Physics Playground

Van de Graaff Generator Instructions

HV Supplier for:

- 400KV DC or AC Powered VDG (built /kit)
- 450 KV High Current VDG (built / kit)
- 600 KV High Current VDG (built / kit)
- 700 KV High Current VDG (built / kit)
- 1 MV VDG (built only)
- VDG Parts
- Jacobs Ladder
- Oil Distillation

About Physics Playground

Thank you for your purchase from Physics Playground. I, Frederick Graff, am a physics/ chemistry teacher here in Tracy California and have been producing high voltage equipment for the past 8 years and truly hope you enjoy your electrostatic generator and lab supplies and find it more than suitable for all your experimentation needs. It has been a personal goal of mine to make science lab equipment that far surpass the integrity of the foreign manufactured items that have flooded the market. These generators are guaranteed to deliver unconventional levels of voltage and current that will do all of the static electricity demos known to high voltage community. Once again, thank you for your purchase and should any questions, comments, or concerns arise along the way, please do not hesitate to contact me at frederick-graff@hotmail.com or (209)914-2619.

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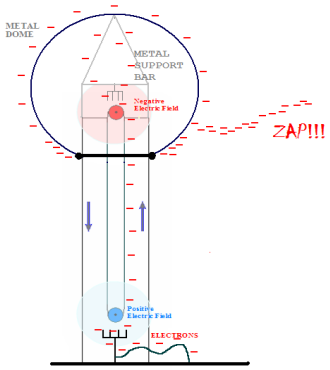
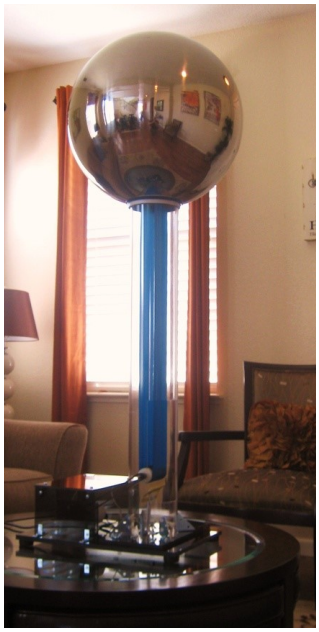
How a Van de Graaf Generator Works

VDG's operate just like a conveyor belt for charge in the sense that they pick up negatively charged electrons from the bottom and take them to the top where the electrons are dropped off. The mechanism that allows the electrons to be picked up from the bottom is that the



lower roller is made from material that can develop a positive charge that in turn attracts the electrons from the bottom of the comb and flings them toward the belt which then transports them to the top. When the negative electrons reach the top they are repelled off the belt



700 KV VDG used by Mad Science , MIT , and Hollywood for special effects

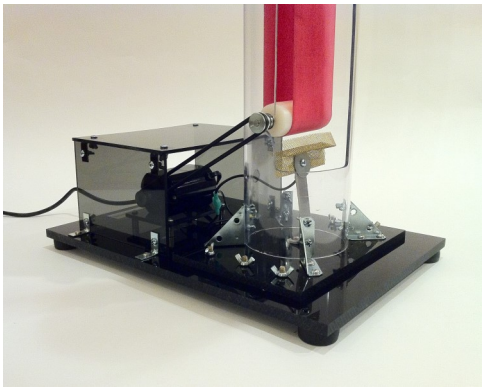
How a VDG Works (cont.)

-tive electrons reach the top they are repelled off the belt by the top roller which is made from a material that can produce a negative charge. Factors that affect the strength of a VDG would be the belt speed, the ability of the rollers to develop positive and negative charges (refer to tribolelectric series), and the size of the sphere which hold the electrons.

Van De Graaff AC High Current Assembly

For 400 KV, 450 KV HC , 600 KV HC, 700 KV, and 1 MV Units

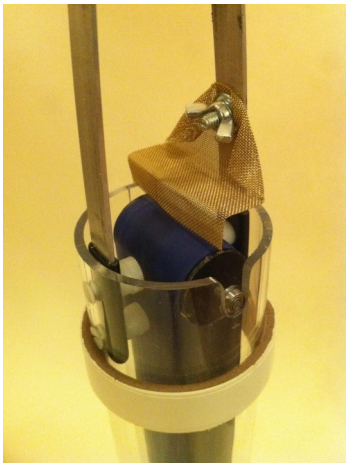
STEP 1) Attach the bottom comb to the base using the 10-24 x 3/8 machine screw..



STEP 2) Bolt in the large tube to the base of the VDG using the metal or nylon machine screws and wing nuts provided. Next, feed the grounding wire through the back hole of the tube and connect male and female terminals

STEP 3) Attach the top aluminum support system using the smaller nylon screws and nylon wing nut. The 600KV and the 700KV units will have the support system on the outside of the tubing and the 400KV and 450KV units will fasten from the inside.

STEP 4) For optimal performance prepare the belt and both rollers by cleaning them with lightly soaped water to remove any form of dirt or oil and then dry them using a paper towel. For best results, rinse the belt and rollers with distilled or filtered water.



Extend the belt life by no letting the combs touch the belt while in operation. For best results use a 1/4 inch gap.

STEP 5) The static belt is fastened by first attaching the top roller and then feeding the belt down through the tube. From the bottom opening, reach up and grab the belt and place the bottom nylon roller through the belt and then connect the roller into the bottom insertion holes. While connecting the roller, always keep one hand through the belt incase the roller slips from you. There will be a significant amount of tension within the belt system.

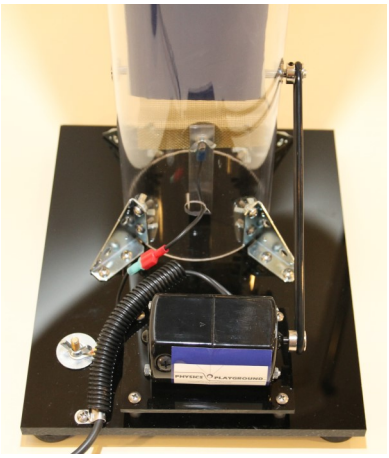
STEP 6) The top and bottom metal combs should be spaced about a 1/4 inch from the belt and facing toward the belt so that they may spray the electrons to and from it. The combs should never touch the belt during operation and will tear the belt if they do.

Van de Graaf Assembly (Cont.)

STEP 7) Fasten the dome on to the aluminum support system using the nylon thumb screw. For the 400KV through 450KV VDG's, the dome should press down on the white insulation to prevent leakage.

VDG Operation: For the high current systems, before turning on, **make sure the speed control is at least 6 feet** from the generator. If the speed control is touched by a person near the generator, the control may be destroyed. For this reason, the **speed controls will not be covered under warranty.**

When testing the VDG, it may take up to 10 minutes before it develops a charge considering that the belt are rollers were cleaned. To accelerate the process blow a hair dryer up the tubing to push out any moisture.



400 KV VDG DC and AC Powered Assembly

STEP 1) For best results, first clean the belt and rollers with lightly soaped water and then rinse with a distilled or filtered water. 300KV and 350KV bottom rollers may be pulled off.

STEP 2) Attach the acrylic tube to the base with the 10-24 nylon machine screws.

STEP 3) Attach the top support system by using the 8-32 x 5/8 nylon screws and thumb nuts. The support system stays on the inside of the tube.

STEP 4) Attach the belt and rollers.

STEP 5) For the DC systems only, there will be a ground wire attached to the bottom comb, that is used to transport electrons for charging. This ground wire should be clamped to an item in the area that is Earth grounded such as a sink, gas port, or metal structure. The ground wire may even be held onto, however it will not work as well as an Earth ground.

STEP 4) The DC powered VDGs will come with a 6 volt battery however other power supplies may be used as listed bellow.

Battery Power Supplies:

- Any 6 Volt battery
- 4 Cell AA battery holder

AC to DC Power supplies:

Most AC to DC power supplies may be found on eBay for less than 5 dollars with shipping included.

- 5V at 2A - 3A
- 6V at 2A - 3A
- 7V at 2A - 3A
- Any lab power supply that can deliver at least 3 amps of current.

These VDGs are designed to operate at much higher currents and voltages than the typical manufactured units, therefore the AC to DC plug in power supplies may easily be damaged if they are interrupted by the current produced from the VDG. To avoid damaging the plug in power supply:

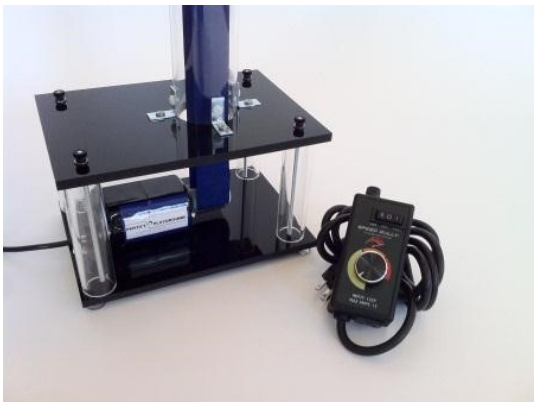
- Do not touch power supply while touching the generator.

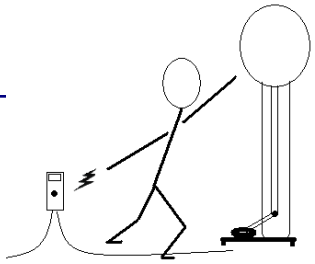
This rechargeable 6 volt battery makes a great power supply due to its voltage, current, and longevity. This battery also very easily tucks into the side behind the motor.

400 KV and 350 KV DC Assembly (Cont.)

VDG Operation:

1) Plug in VDG. Some VDG's may need an initial push on the roller due to the sticky high friction top roller. This will only need done the first few times.
2) Allow the system to run to 10 minutes for system to wear in. Use a hair dryer on the bottom roller if charge is lagging.
3) VDGs will have a constant duty cycle.
4) AC powered VDGs should not be ran at full speed because of the strength of the motor. Only go 80 to 90% full speed.





Touching the speed control while near the VDG will destroy it!

All VDG Safety

1) Always keep VDGs away from people with pacemakers.
2) Keep VDGs away from electronics. Do not use VDG's on the same breaker as computers and AV equipment.
3) To prevent damaging the speed control, keep it at least 6 to 8 feet from the VDG. If you feel sparks on the handle of the speed control, move the control back further.
4) Avoid making human chains that will produce large discharge currents and voltages.
5) Avoid using high voltage capacitors around the VDG.
6) Arcs from VDG will produce small welts on body.
7) Operate in a well ventilated area due to the ozone produced by VDG.

Only use the Gorilla Super Glue to mend belt material

All VDG Maintenance

1) Both belt and rollers should be washed with lightly soaped water after every 2 hours of use. Do not allow water to get on the bearings while washing. VDGs will attract dust due to the high voltage.
2) When cleaning the VDG, only use soap and water. Acetones, alcohol, and thinners will crack the acrylic.
3) The VDG Latex belt will oxidize in UV light. When finished using, place the VDG in a light protected area or remove the static belt.
4) Should the belts ever tear, use **"Gorilla Super Glue"** to re-mend if salvageable..
5) The top roller should be recoated with Pliobond after 20 hours of use.

VDG Trouble Shooting

Van de Graaf generators have two main obstacles that will stop them from working being oil and water. When the VDG first arrives, it is always necessary that the rollers be rewashed and dried before using so that any oil that may have contaminated the system during shipping be removed. Once the VDG is operating, the high voltage produced will continue to attract dust and any suspended oils from the air, therefore it is necessary that the system be regularly cleaned to remove these contaminates.

If the system is washed and it still does not produce a spark, allow it to operate for at least 10 minutes especially for the newer VDG so that the rollers may ware into the belt. Many often find that the more they use the VDG, the stronger it gets. To accelerate the VDG to full operation, it is best to blow a hair dryer through the bottom opening while the VDG is running. Should the system still be struggling to produce high currents, rewash the belt and rollers though it is rare to have to do so.

Humidity will significantly deter the performance of the VDG if not completely stop it from producing a charge. All of the Physics Playground generators are designed to operate in very high humidity conditions up to 85%. To alleviate humidity conditions, a hair dryer may be blown up the tubing while in operation in order to push out moisture or the unit may be ran in a air conditioned environment.

Quick Tips:

- Keep the VDG Clean of oil and dust
- Allow up to 10 minutes of run time after cleaning belt and rollers for full current to develop.
- Use a hair dryer to push out humidity.

Use to recoat the top roller with Pliobond if roller shows signs of significant wear over time. Pliobond may be purchased at most ACE hardware stores.

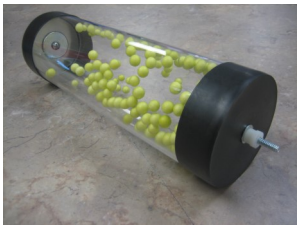
Van de Graaf Generator Demos

1) Insulate yourself using a milk crate and then either place your hand on the generator or point an unfolded paper clip at the generator (this works well for those who do not want to touch it). Look up and you will see your hair standing on end. While being charged, try the following:

- Open your hands and then close them. There will be a very weird feeling all over your body as the voltage jumps from 400KV to 100KV and then back again.
- Point at your neighbor. You will shooting electrons at them.
- Hold a fluorescent tube and have another touch it to light it up or you point at the tube while your neighbor holds it.
- Put pie pans on your head while being charged and then let them go.
- Hold an ion motor in your hands and watch it spin.
- Have your neighbor stand on a milk crate and point at them while being charged and their hair will stand up to.
- Hold either a balloon in your hand, cup of popcorn, a cup of Styrofoam packing balls, paper, or anything insulative and light and then watch it fly.
- Hold on to a Hailstorm static motor.

2) VDGs are also ideal for making electrostatic motors. You may find more on electrostatic motors at **www.phyicsplaygournd.com**

3) VDGs maybe used for particle accelerators, enhancing plant growth, separating fine particles, high voltage effects, and haunted house props plus much more.



Volta's Hailstorm is a simple static motor that shows the transfer of electrons.

Stand on a milk carte and point to the VDG with a pointed paper clip. That's all!

Physics Playground Contact Information
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~Physics Playground for custom high voltage equipment~

Physics Playground is a small and growing business that has been started by Frederick Graff, a mechanical engineer graduate from Penn State and employee of United Technologies that had taken on the passion of education in hope to inspire and guide the youth into the sciences. The origin of the business was rooted in the lacking California educational budget to adequately supply the equipment to operate a physics and chemistry lab class. To supplement the equipment such as acceleration ramps, power supplies and electrostatics, Frederick began the task of building his own lap equipment, which eventually brought forth the first Graff made VDG as seen in the photo bellow. Years later with hundreds of hours of perfecting the static generator design, Physics Playground is pleased to present a product listing of the strongest and most efficiently operating VDG's the market has to offer. Many thanks for your purchase and be sure to always pass on the love for science and search for the greater truth!

Physics Playground Warranty and Replacement Parts

Warranty: Physics Playground generators and high voltage equipment are covered under a one year warranty accept for static belts and speed controls (or AC to DC converter power supplies) Signs of rough use such as dropping, over tightening hardware, and exposure to caustic chemicals will dismiss the equipment from eligibility of the warranty.

Prior to sending the replacement part, the buyer must email a photo of the damaged part to frederickgraff@hotmail.com for verification. All replacement parts will be shipped within 4 business days.

Consumable Parts: Please visit Physics playground for replacement parts. Both belt material and pre-made belts will be sold on the website. For those who wish to mend their own belts, the belt sizes are listed below.

- 400KV VDGs:
  (2 in x 35 in)
- 450KV High Current VDG:
  (3.5 in x 34 in)
- 500KV and 700KV High Current VDGs:
  (4.5 in x 48 inch)

Www.physicsplayground.com