

## Spark detector for alpha particles 512110

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AE 512110



### Description

The spark detector can be viewed as a Geiger-Muller tube with atmospheric air instead of the diluted quenching gas in the tube.

The detector has a set of electrodes with sharp edges. Between the electrodes there is a strong electric field, which will trigger a spark if the air is ionized by a passing alpha particle.

The detector must be connected to a high voltage supply. The normal operating voltage lies between 2 and 5 kV. The voltage must be kept below 7 kV.

The spark detector can be placed on the table or mounted in a stand by means of the provided threaded steel rod.

### Safety

It is strongly recommended to use a power supply with a current limiter. Frederiksen's 366060/367060 supply up to 6 kV with its output current limited to 2 mA.

In order to produce powerful sparks, the detector contains a capacitor that is charged by the high voltage supply. Fully charged, this capacitor is capable of delivering dangerous electric shocks, so a number of measures have been taken to eliminate the risk.

At any rate, do follow the directions given below, in case you need to open the detector:

Remove the cables from the sockets of the detector. Short circuit the two connectors with a short cable. The enclosure may now be opened.



Connect only the detector to a power supply when the box is fully assembled. **Don't ever** connect the supply to the printed circuit board with crocodile clips or the like – **it is highly dangerous.**



The electrodes are razor sharp – take care of your fingers.

Don't insert metal object or other hard objects into the opening at the end of the detector.

## Directions for use

Connect the detector to the high voltage supply and turn the voltage up slowly. You will reach a point where sparks spontaneously start to jump between the electrodes – turn the voltage slightly down from here until the sparking stops again. The detector is now ready for use.

Bring an alpha source close (20 mm) to the electrodes – the radiation triggers sparks between the electrodes.

## Determining the range and energy of alpha particles

This experiment is described here using our bench for experiments with radioactivity (5141.00) and the alpha source from Risø. If another source or other stand material is used, this description can still be used as a starting point.

First, we find the zero point of the scale.

The radioactive material inside the source is placed approx. 3.5 mm from the front of the black source holder with the source fully screwed into the holder.

The distance from the spark gap in the detector to the edge of the plastic housing must be measured due to tolerances in the chassis. In the following example, we use the value 7.5 mm.

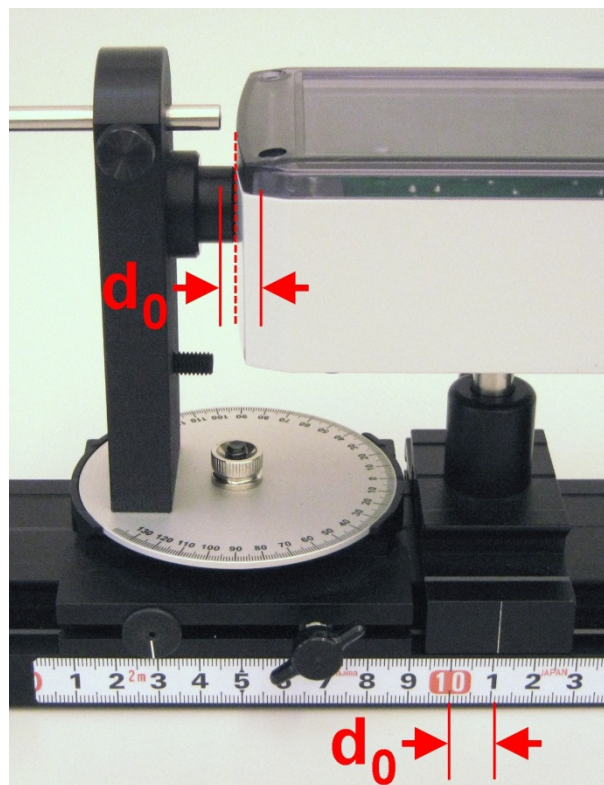
Using these numbers, the combined “internal” distance is 3.5 mm + 7.5 mm = 11.0 mm. The sliding saddle that carries the spark detector is now to be placed at the 10 cm + 11.0 mm = 11.10 cm mark on the measuring tape.

Next, slide the source holder towards the detector until the edges of the detector and source holder has zero distance. (The source holder can reach a little into the hole in the detector, so they should not just be pushed as far together as they can get.) Tighten the finger screw on the source holder to keep it at the current position. Now the distance between the source and the spark gap is precisely the reading of the measuring tape minus 10 cm.

The detector can for instance be used to determine the range of alpha particles in air. Contrary to a Geiger tube, the spark detector doesn't have a window that decelerates the alpha particles. Use a plastic ruler or similar to measure the distance to the electrodes – not anything hard or electrically conductive.

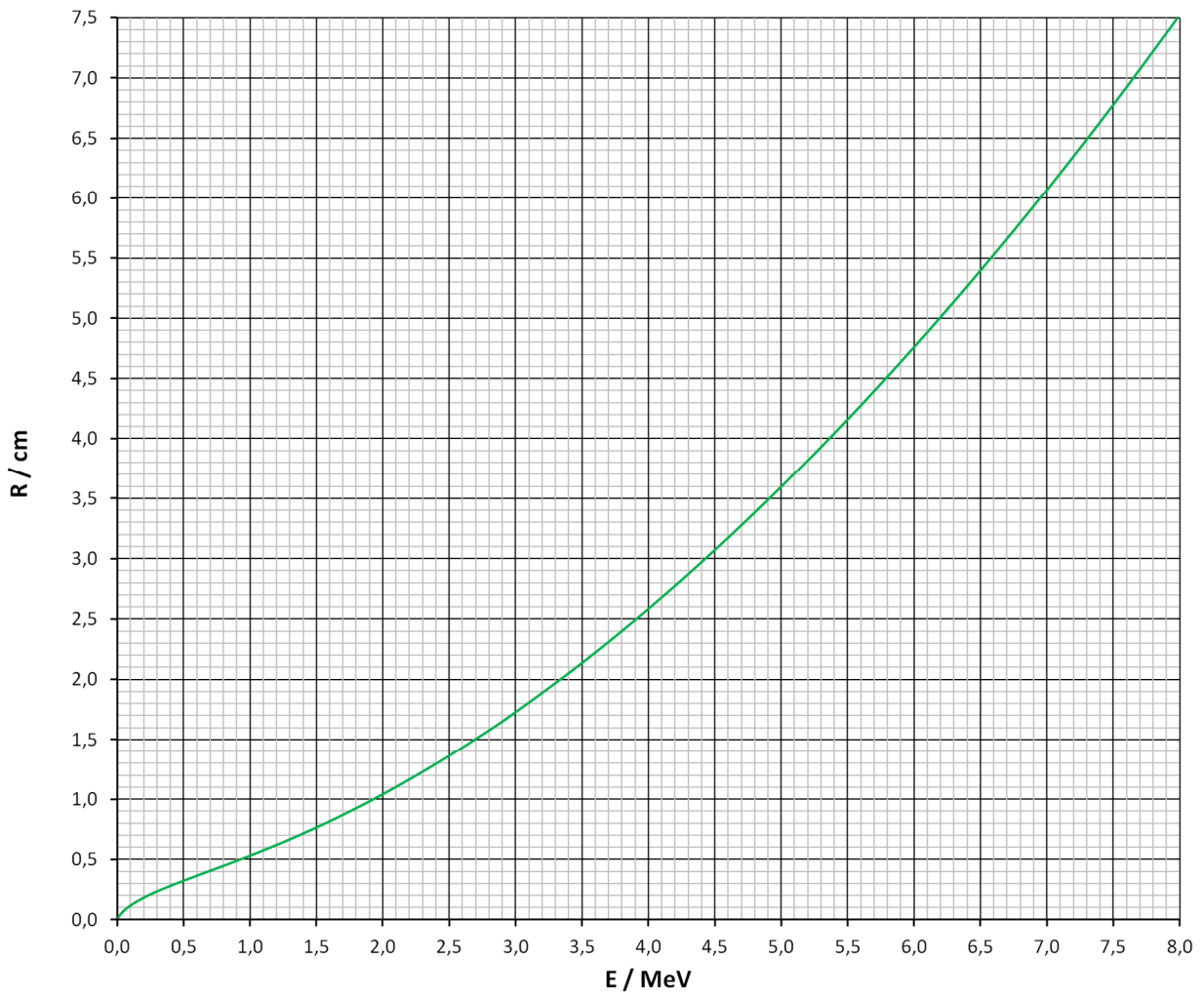
Certain minerals are radioactive and emit alpha particles to the extent that it can be detected with this detector.

Increase the distance between the source and the detector until the very point where the alpha particles are no longer detected. Determine the position as precisely as possible by sliding the detector a little bit back and forth.



The graph below can be used for determining the kinetic energy of the alpha particles based on their range in air. (The graph is valid for dry atmospheric air at room temperature and standard barometric pressure.)

### Alpha particle mean range in air



## Replacing and adjusting the electrodes

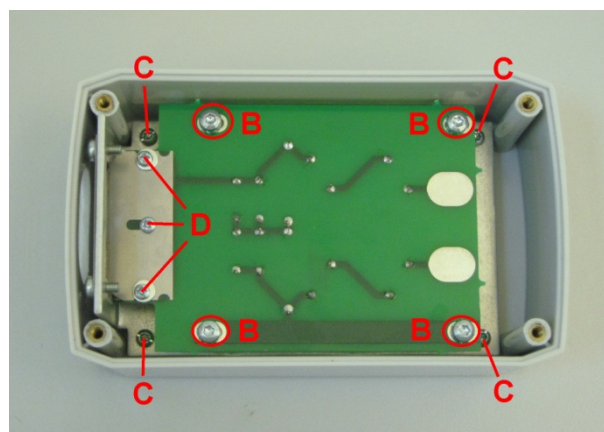
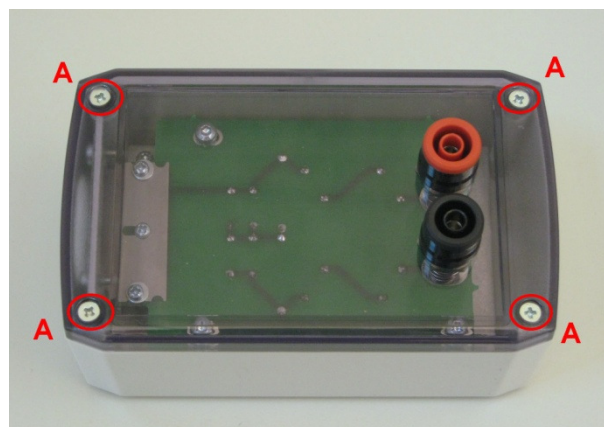
The sharp electrodes are exposed to a very aggressive action from the sparks and will corrode over time. A new set of electrodes has item number 512111.

If the electrodes need to be replaced or adjusted:  
**Read the paragraph on safety before you start.**

The enclosure is opened by removing the four screws A in the corners of the top part.

The back electrode: Loosen the four screws B in the corners of the printed circuit board. The PCB and the electrode can now be displaced a little. When replacing the back electrode, shift the PCB as far back as possible. The screws D, holding the back electrode, must be handled gently as they are screwed directly into the PCB. Subsequently, the position is adjusted until the edge is just inside the front electrodes.

The front electrodes: It is necessary to remove the enclosure from the chassis; it is fixed by the four screws C in the bottom. Replace one of the razor blades at a time and use a plastic plate or similar with a suitable thickness to keep them parallel. A distance of 1.6 mm is fine.



## Compatible equipment and accessories

- 367060 6 kV power supply (or equiv.)
- 514100 Bench for experiments with radioactivity
- 510010 Alpha source, Risø Am-241, 37 kBq
- 510040 Holder for radioactive sources (room for three)
- 510505 Americium source, Am-241, 3.7 kBq
- 510510 Storage holder for 510505
- 670255 Radioactive stones
- 512111 Spare electrodes for 512110