FireFly –VS- ZEEION

We acquired three, brand new, ZEEION Anti Static Blowers (By Visible Dust) with the intent of comparing their performance to the performance of the FireFly Digital Sensor Cleaner (By NRD), which we already had. This proved to be an interesting exercise, because identifying, selecting, and then implementing an objective test method is critical to the validity of the conclusions one could reach upon evaluating the test results.

Our first thought was the obvious test of comparing how well either product could remove the dust from a camera sensor. For this to be reasonably objective, we would need to know a lot about the composition and particle size distribution of our dust. We would also need to control the number of dust particles placed onto the camera sensor before each trial. And, to minimize the impact of environmental conditions on our results, we would want to perform these tests in a class 100, or better, clean room. This was starting to look like a lot of time and effort.

Then we asked ourselves, what single characteristic, shared by these two different anti-static blowers, would be the most important characteristic necessary for removing dust from a camera sensor. We believe that without the air, compressed by the hand operated bulb and then ejected from the nozzle, it would be very difficult, if not impossible, to remove dust from a camera sensor. It was time to change the question.

O.K. – What unique, single characteristic, shared by these two different anti-static blowers, would be the most important characteristic necessary for removing dust from a camera sensor? Air Ionization is what both manufacturers claim makes their products able to quickly and safely remove dust from a camera sensor. They claim that by ionizing the air stream delivered to the nozzle, static charges that are holding dust onto the sensor can be neutralized, allowing the air stream to sweep the dust away from the sensor. Now we have a performance characteristic that can be measured with the appropriate instrumentation, and then objectively evaluated.

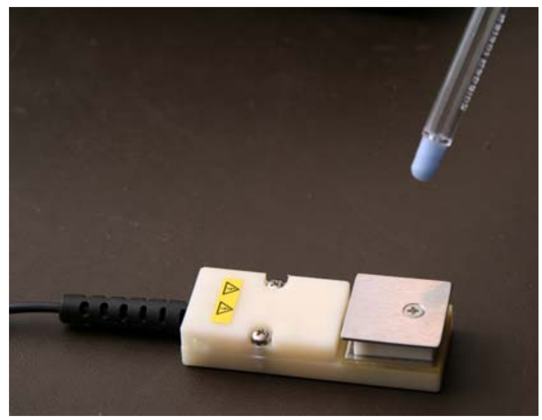
A review of the literature from each manufacturer shows a very important difference in the ionization characteristics. The ZEEION creates only NEGATIVE ions, whereas the FireFly creates both POSITIVE and NEGATIVE ions. We will need to consider this when we choose a test method. However, as a sidebar and from a practical standpoint, the FireFly can neutralize both POSITIVE and NEGATIVE static charges, but the ZEEION can only neutralize POSITIVE static charges. This means that the ZEEION may not be effective in circumstances where dust is being held by a NEGATIVE static charge.

As we considered various instruments and methods to evaluate the ionization created and delivered by the ZEEION and the FireFly, we reviewed Standards and Advisories published by the Electrostatic Discharge Association. Two documents in particular, ESD ADV 3.2-1995 “Selection and Acceptance of Air Ionizers”, and ESD STM 3.1-2000 “Ionization”. From this we concluded that the best method we could employ to evaluate and compare the performance of the ZEEION and the FireFly would be to measure the discharge time of a charged plate. We elected to utilize a Trek model 158 Charged-Plate Monitor with a Trek model 156P one-inch by one-inch square plate.

Because the ZEEION can only generate negative ions, and therefore it can’t neutralize the charge on a negatively charged plate, we decided to measure the time required to discharge the plate from a positive 1000 volts down to a positive 100 volts. Opting to measure the decay time between 1000 volts and 100 volts is a common practice and is discussed in the standards referenced above.

To minimize the influence of unknown and undesirable electrical charges in the test environment, our charge plate and monitor would be placed onto a grounded, static dissipative surface, and a grounded wrist strap would be worn on the hand that was used to operate each blower bulb. We would hold the outlet nozzle, of the device under test, at a distance of approximately one-inch from the charged-plate. We would initiate the preprogrammed test sequence and then squeeze the blower bulbs as hard and fast as possible during the 30-second test, or until the plate voltage dropped below 100 volts.

After setting up the equipment in the test area, we configured the Trek Charged-Plate Monitor to perform decay time measurements from a positive 1000 volts to 100 volts and programmed a time limit of 30 seconds on each test. Before running the experiment, we ran a couple of quick tests of the FireFly, and observed that we could get consistent, reasonable decay times. But, tests of the ZEEION showed NO voltage decay during the 30-second tests. It became obvious that this test method would not provide useful data for the ZEEION.



The question then became, how could we evaluate the ability of the ZEEION to neutralize a positive charge? As it turns out, the Trek Charged-Plate Monitor is also capable of measuring the voltage on the plate, which is present because of ions impinging upon the plate. This is also a common test described in the standards referenced above. The Electrostatic Discharge Association calls this parameter the “Offset Voltage” and in ESD ADV 1.0-2003 “Glossary” defines it as “The observed voltage on the isolated conductive plate of a charged plate monitor that has been placed in an ionized environment.”

By knowing the capacitance of the plate and the voltage on the plate, we can calculate the charge on the plate using the following equation:

$$Q = CV$$

Where: Q is the charge present on the plate, with the unit of Coulomb

C is the capacitance of the plate, with the unit of Farad

V is the voltage present on the plate, with the unit of Volt

This gave us a method to measure the negative charge delivered to the plate by the ZEEION in 30 seconds. We couldn’t use this method to measure the charge delivered to the plate by the FireFly because the FireFly generates both positive and negative ions, with a net of zero. However, we can still use the decay rate test to indirectly measure the negative charge delivered to the plate by the FireFly. By charging the plate to a positive 1000 volts, then measuring the time required to discharge it to 100 volts, we can calculate the charge neutralized (or delivered to the plate) using the following equation:

$$Q_{(neutralized)} = Q_{(1)} - Q_{(2)}$$

Where: $Q_{(1)}$ is the charge present on the plate at 1000 volts

$Q_{(2)}$ is the charge present on the plate at 100 volts

First we configured the Trek Charged-Plate Monitor to measure the offset voltage, averaged over a 30-second period, and proceeded with the experiment. We ran three trials on each of the three ZEEION Anti Static Blowers, for a total of nine trials, and averaged the offset voltage readings. The average offset voltage reading was –3.86 volts. Calculating the charge we have:

$$Q = CV = (2.0x10^{-11}\ Farad)(-3.86 Volt) = -7.7x10^{-11}\ Coulomb$$

The negative sign in V and Q above indicate the polarity of the voltage and charge on the plate. We can now calculate the charge generation rate by dividing the charge by the time period. Ignoring the negative sign we have:

$$Charge\ Generation\ Rate = \frac{Q}{Time} = \frac{7.7x10^{-11} Coulomb}{30\ Seconds} = 2.6x10^{-12}\ Coulomb\ per\ Second$$

Next, we reconfigured the Trek Charged-Plate Monitor to measure the decay time between a positive 1000 volts and 100 volts, and programmed a time limit of 30 seconds. We ran three trials and averaged the time measured. The average decay time was 2.8 seconds. Calculating the charges we have:

$$Q_{(1)} = CV = (2.0x10^{-11}\ Farad)(1000 Volt) = 2.0x10^{-8}\ Coulomb$$

$$Q_{(2)} = CV = (2.0x10^{-11}\ Farad)(100 Volt) = 2.0x10^{-9}\ Coulomb$$

$$Q_{(neutralized)} = Q_{(1)} - Q_{(2)} = 2.0x10^{-8} - 2.0x10^{-9} = 1.8x10^{-8}\ Coulomb$$

$$Charge\ Generation\ Rate = \frac{Q_{(neutralized)}}{AverageTime} = \frac{1.8x10^{-8} Coulomb}{2.8\ Seconds} = 6.4x10^{-9}\ Coulomb\ per\ Second$$

Lets compare the charge generation rate of the ZEEION to that of the FireFly by expressing it as the ratio of the larger rate to the smaller rate:

$$Ratio = \frac{LargerRate}{SmallerRate} = \frac{FireFly\ Rate}{ZEEION\ Rate} = \frac{6.4x10^{-9}}{2.6x10^{-12}} = 2462$$

This demonstrates that the FireFly generates approximately 2500 times as much neutralizing charge per second as the ZEEION. From this, one could conclude that the FireFly would be immensely more effective than the ZEEION across a broader range of conditions.

Summary: In the static control world, you use both polarities of ions (NEGATIVE & POSITIVE) to neutralize a static charge, using a single polarity can actually cause damage under the right conditions. The FireFly emitting both NEGATIVE and POSITIVE ions meets its claim to remove the static charge from the sensor, releasing the dust. The ZEEION on the other hand only emits a single polarity (very small amounts of NEGATIVE ions) and FAILS to remove the static charge holding the dust on a sensor.

If you would like to see a spec sheet on the test equipment used in this test, please visit
http:// www.trekinc.com/products/158.asp

If you would like to see a visual demonstration, please visit
http://www.dustfreephoto.com/Blower-Challenge.html

For more information on the Sensor Cleaning subject, please visit our web site at
http://www. CleaningDigitalCameras.com