Diffusion Cloud Chamber Manual

(Model 500 and 600)

Includes the following:

Cloud Chamber
12V DC Power Supply and Cable
Water Circulation Pump
2 Rubber Hoses
Extraction Pipette
Source Holder and Stopper
High Voltage Connecting Cable
Coupon for Pb 210 Source Needle redeemable from Spectech™

Operating Principle

The bottom of the chamber is cooled to approximately -35°C or colder. Alcohol placed in the chamber wicks up the inside chamber lining where it evaporates in the warmer region of the chamber and diffuses downward. Alcohol vapor is cooled near the chamber bottom and becomes super-saturated.

This super-saturated region is highly unstable. As energetic α (alpha) and β (beta) particles are emitted from the radioactive source, ions are produced which serve as nuclei for the vapor to condense on. These droplets of condensation appear in the strong cross-lighting as tracks.

The dense straight tracks are produced by α and other massive charged particles, while the β particles produce faint and often crooked tracks. In addition, γ (gamma) rays interact with gas molecules to produce energetic photo electrons, Compton electrons, and positive and negative electron pairs. These electrons produce tracks identical to β tracks.

Excess ions produced by background radiation and other natural sources can interfere in the display of the particle tracks. A high-voltage supply (~800 Volts†), when connected to the brass source holder, creates a clearing field between it and the base, removing the unwanted ions.

†High voltage is protected by a resistance of 10^8 Ω for your safety!

Instructions

1. Adjust the chamber liner, if necessary, so it touches the bottom of the chamber and all LEDs are visible. Pour 30-40mL of ethyl, methyl, or isopropyl alcohol (90% or higher purity recommended) into the chamber. The pipette can be used to wet the wall liner to speed up the initial wicking process. After the liner is saturated, there should still be about 2 mm of alcohol on the bottom of the chamber.
2. Place the source rod with stopper into the hole in the viewing window. Adjust the rod up or down so that the position of the needle's eye is about 1.5 to 2 cm above the surface of the alcohol.

3. Connect the two rubber hoses to the cloud chamber. Depending on your situation, follow one of the two methods below:

A. Using Ice Water (preferred method)

Connect one hose to the included circulation pump and place it on the bottom of an ice chest (not provided). The second hose should drain back into the chest. Add just enough water to cover the pump inlet. Shake the pump up and down in the water to expel air from the impeller. Fill the ice chest with approximately 1 kg of ice per hour of operation.

Connect the pump to AC power. If water does not start flowing, you may need to re-prime the pump as described above or by sucking on the drain hose.

> **Notice!** During shipment and/or handling, the impeller housing may come loose and the pump will not work. If this occurs, remove the inlet cover (lower portion of the pump) and press the impeller housing firmly back in place. Replace the inlet cover.

B. Using Cold Tap Water

If your tap water is 10°C or colder, connect one hose to the water tap and let the other hose drain into a sink or waste line. Start a flow of water of approximately 1/2 to 1 liter per minute. The colder the water is, the better it will work!

> ***Warning!***
> *The cloud chamber may be permanently damaged if it is not cooled sufficiently with a steady flow of cold water! If, for any reason, the circulation of water should stop, or the water warms up above 40°C, unplug the power to the cloud chamber immediately!!*

4. Now connect the 12V power supply to the cloud chamber and then connect the power supply to AC power. The LED cross-lights in the chamber should turn on and cooling should begin. In about 15-30 minutes, the first tracks should appear. Tracks are best observed if room lighting is dimmed or the chamber is shielded from exposure to overhead lights.

5. When finished, unplug the 12V power supply from the AC power. To prevent water from freezing and damaging the heat exchanger, continue to circulate water through the cloud chamber for 5 minutes, or immediately drain the water from the heat exchanger.

Notes On Operation

1. To observe radioactivity from other sources such as cosmic rays or background radiation, remove the needle source and store it in the tube it was shipped in. Insert the other brass rod and stopper into the viewing window and connect the high voltage cable to it. Tracks will be observed less frequently than with the needle source. A γ source can be placed on the observation window or near the chamber to produce electron tracks as described under Operating Principle.

2. If at some point you observe a continuous stream of condensation emanating from a single spot on the brass rod or needle source, remove the rod/needle and very gently wipe the spot clean with a soft cloth. Lint or dust on the rod/needle can cause ions to be produced due to the high voltage of the clearing field.

3. Particle tracks may stop showing if condensation builds up on the source needle. If this occurs, remove the source and gently wipe it clean with a soft cloth.

Care and Maintenance

When storing the cloud chamber, always remove all alcohol from the chamber, and remove all water from the heat exchanger.

When moving or transporting the cloud chamber, never pick up or move the apparatus by the chamber, but

always lift or move the unit by the base (metal housing).

Warranty

The cloud chamber is warranted by AU Physics Enterprises for a period of one year from date of purchase. This warranty covers any defects in workmanship or materials. It does not cover accidental damage, damage as a result of operator error, negligence, or abuse.

The included 12V DC power supply is warranted for one year by the manufacturer provided that the registration card is completed and returned in a timely manner.

Liability

This product has been designed for educational demonstration purposes and for use with exempt quantity radioactive sources only! Use in research, medical, commercial, or industrial applications is prohibited. Any use of this product outside of its intended purpose is done so at the risk of the end user, who shall assume full liability, and fully indemnify A.U. Physics Enterprises and its agents, for any and all damages resulting from such prohibited use.

About A.U. Physics Enterprises

Started in 1977 by Bruce Lee, of the Andrews University Physics Department, Physics Enterprises began as a way to bring affordable teaching equipment to colleges and high schools at a time when most demonstration tools and lab equipment were very expensive or had to be hand-made. Now, over 25 years later, the business continues to provide quality affordable equipment that is used world-wide in all levels of education!

Even more important, proceeds from the business are put right back into the educational system! Whether it is purchasing new scientific instruments and equipment, or providing scholarships and grants, A.U. Physics Enterprises is dedicated to the continuing education of tomorrow's scientists and teachers!

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