DON'T GUESS

When It Comes to
Vacuum Interrupter Protection

Magnetron Atmospheric Condition (MAC) testing service from Western Electrical Services can tell you the remaining life of your vacuum interrupters in the field or shop.

Western Electrical Services, Inc. is proud to be among the first to offer **Magnetron Atmospheric Condition (MAC) field and shop testing services** to its customers for quantifying the remaining life of vacuum interrupters used in medium-voltage circuit protection devices. Before MAC testing, technicians only could determine if a vacuum interrupter passed or failed using a HiPot test. *(See reverse side for tech brief.)*

MAC-TS1

Pressure Range: 1x10^{-3} mbar – 1x10^{-7} mbar

Error: < 10%

Vacuum Interrupter Test Principle:
Penning Discharge Magnetron

Magnetron Atmospheric Condition (MAC) Test Principle

MAC testing is based on the Penning discharge principle. This principle states that when a high voltage is applied to open contacts in a gas and the contact structure is surrounded by a magnetic field, the amount of current (ion) flow between the plates is a function of the gas pressure, applied voltage, and magnetic field strength.

Western Electrical Services' technicians can predict the remaining life of your vacuum interrupters by placing the interrupter in a constant magnetic field, applying a DC voltage to the vacuum interrupter's open contacts, and measuring the current flow, which directly relates to the pressure inside the vacuum interrupter. Most new vacuum interrupters ship with internal pressures of 10^{-5} Pa or less. If the pressure rises above 10^{-2} Pa, the bottle needs to be replaced.

Don't guess about the health of your vacuum interrupters.
Email us at info@WesternElectricalServices.com

WES WESTERN ELECTRICAL SERVICES, INC.

Your Electrical Solutions Provider

A Group CBS Company

For more information about Group CBS and its affiliate companies, visit **www.GroupCBS.com.**

Toll-Free **888 395-2021**

www.WesternElectricalServices.com

Phoenix, Arizona 85040
5680 SOUTH 32ND ST.

Salt Lake City, Utah 84104
3676 W. CALIFORNIA AVE., BLDG C, UNIT 106

Sumner, WA 98390
14311 29TH STREET EAST

Vancouver, WA 98661
4510 NE 68TH DR., SUITE 122

How HiPot Tests Can Make Bad Vacuum Interrupters Appear Good

Under certain circumstances, you may unknowingly place a failed vacuum interrupter back into service.

A West Texas utility company received an alarm on one of its load tap changers. Field technicians found that one of the vacuum interrupters failed an AC HiPot test. The tap changer was disassembled, and the vacuum interrupter in question was tested again. Once removed, the vacuum interrupter passed the AC HiPot test. The vacuum interrupter was reinstalled and placed back into service, where it again failed an AC HiPot test.

How did this utility company place a failed vacuum interrupter back into service? In order to interrupt high voltages, vacuum interrupters are manufactured with a very low pressure (vacuum) inside. At constant temperature, the internal pressure of the vacuum interrupter is directly proportional to the number of gas molecules inside. Therefore, more molecules inside correspond to a higher pressure, and fewer molecules correspond to a lower pressure. When the internal pressure of a vacuum interrupter increases to a certain point, the interrupter will no longer be able to insulate these high voltages. This means the vacuum interrupter will not pass a HiPot test.

If the internal pressure of a vacuum interrupter is just past the point of failing a HiPot test, a phenomenon can occur that can temporarily reduce the pressure inside enough to pass the test. Figure 1 shows a vacuum interrupter with a finite amount of gas molecules inside. Figure 2 shows a high voltage being applied across the open contacts, as in a HiPot test. This high voltage breaks down, or ionizes, the gas molecules inside the vacuum interrupter into charged particles, ions, and electrons, seen in Figure 3. After the high voltage is removed, these charged particles immediately begin recombining into gas molecules. Under certain conditions, some of these charged particles may "stick" to the inner surfaces of the vacuum interrupter which, in turn, reduces the number of gas molecules inside, shown in Figure 4.

When the number of gas molecules is reduced, the pressure is also reduced. This reduction in pressure is temporary and dependent on a number of factors; however, it can result in a vacuum interrupter's internal pressure being reduced enough to pass a HiPot test. These remaining charged particles eventually will recombine and return the pressure to an unsatisfactory level. After this recombination occurs, the vacuum interrupter will, again, not pass a HiPot test. ■

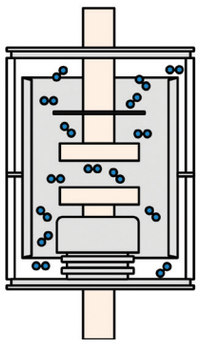

Figure 1: Vacuum interrupter showing gas molecules inside.

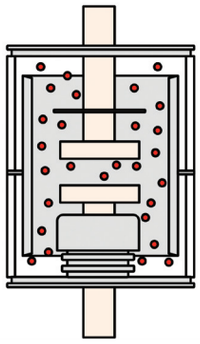

Figure 2: Vacuum interrupter with high voltage applied.

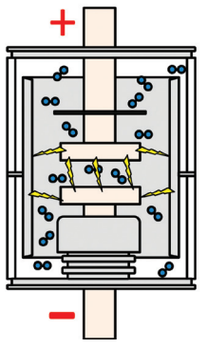

Figure 3: Vacuum interrupter showing ionized gas molecules.

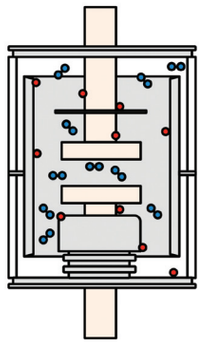

Figure 4: Vacuum interrupter showing partially recombined gas molecules.