# RANK BROTHERS MICROELECTROPHORESIS APPARATUS MK II

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# PHYSICAL AND BIOLOGICAL APPLICATIONS

The term electrophoresis refers to the motion of a charged particle when an electric field is applied. When the velocity of the particle is measured, by timing over a known distance, it is possible to calculate the electrical potential at the surface of shear between the particle and the surrounding medium and from this the electric charge contained within the surface of shear. When the particle is in a relatively charge free medium, such as air or a low dielectric constant liquid, it becomes convenient to calculate the charge directly, but then careful consideration must be given to whether the charge is an equilibrium property of the particle or whether it is an accidental property determined by the history of the particle and what it happens to have collided with. However in aqueous solution or in liquids of all but the lowest dielectric constant the surface potential and charge of a particle is a reproducible quantity which gives valuable information both on the way the particle can interact with other particles or surfaces and also on the nature of the particle surface. In the latter respect it is noteworthy that only a few particles, and therefore a minute surface area, are necessary for the measurement.

So far as inter-particle behaviour is concerned the electric charge is one of the most important factors leading to stability of a dispersion against flocculation, coagulation or adhesion to surfaces. In all technologies involving dispersions or suspensions, whether these are required to be flocculated or de-flocculated, a knowledge of the particle charge and/or potential is a necessary pre-requisite to prediction of the behaviour of the system, either alone or in presence of additives.

Increasing use is being made of measurements of the electrophoretic mobility of the various particles present in blood to help predict and prevent clotting of the blood and its adhesion to the walls of both natural and artificial blood vessels.

Quite apart from using electrophoretic mobilities to explain or predict the behaviour of particles or surface coatings, such measurements can be used as an aid to identifying the chemical groupings present at the particle surface, for example the variation of particle surface charge with variations of pH of aqueous solutions gives important information on the dissociation of surface acidic and basic groups and can be used to identify them. Alternatively, in complex biological systems, the mobilities of the various particles present (which to some extent can be obtained without separation) can be used to identify these particles and may be characteristic of pathological conditions. In this connection it should be remembered that electrophoretic mobilities are most susceptable to change in conditions, and therefore most characteristic of the particles, when they (the mobilities) are small. Conditions such as pH can often be adjusted to achieve this.

# CAPABILITIES OF THE RANK BROS MARK II ELECTROPHORESIS APPARATUS

This apparatus can be used whenever the particles can be made visible relative to the suspending medium. Such visibility depends apart from the intensity of the illumination and effiency of the viewing optics, on the size of the particles and on the ratio of the particle refractive index to that of the surrounding medium. Using the quartz-iodine illumination unit of the standard instrument test aqueous dispersion of polystyrene particles, which have a rather unfavourable refractive ratio ($\sim$1.1), have been shown to be visible down to a diameter of about 0.2$\mu$m. Particles with a more favourable refractive index ratio, e.g. carbon particles, can be seen down to much smaller sizes but it is difficult to give any precise limit in cases where monodisperse suspensions cannot be prepared.

## Lower Limit of Particle Size

One effective means of lowering the limit of particle visibility is use of a laser illuminator. Even a 3mW He: Ne continuous laser can concentrate more illumination into the observed volume than the 100 watt conventional illuminator, and polystyrene particles of diameter only ·09 $\mu$m become visible. It must be remembered however that the necessary illumination power goes up very sharply as the size of the particles decreases below the figures quoted. RANK BROS. are pleased to perform free trials of particle visibility on samples sent to them by prospective purchasers of the apparatus.

The cylindrical cell, with extremely thin walls and ultra microscope illumination, is especially suitable when very small particles are involved.

## Upper Limit of Particle Size

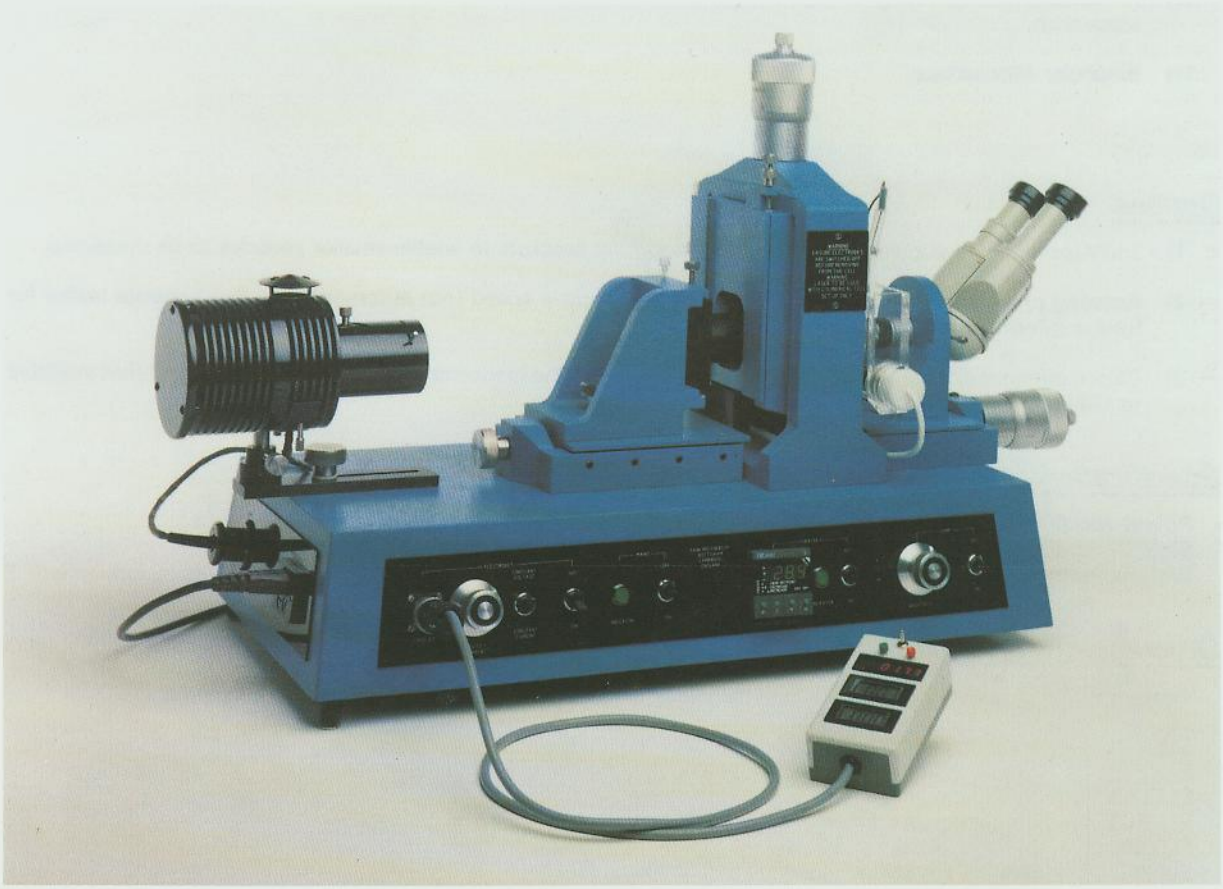
There is obviously no upper limit of particle size so far as visibility is concerned, the effective limit being set by the rate of gravitational fall or rise in the dispersion medium concerned. The flat cell is especially useful here because sedimenting particles fall neither out of view nor out of the 'stationary level'. Moreover provided the rectangular cross section of the flat cell has its major dimension vertical, the sediment collects on an electroosmotically unimportant surface so that measurements at the stationary level remain valid. The vertical gravitational component of the particles motion can quite properly be ignored while the horizontal electrophoretic component is measured. Since the field of view is about 500 $\mu$m across it follows that if times of vertical transit in excess of 20 sec are accepted, the upper useful limit of particle diameter in aqueous solution at 25°C with particle specific gravity 2·0, is about 20$\mu$. Particles with density nearer to that of water can be used up to much larger sizes.

The front cover picture shows the instrument set up for electrophoretic mobility measurements using pyrex cylindrical thin walled cell. Especially suitable for:-

(a) very small particles (ultra-microscope conventional or laser illumination)

(b) high electrolyte concentration (small cross section, giving small currents and little polarization)

(c) rapid thermostatting and freedom from convection currents



The above picture shows the instrument set up for use with flat cell, especially suitable for:-

(a) large particles (which remain in field of view and 'stationary layer' while sedimenting)

(b) low conductivity solvents (silica walls of high resistivity)

(c) applications requiring bright field or phase contrast illumination

## *Instrument details*

The Standard MK II Microelectrophoresis apparatus comes complete with the following:

1) Thermostatted water bath suitable for using cylindrical cell.
2) Thermostatted water bath suitable for using flat cell.
3) 100 watt Quartz iodide lamp illumination.
4) Constant voltage and constant current electrode supply (0-100V, 0-5mA approx.).
5) Circulating pump for water baths.
6) Temperature controller for water baths (ambient to 60 degrees Centigrade).
7) A flat cell and holder.
8) A cylindrical cell and holder.
9) A pair of Platinum electrodes.
10) A handset incorporating a digital voltmeter, ammeter (to monitor Electrode voltage and current) and stopwatch.
11) Binocular Microscope.

## *Options*

1) 3mW laser can be supplied complete with mounting brackets to enable smaller particles to be measured.
2) Rotating prism system enabling direct readout of particle speed (not automatically). See separate leaflet for further information.
3) Closed circuit monochrome TV system, used instead of the binocular microscope to aid operator (not available to USA).

## *Specification*

**Power requirements:** 110V, 220V or 240V 50/60Hz approx. 400VA (Voltage factory set)
**Size:** W 80, D 30, H 54 cms approx.
**Weight:** 40 kgs approx.

## *Ordering information*

Please specify supply voltage required for first four items.

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| ELEMK2 | — Microelectrophoresis Apparatus MK II |
| ELETVS | — Monochrome TV system for MK II |
| ELELA3 | — 3mW Laser and mounts |
| ELEROT | — Rotating prism system |
| ELE2RC | — Cylindrical cell for MK II |
| ELE2FC | — Flat cell for MK II |
| ELE2QI | — Quartz iodide bulb for MK II |
| ELE2PL | — Pair of Platinum electrodes |
| ELE2PA | — Pair of Palladium electrodes |