

VAN DE GRAAFF GENERATORS - 400kV

**EM4134-101 220/240V.AC. with earth. 50/60 Hz.
250mm diameter ball generates about 400kV**

DESCRIPTION: The "IEC" 250mm diameter Van De Graaff is a modern, compact and robust instrument that is specially designed with all parts fully exposed for use in the classroom. This model is available also with a remote speed control (EM4134-101R).

EM4134-101 400kV standard model



The IEC Van De Graaff is available either with or without remote speed control.

Physical:	Main ball:	Height:	Weight:
EM4134-101	250mm D	800mm	3.4kg

REMOTE SPEED CONTROL:

In some cases, the user feels uncomfortable to reach towards a sparking machine to adjust the speed. The "Remote Speed Control" cable plugs into a socket provided and permits adjustment of the sparking speed without the user being close to the sparks. When removed, control reverts to the control on the machine (model EM4134-101R).

SPECIFICATIONS:

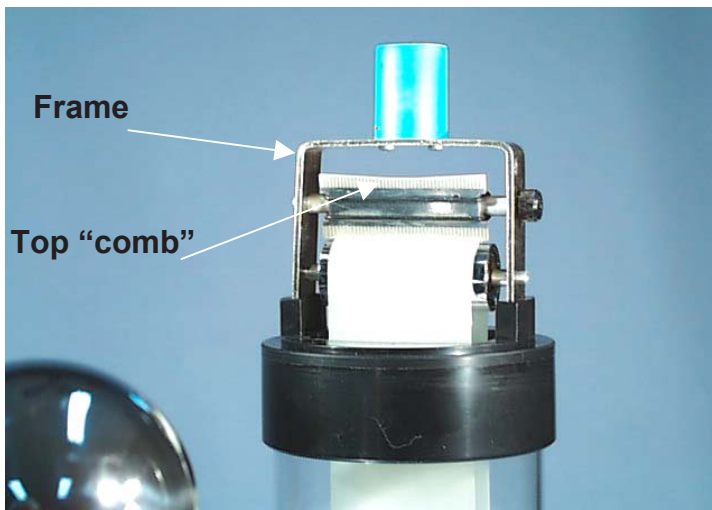
Output: EM4134-101 400kV under good conditions. Approx. 15cm spark gap.

Discharge ball: 80mm.D. with insulated handle and earth terminal connection.

Charging Belt: 55mm wide silicone rubber. PA4138- 010S

Drive belt: Belt driven from a speed controlled DC electric motor.

NOTE: Most countries have an earthed mains power system But some do not. It is important that the mains power outlet and mains cable being used has an earth connection so that the spark discharge current can pass to earth. Please refer to the section explaining discharge currents in the earth wiring of buildings.



Fit top pulley to frame:

At the top of the tube, lift the upper pulley with the belt around it and take the frame. Fit the two ends of the pulley shaft into the 2x empty holes. Squeeze the two legs together a few mm and push them into the plastic collar. Adjust the "comb" so the edge is almost touching the belt surface. The plastic socket has a magnet to retain the pin inside the ball.



Bottom Pulley arrangement:

The bottom pulley should run true and smoothly. The bottom "comb" should be adjusted so it is vertical and the upper edge is almost touching the belt surface. The 'comb' is the device that induces the charge to be created on the belt surface after the belt contacts the surface of the plastic pulley. It is important that the comb is as close as possible to the belt without touching it.



Ball retaining system

Inside the main ball, steel pin is retained into a socket by magnetic pull.

Remove the ball by firmly bumping it upwards to break the magnetic pull.

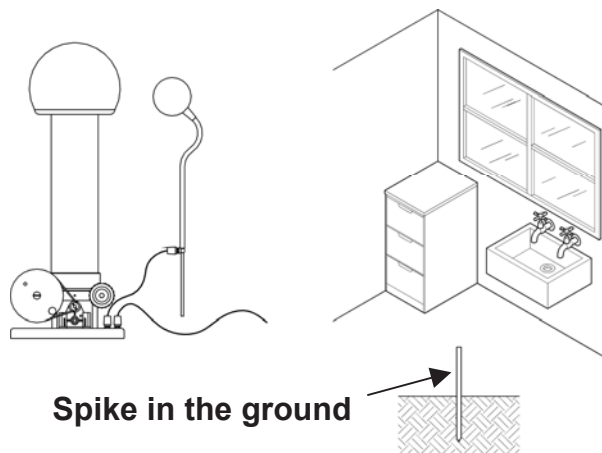
TO REFIT THE LARGE BALL: mentally imagine the pin's position in space to engage it into the plastic socket. When engaged, a magnet inside the socket will pull the pin and hold the ball firmly in place.

BEFORE CREATING STATIC CHARGES, PLEASE READ THE NEXT SECTION ABOUT EARTHING THE BASE OF THE VAN DE GRAEFF.

This charge created and sparked between the balls passes from the dome to the metal plate in the base and passes down the earth wire of the mains cable to the earth system of the building. This causes the earth wire in the building to spike in voltage on each discharge. **Usually this simple arrangement is OK,** but, sometimes, given certain conditions, the voltage spike in the earth wiring system can be quite high and other equipment plugged into other power outlets can be electrically damaged.

To avoid this, it is often desirable to connect a wire from one of the earth terminals to some earthed part of the building such as a sink or water pipe etc.. This will reduce the discharge current down the cable into the power outlet. Suitable earthing points are: any metallic part of the building's construction, a metal pillar or beam, a large metal object like a filing cabinet or a large metal window frame. Or, a wire can be run through a window to an external pipe or garden tap or to a spike driven well into the soil. **Be sure NOT to connect to GAS PIPES.**

The Van De Graaff base can be earthed to any large metal earthed object. Metal window frame, large filing cabinet, metal sink, water taps or a wire to outside water tap or spike into the ground.





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. Negative electrons jump from the belt to the earthed comb to cause the belt surface to become positive potential.

The belt carries the charge to the dome. The inside surface of the belt touches the metal pulley to become 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 adds to the dome's existing charge so that the charge rises over time.

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

OPERATING CONDITIONS:

The best results will be obtained in a dust-free atmosphere of low humidity and with clean and smooth dome, discharge ball and insulating tube. The machine should be placed at least 1 metre 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 Earth terminal on the base of the unit using the flexible wire supplied and the unit itself can, if desired, be earthed to a large mass by using the other terminal (see previous explanations).

During prolonged operation, the discharge ball rod (with or without the earth cable attached) may be 'parked' by inserting into the hole in the discharge ball support device mounted on the base. To alter the spark gap, adjust the 'parking' angle of the discharge ball.

The discharge ball's insulated rod may be held in the hand, but to avoid sensations to the hand, the earthing cable should be attached to one of the earthing terminals on the base.

GENERAL PRECAUTIONS all models:

- Approach the operating Van De Graaff machine with caution at all times. A spark discharge, although harmless, can be a little uncomfortable.
- 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.
- 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.
- 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 on carpet or wearing insulating soled shoes. As you touch some neutral object, a small discharge may often be felt as you discharge.
- Handle the large dome gently since dents are difficult to remove and, if seriously dented or scratched, operating efficiency can be reduced.
- Always hold the discharge ball support rod by the insulated handle provided. Always have the earth cable attached.
- Since sunlight causes deterioration of most materials, the unit should always be stored in a well shaded place when not in use. Do not store in front of an unshaded window.



HOW TO RUN THE MACHINE:

Turn on the power, turn switch to ON position and adjust to a medium speed. 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. Adjust the spark gap and motor speed as required. Provided the discharge ball handle is connected to the earth terminal on the base, the discharge ball can be held by its handle to draw larger sparks for the main ball.

MAINTENANCE and CLEANING:

Dirt and moisture both cause poor performance. If very dirty, the charging belt may be wiped with a cloth moistened with alcohol (methylated spirits). Be sure it is dry before using and, a very small amount of talc can be rubbed into the belt inner surface to help charging. The plastic insulation tube may be cleaned by wiping with a soft cloth or, if necessary, with warm water & detergent. **Never use solvents of any type on the tube or the plastic base.**

Both pulleys must be free from any dirt or rubber build-up. They can be wiped firmly 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 tube 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. It is a good idea to cover the instrument when in storage.

FITTING AND REMOVING THE MAIN DOME:

To remove the dome, with both hands at the same time, bump the dome gently upwards and lift from its socket.

THE CHARGING BELT:

SILICONE: The silicone rubber belt has a high contact potential with the material of the lower pulley. If a belt loses the ability to charge, application of a very small amount 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.

The moulded IEC silicone rubber belts have now superseded the old latex belts that have been used for many years..

REMOVAL AND REPLACEMENT OF THE CHARGING BELT:

Lift the upper dome from its socket and twist the upper and lower 'combs' away from the belt. Slide the belt off the lower pulley so that it hangs loose in the plastic tube, then pull the metal 'U' frame from the upper plastic socket with the belt dangling.

If necessary, loosen the knurled screw holding the 'comb' support rod a few turns and, using both hands, spread the legs of the 'U' frame a little to remove the pulley shaft from the 2x holes in the frame. Slide a new belt on the pulley and allow it to dangle down the tube to be caught at the bottom and slid on the bottom pulley. Then refit the top pulley shaft to the holes in the 'U' frame. Re-tighten the small knurled screw. Squeeze the 2x legs together slightly to hold the top pulley firmly and slide them into the plastic collar.

At both the top and bottom pulleys, adjust the comb to be almost touching the belt.

ATTACHMENTS:

IEC manufactures a set of 7x different useful attachment to fit to the top of the main dome. This set is catalogue number EM4144-001. Details can be obtained from the IEC website:

www.iecpl.com.au

OPTION: Remote speed control:

For model EM4134-101R, a special socket is provided near the speed control knob. When the Remote Speed Control is plugged into the special socket, the speed is then controlled by the knob at the end of the cable.

The belt can be stopped before approaching the Van De Graaffe

**USEFUL OBSERVATIONS:**

- Discharge rates, colours and intensities at various spark gaps.
- Pull of attraction between balls as the charge increases.
- 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 base) to a place of high potential (the upper dome).

Designed and manufactured in Australia