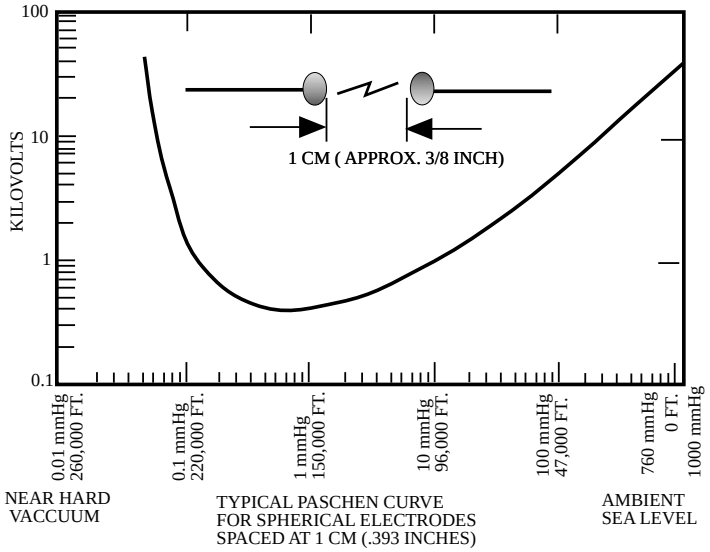
Paschen Curve



TYPICAL PASCHEN CURVE
FOR SPHERICAL ELECTRODES
SPACED AT 1 CM (.393 INCHES)

Paschen's results

In the 19th century, Paschen, a German scientist, conducted experiments to determine electrical arc characteristics when ambient pressure changed. He spaced two spherical electrodes at a constant 3/8 inch (1cm). He then reduced the ambient pressure in increments from sea level (760 mm Hg.) to 260,000 feet (0.01 mmHg.). At each selected pressure increment he increased the voltage across the electrodes until a low energy arc occurred.

The curve on the chart above tells the story. At sea level, about 30,000 VDC is required to initiate an arc across the electrode gap. At 47,000 feet the arc level drops to about 1200 VDC. Accordingly, the worst altitude is 150,000 feet, where only about 300 VDC will arc across the electrodes. Electronic Countermeasure Systems (ECM) and other radar and electronic systems aboard aircraft require high voltage connectors and cable assemblies to function at altitudes up to 70,000 feet with 1,500 to 40,000 volts applied. Missile borne ECM systems raise the requirement to 150,000 feet.

The problem

In low voltage electrical connector applications (less than 500 volts DC), reduced air pressure presents little concern or special design considerations. But to take just one example, a high voltage connector operating requirement of 10,000 volts D.C., the creep path (arc distance) between two conductors at sea level would be 1/2 inch (12.7 mm), and at 70,000 feet it would be 5 inches (127mm) minimum.

The extended creep path solution

If no design solution were possible other than the lengthening of the creep path, then aerospace high voltage connectors would occupy unreasonable volume and would be extremely heavy.

Elastomer seals

To eliminate the need for a lengthened creep path, all connectors manufactured by Reynolds that are rated for altitude operation have precision elastomer seals incorporated into the design. These seals block high voltage creep at reduced air pressure.

Temperature swing effect

Temperature swings from -55°C to +125°C can cause elastomer materials to exhibit compression set or loss of memory between hot and cold cycles. This can result in voltage creep past the seals and subsequent failure of the connector. Through the use of select elastomer materials and seal geometry, Reynolds altitude rated connectors will operate reliably when exposed to reduced pressure and hot and cold cycling.