

THE EFFECT OF COPPER OXIDE ON TELEPHONE AND D.S.L BEARERS AND THE NECESSITY FOR CHANGE OF TEST PROCEDURE AND SELECTION OF SUITABLE TESTING EQUIPMENT TO LOCATE PREVALENT COPPER OXIDE FAULTS.

Cables for Telephone and D.S.L connections between Telephone Exchanges and Customers premises are manufactured using Copper Wire. (Aluminium has also been used).

All metallic joints in these cables are relied upon for good electrical contact, and if not correctly performed or sealed may become oxidised, forming a high resistance joint and becoming increasingly severe over time.

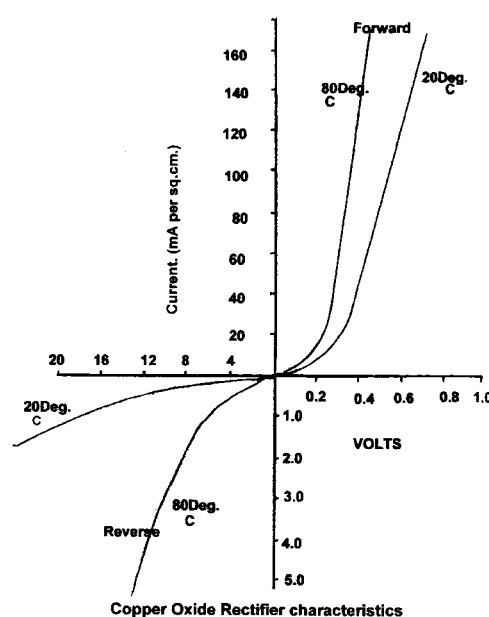
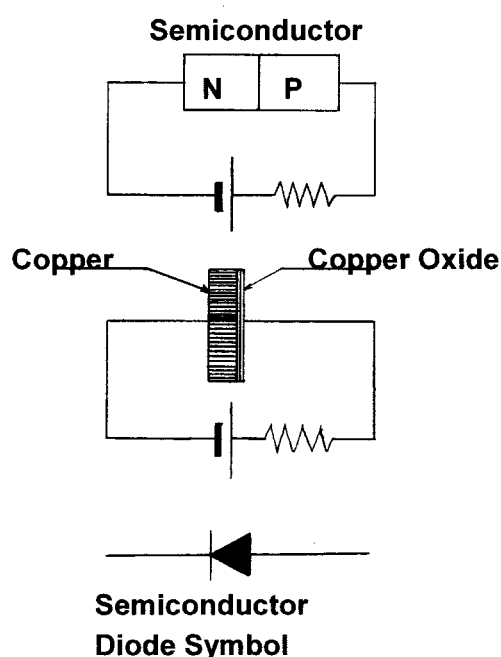
Oxidised copper exhibits the characteristics of a Semiconductor, specifically acting as a copper oxide rectifier (Semiconductor Diode) with its attendant unilateral or asymmetric conductivity properties.

Copper oxide joints behave exactly as a “P – N” crystal junction similar to a Germanium or Silicon diode junction.

Copper Oxide rectifiers were the first Metal Rectifiers introduced commercially in Battery Chargers, Telephony etc. before Selenium, Germanium, and Silicon.

Metal rectifiers conduct when the oxide surface is sufficiently more Positive than the metal, (Forward biased) and become non conductive or blocking, when the polarity is reversed, (Reverse biased).

This effect is represented below :-



Copper Oxide Rectifier.

Copper oxide rectifiers (Diodes) were originally made from copper discs or strips that were heat treated and annealed to form copper oxide on one face. The resistance of these discs varies with the magnitude and polarity of the applied voltage.

If forward biased with the oxide side more positive than the copper by several hundred millivolts, the diode conducts. If reverse biased with the oxide side less positive than the copper (more negative), the diode blocks i.e. becomes for practical purposes, non conductive.

The following graphs indicate the important Voltage/Current characteristics and the Voltage/Resistance characteristic of a typical copper oxide rectifier junction. Please note the significantly different scales used for the forward and reverse values in the Voltage/Current graph.

The 'Resistance variation with applied voltage' graph shows that when the oxide is more positive than the copper by less than 1 Volt, the resistance of the junction becomes very low. If the applied voltage is reversed then the resistance of the diode junction becomes extremely high up to about -5 or -6Volts and then rapidly starts to decline.

The heating effect of the junction is severe in the reverse bias direction due to the junction resistance being high and the current increasing. The power dissipated is proportional to the current squared, multiplied by the resistance of the junction.

If a voltage such as -30, -50 or -100 is applied during loop resistance or capacitance testing of a cable pair, the metal oxide junction is destroyed and short circuits, thus preventing the Tester from observing the High series resistance that was previously present

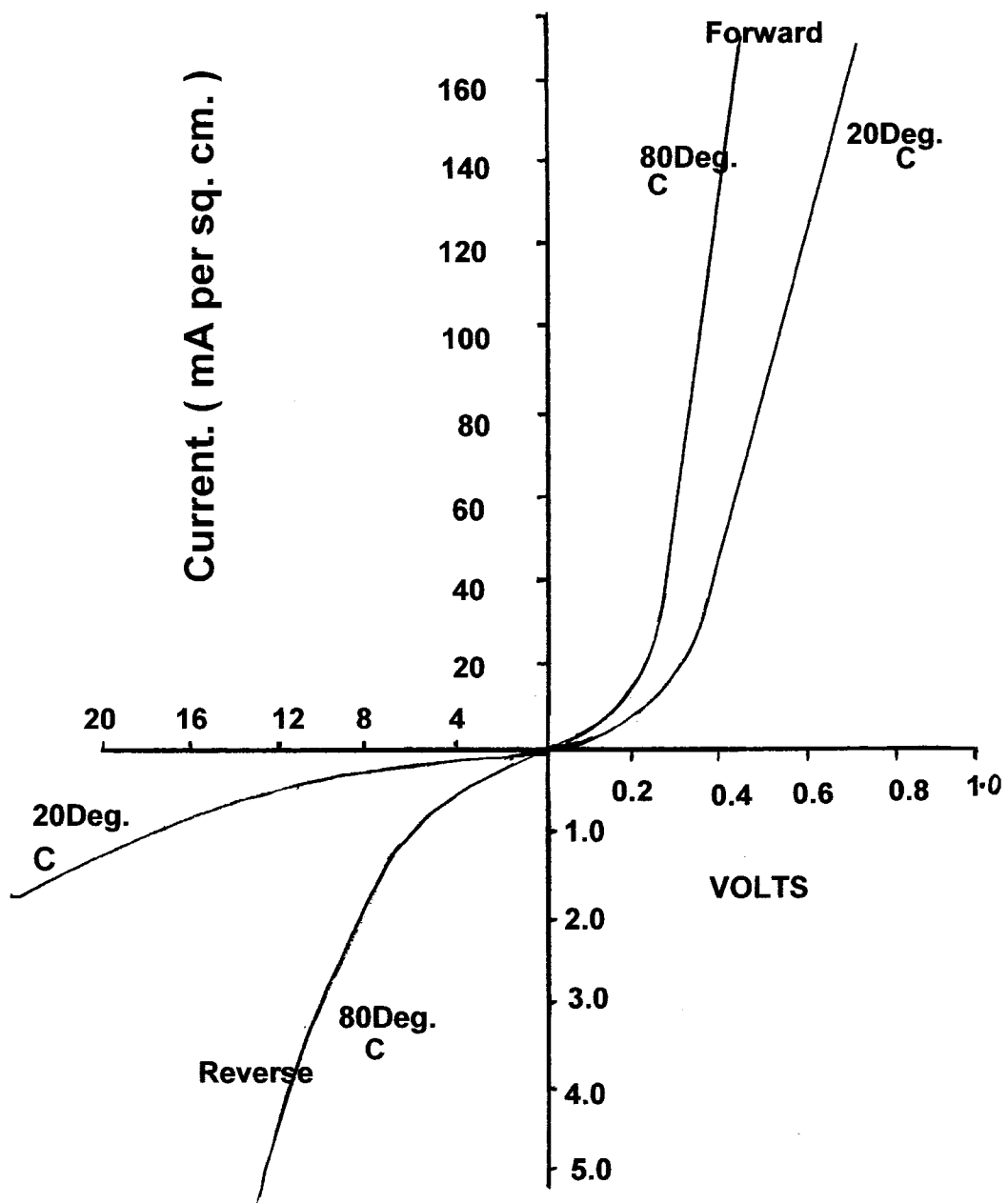
The oxide layer will eventually reform once the testing voltage is removed, and will cause problems with the small signal levels used in Telephony and Broadband.

A "Wetting" voltage and current is deliberately injected into circuits by designers to help overcome this problem.

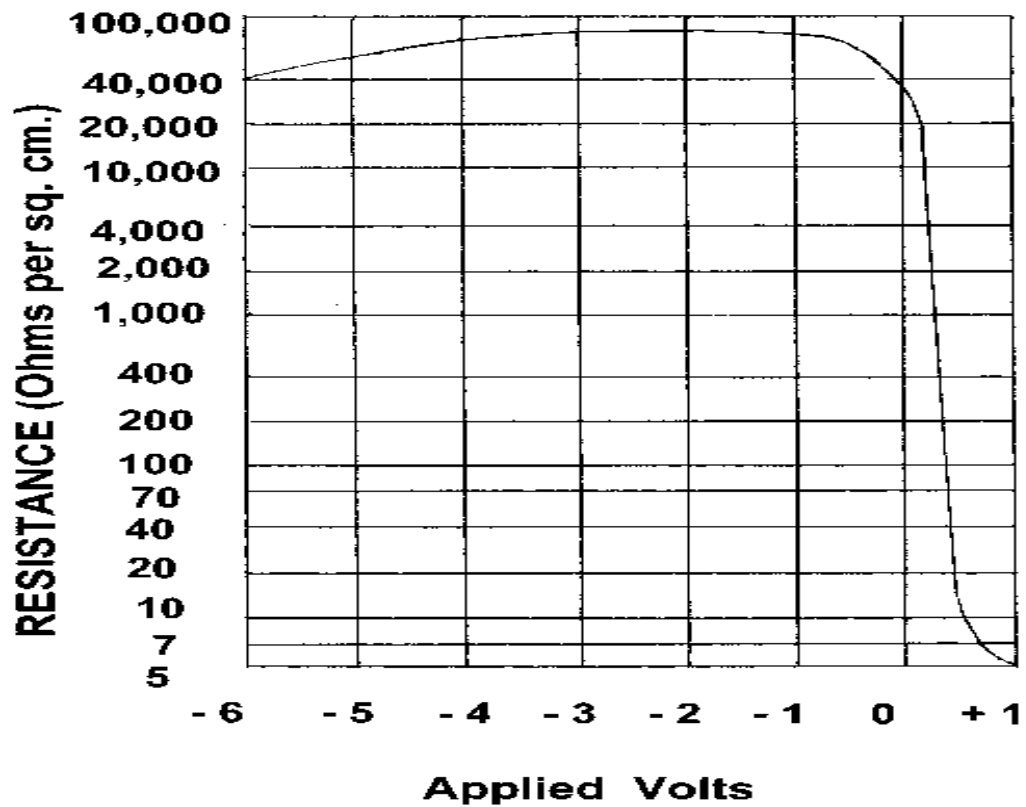
Test equipment used for testing circuits where copper oxide may be present, obviously must be selected and applied appropriately to discover the presence of the fault.

The procedure used currently by Telstra is not suitable and must be altered to avoid incorrect conclusions and charges.

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Copper Oxide Rectifier characteristics



**Copper Oxide Rectifier Resistance
Variation with Applied Voltage**