

## **CORONA AND ITS EFFECT**

Corona is a phenomenon that has the capability for degrading insulators, and causing systems to fail. In this discussion, formulas are provided to calculate the voltage at which corona occurs, and a mention is made of a useful application for corona. Corona, also known as partial discharge, is a type of localized emission resulting from transient gaseous ionization in an insulation system when the voltage stress, i.e., voltage gradient, exceeds a critical value.

The ionization is usually localized over only a portion of the distance between the electrodes of the system. Corona can occur within voids in insulators as well as at the conductor/insulator interface.

### **Corona Inception**

Corona inception voltage is the lowest voltage at which continuous corona of specified pulse amplitude occurs as the applied voltage is gradually increased. Corona inception voltage decreases as the frequency of the applied voltage increases. Corona can occur in applications as low as 300V.

### **Corona Extinction**

Corona extinction voltage is the highest voltage at which continuous corona of specified pulse amplitude no longer occurs as the applied voltage is gradually decreased from above the corona inception value. Thus, once corona starts, the voltage must be decreased to get it to stop.

### **Corona Detection**

Corona can be visible in the form of light, typically a purple glow, as corona generally consists of micro arcs. Darkening the environment can help to visualize the corona. We once attached a camera (set to a long exposure time) to a viewing window in a vacuum chamber to confirm that corona was indeed occurring, and thereby confirming our suspicions. You can often hear corona hissing or cracking. Thus, stethoscopes or ultrasonic detectors (assuming you can place them in a safe location) can be used to find corona. In addition, you can sometimes smell the presence of ozone that was produced by the corona. (Who said you don't use all your senses when troubleshooting?). It is important that the voltage source and the coupling capacitor exhibit low noise so as not to obscure the corona. In its simplest form the pulse detection network is a resistor

monitored by an oscilloscope. Don't dismiss this simple technique as crude, as we once used this method to observe the presence of corona in an improperly terminated high voltage connector, even after a dedicated corona tester failed to find any.

### **Corona Effects**

The presence of corona can reduce the reliability of a system by degrading insulation. While corona is a low energy process, over long periods of time, it can substantially degrade insulators, causing a system to fail due to dielectric breakdown. The effects of corona are cumulative and permanent, and failure can occur without warning.

#### **Corona causes:**

- Light
- Ultraviolet radiation
- Sound (hissing, or cracking as caused by explosive gas expansions)
- Ozone
- Nitric and various other acids
- Salts, sometimes seen as white powder deposits
- Other chemicals, depending on the insulator material
- Mechanical erosion of surfaces by ion bombardment
- Heat (although generally very little, and primarily in the insulator)
- Carbon deposits, thereby creating a path for severe arcing.

### **Beneficial Corona**

The sound generation effects of corona can be utilized to build high accuracy audio speakers! The major advantage is that there is zero mass that needs to be moved to create the sound, so that transient response is improved.

### **Corona Prevention**

Corona can be avoided by minimizing the voltage stress and electric field gradient. This is accomplished by using utilizing good high voltage design practices, i.e., maximizing the distance between conductors that have large voltage differentials, using conductors.