



VAN DE GRAAFF GENERATOR - 200kV

Cat: EM4137-001 (DC motor, controlled speed) 240V.AC.50Hz.

DESCRIPTION: The IEC VAN DE GRAAFF GENERATOR is a modern, compact and robust instrument that is specially designed for use in the classroom.

Power Input: 220/240V.AC 50/60 Hz. Approx. 1 Amp

Output: 200 kV under good conditions. Approx. 75mm spark between balls.

Size: Overall: 640mm high. Dome: 200mm.d. Discharge ball: 80mm.d.

Belts: Charging belt:: 55mm wide. PA4137-010 Motor belt: PA4137-012

Drive: Motor, low voltage, with belt reduction and electronic speed controller.

Supplied with 1x spare motor drive belt and 1x spare main belt.

EM4137-001 200kV model



Features:

- Full access to the belt
- Removable belt cover
- Excellent speed control
- Adjustable belt tension
- Easy removal of ball
- Adjustable spark gap



Physical size: Main ball: 220mm D Height: 650mm

Weight: 3 kg

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CONSTRUCTION: The generator is robustly designed, both motor drive and charging belts are easily changed. The housing contains the motor with a belt drive to a plastic pulley, speed control and power switch. The plastic pulley drives the rubber belt over a roller inside the large stainless steel dome and the tension of the main belt is adjustable. Transparent and easily removable covers protect both the motor drive belt and the charging belt.

The support columns are clamped firmly and they may be used to carry the unit. The discharge ball is screwed to a long support rod which provides an insulated handle and an earth connection terminal. This rod may be located in the adjustable support provided on the rear face of the housing to hold the discharge ball at the correct position relative to the dome for prolonged 'hands off' use.

The power and speed of the motor may be adjusted to demonstrate that work is done when the charge on the belt is transported from a place of low potential to a place of high potential. The belt can be seen to slow down as the charge increases on the large dome.

OPERATING CONDITIONS: The best results will be obtained in a dust-free atmosphere of low humidity and with absolutely clean and smooth domes, support rails and cover. The machine should be placed at least 2 metres from walls, light fittings, plumbing, etc. particularly if these objects present sharp corners or edges. The discharge ball should be earthed by connecting to the terminal on the base of the unit with the flexible wire supplied.

During prolonged operation, the discharge ball rod (with or without the earth cable attached) may be 'parked' by inserting into the hole in the adjustable holder mounted on the rear of the housing.

To adjust the 'parking' angle of the discharge ball, use the rod to twist the holder on the rear panel. If desired, the discharge ball's insulated rod may be held in the hand, **but the earthing cable must be attached.**

PRECAUTIONS:

- A Van De Graaff spark is normally harmless but it can make you 'jump', however, never come close to a Van De Graaff if you are wearing any electronic equipment similar to say a 'pacemaker' heart instrument and so on.
- The discharge current that makes the spark from the dome passes through the discharge ball to earth through the earth wiring of the mains socket on the wall. This short duration high sparking current can make the earth potential of other power outlets rise at each spark. ***It is advised that computers in the building are turned off when using a Van De Graaff.*** To reduce earth potential problems in the wiring of the building, the earth terminal on the front panel should be solidly connected with a separate short wire directly to a well earthed point in the building (a metal water pipe etc.). The discharge current through the building's earth wiring will then be reduced.
- If the discharge ball is closer to the dome than the user, sparking will jump to the ball first, therefore, try to stand behind the discharge ball and do not approach too close to the charged dome. Note that if the earthed discharge ball is positioned so it is touching the dome, the dome will be held at earth potential and will be safe to touch.
- At spark gaps greater than 100mm care must be taken when altering the speed or when touching the base of the machine, because leakage through the air may cause a small discharge from the user's hand to the base. It is not dangerous, but will make you jump.
- After switching off the machine, always earth the large dome to discharge it by touching it to the earthed discharge ball before touching it with the hand.
- Remember that just being in proximity to a Van De Graaff will make your body collect a static charge, especially if wearing rubber soled shoes. As you touch some neutral object, a small discharge may often be felt.



- Handle the large dome gently since dents are difficult to remove and they reduce operating efficiency.
- Always hold the discharge ball support rod by the insulated handle provided. Always have the earth cable attached.
- Since sunlight causes deterioration of rubber, the unit should always be stored in a well shaded place when not in use. Do not store in front of an unshaded window.

MAINTENANCE: CLEANING: Dirt and moisture cause poor performance:

The belt may be removed and wiped with a cloth moistened with alcohol (methylated spirits). Be sure it is dry before using. The plastic rails may be cleaned by wiping with a soft cloth or, if necessary, scrubbing with a tooth brush and warm water & detergent. **Do not use solvents of any type on the rails or covers.**

The surfaces of both main pulleys should be wiped with a cloth moistened with alcohol. Allow all components to dry before evaluating the performance of the unit.

The above procedure is a major cleaning operation and should be performed only when most adverse conditions demand it. A normal cleaning routine is to simply wipe the large dome, the small discharge ball and the surface of the plastic rails and cover with a soft lint-free cloth. **Note that ANY dirt or dust particles on either the dome or the discharge ball will make the sparking deteriorate. Keep the system clean.**

INSTRUCTIONS FOR USE:

REFER TO THE DRAWING FOR PARTS IDENTIFICATION: Components are:

- 1 pce. Base housing with motor and controls. Motor pulley (out of sight), driven pulley 'M', small belt 'N', two plastic support rails 'U', lower pulley 'L', upper pulley 'G', with knob 'E' for clamping the upper pulley assembly to the rails. By unclamping and sliding the bracket 'H', the tension of belt 'J' is fully adjustable.
- 1 set Stainless steel large dome & internal mounting pin 'A' to fit socket 'D'.
- 1 pce. Discharge ball 'I' with handle, with handle 'T' and earth terminal 'K'.
- 1 pce. Cable with 4mm plugs to connect discharge ball handle to base.
- 2 pcs. Rubber belt 'J' (one fitted and 1 spare belt).
- 1 pce. Mains power cable & plug

Remove the parts from the packing and check that all parts are present.

As supplied, the 200 kV. Van de Graaff machine is assembled, but check the assembly details as follows:

FITTING AND REMOVING THE MAIN DOME:

The top dome connects to the upper pulley bracket by a pin 'A' that slides into a hole 'D'. Place the dome over the pulley bracket assembly and move it so its mouth is just resting against the sides of the plastic support rails. At this position, the pin is close to aligned with the socket and, when the pin 'A' has entered into socket 'D', lower the dome until the magnet 'S' is felt holding the dome firmly in place. **To remove the dome, bump the dome gently upwards and lift from its socket.**



THE CHARGING BELT: The gum rubber belt has a high contact potential with the material of the lower pulley. If a belt loses the ability to charge, application of talc into the surface of the rubber will improve insulation and slip and often improves the performance. Wipe off all excess talc because too much will make a mess.

REMOVAL AND REPLACEMENT OF THE CHARGING BELT: Lift the upper dome from its socket 'D', twist the upper and lower 'comb' 'C' away from the belt or unplug the combs from the banana plugs. Unhook the small rubber loops 'V' from the notches in the top edge of the belt cover 'B' and completely remove the cover.

Slide the belt 'J' off the pulleys 'G' and 'L' and slide a new belt on the pulleys. Reposition the 'combs' so that the points are close to the belt surface.

Only if necessary, adjust belt tension by loosening plastic knob 'E', use the top pulley to gently release the clamping effect and slide the pulley bracket 'H' assembly up or down the rails. Belt should be stretched about 50mm for best performance. **CAUTION:** If the rails protrude too far beyond the metal bearing housings, the dome will not fully engage the socket properly. When the belt tension is adjusted, use the knob 'E' to re-clamp metal bearing housings tightly to the rails.

Be sure the bearing housings are clamped parallel so the upper pulley is horizontal and the belt runs correctly on the pulley.

REFIT THE CHARGING BELT COVER: With the notches at the upper edge, engage the lowest edges of the cover 'B' into the thin grooves provided on the plastic rails. When partially engaged, slide the cover down so it fits in front of the 2 retainer pins 'R' in the base. Guide both edges of the cover into the thin grooves and stretch and hook the rubber loop 'V' into the notch on each side of the cover. Refit the large dome as explained previously.

REMOVAL AND REPLACEMENT OF THE MOTOR DRIVE BELT: Turn off the power, hold the upper edge with fingers and slide small transparent motor belt cover 'Q' upwards to disengage it from the metal bracket.

Insert the new motor belt 'N' down the hole to pass under the motor pulley. Pull up gently on the belt to engage it into the groove in the motor pulley. Stretch the belt slightly to fit into the groove in the larger pulley 'M'.

Position the cover so the front edges hold behind the metal frame and push the cover 'Q' down firmly.

RUN THE MACHINE: Attach the green earth cable between the terminal on the discharge ball handle and the earth terminal on the front panel of the machine. For 'hands-free' operation, insert the rod of the discharge ball into the special holder 'O' on the rear of the instrument. Adjust the discharge ball to the desired spark gap.

Turn on the motor and hold the discharge ball about 50mm away from the large dome. After a short time, sparking will begin and strong repetitive sparks should be obtained. Depending on various conditions, it sometimes it takes several minutes of running to begin strong charging.

REPLACING THE FUSE: Type: 20x5mm LxD 1 Amp. Disconnect from mains power. Remove the 4x screws and remove the right hand end panel from the housing. The circuit board can be seen. The fuse can be seen behind the 2x wires. Without removing the wires and with the aid of a small screwdriver, lift the small plastic cover from the fuse holder, replace the fuse and replace the cover. Finally, replace the plastic end panel.



PRINCIPLE OF OPERATION: The rubber belt is driven by the plastic pulley and a charge is induced on the surface of the belt as the rubber belt leaves contact with the plastic pulley. This charge on the outer surface of the belt is positive relative to the lower 'comb' which is connected to earth potential.

The belt carries the charge to the dome. The inside surface of the belt touches the metal pulley to be at the same potential as the dome and the positive charge across the belt thickness is removed from the belt by the sharp points of the upper 'comb'. This charge from the belt is added to the dome's existing charge.

The outer surface of the dome acquires a positive charge in respect to earth. This 'charge pumping' effect is cumulative until a voltage on the large dome is sufficient to cause a spark discharge between the dome and the discharge ball.

USEFUL OBSERVATIONS:

- Discharge rates, colours and intensities at various spark gaps.
- Pull of attraction between balls of opposite polarity.
- In the dark, see the corona discharge from tip of discharge ball support rod.
- If a person stands on an insulating sheet of plastic and places his/her hands on the Van De Graaff dome, as the generator begins to charge, the charge on the person's body will make long dry hair stand up from their head. This is a popular and harmless trick done with Van De Graaff machines.
- Check polarity and measure actual current flow with 0-25 micro-amp meter. This current measurement is a good check on the performance of the unit. A unit that will perform well and charge at a high rate and provide rapid large sparks will have a short circuit current of about 4 microamps or higher. If the current is high but the performance is poor, look for dirt or dust on the dome or discharge ball and look for unwanted discharges to sharp corners or points of nearby items. If the current is poor, it is usually that the belt requires replacement or the belt or pulleys are dirty. Clean with a soft cloth dampened with methylated spirits.
- Retention of charge after machine is switched off.
- Difference between discharge to a ball and discharge to a point.
- After switching off, note charge on belt surface. Touch with the finger.
- In a darkened room, see leakage paths, discharges to dust in the air, brush discharge from the 'combs', different shapes of sparks, effect of bringing different objects close to the dome when it is at a high potential.
- Note the behavior of a scrap of paper dropped between the balls.
- Reduce the power (torque) of the motor and observe the belt slow down as the charge on the dome increases. Work is done to transport charge on the belt from a place of low potential (the lower housing) to a place of high potential (the upper dome).

Designed and manufactured in Australia



VAN DE GRAAFF PARTS:.....

