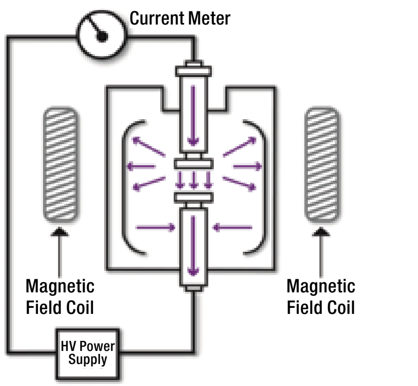
DON'T GUESS
When It Comes to Vacuum Interrupter Protection

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

CBS Nuclear Services 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.

CBS Nuclear 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.
Call CBS Nuclear Services.

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Test, Don't Guess, When It Comes to Your Vacuum Interrupters

Paschen's curve and magnetron atmospheric condition (MAC) testing can provide predictive guidance on the remaining life of vacuum interrupters in the shop or field.

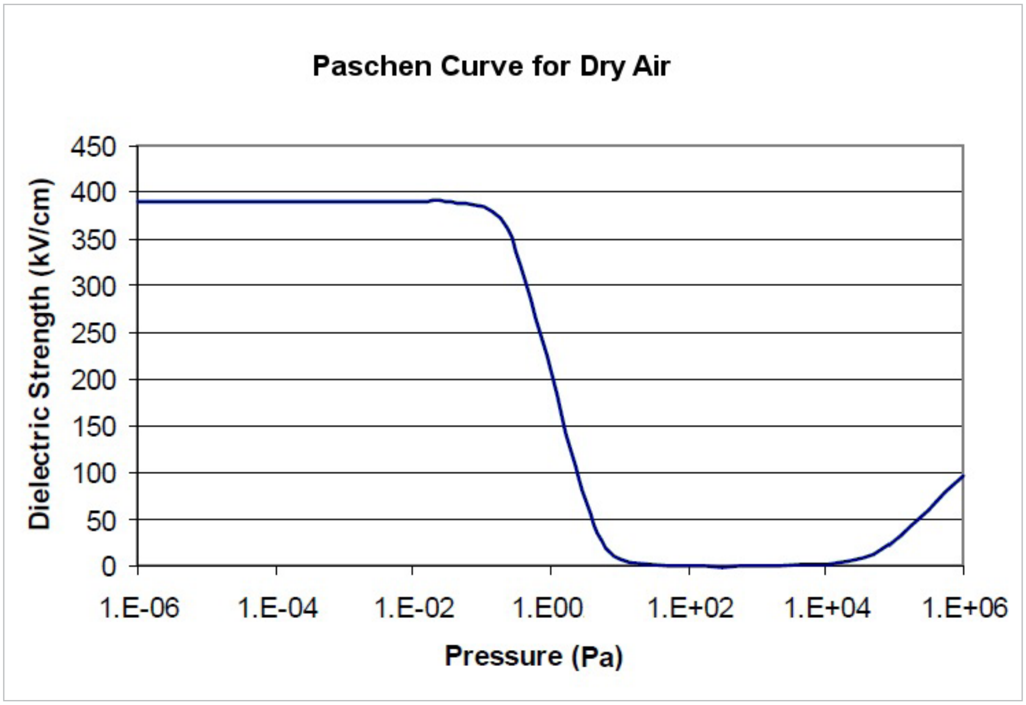
Since the first large influx in the early 1970s of equipment and breakers based on vacuum interruption, the technology has become the most widely applied power interruption technique in the medium voltage range (2.4 kV – 38 kV). There are millions of vacuum circuit breakers (VCBs) installed, and probably on the order of 10 million vacuum contactors. There are hundreds of thousands of VI breakers and contactors in the field that were manufactured 20 or more years ago. That raises the question of how long these VIs manufactured many years ago will maintain the vacuum level required to function successfully.

All vacuum interrupters (VIs) increase in internal pressure over time. The pressure increase may be due to small, long-path leaks from outside to inside, diffusion through the container materials, and/or virtual leaks from materials within the internal volume. VI manufacturers design and test their vacuum interrupters for a minimum lifetime of 20 to 30 years. VIs may successfully operate beyond this period, but it is beyond their design life. With the large number of VIs in the field that were manufactured more than 20 or 30 years ago, it seems likely that in-service VI failures caused by vacuum loss have greatly increased over the last 10 years.

As part of their vacuum breaker maintenance routine, manufacturers recommend a vacuum integrity test. This test consists of applying an AC power frequency-rated voltage across the terminals of a VI at its rated gap. If the VI is able to withstand the voltage for the manufacturer-specified length of time, the VI is deemed to have good vacuum. Passing this test indicates that the VI vacuum can successfully interrupt a fault, but gives no indication of how close the VI is to having a vacuum level that would cause it to lose its capability for clearing a fault.

Vacuum Level vs. Interrupting Rating

From Paschen's Law, we know that the dielectric strength between two electrodes is a function of the pressure of the gas between them. The diagram below shows Paschen's Law applied to dry air in a volume containing electrodes at spacing typical of those in a vacuum interrupter. The horizontal axis is the air pressure in Pascals (Pa), and the vertical axis is the dielectric strength in kilovolts per centimeter of electrode separation. ■



For more information, please visit www.CBSNuclear.com/VI

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