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by Michael Brush

TECHNOLOGY PROFILE

Laid Out Flat: Mini Horizontal Electrophoresis Devices

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Horizontal Gel Apparatus

One needs only a glimpse of the total number of horizontal submarine electrophoresis devices currently on the market to understand the importance of electrophoresis to the life scientist. This importance has spawned a vast market with many players striving diligently to find niches as successful manufacturers and suppliers. The resulting competition has produced a bevy of electrophoretic systems and devices, some with a few clever and unique characteristics.

In this profile, LabConsumer rounds up a small herd of mini-horizontal electrophoresis systems. Offering faster run times and less reagent consumption than their larger cousins, the minigel devices profiled here represent a small subset of the raft of available electrophoresis units. For the most part, when selecting the equipment featured here, LabConsumer relied on the manufacturers' designations of the size status of their products.

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Generally, the mini-horizontal devices run gels ranging from 50 to 150 cm^2, with gels near 70 cm^2 being the most common size.

The process of casting agarose gels constitutes a large part of the operation of mini-horizontal gel devices. Two casting strategies are prevalent. The first involves the use of a casting tray independent of the buffer chamber so that gels can be cast and run simultaneously. The second uses wedges or dams to form a gel mold directly inside the buffer chamber. This method has the advantage of reducing the number of system components required to pour and run a gel. Indeed, some of these devices include storage compartments for the wedges and combs so that the entire device becomes a self-contained unit. Personal preference and frequency of gel use are probably the most likely reasons to choose one method over the other.

Practically all of the minigel devices use a UV-transparent gel tray sealed in some temporary fashion at gel-pouring time. Designed to eliminate the use of tape, the seals run the gamut from tapered baffles to neoprene rubber dams, with one system using frozen aluminum bars to solidify molten agarose on contact.

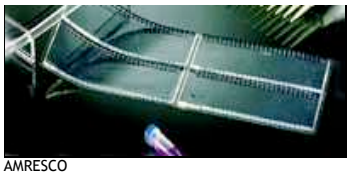
Sample-well-forming combs create one or two preparative wells to as many as 120 sample wells. A few companies offer combs with microtiter plate spacing. List prices for the minigel devices ran from a low of $90 for the smallest Bare Bones Horizontal system from R. Shadel, Inc., to a high of $1,550 for the automated SEA 2000 from AMRESCO.

Pushing the fast running characteristics of minigels to their limits, the new RAGE® (Rapid Agarose Gel Electrophoresis) devices from **Cascade Biologics**, run minigels in 10 minutes or less according to company literature. Employing patented direct water cooling technology that places a reservoir of distilled water directly over the gel, the easy-to-use RAGE devices enable faster run times by reducing heat generation and increasing heat absorption in the system. The combination permits the use of higher voltages and, consequently, faster run times. All this is made possible by the unique construction of the RAGE devices, where the gel forms a barrier between the running buffer chambers and its overlying cooling water reservoir.

The speedy nature of the RAGE devices has been improved with the recent introduction of a new gel tray for the RGX-60, the smaller of the two RAGE devices. This gel tray accommodates Reliant® Ready-To-Use precast agarose gels from FMC BioProducts, eliminating the time required for gel pouring. An additional new gel tray designed for the larger RGX-100 device accepts four combs, creating enough wells for 96 samples and 8 standards on a single gel. The RGX-100 resolves these samples in 6 minutes or less.

A well-thought-out selection of combs, all of which are compatible with multi-channel pipettors, is available for both RAGE models. Most of these combs are available in 2 different thicknesses, allowing for greater flexibility in loading volume and resolution.

AMRESCO, distributes the SEA 2000 submarine electrophoresis apparatus and a


AMRESCO

battalion of 55 different precast gels manufactured by Guest Elchrom Scientific AG of Switzerland. The SEA 2000 is an advanced device engineered with innovative features. These include electrodes positioned in the same plane as the gel to provide a uniform electric field, a built-in buffer recirculation pump, and a heat exchange element in contact with the gel and running buffer. An optional temperature probe, used in conjunction with a constant-temperature circulating water bath, maintains running temperatures to within 0.5°C. The water bath, temperature probe and programmable power supplies are also available.

The SEA 2000 runs three minigels or one wide minigel and includes gel casting accessories as an option. Its real strength, however, comes from Elchrom's long line of precast gels. First of all, Elchrom's Spreadex™ gels offer superior resolving power. This is achieved partly due to the novel "Exclusion Limit" in each type of gel, which limits the size of the fragments that migrate from the well into the gel. These gels can resolve DNA bands differing by 4 base pairs on a 4 cm gel and by 1 bp on an 8 cm gel and can resolve bands up to 1,200 bp overall. Elchrom's second type of precast gels, called Poly(NAT)™, consists of a nontoxic monomer derived from tris(hydroxymethyl)-aminomethane, a common buffer compound. Chemically similar to acrylamide, Poly(NAT) gels provide high resolution, capable of 1 to 2% resolution in the 100 to 2000 bp size range.

AMRESCO sells these gels in three concentrations designed to resolve fragments ranging from 10 to 20,000 bp. Finally, the optically clear Clearose™ BG gels are composed of agarose cross-linked with butanediol diglycidylene. Tough and elastic, Clearose BG gels are the first reusable precast gels available. At the completion of an experiment, the DNA bands are driven out of the gel by reversing the gel in the electric field and running it for 10 minutes longer than the original sample resolution run. The gels can then be reloaded with new samples and used again. Because Clearose BG does not melt at 100°C, DNA bands are easily recovered by diffusion at 70 to 75°C.

These precast gels are available in mini (9.2 x 6.2 x 0.3 cm) and wide mini (25.7 x 9.2 x 0.3 cm) formats with up to 100 sample wells. While designed to function in other gel devices, they perform best in the SEA 2000.


Embi Tech Run One

Four companies offer all-in-one horizontal systems complete with dedicated, mini power supplies and independent casting trays for preparing up to six gels. Three of the four systems handle both agarose and polyacrylamide gels. The RunOne Electrophoresis System from **Embi Tec** is representative of the four. Its casting tray consists of six molded compartments for four mini (5.2 x 5.9 cm) and two mini wide (10.7 x 5.9 cm) gels

and includes gel covers for casting polyacrylamide gels. Overall, the casting tray has the flexibility to cast up to six gels, including a mixture of agarose and acrylamide gels, simultaneously. Extra gels are readily stored in the refrigerator. The available combs form 6 or 8 wells in the minigels and 12 or 17 wells in the mini wide gels.

Two minigels or one wide gel can be run in the RunOne Electrophoresis Cell. The RunOne Power Supply slides right into the running unit, supplying 25, 50, or 100 volts of output, and the Electrophoresis Cell's vented lid eliminates condensation for improved visibility. Additionally, Embi Tec offers precast acrylamice gels for resolving DNA f ragments from 40 to 2,000 base pairs, as well as over 100 different precast agarose and acrylamide gels.

Operating in a similar fashion with many of the same features and benefits as the RunOne system, are the Mupid-21 Mini-Gel Electrophoresis Unit, manufactured by Nihonbashi Kobuna (Tokyo) and distributed in this country by **DNA Technologies** and **EY Laboratories,** and the Joule Box Minigel Electrophoresis System from Stratagene. The Mupic-21 casts six agarose and/or acrylamide gels and include a 50/100 volt power supply. Both systems, as well, have the capability of resolving nucleic acids and proteins. Look for Stratagene to introduce VisiGel precast gels for the Joule Box soon. VisiGels consist of a novel gel matrix developed for the resolution of nucleic acid fragments.

The all-in-one Pico-2 System from **TAITEC Instruments USA, Inc**., has been designed for agarose gels only. Its gel-maker component forms five gels in three different sizes using UV-transparent gel trays; in fact, the Pico-2 is the only all-in-one systems to provide UV-transparent components. The power supply generates 80 or 120 volts.

Amersham Pharmacia Biotech offers two automated horizontal gel systems. The first, the GenePhor DNA Electrophoresis Unit, brings maximized separation and reproducibility to advanced DNA analysis techniques such as SSCP, VNTR, RAPD, and DDRT. The GenePhor uses precast 12.5 and 15% acrylamide gels placed onto a compact, temperature-controlled, flatbed electrophoresis unit equipped with a Peltier heating and cooling system. DNA bands are visualized by silver staining technology provided by the Hoefer Automated Gel Stainer.

The PhastSystem automatically separates and stains proteins and nucleic acids resolved on 43 x 50 x 0.45 mm precast polyacrylamide gels cast on a Gelbond film backing. A variety of gel formulations are available, including homogeneous, gradient, and IEF gels. The PhastSystem consists of a separation-control unit for system control and electrophoresis and a development unit for staining. The latter unit runs Coomassie Blue and silver staining procedures.

Not to be ignored or forgotten, here are brief profiles of 38 more horizontal minigel devices from 20 companies.


Ambion

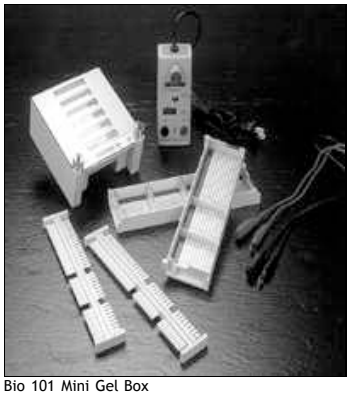
Ambion
Ambion's Horizontal Gel Electrophoresis Apparatus features a casting tray with adjustable rubber end caps that enable the formation of gels from 3 to 12 cm in

length. With positions for up to four sample-well combs and 40 wells, this system provides plenty of versatility. Gels for rapid analysis of restriction digests or high-resolution applications such as Northern or Southern blots can be readily prepared.

Amersham Pharmacia Biotech
In addition to its automated systems mentioned earlier, Amersham Pharmacia Biotech sells two traditional mini-horizontal systems. The Hoefer HE 33 Mini Submarine Electrophoresis Unit runs a 7 x 10 cm gel in less than 20 minutes using a unique coolant-filled base. The HE 33's hollow, molded base holds 500 ml of a 50 percent ethylene glycol solution. Refrigerating or freezing the base unit provides passive cooling during electrophoresis, enabling faster runs.


Hoefer HE 33

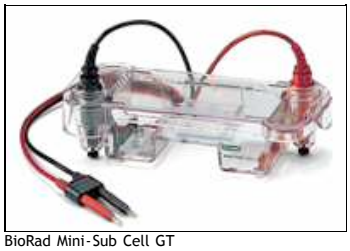
The GNA 100 Submarine Electrophoresis Unit features two casting trays for forming 7.5 cm wide gels that are 5 or 10 cm long. The GNA 100 also has a UV- transparent lid for monitoring the progress of separations with a hand-held UV light.


Bio 101 Mini Gel Box

Bio 101
The Mini Gel Box from Bio 101 is constructed in one piece using automated manufacturing methods, producing an economical unit free of leaks sprouting from faulty glue lines. Stackable UV-transparent trays are used for gel casting without tape or dams; several gels may be poured and stacked at one time using the EZ-Pour Gel Condo. Bio 101's patented 4-in-1 Paddlewheel™ comb offers a choice of four sample-well configurations.

The Blot-o-matic Mini/Midi Electrophoresis and Blotting System uses a gel casting system with spaces to form three agarose gels, each in a separate tray. This system forms two minigels (5 x 8.3 cm) and one midigel (10.5 x 8.3 cm) with 6 or 8 and 13 or 17 sample wells, respectively. The gel box runs either the minigels or the midigel and relies on the Programmable Midi Power Supply sold separately.

Bio-Rad Laboratories
Members of Bio-Rad's family of SubCell electrophoresis units, the Mini-Sub Cell GT and the Wide Mini-Sub Cell GT feature


BioRad Mini-Sub Cell GT

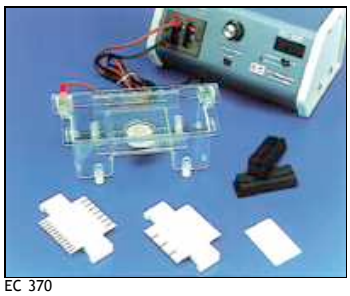
injection molded polycarbonate construction. UV-transparent gel trays are thicker than most with built-in fluorescent rulers. Gel casting gates in the unit and the external Mini Gel Caster have been designed to provide flexibility in gel preparation. Other features touted for these units include easy to change electrode cartridges, gel depth indicators and smoothly releasing safety lids. The Mini-Sub GT has performed separation of small DNA fragments in 15 minutes at 150 volts, and the Wide Mini-Sub GT has been designed for rapid screening applications of multiple samples.


CBS MGU-100T

C.B.S. Scientific Company
C.B.S. Scientific offers two horizontal minigel systems: the MGU-100T and the MGU-200T. The MGU-200T runs a slightly larger gel than the MGU-100T, but both units employ tapered baffles for casting gels inside the running unit. Each unit also features storage slots for the baffles when they aren't needed. Gel casting support trays for pouring one, three, or six gels are also available. Additionally, these units feature optional hinged Flip-Lid safety covers designed for smooth opening to prevent sample disturbance. And to brighten up that bleak lab environment, the MGU-200T is available in a choice of three fluorescent colors: yellow, green, and pink.

C.B.S. Scientific also sells the British Mini-Gel System, which is one of the most popular minigel devices used in the United Kingdom. Its 8 x 10 cm gels are easily poured by inserting the necessary dams and combs into grooves positioned in the body of the unit.

Crescent Chemical Company
Crescent Chemical distributes the AE-6100 Agarose EP Kit manufactured by ATTO Corporation of Tokyo, Japan. This compact unit runs an 8 x 10 cm gel with a choice of 1, 6, 10, or 16 sample wells.

E-C Apparatus

EC 370

The EC370 Minicell™ from E-C Apparatus has been designed with several minor improvements that, when combined, become significant to the unit's overall operation. To begin with, the Minicell runs an 8.2 x 6.5 cm gel on a UV-transparent gel tray featuring a fluorescent ruler and fill lines. These lines facilitate the reproducible pouring of uniform-thickness gels, and inclusion of the ruler eliminates the need to purchase a separate one. Seals on the gel tray are formed by easy-to-use, leak-free end blocks. One of the few minigel devices equipped with a built-in level and leveling feet for added consistency of operation, the Minicell's injection-molded construction provides for years of leak-free operation. The system also includes a

safety interlock lid and two unique depth and leveling gauges used to ensure correct comb positioning.

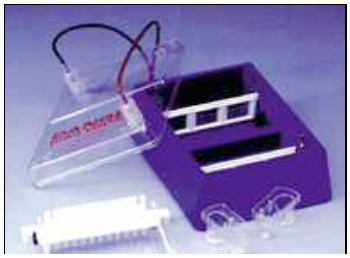
Fisher Scientific
The FisherBiotech Horizontal Electrophoresis Minigel System uses a gasket-sided gel tray for casting its 7 x 10 cm gels. Here, the UV-transparent gel tray is pushed into position inside a heavy-duty buffer chamber before the melted agarose is poured in. After the gel has solidified, the tray is simply lifted out, rotated 90 degrees, and placed back into the chamber. This system runs up to 24 samples.


Fotodyne Mini Single Cell

Fotodyne
Fotodyne's Mini Single and Mini Dual Cell Electrophoresis Chambers have been designed to run one or two 7.1 x 9.3 cm gels, respectively. Both units use UV-transparent, "no-tape" gel trays equipped with self-sealing, adjustable, leak-proof gates. The trays feature notches for positive placement of two combs. The two chambers are supplied with the appropriate number of 6-, 8-, 10-, and 12-well forming combs and casting trays. Lastly, the Mini Dual Cell Chamber comes supplied with acrylic centering blocks used for running single gels.

Idea Scientific
The Mini-Chameleon Submarine Gel from Idea Scientific has some unique features. Its most interesting one is the aluminum casting bar system. With this method, chilled aluminum bars taken from the freezer are placed against the end of the UV-transparent gel trays. When molten agarose contacts the chilled bars, it gels immediately, forming an instant seal. Multiple 7 x 10 cm gels are easily poured simultaneously by positioning the gel trays end to end with a single chilled bar in between each tray. Other features include positioning notches on the gel trays to prevent the gels from floating or sliding, an internal port for buffer recirculation on a stir plate, and vented covers. The vents also act as a guide for sample loading. Each tray includes an etched centimeter ruler that forms a ruler into each gel. A slightly larger 10 x 15 cm unit, the Chameleon has positions for up to five combs, allowing the formation of a maximum 120 sample wells with a 2.5 cm path length.


Idea Scientific Chameleon

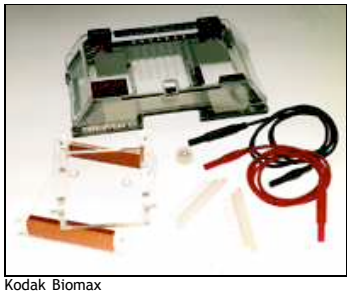


Isco
Isco's Little Blue Tank does a lot more than its name implies. Besides running a 9 x 10 cm gel, the Little Blue Tank functions as an electroelutor for


ISCO Little Blue Tank

the recovery of proteins and other macromolecules from gels. It also concentrates proteins, nucleic acids, certain whole cells and cell fragments, and other ionic macromolecules from solutions and suspensions. In the agarose gel casting department, the Little Blue Tank features neoprene casting dams that tolerate hot agarose poured directly from the microwave. This system includes combs for 12-well analytical and 3-lane preparative gels and features a UV-transparent tray with a fluorescing scale.

Kodak Scientific Imaging Systems


Kodak Biomax

Designed for the rapid separation of nucleic acids and electrophoresis procedures that do not require buffer recirculation, the BioMax QS 710 (Quick Screening 7 x 10 cm unit) includes a casting unit with a UV- transparent casting tray, two eight-tooth combs, power cords, a leveling bubble, and a manual. The dedicated casting unit casts gels without tape independently of the unit. The vented lid on the BioMax allows heat to escape, resulting in better resolution of fast runs andimproved visibility of the gels by reducing condensation. Its patented Gravity electrical connector increases user safety by disconnecting the power when the lid is removed.

Koh Development

Among the many electrophoresis systems designed and manufactured by Koh Development, Inc., four fit the mini-horizontal device description. All four use UV-transparent gel trays with end caps for gel casting. The Single Chamber Mini System runs a 9.5 x 10.5 cm gel. The larger Double Chamber Mini System accommodates a smaller gel (6.5 x 8 cm) but has a larger buffer capacity for better cooling of the gel during electrophoresis. These systems use combs with up to nine teeth.

The Wide Chamber Mini System drives an extra-wide 6.5 x 15 cm gel with room for up to 25 samples. For direct photography of the gels directly within the gel box, Koh has developed the new Direct Photo Electrophoresis Chambers. Built in two sizes for either a 5.1 x 10.2 cm gel or a 10.2 x 7.6 cm gel, these gel chambers feature a UV-transparent base and 9.5 mm thick acrylic walls for added protection from radioactive samples.

Koh Development also builds custom electrophoresis systems.

Life Technologies

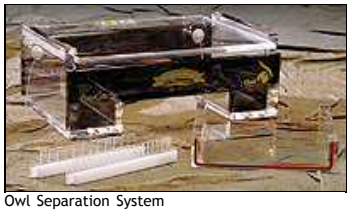
The Horizon 58 Horizontal Gel Electrophoresis Apparatus has been designed to cast, load, and run a 5.7 x 8.3 cm gel in as little as 30 minutes. Its patented drop-in dams and gel

Life Technologies Horizon

casting components withstand boiling agarose for rapid gel preparation. The unit also includes a removable buffer tray and gel deck with three visualization stripes and multiple comb slots. The Horizon 58 is part of a family of Horizon electrophoresis systems. Each system is composed of three primary components: the electrophoresis apparatus: an external, stand-alone casting system; and a blot transfer apparatus.

Medical Research Apparatus International
MRA International, an "Original Equipment Manufacturer" specializing in medical research equipment, manufactures two mini-horizontal systems. The first, the EG7010 Mini-Gel Horizontal System, is the company's most popular minigel system. This system includes a gel box with a hinged lid, four gel trays, a casting bed, two combs, cables, and proprietary "Snap-In" electrodes. These electrodes are removable to simplify cleaning.

MRA International's second unit is the EG8000 Mini-Wide Horizontal System. Billed as feature packed and value priced, the Mini-Wide System is constructed of plastic injection-molded components. The system includes the gel box, a vented lid, gel trays, a casting bed, combs, and power cables.


Owl Separation System

Owl Separation Systems
With six separate mini-horizontal devices, Owl Separation Systems has the widest selection of products in the profile. The three units belonging to Owl's family of EasyCast(Minigel Systems all use a proven, simple, in-place casting design. Here, a gasketed gel tray fits into the buffer chamber so that the gaskets form a seal against the chamber walls. After the agarose has solidified, the tray is removed and rotated 90 degrees into its running position. This design eliminates the need for additional equipment by casting and running gels in the same chamber.

All three EasyCast devices feature UV-transparent gel trays with fluorescent rulers, lane markers, and two comb positions. The individual devices run a 7 x 8 cm, a 9 x 11 cm, or a 12 x 14 cm gel with a maximum of 24, 28, and 48 wells, respectively. Custom combs are also available.

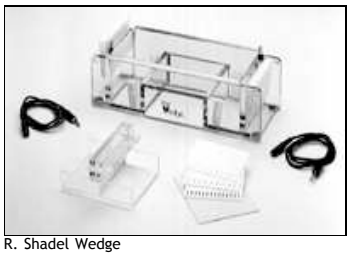
Owl's Buffer Puffer Recirculating Gel System is identical to the largest EasyCast Minigel device in terms of the EasyCast casting technique, gel size, and sample capacity, but the Buffer Puffer incorporates a buffer recirculation system that does not require any external equipment or accessories. This system uses the gas bubbles formed at the cathode side of the unit to displace the buffer on the anode side, creating a buffer circulation flow within the chamber.

The Wide Format Minigel System runs a 14.4 x 10.2 cm gel on an EasyCast- gasketed UV-transparent tray with a maximum sample capacity of 80 wells. A 15-well comb designed to accommodate multichannel pipettors is also available.

Finally, Owl's Extra Small Minigel System runs gels prepared on 2 x 3 inch glass slides. This system includes a

casting chamber and a seven-well comb. Ten-well combs, as well as custom combs, are available as optional accessories.

Owl Separation Systems also manufactures custom electrophoresis equipment.

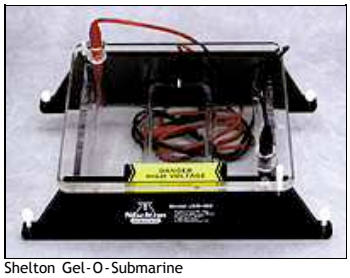

R. Shadel Wedge

R. Shadel
The solidly constructed Wedge™ Series of horizontal gel systems from R. Shadel, Inc., is comprised of four units with two falling into the minigel category. Designed to save time and space by pouring gels directly in the box, the Wedge devices use white acrylic wedges to form seals against the ends of the gel bed. Gels are cast directly on the UV-transparent gel bed of the box or onto glass slides or UV-transparent trays inserted into the chamber first. When the gel is ready, the wedges are pulled out and stored behind the electrodes. Easily adjustable comb bridges hold a variety of combs with up to 20 wells, and custom comb designs are available upon request. Gel sizes are 5 x 8 cm in the Wedge # 61510, and 8 x 10 cm in the Wedge # 61530.

R. Shadel manufactures the Bare Bones Horizontal, the least expensive mini-horizontal gel device in the profile. Available in two sizes for either doublewide microscope slides (5.1 x 7.6 cm) or lantern slides (8.3 x 10.2 cm), these devices cost $90 and $100, respectively. The Bare Bones Horizontal devices have been designed for the quick analysis of restriction digests.

R. Shadel, Inc., also builds custom acrylic electrophoresis and laboratory products.

SERVA Electrophoresis
The Blue Marine 100 from SERVA Electrophoresis employs casting gates inserted into the ends of the gel tray for forming its 7 x 10 cm gels. The two comb positions are highlighted by red stripes on the gel support to facilitate sample loading. The Blue Marine 100 has been built with external carrying handles for easy transport of the closed unit, a feature unique to the profile.


Shelton Gel-O-Submarine

Shelton Scientific Company
Shelton Scientific Company, formerly known as Jordan Scientific, has two very durable mini-horizontal systems. Backed by five-year warranties, their design won the Editor's Choice Award in a review of 10 horizontal systems in 1995 (R. L. Baldwin, BioConsumer Review, 2: 4-10). Both systems use the QuickCast Casting System. The three available UV-transparent gel trays for each device fit into the adjustable gel casting clamp that seals the ends with rubber gaskets. The casting clamp also features a built-in leveling gauge and leveling feet. The Mini Gel-O-Submarine System runs a 7.5 cm wide gel with a choice

of three lengths: 5, 7.5, or 10 cm. Its larger counterpart, the Ultrawide Mini Gel-O-Submarine System, handles a 23.5 cm wide gel with 7.5, 10, or 15 cm lengths. The sample-well combs for the Ultrawide System form up to 100 sample wells in a microtiter format.


Stratagene Joule Box

Stratagene
Stratagene's Horizontal Electrophoresis Apparatus consists of a thermoformed plastic base and a UV-transparent acrylic gel bed. The mini version runs a 10 x 10 and a 20 x 20 cm gel formed with a unique C-shaped gel casting clamp that fits over the gel tray sealing the ends with rubber gaskets. Combs are settable with a choice of two depths to accommodate thin and thick gels. This unit runs up to 20 samples.

Horizontal Gel Apparatus

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