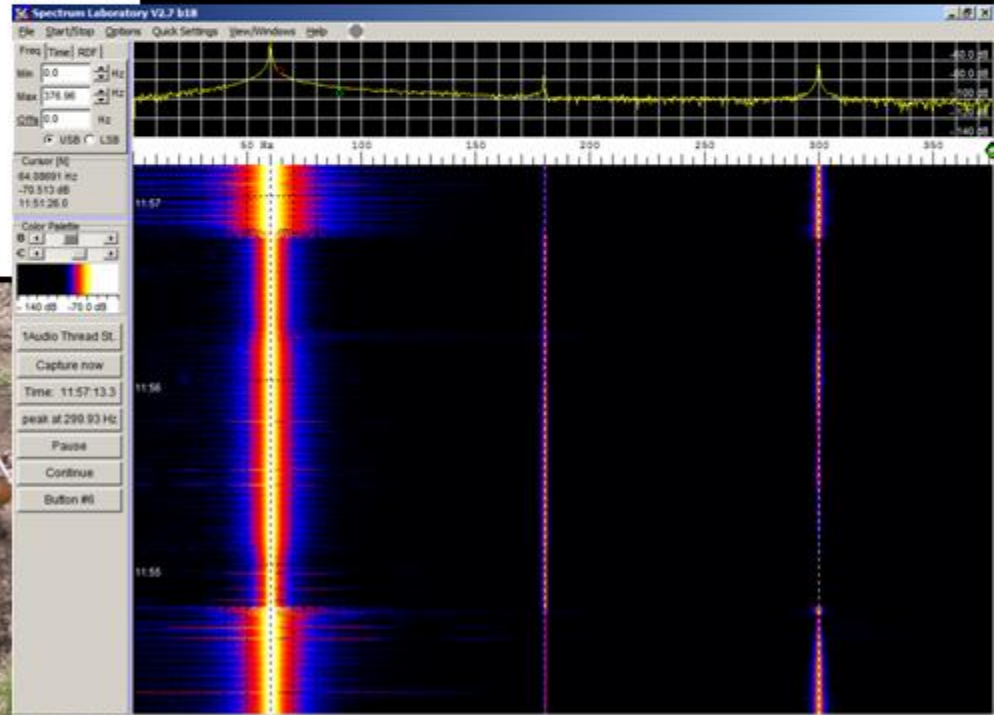


- Advanced Diagnostics
- Source identification
- Source resistance
- Fault, Induced or NEV?
- Review last years Evals at Lenox
- Discuss the advanced early detection ideas
- Discuss the case study options

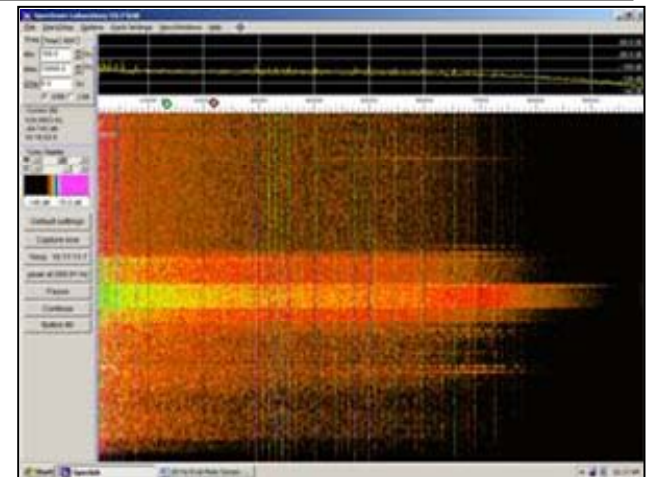
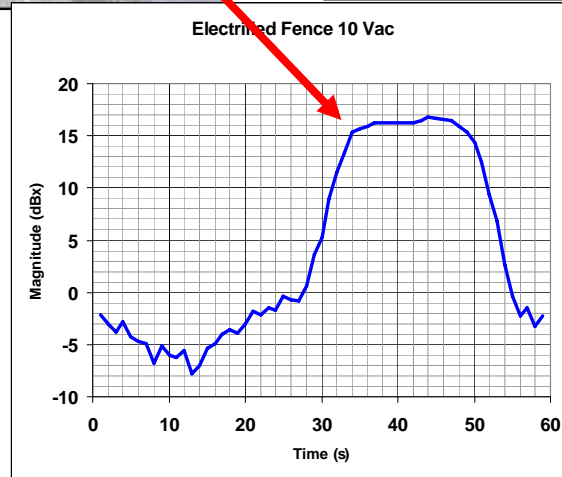
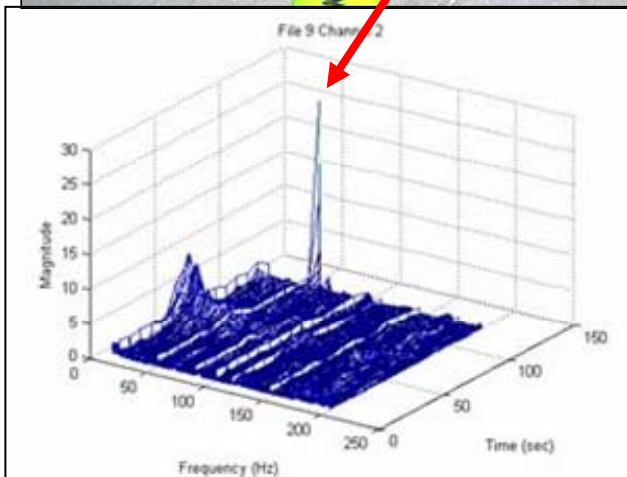
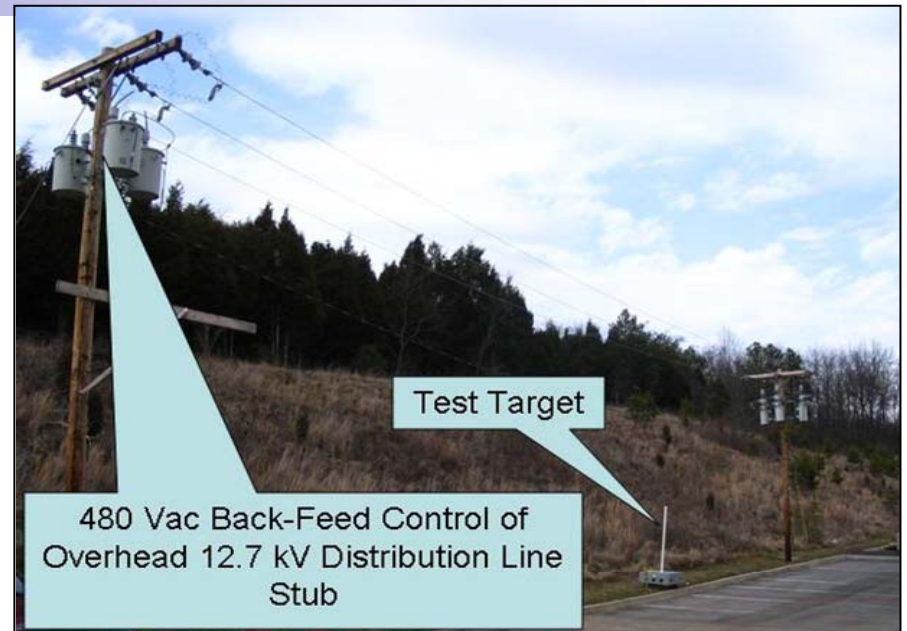
Developmental Measurement Devices



- Testing covered frequency range from 60Hz to 400 MHz
- 10 different test and measurement devices were evaluated



Energized Object Testing







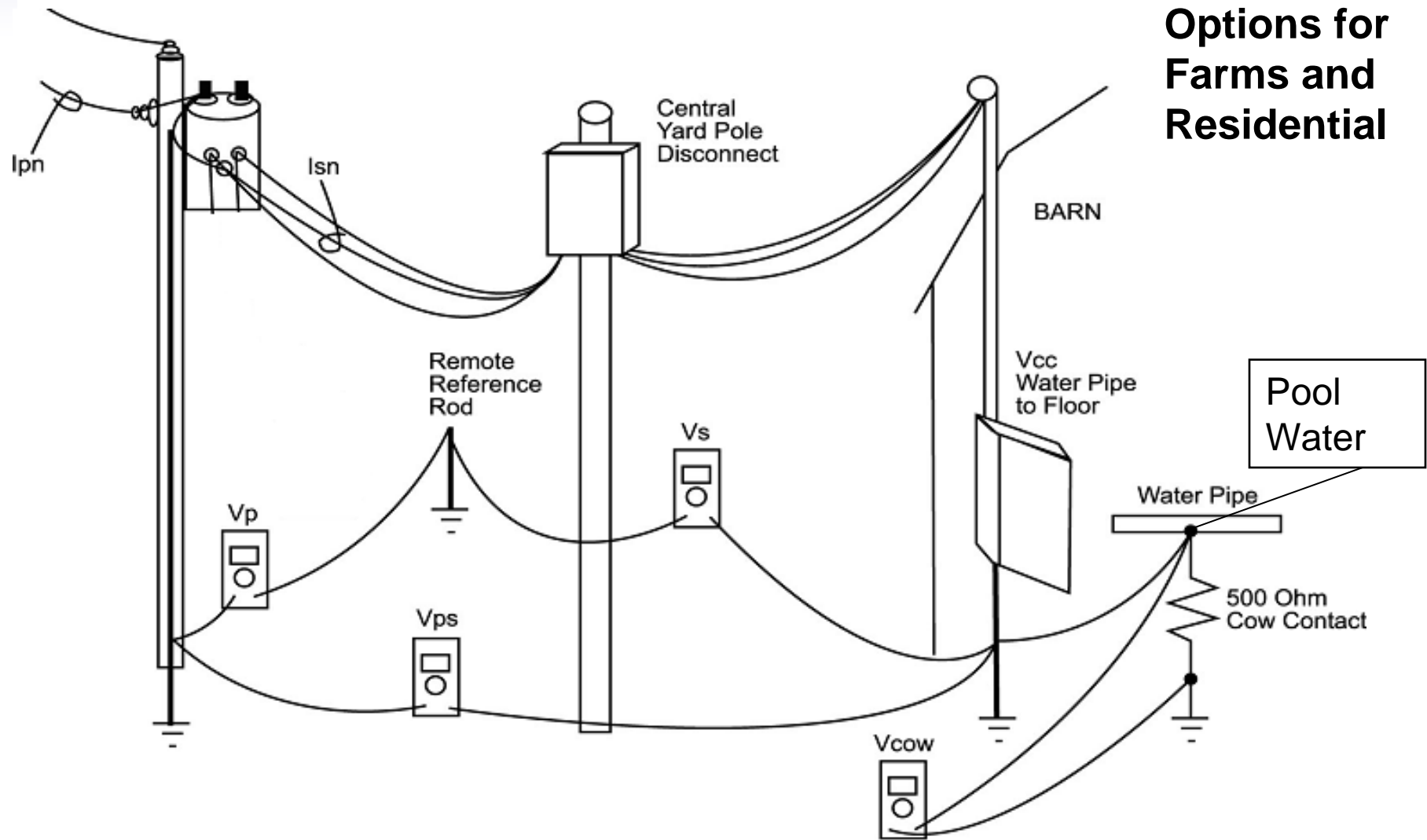


Simulated Residences

Options for Shared Water Main



Electrical Configurations for Testing

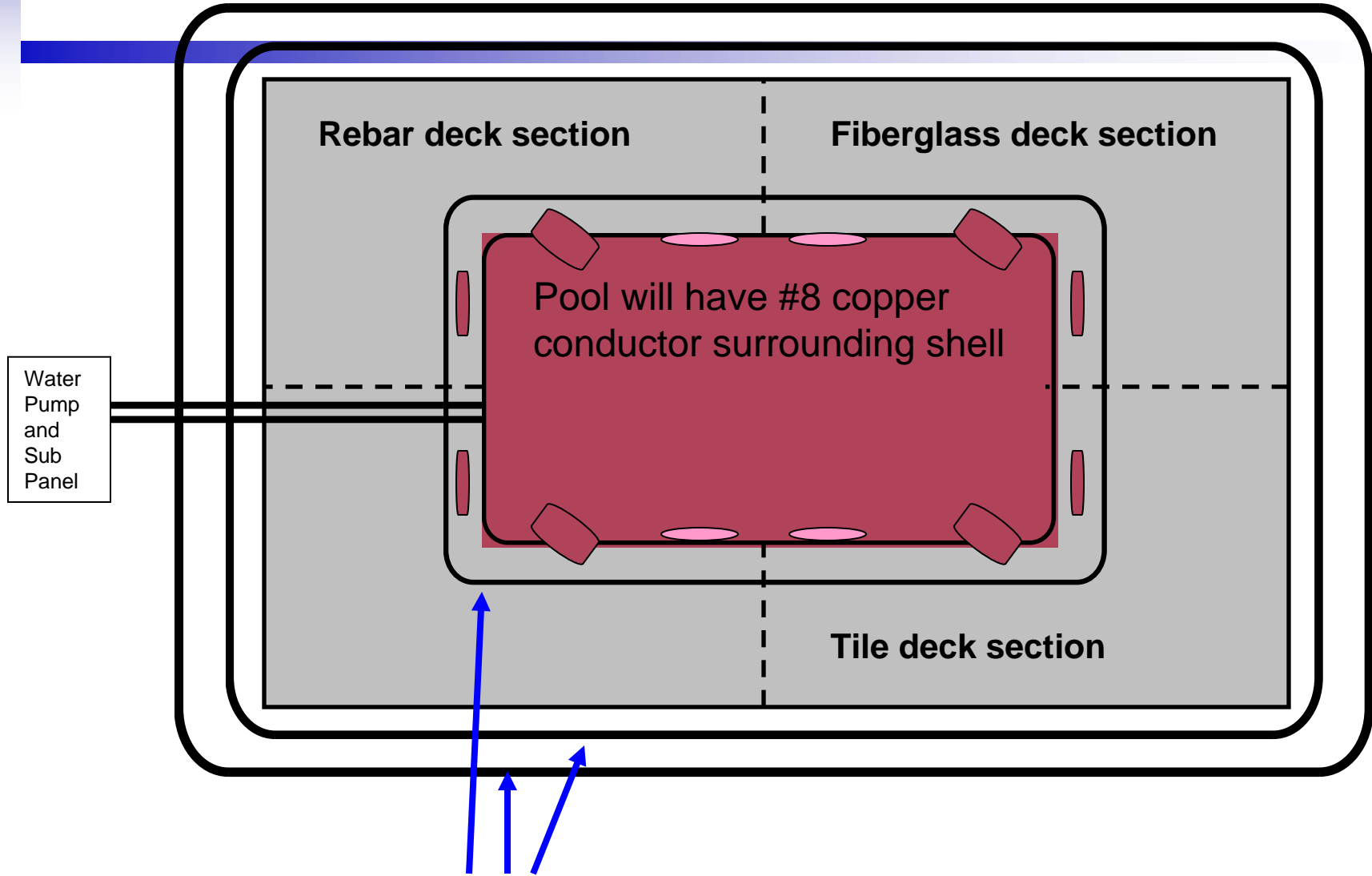


Options for Farms and Residential

○ = Underwater Light

▭ = Metal Handrail

▭ = Ladder



Three ground rings will be connectable or disconnect able

NNC Device

Stray Voltages

Although the issue of stray voltage is totally separate from that of magnetic fields, a beneficial effect of NCC devices is the reduction of stray system voltages caused by net currents. Stray voltage problems have received a lot of media attention and are often associated with dairy farms. In this case, a portion of distribution line primary currents may return to the substation through water pipes or other parts of the grounding system at dairy farms. When this happens, small voltage gradients are produced in the dairy farm grounding system which can cause problems with the dairy cows. Application of an NCC device can, in some situations, reduce stray voltages by reducing net currents.

Voltages with An Open Neutral Conductor

Another potentially adverse effect can occur as a result of an abnormal condition where a service cable neutral conductor is faulty (i.e., open circuit or high resistance). This condition can be caused by mechanical damage to the service cable or corrosion. In the case of an open neutral conductor, two undesirable conditions would arise.

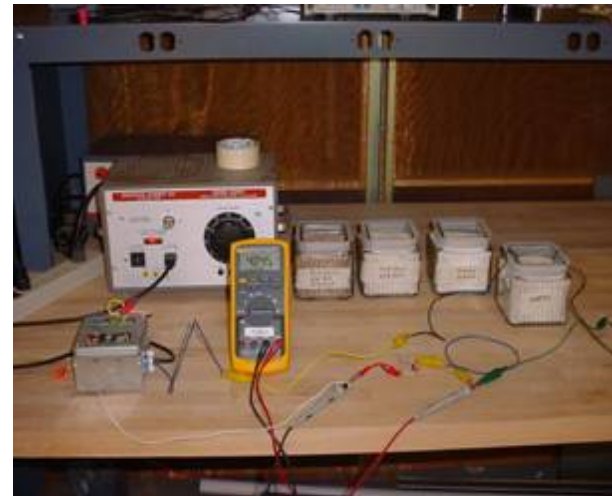
First, the NCC device would cause a reduction in voltage across the unbalanced load because all of the unbalanced load current must flow in the water pipe/earth return path. This power frequency voltage drop would be limited by the voltage capability of

Question 1

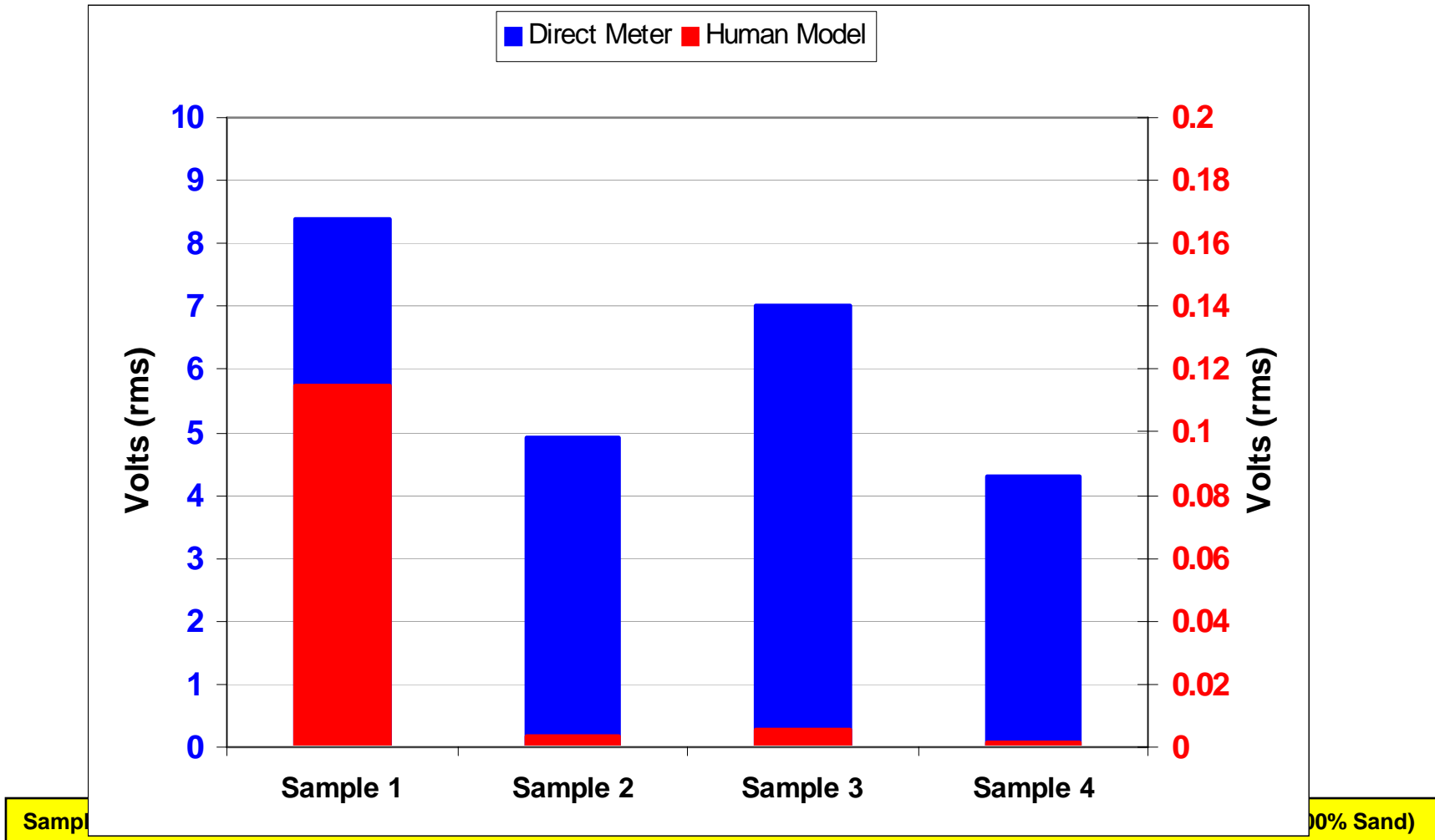
- How does the actual soil moisture and content impact voltage measurements during steady state fault conditions?

Direct Contact Measurement

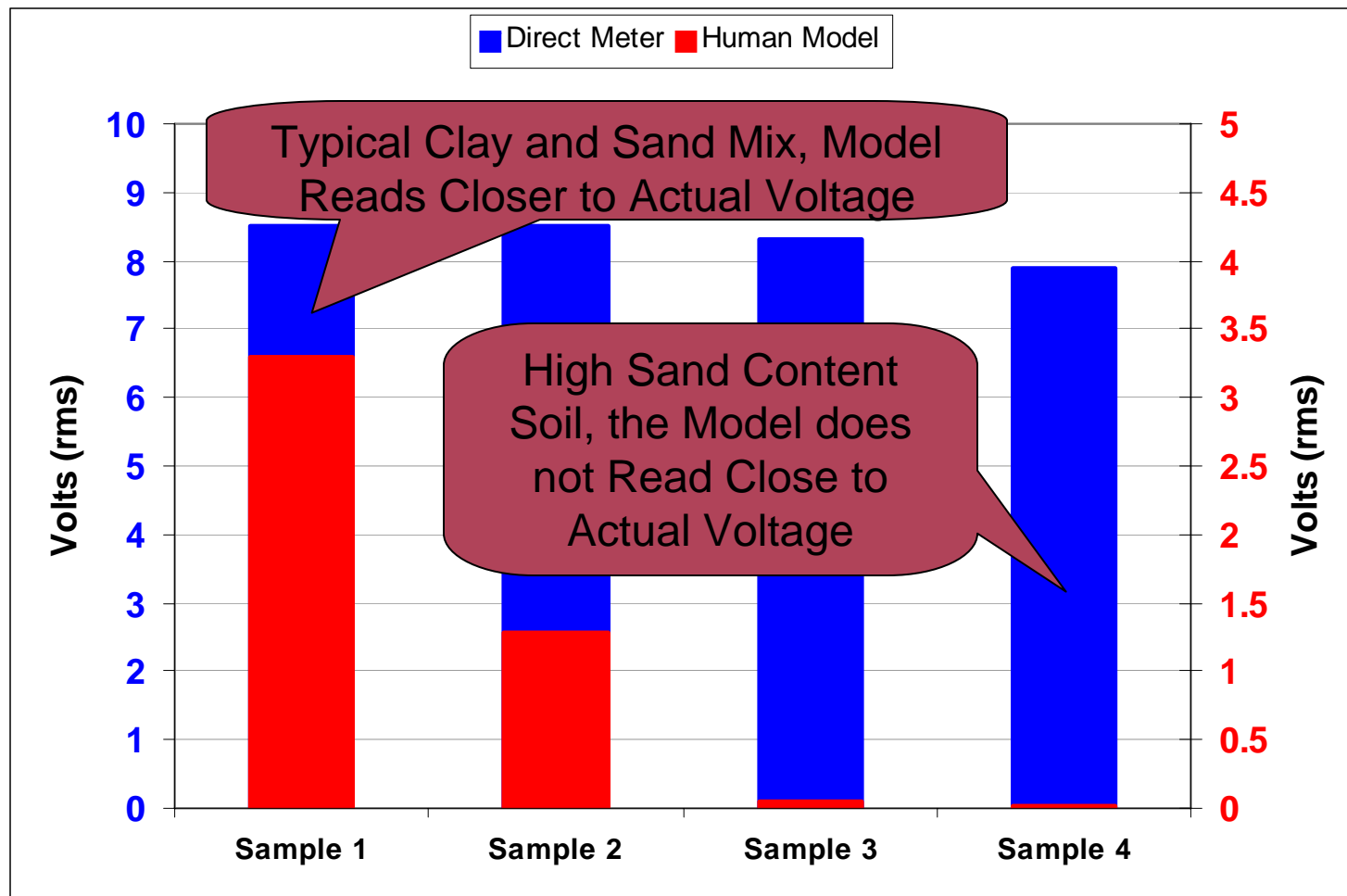
- Wet and Dry Samples
 - Sample 1
 - 50% Clay
 - 25% Sand
 - 25% Salt
 - Sample 2
 - 75% Sand
 - 25% Salt
 - Sample 3
 - 50% Sand
 - 50% Salt
 - Sample 4
 - 100% Sand



For Dry Samples – Resistor is Important



Accuracy Better with Wet Samples



Sample 1 – (50% Clay 25% Sand 25% Salt) Sample 2 – (75% Sand 25% Salt) Sample 3 – (50% Sand 50% Salt) Sample 4 – (100% Sand)

Dry vs Wet with Human Model

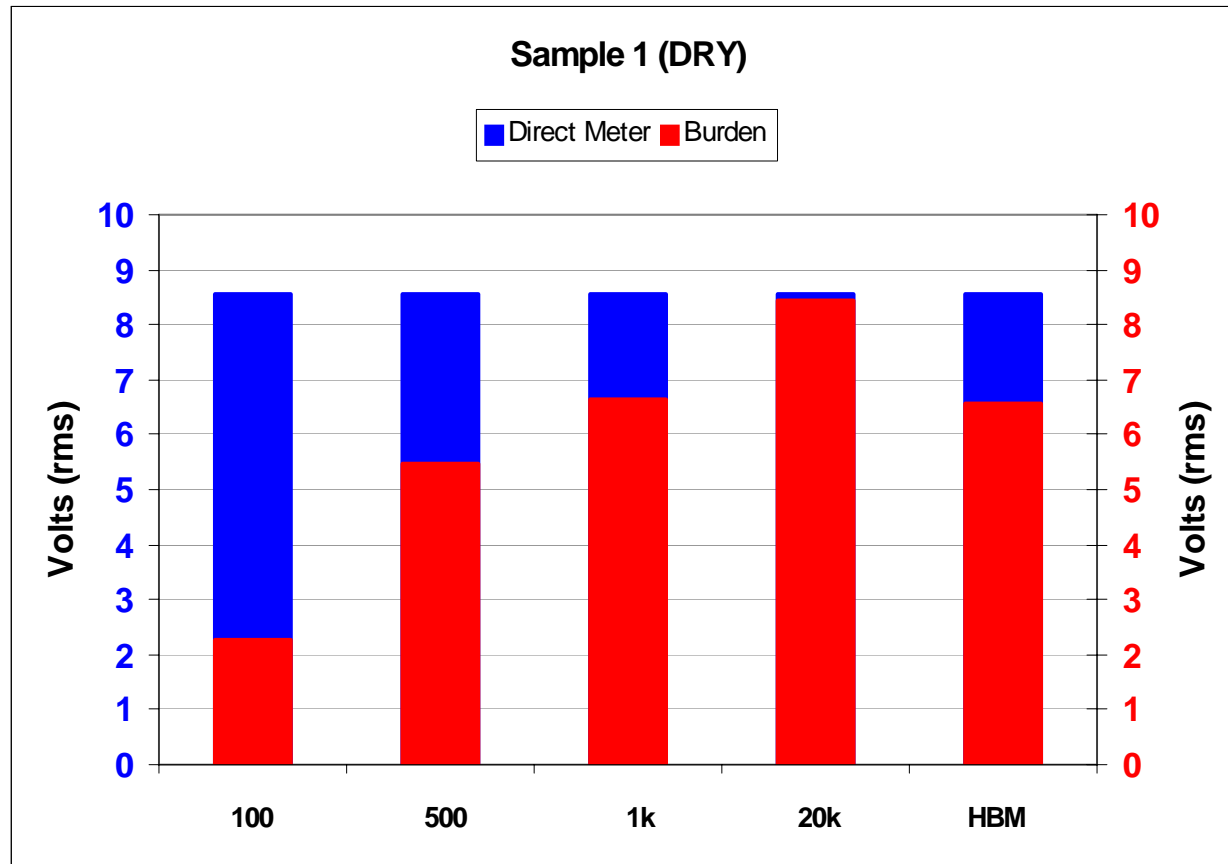
- When the soil is highly conductive with salt or moisture - the voltage measured with the Human Model may be close to the actual fault voltage
- When the soil is a poor conductor (or dry) the actual fault voltage reading may be very very low - but if 60 Hz is measured then it 'may represent' a fault condition

Question 2

- How does the actual resistance value selected for the measurement impact the reading?

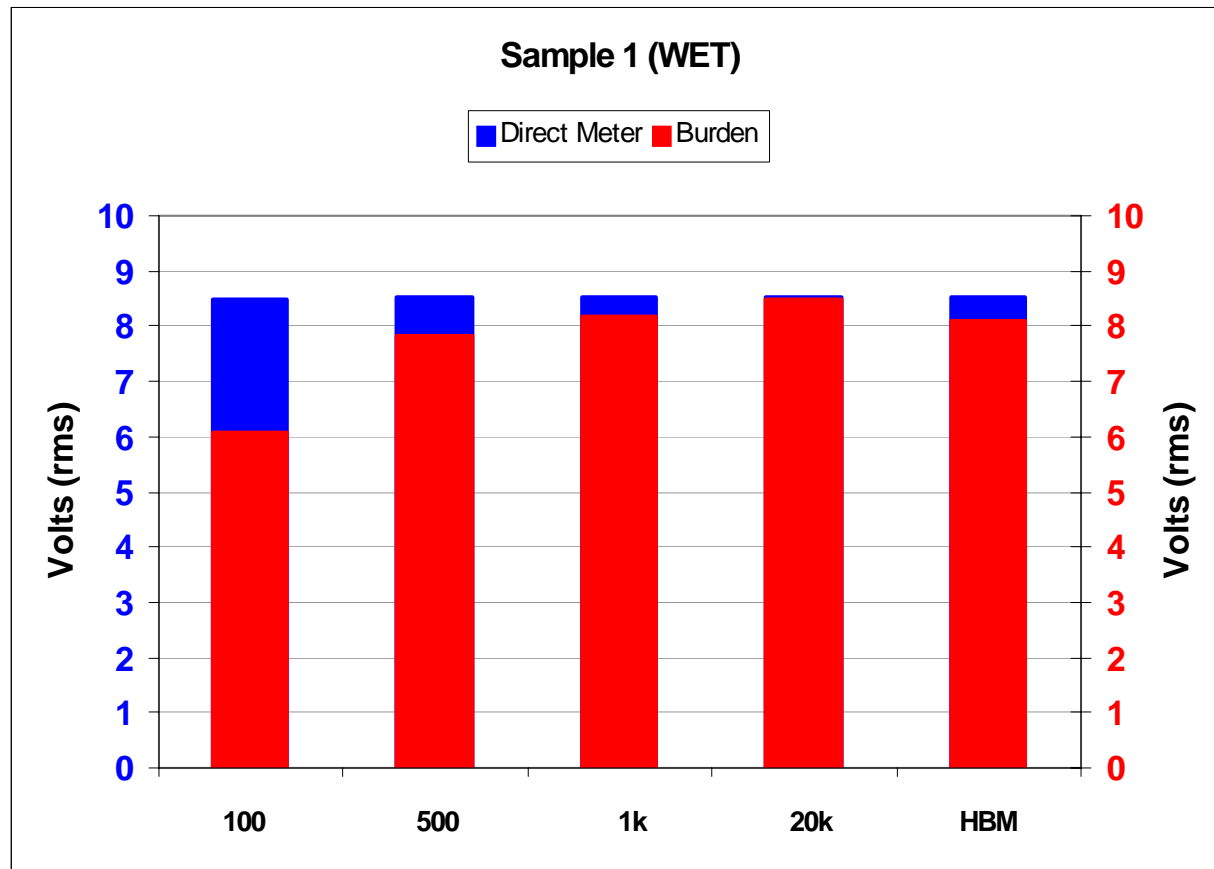
Different Burden Resistance

Following Examples, Direct Meter is Source Voltage



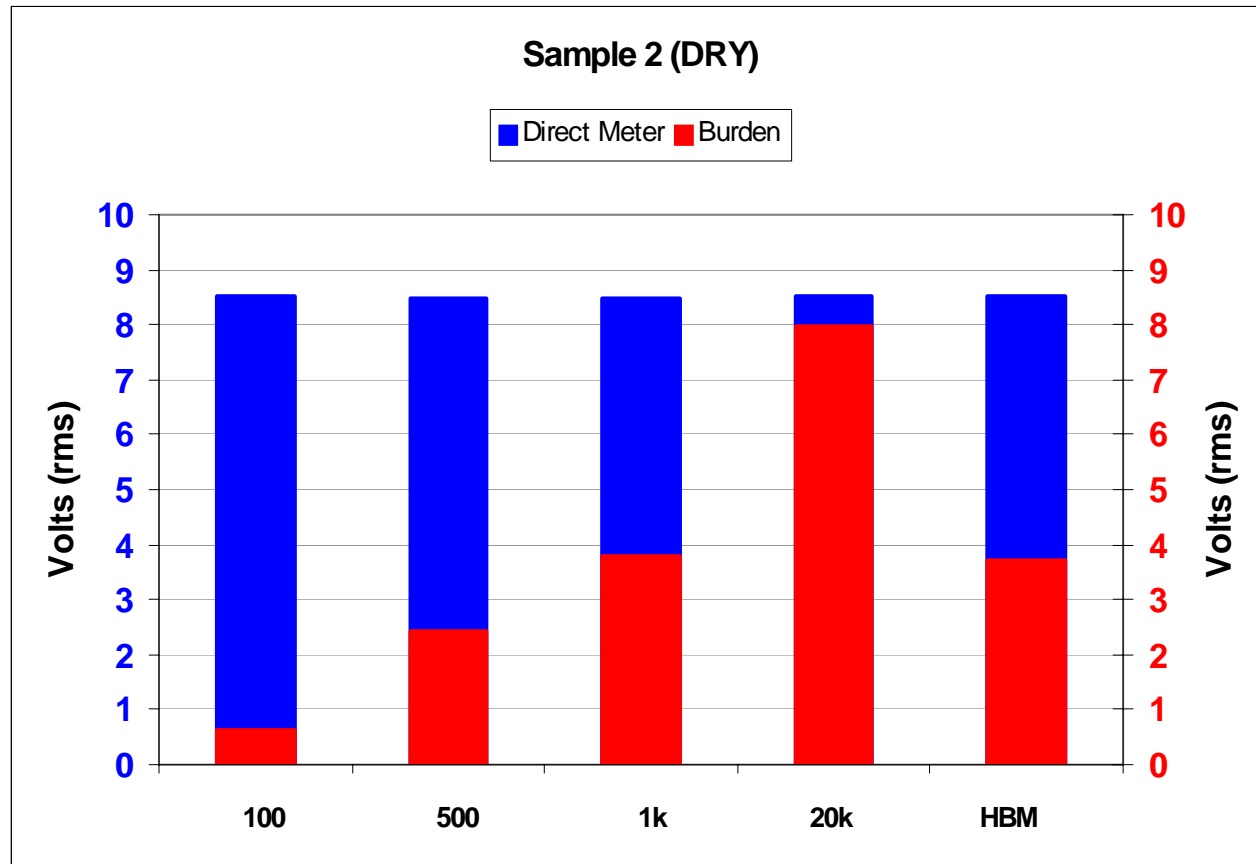
Sample 1 – (50% Clay 25% Sand 25% Salt)

Different Burden Resistance



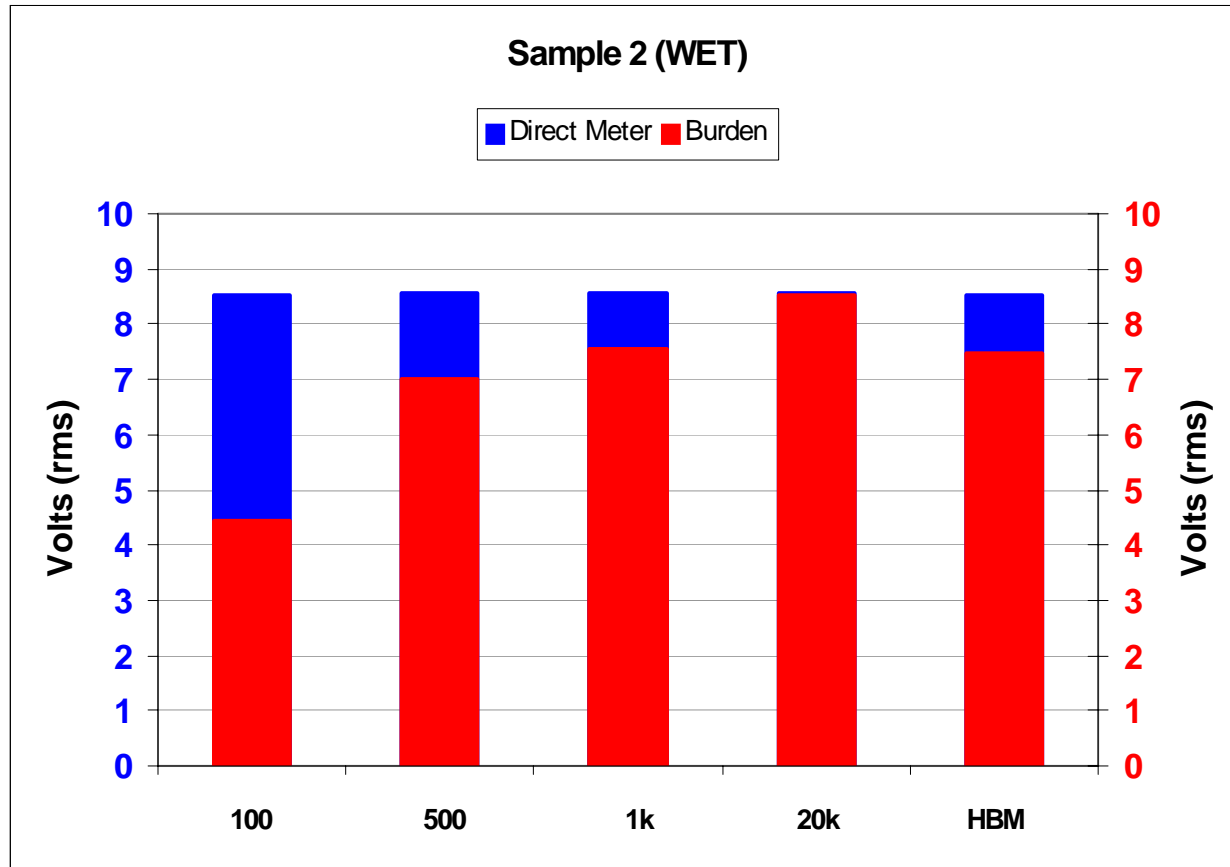
Sample 1 – (50% Clay 25% Sand 25% Salt)

Different Burden Resistance



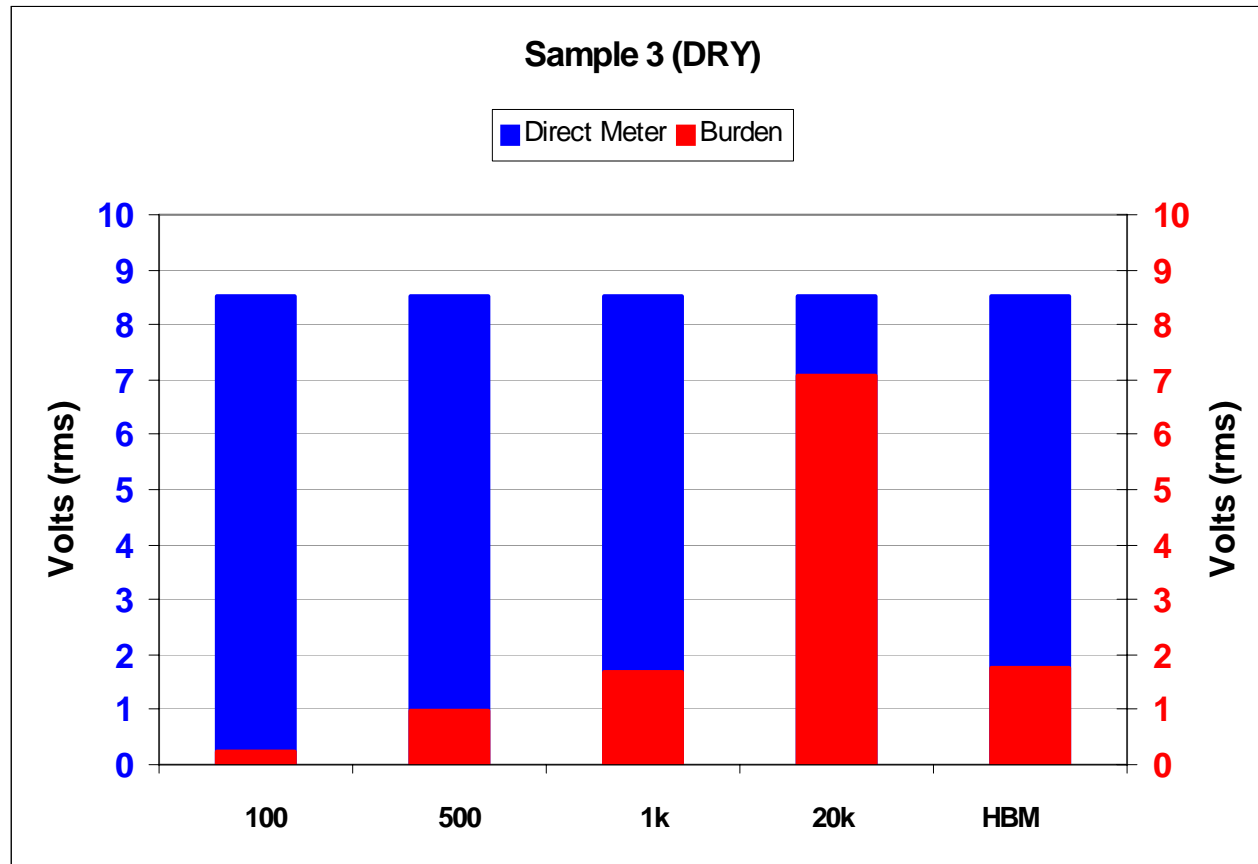
Sample 2 – (75% Sand 25% Salt)

Different Burden Resistance



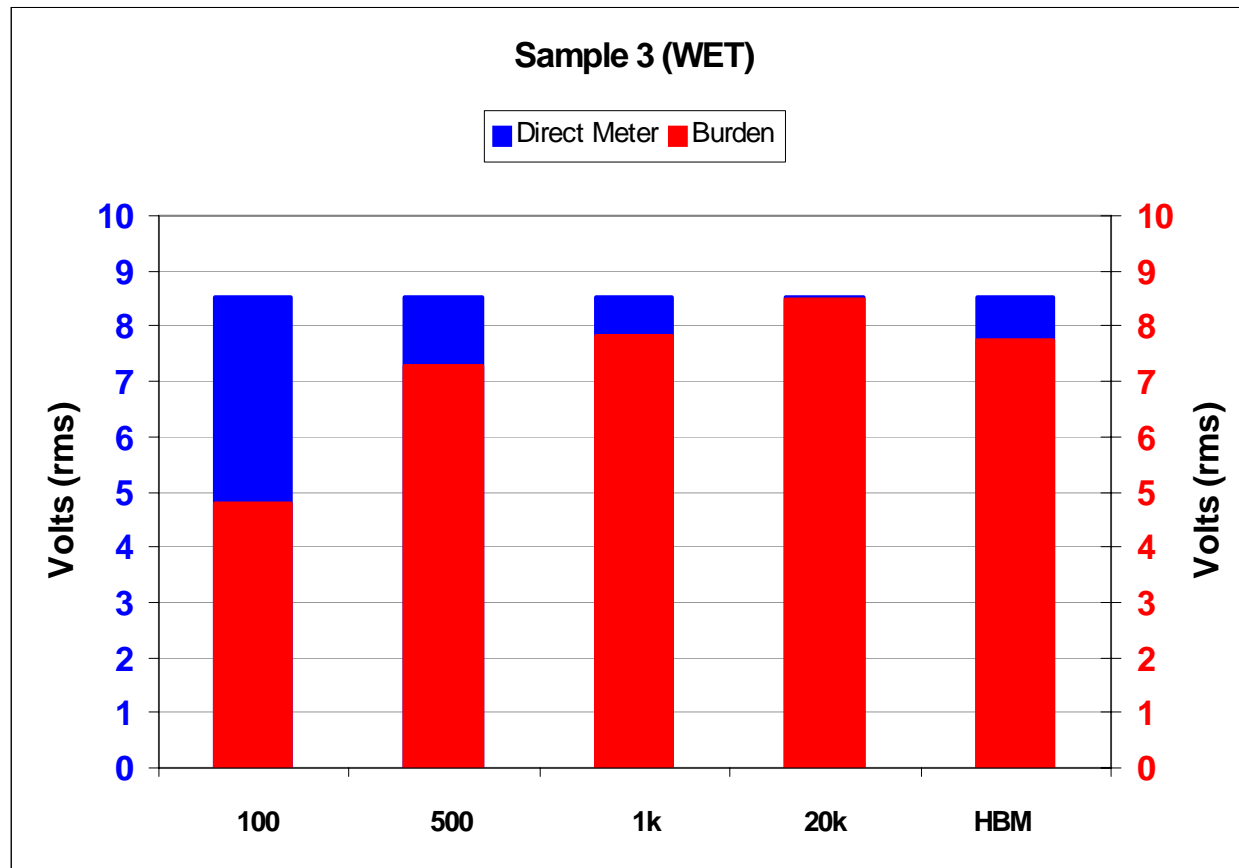
Sample 2 – (75% Sand 25% Salt)

Different Burden Resistance



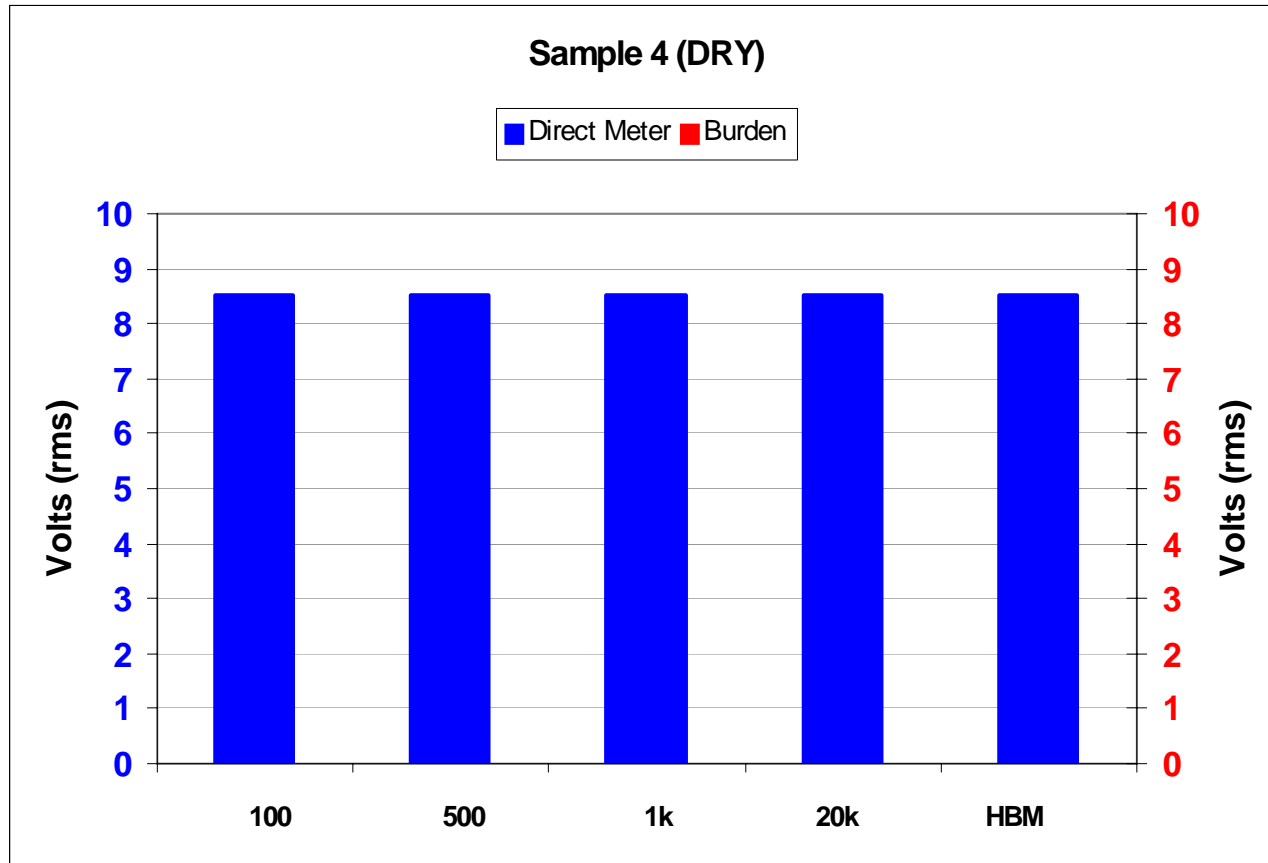
Sample 3 – (50% Sand 50% Salt)

Different Burden Resistance



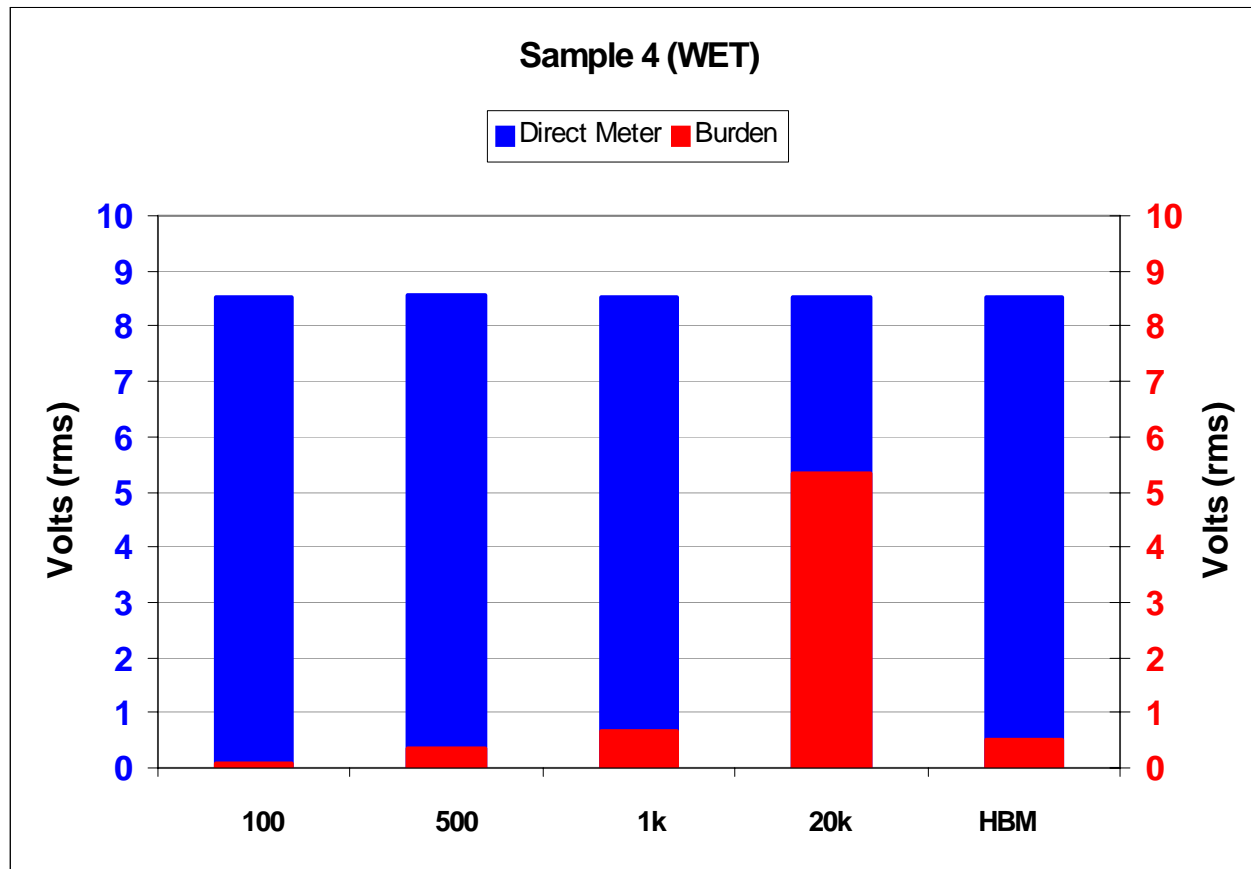
Sample 3 – (50% Sand 50% Salt)

Different Burden Resistance



Sample 4 – (100% Sand)

Different Burden Resistance



Sample 4 – (100% Sand)