READINGS LESS THAN ONE

Occasionally the **Ω-Check** will yield resistance ratios less than 1.00. In all of the test results reviewed by UTS, this anomalies has invariable occurred on cables where the test current is high and the test voltage and power factor are low, indicating a high quality neutral. There are several phenomena that can cause this.

Basic Instrument Accuracy.

The accuracy of the **Ω-Check** is as follows:

- Current: 1 % (greater than 5 Amperes)
- Voltage: 2% (less than 5 Volts)
- Phase Angle: 1.5°

In the case of a test with high neutral current, low-test voltage and low power factor, these errors may result in readings less than 1.00. Assuming a power factor of 0.50:

$$\text{PF} - 0.50 = \cos 60°$$
$$\text{PF} - \cos 58.5° \ - 0.522$$

With a phase angle error of 1.5°

$$\text{Error} = \frac{(0.522 - 0.500) \times 100}{0.\ 500} = 4.4\%$$

The combined error (current, voltage and power factor) could be as high as 7.5 percent.

Lay Factor

Since the neutral strands are helically applied to the cable, the length of the neutral strands are longer than the cable length. For a cable manufactured in accordance with ICEA S-66-524, the lay factor could result in neutral lengths from 1.05 to 1.13 times the cable length. The **Ω-Check** calculates the neutral resistance based on a lay factor of 1.10. If the actual lay factor for the cable being tested is higher than 1.10, the calculated ratio would be lower than the actual ratio.

Measured Cable Length

The cable length is determined in the field using a measuring wheel and an assumed cable routing. Errors in the cable length measurements will introduce inversely proportional errors into the ratio calculation. If the measured length is longer than the actual length, the calculated ratio will be lower the actual ratio.

Common Trench Construction

Often distribution systems are constructed with multiple primary cables in a common trench. In this situation, contact between the neutral being tested and the neutrals of other cables in the trench are unavoidable. In some cases these incidental contacts may allow a portion of the test current to flow in the adjacent neutrals, resulting in a lower resistance measurement.

Induced Voltages

The operation of the **Ω-Check** effectively mitigates the induced effects from system load current. However, induced effects are possible from the test current flowing in adjacent paths parallel to the cable being tested. The parallel may be another cable, foreign utility or the test lead. This effect is particularly apparent when testing three phase cables since a large portion of the test current flows in the neutrals of each phase. When testing cables known to be in new condition, readings above or below 1.00 are obtained when the phases are tested individually. When all three phases are tested simultaneously, accurate readings are obtained. Induced effects from the test current are most apparent in cases where the test current is high, the test voltage and power factor are low. In these cases, small changes in the voltage magnitude or phase angle can result in significant errors in the calculated resistance and ratio.

Conclusions

Several factors can contribute to producing ratio measurements of less than 1.00. These factors are most pronounced when the neutral being tested is in new condition. Reviewing the field data, this is evident based on the magnitudes of current, voltage and power factor for these tests. In our opinion, it is safe and reasonable to assume that readings less than 1.00, when accompanied by high neutral current, low voltage measurements and low power factor are indicative of a high quality neutral.