

What's That Hissing, Cracking, Buzzing Noise?



What's that hissing, cracking, buzzing noise? (on photo: Corona discharge on insulator string of a 500 kV transmission line)

Corona or Partial Discharge with Buzzing Noise

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?)

The corona discharges in insulation systems **result in voltage transients**. These pulses are superimposed on the applied voltage and may be detected, which is precisely what corona

detection equipment looks for. In its most basic form, the following diagram is a corona (or partial discharge) measuring system.



Partial discharge activity on sharp metal edge (photo by partial-discharge-academy.com)

When corona occurs **it creates ozone** (detrimental to the human lungs, eyes, etc.), ultraviolet light, nitric acid, electromagnetic emissions and sound.

Ozone is a strong odorous gas that deteriorates rubber-based insulation.

If moisture or high humidity conditions exist nitric acids can also be formed that attacks copper and other metals. The **electromagnetic emission** can be heard as **interference on AM radios** and the corona sound can be heard by the human ear and be ultrasonic scanning devices.



Damaged electrical cable due to the partial discharge (photo by JIM CAHILL at emersonprocessxperts.com)

One important point to consider is that unlike infrared that detects heating due to current flow, corona indicates voltage problems and can be present without current flow. High potential in the electrical field is the major dictating factor for its presence.

Corona activity is at its strongest on the positive (+) and negative (-) peaks **of the 60Hz cycle**. 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

How Corona works?

Focussing on corona discharge and surface discharge, i.e. electrical gas discharges occurring in ambient atmosphere, **ionisation phenomena** are initiated in the high electrical field region respectively resulting from the **conductor geometry** (*wire, point, sharp edge*) or from a **triple point** (*metallic conductor / insulation material / gas*).

According to the conductor geometry, applied voltage amplitude and polarity, ionisation phenomena will be confined in the vicinity of the high field region or will propagate in gas from this region as transient successive **ionisation waves** (*streamer regime with current pulses associated with the development of filamentary discharges*).

In any case, electron in elastic collisions will also lead to gas molecules dissociation and excitation resulting in chemical active species formation and light emission; elastic collision between ions and neutral molecules will result in local gas heating.



Surface partial discharge effect (photo by <http://natfield.com/>)

Light, gaseous chemical reactants and heating are consequently evidence of gas discharges.

References:

1. *Corona and Tracking Conditions in Metal-clad Switchgear Case Studies* By James Brady, Level-III Certified Thermographer
2. *CHARACTERIZATION OF MEDIUM VOLTAGE EQUIPMENT AGEING BY MONITORING OF PARTIAL DISCHARGES CHEMICAL AND ACOUSTICAL EMISSION* E.Odic*, E.Jouseau**, G. Vivien**, C-S.Maroni**

Source:

<http://electrical-engineering-portal.com/whats-that-hissing-cracking-buzzing-noise>