

DELUXE VAN DE GRAAFF GENERATOR

P6-3300 and P6-3500

DESCRIPTION OF EQUIPMENT:

The **Deluxe Van de Graaff Generator (P6-3300 and P6-3500)** is designed to attain potentials up to 350,000 volts or more under favorable operating conditions. Potentials of 250,000 volts are perhaps more usual and provide more than enough voltage for forceful demonstrations. All units are shipped completely assembled, ready to operate. The Van de Graaff Generator consists essentially of a motor driven belt that runs between pulleys, one on the motor shaft and the other inside the dome at the top of the column. The variable speed motor is controlled by a rheostat whose knob is on the front panel. When the Van de Graaff is new, it is normal for the motor to not start turning until the rheostat is almost at full speed. This is because the bearings in the motor and the upper pulley are still relatively tight. Over time those bearings will loosen up and the unit will start more easily.

MAINTENANCE:

Keep the dome and column free of dust and fingerprints. Clean with a soft cloth and an aerosol dusting polish. If dust and grime are allowed to accumulate, they present thousands of little discharge points on the surface of the dome. They can easily reduce the available voltage by 50%.

The latex transport belt is slowly attacked by the oxygen in the atmosphere, just as is an ordinary rubber band. The ozone created during operation is even more damaging, and so the belt will need to be replaced from time to time. We suggest that you have one belt on the machine and one spare.

Replacement belts are always readily available and may be purchased directly from our website at: arborsci.com/van-de-graaff-replacement-belt

WARNING:

The demonstrations described in the following instructions may involve hazards arising from careless handling or incorrect procedures. This equipment should be used only under the supervision of a qualified, certified science teacher.

SUGGESTED DEMONSTRATIONS:

The descriptions that follow are intended as an overview of a variety of demonstrations and include a brief description of each.

THE DISRUPTIVE ARC:

One of the more attention-getting demonstrations using the Van de Graaff Generator is the arc discharge. Bring a round object, such as the Discharge Electrode (**P6-3310**), within 3 or 4 inches of the dome. Be sure you have properly grounded the unit to the binding post on the top of the generator base. If the generator is operating up to voltage, there will be a sharp crack and a bright bluish-white arc as it jumps from the dome to the smaller electrode. With a discharge electrode of this size, about 4 inches in diameter, you can estimate the voltage on the dome at approximately 50,000 volts per inch of the maximum arc length. With a smaller diameter discharge electrode, the arc length would be greater but the intensity would be less.

CONTINUOUS DISCHARGE:

If you point a finger at the dome from a distance of about 3 inches, you will feel a slight tingle on a continuing basis. If there is more of an intermittent zap, move your finger a little closer until the current flow is continuous. Instead of a finger, now hold a common nail or metal screwdriver pointed at the dome. Be sure to hold the screwdriver on some part of the metal and not by the handle. The effect of the metal point is more pronounced than the finger but, in both cases, we are continuously discharging the dome. If you now bring the **Discharge Electrode (P6-3310)** near the dome while holding the nail, you will not get an arc as before. When this demonstration is performed in the dark, you will see a faint glow around the point of the nail. This is called a corona discharge. It is the continuous excitation and ionization of the air, causing the emission of light.

THE ELECTRIC WIND:

Repeat the previous demonstration while holding a candle flame between the point (nail) and the dome, but nearer the point. You will see that the flame is bent over by a wind that is blowing away from the dome. The effect is caused by charged particles of air trying to get away from the dome and from each other. (Like charges repel one another.) The same wind effect can be seen by placing the N-127 Point Terminal on the side of the dome and holding the candle several inches away. A child's plastic pinwheel or thin sheets of facial tissue are excellent demonstration devices.

THE ELECTRIC WHIRL:

Bring an Electric Whirl (P6-3340) near the dome when it is up to voltage. The three-arm pivoted assembly will immediately begin to turn. The direction of rotation will be away from the pointed ends of the spokes. What is happening is that the arms are being charged negatively by leakage from the dome and the points are in turn ionizing the air nearby. As these charged particles are repulsed by the point, there is also a reaction force that causes the arms to turn.

VOLTA'S HALL STORM:

Bring the Volta's Hail Storm (P6-3320) near the dome of the Generator and the small particles of vermiculite will immediately begin to jump up and down. They are first attracted to the upper plate, but when they get there, they receive a charge that causes them to be repelled. When the particles again reach the grounded lower plate, they lose their charge and then the process will repeat. Just holding the base will usually provide enough grounding for successful operation.

SMOKE PRECIPITATION:

Remove the vermiculite from the Volta's Hail Storm (P6-3320) and stand the little piece of wire screen on edge. If necessary, roll the screen into a partial cylinder to help it stand on its side. Fill with smoke, replace the top and then bring the unit near the dome of the Generator. The smoke will immediately become charged and be attracted to one of the electrodes. It will vanish almost instantly.

NEON WAND:

The Neon Wand (P6-3360) is a very sensitive indicator of the extent of the electrostatic field near the dome of the generator. Pointing the glass tube at the dome from a distance of 2 or 3 feet will cause it to light up with the typical orange neon glow. As you bring it closer to the dome, it will become brighter. If you stick a small piece of foam on the wires at the end of the tube and then hold it against the dome, you should get the very brightest output. In this case, the foam is providing a small amount of insulation so that the dome has to build up to a high charge level before it can arc to the wires. The neon tube now receives a quick repetition of high-energy discharges that create more light than the continuous current flow that was present without the foam.

THE FLYING BALL:

Hold the "fishing pole" of the Flying Ball (P6-3330) so that the ball is perhaps 6 or 8 inches from the dome. Note carefully that, at first, it is attracted to the dome, but if it touches the dome, it is then violently repelled. Until this newly acquired charge is dissipated, the ball will "fly" at the end of its thread and remain quite far from the dome. If you touch the ball and thereby remove the charge, the performance will be repeated. First, attraction by induction, and then repulsion after it touches the dome. The round, smooth shape of the ball allows it to hold a charge for quite a long time.

THE SILVER SNAKE:

The Silver Snake (P6-3330) is a metallized ribbon that will be attracted to the dome, but repelled as soon as it touches. Its geometric shape with edges causes the loss of charge into the air very quickly and so the cycle repeats.

CHARGING A PERSON'S HAIR:

This is fun for all the class but not necessarily an easy demonstration to pull off. If you can raise the entire person to the voltage level of the dome, then their hair should act in much the same way as the electric plume did.

The first step is to insulate the subject from ground by having them stand on something like a sturdy plastic milk crate or some glass building blocks. You need to get the subject about one foot above the floor. A rubber mat or plastic sheet simply will not work. Have your volunteer place his or her hand on the dome and then start the machine. The subject must understand that he is not to remove his hand or he will receive a shock when he puts it back. In a minute or so the subject will have been raised to about as high a potential as you're going to get. If the hair is now standing up, you have succeeded. If not, it's time to consider what might be wrong.

First, this Van De Graaff is not a huge machine, so the smaller the person you have selected, the better. There will be less surface from which to lose charge. Second, be sure there are as few "points" of loss as possible. Things like rings on fingers, metal barrettes, and belt buckles should be avoided. Third, be sure the machine is in good operating condition and is putting out plenty of voltage. Do not even think about trying this demonstration on a day of high humidity. The generator output will be low and leakage will be high.

The repulsive forces available are relatively small and are quite insufficient to untangle hair or overcome any type of hair spray. The best results will come from clean, straight, dry hair of perhaps 3 or 4 inches in length.

For more information about Van de Graaff Generators, or questions, please contact us at mail@arborsci.com, or 800-367-6695.