

## VAN DE GRAEFF "RAIJIN"



### **Manual Of Operation Important!**

**Read the following before using this equipment:**  
Carefully follow all instructions and observe all precautions outlined in this manual.

## N99-B10-1323 Van de Graaff Electrostatic Generator "Raijin"

Please carefully read this Operation Manual prior to using this unit to ensure safety and proper handling of the equipment.

### Introduction

This device is a Van de Graaff-type electrostatic generator. It uses static electricity generated by friction between the belt and rollers to ionize air molecules and accumulates the air ions in the collecting bulb at the top of the electrostatic generator. The generator's performance varies from season to season or depending on the generators' maintenance condition. Therefore, we strongly recommend the user to diligently conduct generator maintenance to allow it to deliver optimal performance. Raijin is constructed such that it can be serviced far easier than comparable models. We hope that Raijin is properly maintained and utilized in various electrostatic experiments.

### 1. Parts and Accessories Provided for the Electrostatic Generator "Raijin"

Upon receiving the product, please verify that the box contains the following items:

- 1) Raijin main unit equipped with a controller to change the speed of the belt
- 2) Discharge bulb (small bulb) for conducting high-voltage discharge experiments
- 3) Simplified Hamilton flywheel assembly kit: 1 set (six discharge needles are not yet bent.)
- 4) Three-colored fluorescent tube: 1 piece
- 5) Electric umbrella preparation kit: 1 set (plastic strings need to be split by the customer)
- 6) Paper pattern for an electrostatic rocket: A4, one sheet

### 2. Main Unit Operation Test

- 1) Check that the Power switch on the controller shown in Fig. 1 is in the OFF position and then connect the AC power plug of the Raijin main unit to an electrical outlet.
- 2) There is a banana jack electrode terminal at a lower part of the side face of the main unit. Connect the cable of the provided discharge bulb (small bulb) to this terminal as shown in Fig. 2.
- 3) Provide a distance of about 6 cm between the collecting bulb at the top of the main unit and the discharge bulb.



Fig. 1 Belt Speed Controller

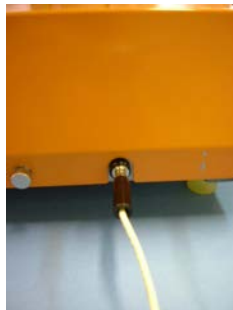


Fig. 2 Electrode Terminal in the Main Unit



Fig. 3 Connecting the Discharge Bulb to the Raijin Main Unit

- 4) Check that the belt speed controller's variable resistor knob is turned fully counterclockwise, turn ON the Power switch, and then gradually turn the knob clockwise.
- 5) Discharge occurs even at low revolution speeds, and as you increase the VR's turning angle, the discharge interval (time) becomes shorter. When this condition consistently continues, gradually increase the distance between the collecting bulb and discharge bulb. When maintenance of the generator is successful, discharge can occur at a distance of more than 100 mm under dry conditions in the middle of winter.

If this operation verification results in a significantly short discharge distance, perform maintenance of the electrostatic generator using the following method.

The product is adjusted to optimal conditions at factory shipment; however, its performance may degrade depending on the season or the degree of humidity or dust in the environment it is being used.

### 3. How to Maintain this Unit

- 1) First, unscrew the two screws installed in the side face of the Raijin main unit's metal cover, and then unscrew the four screws attached to the lower parts of the clear, acrylic column (belt cover). Save the removed screws. Carry out work in the order from Fig. 4 to Fig. 5.



Fig. 4 Removing Screws from Lower Parts of the Side Faces of the Main Unit

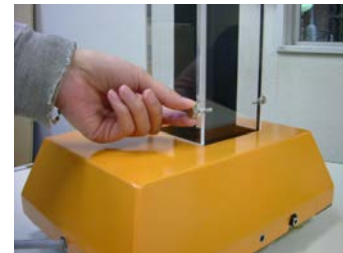


Fig. 5 Removing Screws from the Side Faces of the Acrylic Column

- 2) Remove two panels from the acrylic column as shown in Fig. 6. Then bring the main unit's metal cover to an upper part of the column and hold the cover with one hand. Locate the threaded holes for fixing screws at a center part of the column and screw the two screws removed in step 1 into these holes (Fig. 7). Lower the main unit's metal cover carefully to be placed on the screws fixed at the center part of the column (Fig. 8).



Fig. 6 Unscrewing All Screws from the Column to Remove Two Acrylic Panels



Fig. 7 Fixing the Two Screws in a Center Part of the Column

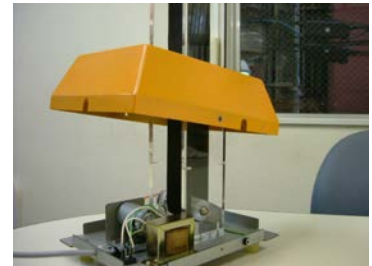


Fig. 8 Placing the Main Unit's Cover onto the Fixed Screws

#### Caution:

1. When raising the main unit's cover to an upper part of the acrylic column or lowering it to a center part of it, exercise care not to damage the column.
2. Do not drop the main unit's cover onto the screws, but lower it slowly. Otherwise, the threaded holes in the center part of the column may be damaged.

- 3) When the cover has been raised to the center part of the column, the main unit's inside is exposed; first remove the orange timing belt connecting the motor at the rear of the main unit and the roller at the front. Remove the top half of the collecting bulb and turn the screws attached to both ends of the upper roller shaft counterclockwise to loosen the belt. Unscrew the set screw (the one with the black head) from the bottom roller and pull the roller out. Place the removed roller in locations where dust cannot settle on it.



Fig. 9 Removing the Top Half of the Collecting Bulb

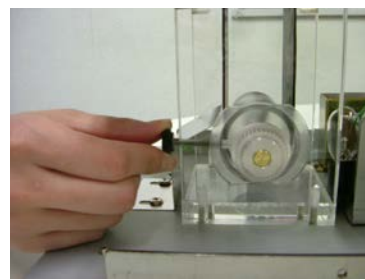


Fig. 10 Unscrewing the Screw from the Bottom Roller



Fig. 11 Removing the Bottom Roller



Fig. 12 Removing the Upper Roller Together with the Belt

- 4) Hold the roller shaft with both of your hands as shown in Fig. 12 and pull it up together with the belt. For this step, exercise caution and prevent the belt from rubbing against the electrode.
- 5) Clean the removed rollers and belt using ethanol for disinfection (available from a pharmacy). For the rollers, gently wipe their surfaces with tissue paper dampened with small amounts of ethanol. For the belt, immerse it into ethanol as shown in Fig. 13 to sufficiently remove oil, grease, and dirt. Then dry it in the shade as shown in Fig. 14. (Do not wipe the belt surface with a fluffy cloth such as a towel.)



Fig. 13 Cleaning the Belt in a 1-liter Beaker Filled with Ethanol for Disinfection



Fig. 14 Hanging the Cleaned Belt over a Pole or Rod to Dry it in the Shade in Locations with Little Dust

This is the overview of the cleaning method. Dry the belt and rollers in locations with little dust for approximately one hour. To assemble the belt and rollers, follow the reverse of disassembly.

**Caution:**

- (1) For cleaning ethanol, always use ethanol for disinfection that is diluted with water (ethanol diluted with water to about 75% volume). When cleaning a roller, use ethanol further diluted with water.
- (2) Do not immerse a roller into diluted ethanol for cleaning. (Otherwise, the roller may crack.)

**Assembly Procedure:**

- 1) Put the belt over the upper roller. In this case, check that the two screws at both ends of the roller shaft are not projecting from the shaft. (Make sure that the belt is in its slackest condition when the belt is looped over the upper and lower rollers.)
- 2) Pass the bottom roller through the belt to fix the roller to the acrylic column using the screw. In this case, do not force screwing in the screw (the one with the black head). Otherwise, the threads may be damaged. Carefully check the location of the threaded hole in the roller holder.
- 3) Link the bottom roller gear and the motor shaft gear using the timing belt.
- 4) Unscrew the two screws attached to the center part of the acrylic column, lower the metal cover to the bottom of the main unit, and fasten it with the screws.
- 5) Then attach the two acrylic panels to the column and fix them using the screws.
- 6) Next, adjust the belt tension. Pay special attention to electrical shock because this adjustment is made with the electrostatic generator in active condition. Follow the procedure below.
  - (1) Bring the discharge sphere into contact with the collecting bulb.
  - (2) Turn ON the controller's Power switch, turn the belt speed adjusting VR clockwise gradually, and then stop turning the VR at a position where the belt runs consistently at low speeds. In this case, if no whiz, or discharge tone is heard in the vicinity of the electrode, the electrostatic generator has not been serviced successfully.
  - (3) Here, maintaining the condition whereby the belt on the upper roller moves at the center of the roller, turn the two screws at both ends of the shaft clockwise little by little to eliminate slackening of the belt.
- 7) Return the VR to the original position and turn OFF the Power switch.
- 8) Reinstall the top half of the collecting bulb. This completes the assembly of the rollers and belt and belt tension adjustment.

**4. Preparing the Accessories and Examples of Experiments**

Three of the accessories: the simplified Hamilton flywheel, electric umbrella, and electrostatic rocket are included with the product in a semi-finished condition, and therefore they are to be completed by the customer who has bought the product. Finish and assemble these accessories following the instructions below and utilize them in experiments.

1. Simplified Hamilton Flywheel

Preparation and experiment:

The six discharge needles of the flywheel have not yet been bent. As shown in Fig. 15, bend the needles at a point about 40 mm from the tip of one needle by hand to complete them.

Conduct experiments with the needle bending position or bending angle changed to see how the rotation of the flywheel varies.



Fig. 15 Bending the Discharge Needles

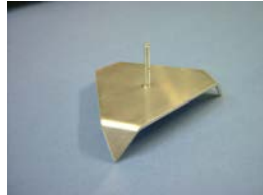


Fig. 16 Hamilton Flywheel Supporting Base

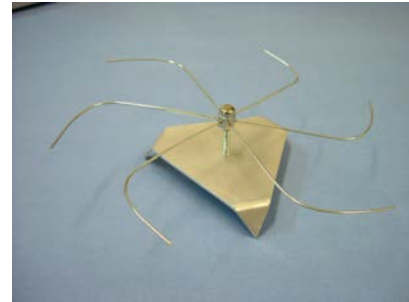


Fig. 17 Completed Simplified Hamilton Flywheel

Use the Hamilton flywheel by placing it on top of the collecting bulb as shown in Fig. 18. In this case, if the legs of the supporting base do not sit on the bulb successfully, re-bend the legs of the base (tips of the regular triangle-shaped aluminum base) to a suitable angle using pliers. It is recommendable to wind a PVC tape around the tips of a tool, such as a pair of long-nose pliers, (the areas pinching the workpiece) to bend a leg. This allows you to finish the workpiece without damage.

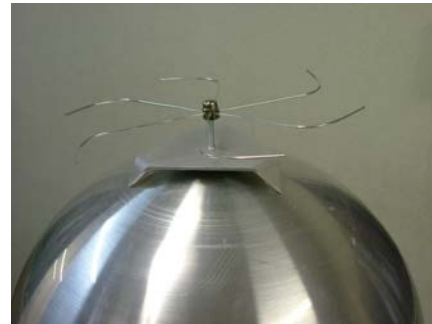


Fig. 18 Simplified Hamilton Flywheel Sitting on the Collecting Bulb

## 2. Electric Umbrella

There is a 50-mm white PVC disk with a black O-ring to which eight approx. 90-mm long polypropylene strings are bonded. Separate these eight polypropylene strings into pieces using a pinholder or metal comb (see Fig. 19) to complete the electric umbrella. When separating a string into pieces, do not excessively separate it. Otherwise, it will break into pieces, resulting in many lost polypropylene pieces. The electric umbrella is used by placing it on top of the collecting bulb as shown in Fig. 20. In this case, run the belt at low speeds. Otherwise, the umbrella may jump up and slips off the bulb when the belt speed increases. You may fasten it using Scotch tape or PVC tape to prevent it from slipping.



Fig. 19 Completed Electric Umbrella



Fig. 20 Electric Umbrella Sitting on the Collecting Bulb

### 3. Electrostatic Rocket

Cut out a rocket pattern with the blue logo mark and one with the red logo mark from the electrostatic rocket paper pattern provided with the product. Cut a notch along the 30-mm black line on each rocket pattern using a cutter, etc. Then, match the notched lines of these two rocket patterns by sliding one over the other, and then bond the contact areas using woodworking adhesive or Scotch tape to complete the paper rocket as shown in Fig. 21.

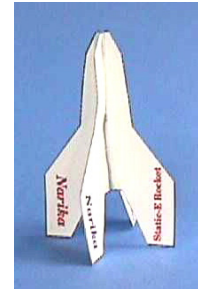
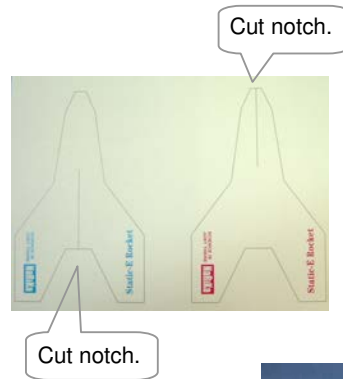


Fig. 21 Electrostatic Rocket

#### Experiment:

First, turn OFF the speed controller's Power switch and turn the speed adjusting VR fully clockwise (to a position where the belt moving speed is maximized). Then place the rocket on top of the collecting bulb as shown in Fig. 22. Turn ON the Power switch. After a short period, the rocket will jump up.



Fig. 22 Electrostatic Rocket Placed on the Collecting Bulb

### 4. Three-colored Fluorescent Tube

The fluorescent tube provided with the product is an 8-Watt fluorescent tube to which three fluorescent paintings of green, red, and blue have been coated in the longitudinal direction. With the belt moving at the maximum speed, hold one end of the fluorescent lamp and slowly bring the other end to the collecting bulb. This causes the lamp to light up. In this case, always hold the lamp with your right hand.

#### **Caution:**

A person who has a weak heart, or an implanted heart pacemaker, or who is in poor physical condition must not conduct these experiments. Never force unwilling participants to conduct this experiment.

- Experiment of raising one's hair requires an insulating stool. Your hair will not be raised in the condition where static electricity flows to the floor through your legs.
- For the fluorescent lamp lighting experiment, adjustment of the controller or turning the switch ON/OFF must be performed by anyone other than the person conducting the experiment holding the fluorescent lamp. Otherwise, an electric shock may be caused during operation of the switch because static electricity accumulates in the person conducting the experiment.