ASTM (G57) and AASHTO (T 288-91) Standards

M. C. Miller soil boxes could be used to satisfy either the ASTM (G57) Standard or the AASHTO (T-288-91) Standard with regard to soil sample resistivity measurements.

In the case of the AASHTO Standard procedure, it should be possible to use the M. C. Miller soil boxes since in the "Report" section (section 11) of the AASHTO Standard it is stated that "*If other size soil boxes are used, it will be necessary to determine the correct multiplier*". This statement implies that other soil box geometries (other than the one quoted in the Standard) could be used. The example of soil box size that is given in the AASHTO Standard results in a multiplier value of 6.67cm, which is just the electrode surface area divided by the separation between the electrodes in the box.

The M. C. Miller soil boxes have a 1cm multiplier value if used in the 4 electrode configuration (ASTM Standard) and multiplier values of 0.67cm and 0.57cm for the small and large boxes, respectively, in the case of the two electrode configuration (AASHTO Standard), as indicated below:

Resistance-to-Resistivity Conversions for M. C. Miller Soil Boxes:

- **4-Electrode Method (ASTM Standard)**

The soil boxes are designed such that the cross-sectional area of the sample (A), with the box filled level, divided by the separation between the interior pins (L) is equal to 1cm.

- Small Soil Box (Cat. # 37006):

  Cross-sectional area (A) = 3cm x 2.4cm = 7.2cm²

  Interior pin separation (L) = 7.2cm

  A/L = 1cm

- Large Soil Box (Cat. # 37008):

  Cross-sectional area (A) = 4cm x 3.2cm = 12.8cm²

  Interior pin separation (L) = 12.8cm

  A/L = 1cm

- **2-Electrode Method (AASHTO Standard)**

In this case, the interior pins are not used and the end electrodes are used for both current and voltage measurements. The cross-sectional area of the end plate electrodes (and therefore of the soil sample) would be the same as in the above case, however, in this case, the electrode separation (L) would be the end plate electrode separation, which is the inside length of the box.

So, for the 2 electrode configuration, the multipliers would be calculated as follows:

Small Soil Box (cat # 37006): A/L = 7.2 square cm/10.8cm = 0.67cm

Large Soil Box (cat # 37008): A/L = 12.8 square cm/22.2cm = 0.57cm

Consequently, with the use of the appropriate multipliers, the M. C. Miller soil boxes could be used to satisfy both the ASTM Standard and the AASHTO Standard, when used in conjunction with a 4 terminal Resistance Meter, such as the Miller 400 or the Nilsson 400.

Example:

4-electrode method (ASTM Standard) using an M. C. Miller soil box (either the small box or the large box):

If you measure 1,000 ohm for the resistance, the resistivity would be 1,000 ohm x 1cm = 1000 ohm.cm

2-electrode method (AASHTO Standard) using an M. C. Miller soil box:
For the same soil sample as above, you should measure the following:

- ***Large soil box**: Resistance should be around 1,754ohm, which would make the resistivity 1,754ohm x 0.57cm = 1,000ohm.cm*

- ***Small soil box:** Resistance should be around 1,492ohm, which would make the resistivity 1,492ohm x 0.67cm = 1,000ohm.cm*

Regardless of the measurement method (4-electrode or 2-electrode) a soil sample's calculated resisitivity, from the measured resistance value, should be independent of the measurement method.