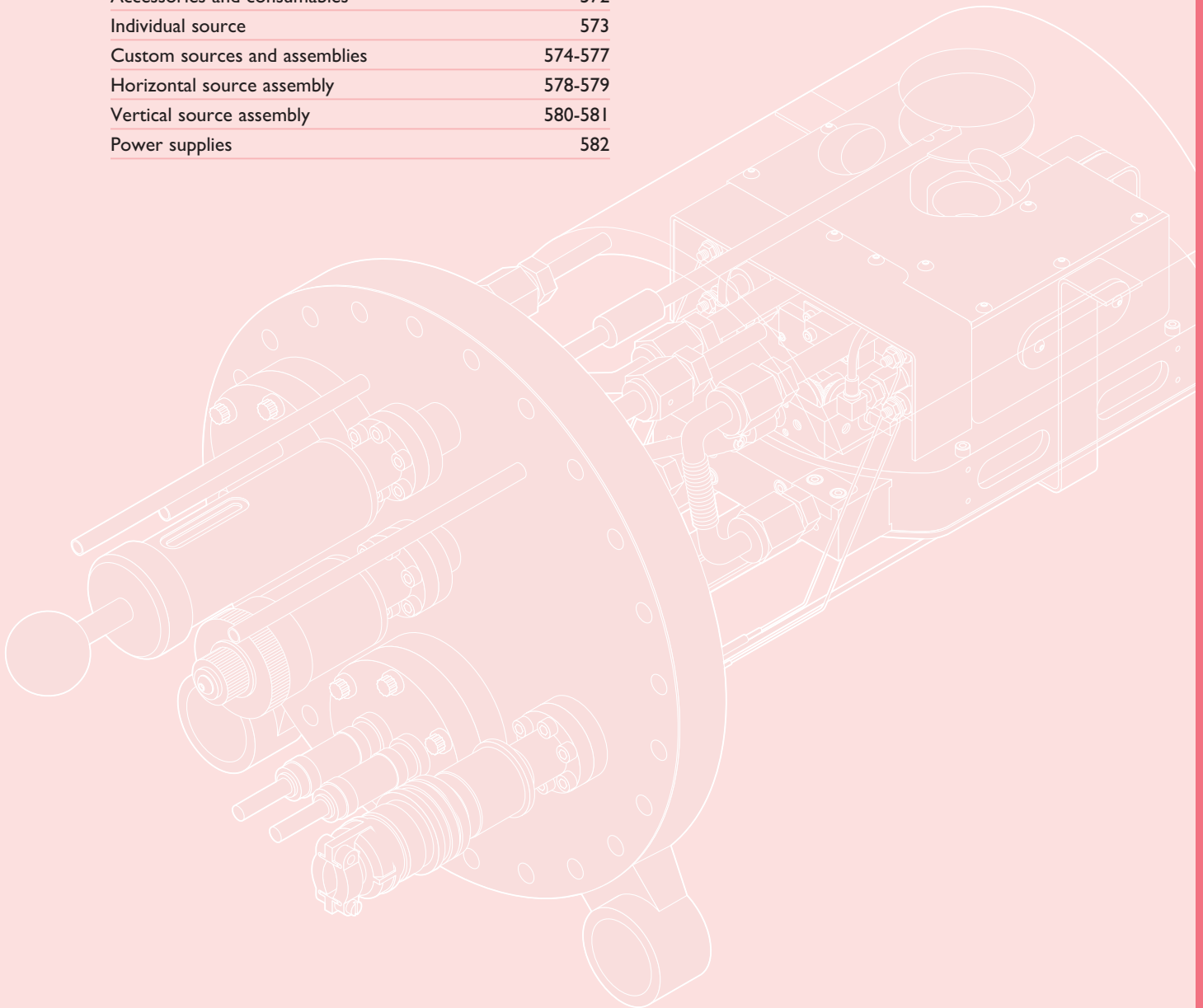


Section 8



e-Vap® thin film deposition

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Thin film deposition technology

Introduction

Thin film deposition

Thin film deposition of metallic, insulating, conductive and dielectric materials plays an important role in a large number of manufacturing, production and research applications. Resistance heating, sputtering and electron beam are the processes most widely used for the deposition of thin film. Techniques employed to perform these processes differ in degree of sophistication and quality of film produced. A resistance-heated evaporation source is relatively simple and inexpensive, but the material capacity is very small. Sputter deposition can be used to coat large areas and complex surfaces in production coating environments utilising time and power for rate control.

Electron beam evaporation is the most versatile means of vacuum evaporation and deposition. This technique allows the production of thin film coatings from pure elements, including most metals, as well as numerous alloys and compounds. Electron beam evaporation offers several advantages over competing processes, including: precise control of low or high deposition rates; excellent material utilization; co-deposition and sequential deposition systems; and, a uniform low-temperature deposition.

Use of electron beam offers higher evaporation rates, freedom from contamination, precise rate control at very low deposition levels, precise film composition and cooler substrate temperatures.

The materials used for evaporation are available in near limitless shapes and forms, the most common being pellets, slugs and disks. Since the introduction of electron beam evaporation in the 1950s, the development of high-performance films and complex coating processes has been delayed by the lack of modern electron beam equipment and technology.

Caburn-MDC's e-Vap[®] product line has taken this challenge head-on and provides electron beam evaporation sources and control electronics that incorporate leading edge technologies unmatched in the industry.

Thin film applications

Thin film applications requiring electron beam evaporation are always increasing. Applications are found in the medical, metallurgical, telecommunication, micro-electronic, optical coating and semiconductor industries. Electron beam evaporation sources are employed in the production of a multitude of low and hi-tech products including: sunglasses, camera lenses, optical filters, infrared detectors, superconductors, automotive decorative trim, costume jewellery, corrosion-resistant surfaces and many others.

Electron beam deposition is ideal for research and production applications due to its widespread material availability, efficient material utilisation and unmatched film purity and uniformity.

e-Vap[®] product line

The e-Vap[®] product line is as vast as the applications requiring electron beam evaporation. Each and every e-Vap[®] source is designed to meet or surpass the stringent requirements put forth by the vacuum coating industry. As a leader and innovator in this field, MDC holds various patents in electron-beam evaporation technology. Two notable U.S. patent numbers are 5,418,348 and 5,473,627.

The first is for Caburn-MDC's unique electron source design, which incorporates higher material capacity with a dramatically smaller source footprint. The second, for an ingenious coolant delivery system incorporated into Caburn-MDC's UHV multi-pocket rotary sources. e-Vap[®] electron beam sources are available in six basic sizes, called frames, which can accommodate small research as well as large production coating requirements with crucible capacities from 2cc to 400cc.

The sources are offered individually or as complete turn-key, flange-mounted systems with all necessary service connections, including fluid and electrical feedthroughs. These state-of-the-art evaporation sources are powered and controlled with equally advanced solid state switching power supplies, beam sweepers and control electronics. The highest rated power supply is capable of a 15,000W output at negative 10,000V, fits on a standard 483mm rack, is only 260mm tall and weighs 45.5kg. Flange-mounted units are factory assembled and tested including all feedthroughs. A range of standard options include a watercooled collimator roof, a stepper motor indexer and a programmable XY sweep controller.

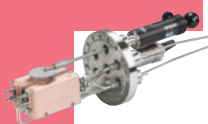
Miniature evaporation systems

Miniature evaporation systems include the e-Vap[®] 100, a precision, wire-fed electron beam source designed specifically for depositing monolayer thin films in ultrahigh vacuum environments. It can deposit refractory metals at an atomic level.

e-Vap[®] 3000 is a 2cc capacity, miniature electron beam evaporation system with a 3kW power supply. This is a versatile deposition tool used for thin film coating processes in high and ultrahigh vacuum environments. The e-Vap[®] 3000 system evaporates virtually all rare earth refractory and dielectric materials. It provides researchers a simple, relatively low-cost means of depositing high-purity thin film coatings.

Re-Vap[™] resistive heater sources are also part of the miniature product line. These sources are available with filament boats or coils and oxide crucibles. Re-Vap[™] sources are by far the most economical method of depositing thin films.

All dimensions are nominal in millimetres unless specified



Thin film deposition technology

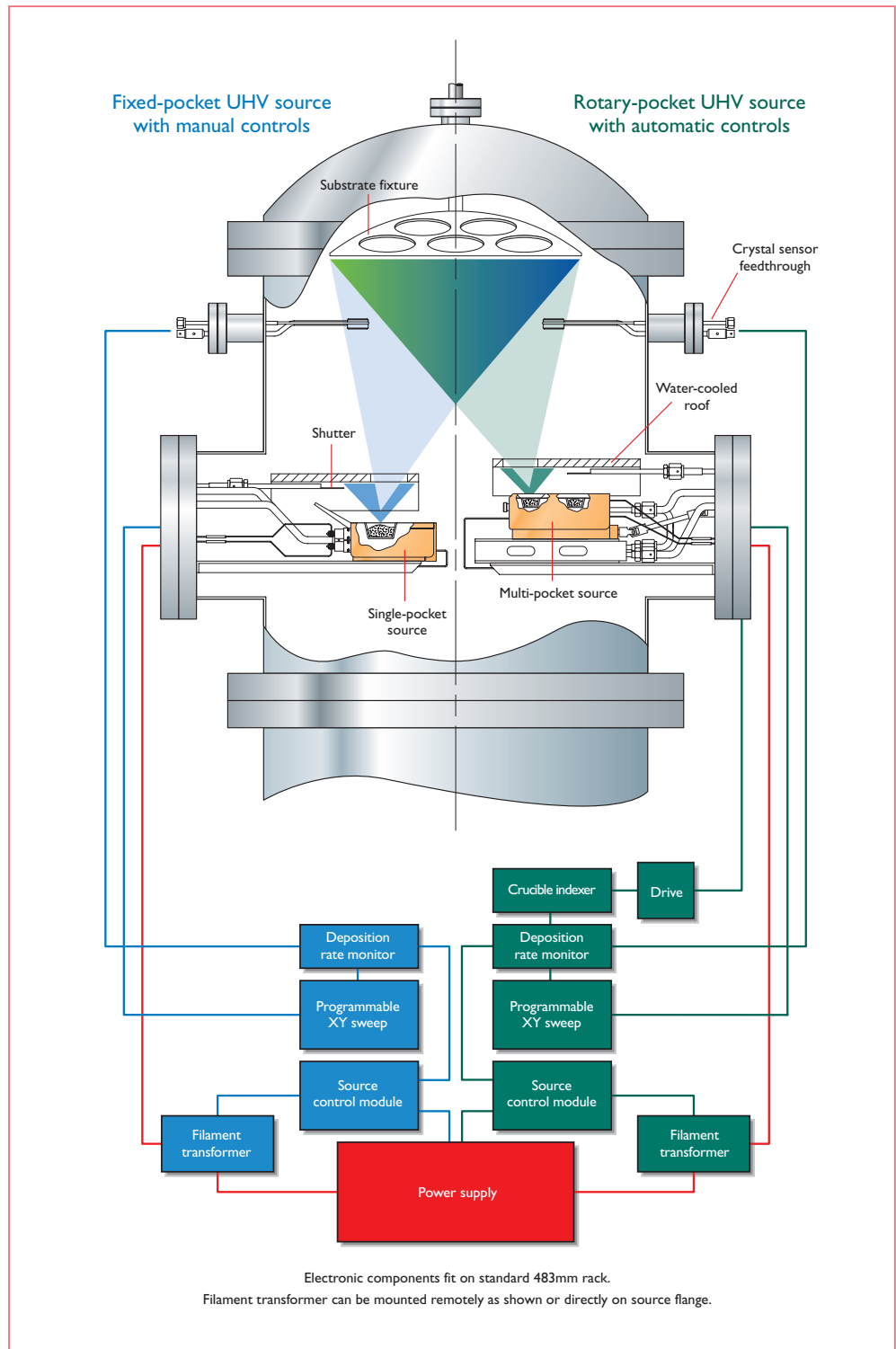
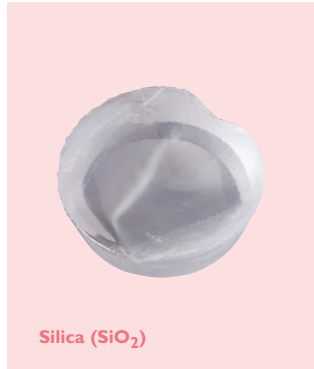
Introduction



Evaporation materials

Caburn-MDC e-Vap[®] sources are rugged, reliable and easy to maintain. Electron beam evaporation is an extremely versatile means of depositing uniform high-purity thin films. Capable of reaching elevated temperatures in excess of 3500°C, evaporation of virtually any material can be accomplished.

The silica, hafnia and magnesium fluoride materials shown were produced using an e-Vap[®] power supply, e-Vap[®] source controller and e-Vap[®] programmable sweep controller with a standard figure-eight pattern at 200Hz sweep frequency. The continuous and superior performance of this arrangement permits the routine evaporation of these and other difficult materials.

Typical e-Vap[®] installation

All dimensions are nominal in millimetres unless specified

Thermal evaporation systems

Resistive heater evaporation



Re-Vap™ 900 watt power supply

Features

- 900W power supply
- 70mm Del-Seal™ CF flange mount
- Ideal for organic material evaporation
- CE Compliant
- Contact your local office for higher current models

Specifications

| | |
|-----------------------|-------------------------------------|
| Cooling | Air cooled |
| Input power | 208V±10%, single-phase, 50/60Hz, 7A |
| Voltage output | 0 to 6V AC |
| Current output | 0 to 150A |
| Weight | 20.5kg |
| Dimensions | |
| Power supply | 406w × 152h × 305l |
| Output cable | 2AWG × 3.05m |

Caburn-MDC's Re-Vap™ resistive filament heater evaporation is an economical and reliable method of depositing thin film coatings in vacuum. Current passing through a resistive element generates sufficient heat to melt and evaporate various coating materials. Materials commonly evaporated using resistive heating include iron, nickel, aluminum, copper, tin, silver, gold and platinum. Re-Vap™ resistive evaporation can be used for decorative metallizing as well as demanding research applications.

Three basic resistive element designs are offered: filament coil, metal foil boat and oxide crucible types. Filament coil designs are by far the most popular. Re-Vap™ heater elements are economical and disposable. They can be discarded after each use to prevent material contamination.

Re-Vap™ coiled filaments are typically three stranded tungsten wires looped into coils. Multi-strand filaments are generally used because they offer a greater surface area than single wire filaments. Under these conditions, the evaporant charge should be small compared with the mass of the filament. The filament can hold up to 1g of evaporant material, formed into staple-like shapes and hung on the central helix of the tungsten filament. Upon melting, the evaporant wets to the filament and is held in place by surface tension. Spreading of the molten evaporant across the wire is desirable to increase evaporation surface area. This is accomplished by distributing the initial charge evenly over the entire length of the filament coil. To minimize dripping of the molten material, the filament coil temperature must be increased rapidly to between 1200°C and 1500°C. Using this technique, the molten material will climb or cling to the hot wire and vaporize efficiently.

Another type of element coil is the filament basket, used to evaporate pellets or chips of materials which either sublime or do not wet the filament wire upon melting. If wetting occurs, the coils of the basket are shorted and the temperature of the source drops.

Metal foil boat type resistive elements are yet another choice for small evaporation applications. Metal foil boats are made from thin refractory metal stampings, usually tungsten, molybdenum or tantalum. These boats have dimples which hold the evaporation material. Their miniature size and small capacity make them ideal for small evaporation jobs. Metal foil boats operate at very high temperatures and may cause alloying to occur with certain types of evaporation materials. Wetting of the metal surface by the molten evaporant is desirable in the interest of good thermal contact, however, the molten metal will lower the electrical resistance of the foil in the melt area, thereby causing a drop in temperature. This problem can be eliminated by using a boat which has been coated with a thin layer of aluminum oxide. The oxide coating will not allow wetting of the molten metal evaporant to the metal foil element.

Crucible heaters are an open, circular wound filament which allows crucibles to be inserted inside the windings. The crucibles are commonly manufactured from alumina, carbon, quartz and boron nitride. Crucibles have insulating properties which form a thermal barrier between the filament and melt, allowing a uniform melt temperature. Crucible evaporation is very stable because of its uniform heating. A wide range of low to moderate temperature metals like palladium, tin, selenium, arsenic, indium and organic materials evaporate well from crucibles. Crucibles are less prone to failure compared to metal foil boats because of the complete isolation between the evaporant and the heater element, thus eliminating shorting or alloying.

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Thermal evaporation systems

Resistive heater source assembly



CE



Re-Vap™ source assembly

| Description | Reference | Part number |
|--|--------------|------------------|
| Complete system ¹ | RH-900 | 992626 |
| 900W power supply | RH-PS-900 | 991256 |
| Resistive source assembly ² | RH-F-900 | 992625 |
| Conductor extension kit | RH-CEK-900 | 992619 |
| Power supply spare parts kit | RH-PSPK-900 | 991257-08 |
| Metal foil boat, tungsten | RH-MFB-900TU | 992624-01 |
| Metal foil boat, tantalum | RH-MFB-900TA | 992624-02 |
| Metal foil boat, molybdenum | RH-MFB-900M | 992624-03 |
| Coated foil boat, tungsten | RH-CFB-900TU | 992623-01 |
| Coated foil boat, molybdenum | RH-CFB-900M | 992623-02 |
| Filament coil | RH-FC-900 | 992622 |
| Filament basket | RH-FB-900 | 992621 |
| Oxide crucible, alumina | RH-OC-900A | 992620-01 |
| Oxide crucible, boron nitride | RH-OC-900BN | 992620-02 |
| Oxide crucible, quartz | RH-OC-900Q | 992620-03 |

¹ Includes power supply and resistive source assembly² Includes filament coil heater element

Heater elements

Coated metal foil boat



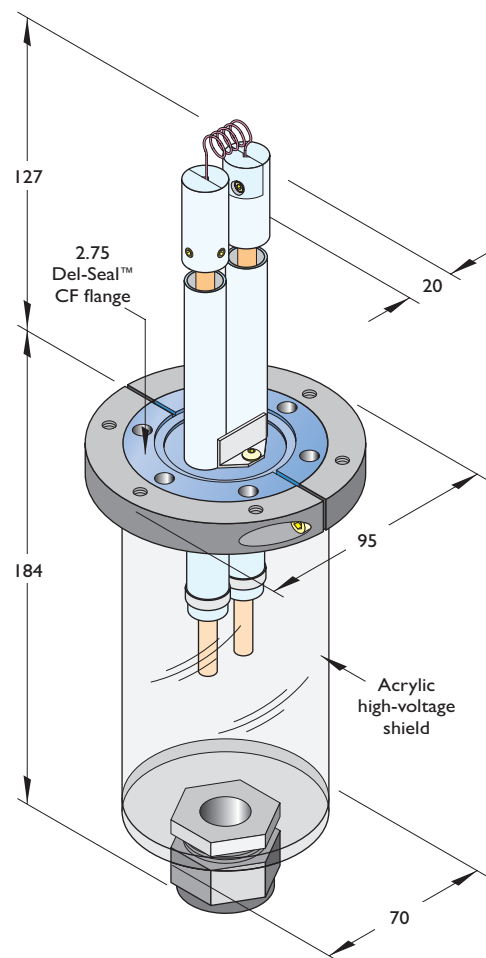
Filament coil



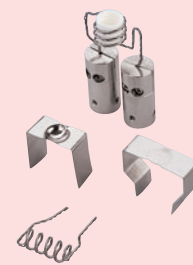
Oxide crucible



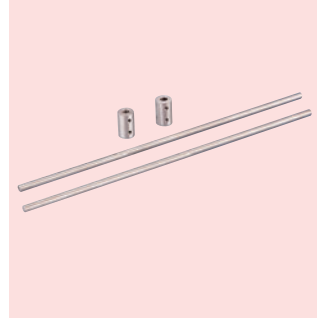
Resistive heater source assembly



Standard elements



Conductor extension kit



All dimensions are nominal in millimetres unless specified

Thermal evaporation systems

Power supply



Features

- 3000 watt output
- Designed for industrial/production applications
- Compact size – mounts underneath chamber
- High frequency switching power supply
- 5 or 10 volt tap option
- Connects to Sigma or Inficon rate controllers – making it stand-alone capable
- CE Compliant
- 6000 watt stack option

Specifications

| | |
|---------------------|---|
| Cooling | Air cooled |
| Input power | 208/220/240V AC, single-phase, 50/60Hz, 25A |
| Power output | 0 to 5V DC @ 600A |
| Option | 0 to 10V DC @ 300A |
| Cable | 1.8m cable included |
| Weight | 14kg shipping |
| Dimensions | 127w x 203h x 330d |

Description

Caburn-MDC's high-powered Re-Vap™ resistive evaporation system is a highly industrial, robustly designed, economical method of depositing thin film coatings. The current passing through a resistive element (filament, boat, etc.) is produced by a unique high-current, low-voltage switch mode high-frequency power supply that produces ample amounts of current needed to evaporate materials such as iron, nickel, aluminum, copper, silver, gold and platinum. Silicon-monoxide, magnesium fluoride, as well as zinc selenide are readily evaporated.



The Re-Vap™ controller is a half-rack width display module displaying the current, voltage, safety interlock and status/operation indicators.

For automated coating processes, it may be connected to a rate/thickness controller for precise control. Power can also be controlled through the front panel or with the hand-held remote control.

Re-Vap™ clamp, high current feedthrough and Z-bar™ extensions

The Re-Vap™ positive clamping method is universally designed for heavy use and quick-change capability. Thumbscrews are provided for fast installation of boats or filaments. Air-side clamping uses silver-plated battery clamp-style hard copper connections designed for maximum surface contact and high current carrying capacity.

The Re-Vap™ high current 19mm feedthroughs are rated at 600A. It uses high purity alumina ceramic as the dielectric material, which is hermetically sealed to a flexible metal transition using vacuum grade braze alloys in a vacuum brazing furnace. Additionally, a removable snap-on ground shield provides protection from line-of-sight coating on exposed ceramic surfaces. Re-Vap™ feedthroughs are fitted with Del-Base™ baseplate mounts in standard one-inch, 32mm or 34mm sizes for use in most vacuum coating systems, including Balzers and Leybold systems.

Z-bar™ extensions are used in cases where normally an evaporation source cannot be positioned because of spacing limitations. The modular Z-bar™ extensions allow you to manoeuvre your evaporation sources around fixed equipment inside your vacuum coating system. Its versatility allows you to use them singularly or in multiples for those hard to reach locations.

Re-Vap™ Power supply and controller

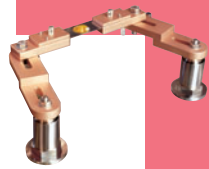
Caburn-MDC has taken advantage of MDC's extensive knowledge of high frequency solid-state switching power supplies by incorporating that technology into a patent applied high-powered 3000W Re-Vap™ power supply. Tremendous size and weight reductions are the result. With overall dimensions of 127w x 203h x 330l and a total weight of just 9kg, the power supply can be mounted underneath the vacuum coating system just centimetres away from the high-current feedthroughs.

The power supply is only one-eighth the size and one-tenth the weight of a typical 3000 watt resistive power supply. Two unique advantages include higher power efficiency and floor space savings. Power efficiency is greater because the output cable length is reduced with a resulting reduction in power loss.

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Thermal evaporation systems

Resistive heater evaporation



Re-Vap™ typical source installation, shown with two z-bars and boat clamps

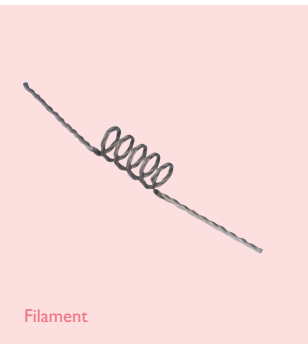
Features

- Industrial design
- Feedthroughs rated at 600A
- Removable, snap-on ground shield protects against coating build up
- Z-bars allow installation of sources in difficult or hard-to-reach locations
- Z-bars may be used singularly or in multiples
- Clamp designed for virtually any type of commercial heater element, up to 32mm wide
- Ultra positive clamping method

Typical heater elements



Metal foil boat

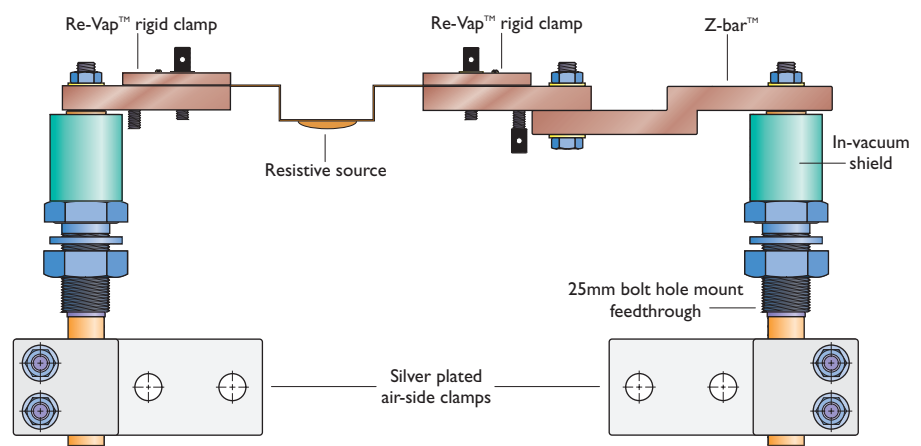


Filament



Baffled boat

Typical installation schematic



- Only one Z-bar shown – may be used in multiples



Re-Vap™ clamp and 2-bar™ extension



Standard elements

All dimensions are nominal in millimetres unless specified



Thermal evaporation systems

Resistive controller

CE



Re-Vap™ resistive controller

Features

- Front panel LED displays current and voltage
- On/off switch
- Safety interlock
- Hand-held remote control
- CE compliant

Description

The Re-vap™ resistive controller is designed for use with the Re-vap™ 3000 power supply. The controller is a half-rack width display module, displaying the current, voltage, safety interlock and status/operation indicators. For automated coating processes, it may be connected to a rate/thickness controller for precise control. Power can also be controlled through the front panel or with the hand-held remote control. Cabling and connectors are

Specifications

| Construction | |
|--------------|--|
| Case | Aluminium sheet |
| Readout | LED display |
| Mount | Half-rack standard electronics cabinet |
| Input power | |
| | 110V, 50/60Hz |
| Weight | |
| | 5kg |
| Dimensions | |
| | 216w x 133h x 356d |

Ordering information

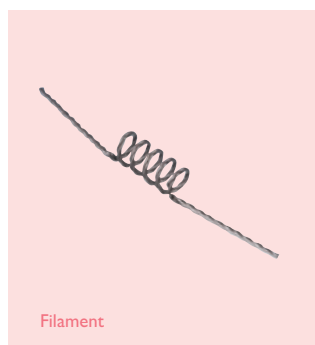
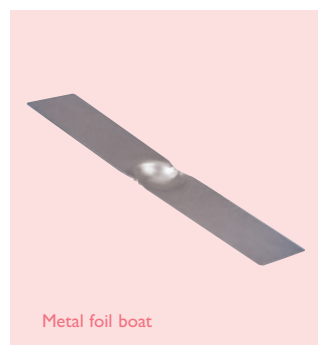
Complete system

A complete Re-Vap™ 3000 system includes:

- One 3000 watt power supply
- One resistive controller
- Two high-current electrical feedthroughs, 25mm bolt style
- Two electrical airside clamps
- Two z-bars with bolts
- Two rigid boat clamp assemblies
- One metal foil boat heater element

Components may be purchased as a complete system or individually.

| Description | Wt kg | Reference | Part number |
|----------------------|-------|-------------|---------------|
| Complete system | 23 | RV-3000-SYS | 992970 |
| power supply | 14 | RV-3000-PS | 991301 |
| resistive controller | 4.5 | RV-3000-RC | 991303 |



Resistive heater elements are sold individually.

| Reference | Part number |
|------------|---------------|
| Metal foil | 993037 |
| Filament | 993038 |
| Baffled | 993039 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Thermal evaporation systems



Accessories

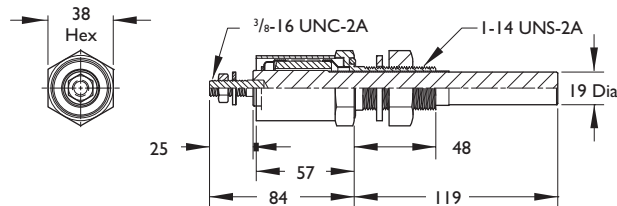


High-current feedthrough

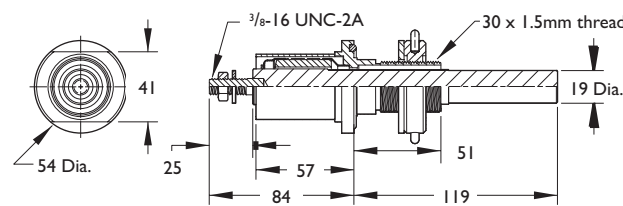
High-current feedthroughs are available for mounting to baseplates in three standard sizes.

A removable shield protects ceramic insulator from contamination during deposition.

Standard 25mm bolt mount



Metric-style 32mm and 34mm bolt mounts



| Reference | Part number |
|-------------|---------------|
| 25mm bolt | 992966 |
| 32mm bolt | 993040 |
| 34mm bolt | 993041 |
| 32mm - 25mm | 991813 |

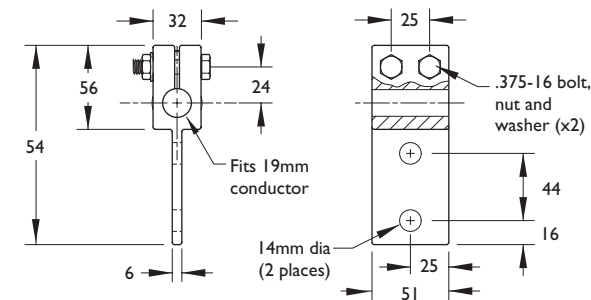
An adaptor is available to mount a 25mm bolt feedthrough to a 32mm bolt hole.

Adaptor not shown.

Two feedthroughs required, sold individually.

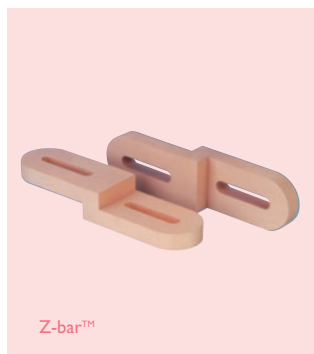


Airside clamps

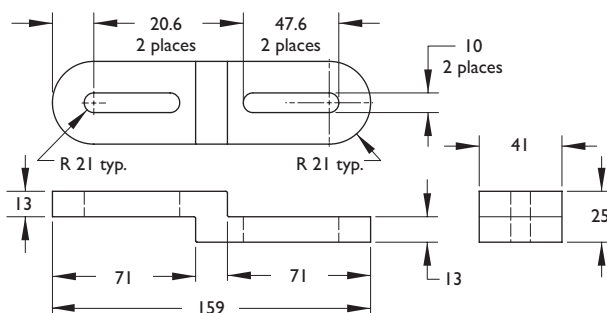


| Reference | Part number |
|-----------|---------------|
| HCC-750 | 640070 |

Made of OFE copper with silver plate to minimise oxidation and contact resistance. Two 14mm holes are provided for fastening eyelet-fitted power cables. Sold



Z-bar™

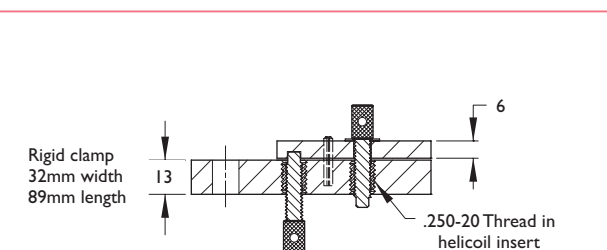


| Reference | Part number |
|-----------|---------------|
| Z-Bar | 992969 |

Caburn-MDC Z-bar™ extensions are used where an evaporation source can't be positioned normally due to limited space. May be used singularly or in multiples. Sold individually.



Boat clamps



| Reference | Part number |
|-----------|------------------|
| Rigid | 992968-02 |

Boat clamps use thumb-screws for fast installation of boats of filaments. Two boat clamps are required. Sold individually.

All dimensions are nominal in millimetres unless specified

Miniature evaporation systems

eVap® 100

e-Vap® 100 System

Specifications

| | |
|------------------------------------|--------------------------------------|
| Metering | Digital emission current |
| Cooling | Air cooled |
| Input power | 220V ±10%, single-phase, 50/60Hz, 3A |
| Voltage output | 2kV, DC negative polarity |
| Output ripple | Less than 2% RMS |
| Voltage regulation | 1% |
| Current output | 0 to 0.05A |
| Emission current regulation | 1% |
| Efficiency | 85% |
| Weight | 9kg |
| Dimensions | 483w x 84h x 457l |

Features

- 100W power supply
- Monolayer e-beam deposition
- Precision control deposition rates
- 1mm wire feed mechanism, 2mm optional
- Refractory materials evaporation
- UHV compatible to 10⁻¹¹ Torr
- Bakeable to 250°C
- No water cooling required
- Mounted on 70mm Del-Seal™ CF flange

e-Vap® 100 is a precision monolayer deposition source employed for evaporative coatings in UHV applications. Its unique design uses an electron beam power source for thermionic emission and pinpoint electrostatic focussing of an electron beam onto a 1mm diameter wire. The wire being evaporated is at ground potential and serves as the source anode, thus attracting electron bombardment. The constant stream of electrons heats the wire tip to its melting point forming a very small liquid ball, which is subsequently vaporized. The wire is manually fed by a precision linear drive feedthrough, and must be fed periodically as determined by source evaporation rates. The e-Vap® 100 source evaporates high-temperature refractory metals including tantalum, molybdenum and

Monolayer deposition rates

| | | | | | | | | | | | | | | | | | | |
|------------------------------|-------------------------------|---|-------------------------------|------------------------------|--------------------------------|--------------------------------|-------------------------------|-----------------------------|-------------------------------|----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|-------------------------------|------------------------|---------------------|--|
| Li 0.4 Lithium | Be 1.3 Beryllium | Numbers indicate the time in minutes required to deposit one monolayer of the specified element. Deposition rates are calculated at element melting point, using a substrate area of 1cm ² , a source to substrate distance of 10cm and a vapour pressure of 10 ⁻³ Torr. These values are intended as reference only, actual rates may vary from those listed. | | | | | | | | | | | | B 2.2 Boron | C 2.8 Carbon | N Nitrogen | O Oxygen | |
| Na 0.4 Sodium | Mg 0.6 Magnesium | | | | | | | | | | | | | Al 1.2 Aluminum | Si 1.5 Silicon | P Phosphorus | S Sulphur | |
| K 0.3 Potassium | Ca 0.6 Calcium | Sc 1.2 Scandium | Ti 1.6 Titanium | V 2.0 Vanadium | Cr 2.0 Chromium | Mn 1.7 Manganese | Fe 2.1 Iron | Co 2.2 Cobalt | Ni 2.2 Nickel | Cu 2.1 Copper | Zn 0.9 Zinc | Ga 1.8 Gallium | Ge 2.1 Germanium | As Arsenic | Se Selenium | | | |
| Rb 0.4 Rubidium | Sr 0.7 Strontium | Y 1.4 Yttrium | Zr 2.1 Zirconium | Nb 2.7 Niobium | Mo 2.8 Molybdenum | Tc 3.0 Technetium | Ru 3.1 Ruthenium | Rh 2.8 Rhodium | Pd 2.4 Palladium | Ag 1.9 Silver | Cd 1.1 Cadmium | In 1.9 Indium | Sn Tin | Sb 1.4 Antimony | Te 1.4 Tellurium | | | |
| Cs Caesium | Ba 0.8 Barium | La 1.7 Lanthanum | Hf 3.0 Hafnium | Ta 4.0 Tantalum | W 4.3 Tungsten | Re 4.4 Rhenium | Os 4.5 Osmium | Ir 4.2 Iridium | Pt 3.7 Platinum | Au 2.9 Gold | Hg Mercury | Tl Thallium | Pb 1.7 Lead | Bi 1.7 Bismuth | Po 1.5 Polonium | | | |
| Fr 0.4 Francium | Ra Radium | Ac 2.0 Actinium | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|-------------------------------|----------------------------|----------------------------------|-------------------------------|-------------------------|------------------------------|-------------------------------|--------------------------------|-----------------------------|--------------------------------|-----------------------------|----------------------------|-----------------------------|-------------------------------|------------------------------|
| La 1.7 Lanthanum | Ce 2.6 Cerium | Pr 1.7 Praseodymium | Nd 1.7 Neodymium | Pm Promethium | Sm 1.4 Samarium | Eu 1.0 Europium | Gd 1.8 Gadolinium | Tb 1.9 Terbium | Dy 1.7 Dysprosium | Ho 1.8 Holmium | Er 1.8 Erbium | Tm 1.6 Thulium | Yb 1.4 Ytterbium | Lu 2.1 Lutetium |
| Ac 2.0 Actinium | Th Thorium | Pa Protactinium | U 3.3 Uranium | Np Neptunium | Pu Plutonium | Am 2.1 Americium | Cm Curium | Bk Berkelium | Cf Californium | Es Einsteinium | Fm Fermium | Md Mendelevium | No Nobelium | Lr Lawrencium |

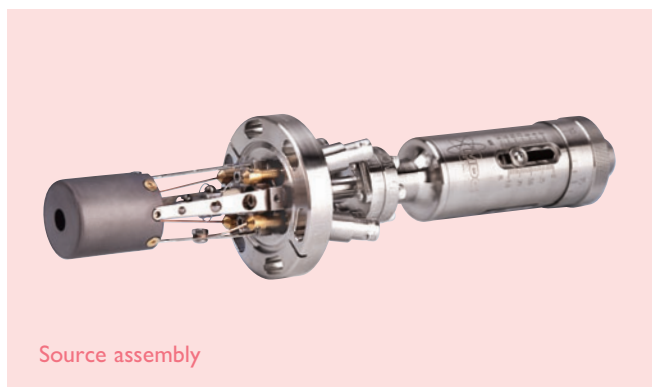
All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Miniature evaporation systems

eVap® 100



Complete system

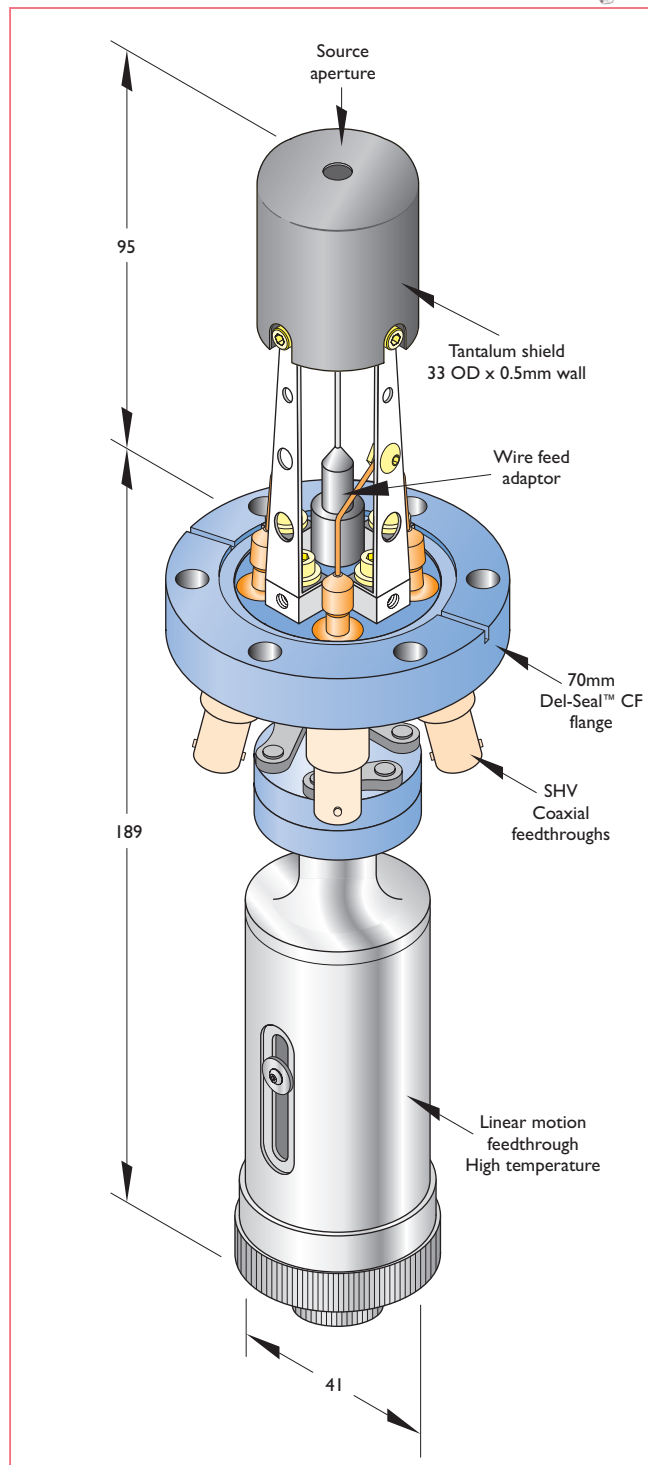


Source assembly

tungsten and most other materials manufactured in a wire form. High-temperature materials are not readily evaporated using Knudsen or Effusion cells, making the e-Vap® 100, because of its miniature size, an excellent physical vapour deposition evaporation source.

The elements table adjacent depicts calculated deposition rates for various pure materials. The e-Vap® 100 source is constructed with refractory metals for rapid equilibrium with minimal outgassing, to withstand elevated temperatures without the need for water cooling and to reduce the possibility of contamination in sensitive UHV applications. The source has an outgas mode to allow vacuum conditioning of the evaporation head. The degas feature allows heating of the e-Vap® 100 head to drive off any adsorbed contaminant. The source is mounted on a 70mm Del-Seal™ CF flange. Power connections are made via four, SHV-coaxial connectors clearly labelled for filament positive, filament negative, anode and screen inputs. Maintenance on the evaporation head is made simple with easy replacement of all key components.

The e-Vap® 100 power supply incorporates all switching technology for the high-voltage and filament sections. This translates to a smaller, lighter package, greatly improved arc suppression and better emission current control. Arcs are suppressed in the order of microseconds rather than millisecond response in other 50/60Hz systems. This, combined with lower levels of stored energy, prevents the molten tip of the evaporant rod from being 'blown away' during an arc, a common occurrence with older systems.



| Description | Reference | Part number |
|------------------------------|---------------|------------------|
| Complete system ¹ | EV-100 | 991029 |
| Source assembly | EV-SA-100 | 992458 |
| 100w power supply | EV-PS-100 | 991192 |
| Power supply spare parts kit | EV-PS-SPK-100 | 991257-07 |
| 2mm wire-feed adaptor | EV-2MM-100 | 992589 |
| Filament set, 5 each | EV-FIL-100 | 992596 |

¹ Includes source and power supply

All dimensions are nominal in millimetres unless specified



Miniature evaporation systems

eVap® 3000

e-Vap® 300 System

Features

- 3kW switching technology power supply
- UHV compatible
- 70mm Del-Seal™ CF flange mount
- Includes water and electrical connections
- Evaporates refractory and dielectric materials
- CE compliant

Specifications

| | |
|------------------------------------|--|
| Metering | Digital emission current |
| Cooling | Power supply: air cooled Source: water cooled |
| Input power | 220V ± 25V, single-phase, 50/60Hz, 18A |
| Voltage output | 5kV, DC negative polarity |
| Output ripple | Less than 1% RMS |
| Voltage regulation | .025% |
| Current output | 0 to 0.6A |
| Emission current regulation | 0.25% |
| Efficiency | 85% |
| Weight | 29kg |
| Dimensions | 483w x 267h x 483l |

Caburn-MDC's 3kW electron beam source is a versatile and economical deposition tool used for thin film coating processes in high and ultra-high vacuum environments. The e-Vap® 3000 system evaporates virtually all rare earth refractory and dielectric materials. It provides researchers a simple, relatively low-cost means of depositing high-purity, thin-film coatings.

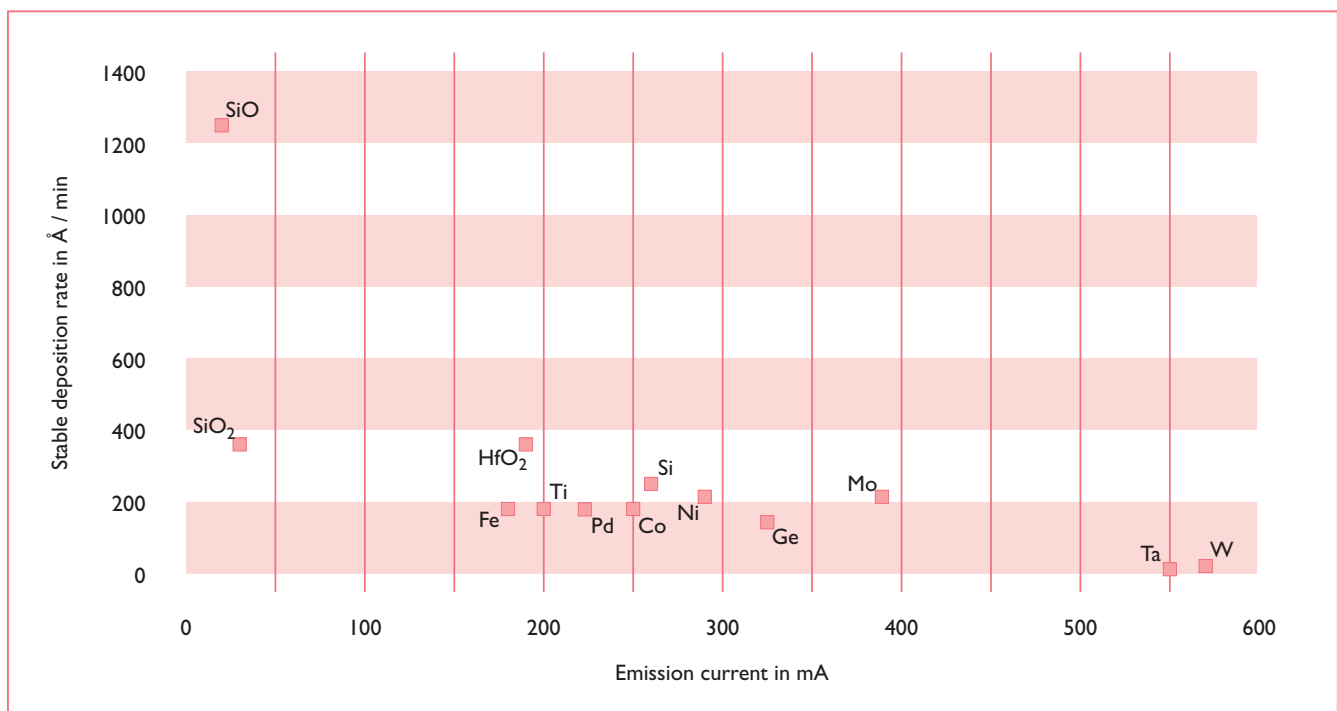
The source is manufactured using all metal sealed gaskets, is extremely compact and has a high level of ruggedness, reliability and efficiency. The compact source design allows the entire source assembly to fit through a 70mm Del-Seal™ CF port opening and eliminates internal water and electrical connections. This 3kW source is available free standing or as a complete turn-key system.

The filament/emitter assembly has a heat sink and features a unique single piece, high-voltage insulator design. The entire emitter assembly slides out for easy maintenance.

A new 3kW switching power supply is available to drive these miniature sources. State-of-the-art switching technology renders a compact, rack-mountable power supply. The built-in source controller also employs switching technology and provides extremely accurate e-Vap® evaporation sources.

These liners offer improved thermal stability while reducing the transfer of heat to the crucible. Liners provide the ability to easily and quickly switch evaporant materials without removing the crucible for cleaning. They also reduce power requirements to achieve specific evaporation rates. See page 594 for a detailed list of crucible liner materials.

Deposition rate V emission current



All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Miniature evaporation systems

eVap® 3000



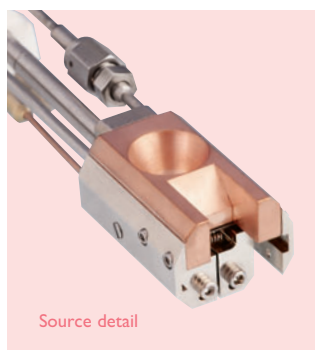
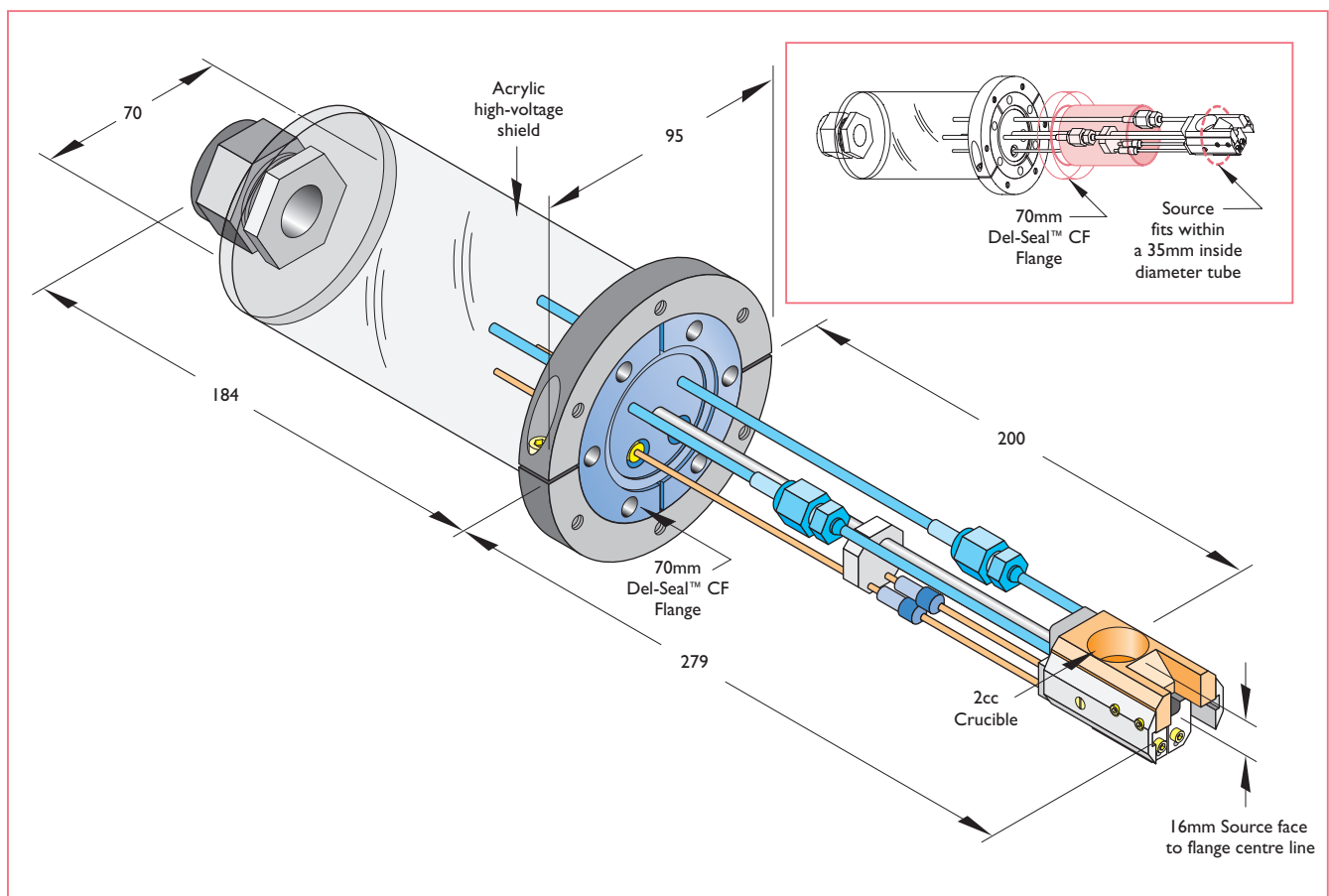
Miniature evaporation systems



Power supply



Source assembly



Source detail



Filament detail

| Description | Reference | Part number |
|------------------------------|----------------|------------------|
| Complete system ¹ | EV-CE-3000 | 992600 |
| Source assembly | EV-SA-3000 | 992601 |
| 3000w power supply | EV-PS-CE-3000 | 991221 |
| Filament set, 5 each | EV-FIL-3000 | 992610 |
| Anode | EV-A-3000 | 991929 |
| Beam former | EV-BF-3000 | 991922 |
| Beam former insulator | EV-IBF-3000 | 990529 |
| High voltage insulator | EV-IVH-3000 | 991921 |
| Power supply spare parts kit | EV-PS-SPK-3000 | 991257-03 |

¹ Includes source and power supply.

All dimensions are nominal in millimetres unless specified

Miniature evaporation systems

Mighty Source™



e-Vap® Mighty Source™ four-pocket evaporation source

Description

Practical, low-cost and highly-reliable electron beam deposition sources are the future as we know it today. Caburn-MDC introduces the e-Vap® Mighty Source™ – a four-pocket by 2cc rotary electron beam source. Affordable and extremely compact, it stands just 61mm tall by 104mm long by 71mm wide. Is there anything smaller out there?

The Mighty Source™ is rated for 3kW of power which makes it an ideal deposition tool for evaporating metals, oxides, metal oxides and magnetic materials. Designed into the source body are two hermetically sealed XY axis sweep coils that allow you to sweep the electron beam across the crucible pocket, resulting in the maximization of your coating process in terms of material stability and consistency.

The Mighty Source™ design is specifically tailored for the following uses: pilot production, lab, R&D applications and the university market place. Its compact design allows it to be mounted onto a 70, 150 or 254mm Del-Seal™ CF flange in either horizontal or vertical configurations. To complete this product system, MDC also offers a 3kW

Specifications

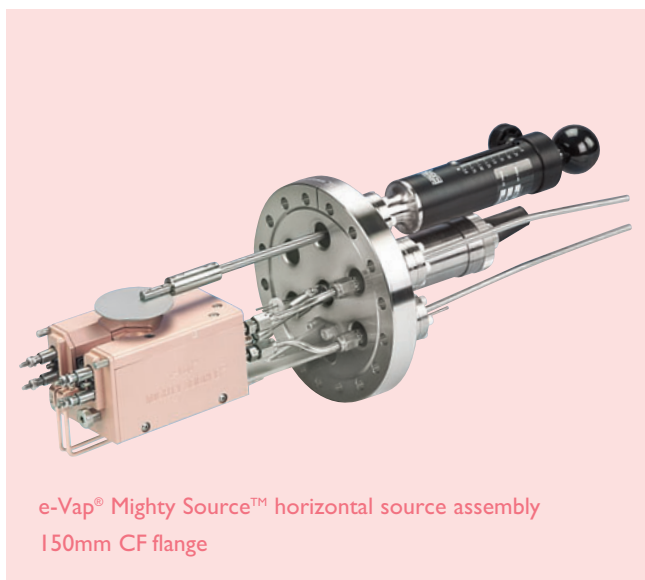
| | |
|----------------------------|----------------------------|
| Maximum power | 3000W |
| Operating voltage | 5000V |
| Beam current | 600mA |
| Compatible vacuum | 2 × 10E ⁻⁸ torr |
| Water flow | 65psi or .62gpm |
| XY Sweep frequency | 0 – 50Hz, 1.0A |
| Beam spot size | 3 – 4m |
| Crucible material | OFE copper |
| Bakeout temperature | 150°C |
| Crucible geometry | 2.0cc volume crucibles × 4 |
| Weight | 2.7kg |
| Dimensions | 61mm × 104mm × 71mm |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Modular source series

Features

- Ideal for evaporating metals, oxides, magnetic materials and dielectrics
- Ideal for universities, lab/R&D, pilot production users
- Applications include metallization, MBE, nano-technology, optics, microscopy and thin film heads
- Rated for 3000W of deposition power
- Four-pocket × 2cc rotating crucible
- Ultra-small footprint – total size is 61h × 104l × 71w
- A contained permanent magnet design produces a very small, highly dense beam spot
- XY sweep coils are included
- Crucible drive can be driven from any position – left, right, down and even angled
- Stand-alone, flange-mounted or turn-key assemblies are standard offerings
- Flange-mounts are installed on a 70mm Del-Seal™ CF flange
- Turn-key assemblies are installed onto a 150 or 254mm Del-Seal™ CF flange and include shutter and all electrical, water and mechanical feedthroughs – ready to operate.



e-Vap® Mighty Source™ horizontal source assembly
150mm CF flange

Miniature evaporation systems

Mighty Source™



Modular source series



e-Vap® mini sweep controller



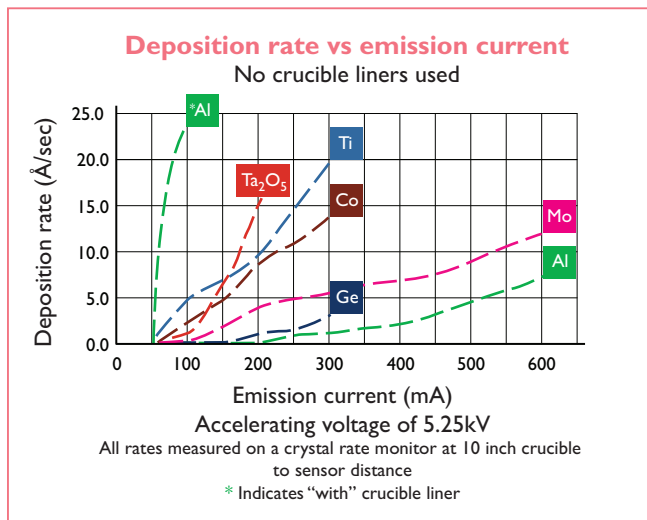
e-Vap® 3kW power supply

Flange-mounted assemblies

Features

- Complete turn-key assemblies – plug 'n' play
- Horizontal assembly is supplied on a 150mm flange
- Vertical assembly is supplied on a 254mm flange
- Water-cooled roofs are available as an option
- Different flange sizes are available upon request

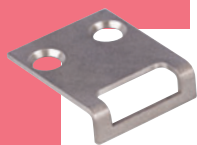
Deposition rate V power



Deposition rate table

| Material | Sweep used Yes or No | Emission Current (MA) | Deposition rate (Å/SEC) |
|----------|-------------------------|--------------------------|----------------------------|
| Al | No | 500 | 4.5 |
| Al* | No | 100 | 28.0 |
| Al2O3 | Yes | 100 | 8.0 |
| Ag | No | 150 | 13.0 |
| Co | No | 200 | 9.0 |
| Cr | Yes | 50 | 13.0 |
| Cu | No | 500 | 2.2 |
| Ge | No | 300 | 3.0 |
| Hf | Yes | 250 | 7.0 |
| HfO2 | Yes | 150 | 9.0 |
| In | No | 200 | 18.0 |
| ITO | Yes | 20 | 10.0 |
| Mo | No | 500 | 8.5 |
| MgF2 | Yes | 10 | 7.0 |
| Nb | No | 500 | 1.0 |
| Ni | No | 300 | 3.0 |
| Pd | No | 100 | 50.0 |
| Si | Yes | 300 | 1.0 |
| SiO2 | Yes | 40 | 25.0 |
| Ta | No | 500 | 8.0 |
| Ta2O5 | Yes | 150 | 7.0 |
| Ti | No | 300 | 20.0 |
| TiO2 | Yes | 150 | 7.5 |
| W | No | 500 | 8.0 |
| Y | No | 150 | 40.0 |
| ZnS | Yes | 30 | 10.0 |
| ZnSe | Yes | 10 | 40.0 |
| ZrO2 | Yes | 200 | 10.0 |

* With crucible liner

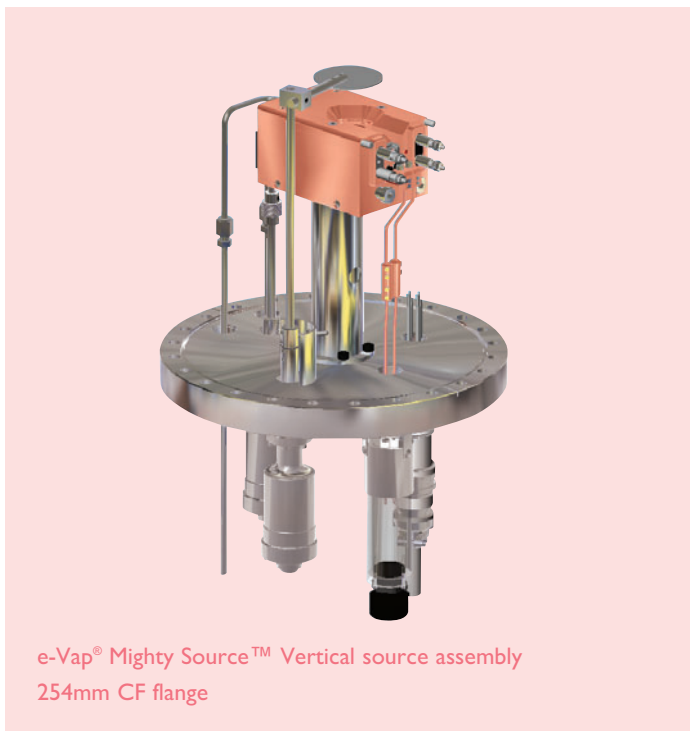


Modular evaporation sources

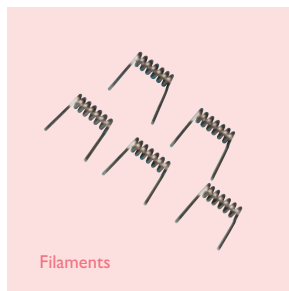
Accessories and consumables

Modular evaporation sources

Modular source series



e-Vap® Mighty Source™ Vertical source assembly
254mm CF flange



Filaments



Anode



Beam former



Beam former insulator



High voltage insulator



Emitter rebuild kit

Mighty Source™ details table

| Description | Reference | Part number |
|---|-------------------|------------------|
| Stand-alone source | *EV- | 993400 |
| 70mm Del Seal™ flange horizontal mount | MS Mighty Source™ | 993450 |
| 254mm Del Seal™ flange vertical mount | EV-MS-F275-H | 993431 |
| 150mm Del seal™ flange horizontal mount | EV-MS-F1000 | 993430 |
| 3kW mini sweep controller | EV-MS-F600H | 991374 |
| Power supply | SVVEEP-MS | 991221 |
| Power supply spares kit | EV-PS-CE-3000 | 991257-03 |
| Filament, pack of 5 | EV-PS-SPK-3000 | 992610 |
| Anode | EV-FIL-3000 | 991929 |
| Beam former | EV-A-3000 | 991922 |
| Beam former insulator | EV-BF-3000 | 990529 |
| High voltage insulator | EV-IBF-3000 | 991921 |
| Emitter rebuild kit ¹ | EV-IHF-3000 | 993410 |
| Crucible seal rebuild kit | ERK-MS | 993439 |
| Gasket 3.18mm VCR | CSRK-MS | 042064 |
| Filament clamp sleeve | EV-CRA-8VCR-SS | 993415 |

¹ Includes two filaments, high voltage insulator, beam former and fasteners

* MS indicates Mighty Source™



Crucible seal rebuild kit



Gasket



Filament clamp sleeve

All dimensions are nominal in millimetres unless specified

Modular evaporation sources

Individual source



Individual source

Description

Caburn-MDC modular e-VAP® sources are state-of-the-art electron beam evaporation sources designed for the demanding and exacting world of vacuum coatings. This unprecedented selection of electron-beam evaporation sources provides vacuum coating solutions for most applications including medical, metallurgical, telecommunications, micro electronics and optics.

Modular sources are offered in six standard frame sizes and are stand alone components for maximum installation flexibility in existing vacuum systems. For those desiring standard, off-the-shelf solutions, complete horizontal and vertical flange-mounted systems are also available.

Modular sources are fitted with direct, water-cooled crucibles. Select modules have indirectly cooled crucibles that allow the user to change crucibles without interrupting the flow of water to the source and without having to disassemble the source. Modular sources are offered with material capacities from 6cc to 400cc in a multitude of pocket geometries and arrangements. They are available in both fixed and rotary pocket mechanisms for high and ultra-high vacuum environments. e-Vap® modular sources are designed for optimum performance with e-Vap® power supplies, controls and electronics. Other essential components and hardware required for the installation of e-Vap® modular sources are detailed starting on page 582. Contact your local technical sales office for custom electron-beam evaporation solutions to meet your needs.

Features

Filament assembly

- Filament is shielded from ion bombardment
- No shorting
- Longer filament life
- Reduced coating of ceramic insulators
- Reduced arcing

Emitter assembly

- 270° arc emitter module
- Heat sunk emitter
- Consistent electrostatic field
- Longer life anode and beam former
- Reduced filament distortion
- Modular plug-in assembly unit
- Simple maintenance
- Simple filament replacement
- Minimal adjustment – only requires verification of filament tolerance

Open cathode design

- No space charging
- Increased emission
- Cooler operating filament, requires only 42A for 15kW

Shielded high voltage ceramics

- Reduces coating of ceramic insulators
- Prevents arcing
- Unique high voltage insulator design – no screws to reduce dielectric breakdown

Beam sweep coil assembly

- Helmholtz design principle produces a uniform magnetic field
- No tunnelling
- Beam maintains constant density and shape when swept across crucible

Magnet assembly

- Permanent magnets
- 270° arc beam deflection with positive beam containment
- Reliable beam positioning
- No pole pieces
- Efficient magnetic field generation
- Beam travels vertically through crucible

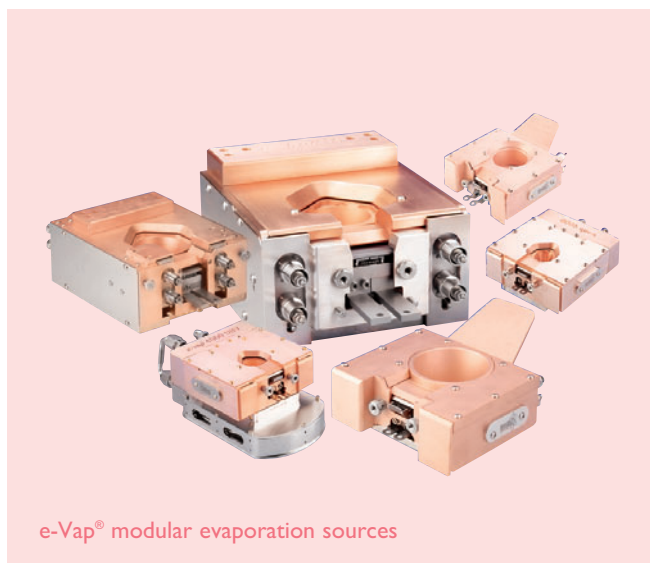
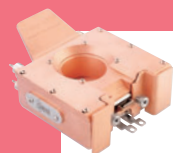
Crucible module / replaceable modules

- Capacity from 6cc to 400cc
- Complete flush-top design
- No condensate build up
- No contamination from flaking condensate
- Complete utilization of vapour cone during deposition – no shadowing
- Reduced cross-contamination during changes of evaporant material

All dimensions are nominal in millimetres unless specified

Modular evaporation sources

Custom sources and assemblies



e-Vap® modular evaporation sources

Features

Custom source and source assemblies

- Six frame sizes
- Single, multi-pocket or carousel crucibles
- Custom crucible configurations available
- Crucible sizes from 6cc to 400cc
- Power ratings from 6kW to 15kW
- Direct or indirect water cooling

Description

Custom source and source assemblies can be designed to fit an existing chamber or for a special application. Contact your local sales office for details regarding custom source assemblies or custom sources.

Options

- **Source options** are available, consult your local sales office for existing designs, availability and prices
- **Single pocket sources** Frame 1 and 2
UHV-compatible sources, volumes 7 to 100cc
- **UHV rotary mechanism** Frame 4 and 5 allow for UHV operation of the multi-pocket sources
- **Direct and indirect cooling** Frame 5 and 6 option for both of these frame sizes. Direct cooling allows for higher power levels to be applied during deposition, the water seal must be disturbed to change the crucible. Indirect cooling allows the crucible to be removed without disturbing the water-to-vacuum seal, however maximum power levels are lower with indirect cooling.
- **Custom crucibles** can be machined with various pocket sizes and configurations depending on your application. Caburn-MDC will manufacture any custom crucible that is required including single, four-pocket, six-pocket, pan-carousel and bananas.

Crucible / pocket geometry

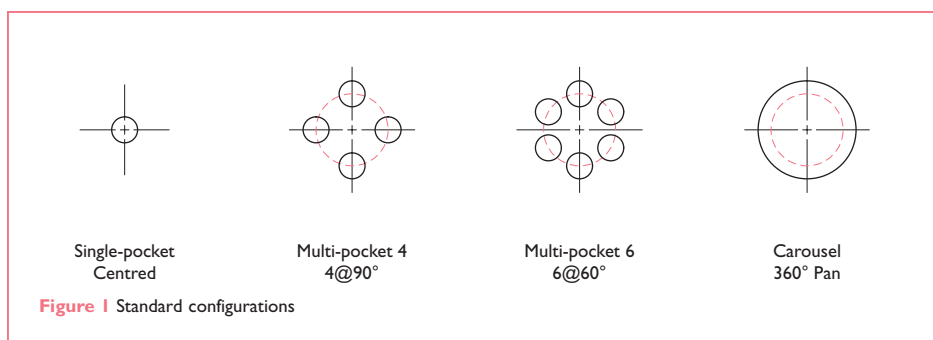


Figure 1 Standard configurations

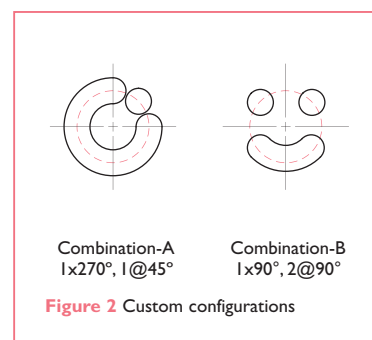


Figure 2 Custom configurations

Standard, multi-pocket sources that have been identified by our customers as the most popular sources are listed to the right. Caburn-MDC has made a commitment with sub-component inventory to offer reduced lead times for standard multi-pocket sources.

| Frame size | Number of pockets | Volume per pocket | Maximum power |
|------------|-------------------|-------------------|---------------|
| 3 | 4 | 6cc | 6kW |
| 4 | 4 | 6cc | 6kW |
| 5 | 4 | 15cc | 10kW |
| 5 | 4 | 25cc | 10kW |
| 5 | 6 | 12cc | 10kW |
| 5 | 1 | 150cc | 10kW |
| 6 | 4 | 40cc | 15kW |
| 6 | 4 | 75cc | 15kW |
| 6 | 1 | 400cc | 15kW |
| 6 | 6 | 40cc | 15kW |

| Reference | Part number |
|----------------|---------------|
| EV-4000-66 | 991600 |
| EV-4000-66UHV | 991700 |
| EV-4000-1015 | 991900 |
| EV-4000-1025 | 991800 |
| EV-6000-1012 | 992100 |
| EV-4000-150CAR | 992523 |
| EV-4000-1540 | 992405 |
| EV-4000-1575 | 992406 |
| EV-4000-400CAR | 993101 |
| EV-6000-1540 | 993100 |

All dimensions are nominal in millimetres unless specified

Modular evaporation sources

Custom sources and assemblies



Frame 1

Specifications

| | |
|-------------------------------|---|
| Source size | Small |
| Source type | Fixed pocket |
| Maximum power | 15kW |
| Operating voltage | 6kV to 10kV |
| Filament | 12V AC |
| Crucible geometry | Single-pocket |
| Crucible volume | 7, 15, 25 and 40cc |
| XY sweep frequency | 200Hz |
| Evaporation rate of aluminium | 50,000Å/min @ 14kW with a source to substrate distance of 250mm |
| Beam spot size | 7mm |
| Crucible material | OFE Copper |
| Bakeout temperature | 200°C |
| Materials | UHV compatible |
| Compatible vacuum | 2x10 ⁻¹¹ Torr |
| Water flow | 3gpm and/or 65psig inlet/outlet differential |
| Dimensions | 168l x 124w x 53h |
| Weight | 4kg |

Small / fixed-pocket



| Crucible volume | Maximum power | Reference | Part number |
|-----------------|---------------|--------------|---------------|
| 7cc | 6kW | EV-1000-67 | 990598 |
| 15cc | 10kW | EV-1000-1015 | 990599 |
| 25cc | 10kW | EV-1000-1025 | 990597 |
| 40cc | 15kW | EV-1000-1540 | 990600 |

Frame 2

Specifications

| | |
|-------------------------------|---|
| Source size | Large |
| Source type | Fixed pocket |
| Maximum power | 15kW |
| Operating voltage | 6kV to 10kV |
| Filament | 12V AC |
| Crucible geometry | Single-pocket |
| Crucible volume | 75 and 100cc |
| XY sweep frequency | 200Hz |
| Evaporation rate of aluminium | 50,000Å/min @ 15kW with a source to substrate distance of 250mm |
| Beam spot size | 7mm |
| Crucible material | OFHC Copper |
| Bakeout temperature | 200°C |
| Materials | UHV Compatible |
| Compatible vacuum | 2x10 ⁻¹¹ Torr |
| Water flow | 3gpm and/or 65psig inlet/outlet differential |
| Dimensions | 168l x 140w x 57h |
| Weight | 4.5kg |

Large / fixed-pocket



| Crucible volume | Maximum power | Reference | Part number |
|-----------------|---------------|---------------|---------------|
| 75cc | 15kW | EV-1000-1575 | 992250 |
| 100cc | 15kW | EV-1000-15100 | 992430 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.



Modular evaporation sources

Custom sources and assemblies

Frame 3

Specifications

| | |
|-------------------------------|---|
| Source size | Small |
| Source type | Rotary pocket |
| Maximum power | 6kW |
| Operating voltage | 6kV to 10kV |
| Filament | 12V AC |
| Crucible geometry / volume | |
| Multi-pocket | 4x 6cc, 6x 3cc |
| Carousel | 360°, 15cc |
| XY sweep frequency | 200Hz |
| Evaporation rate of aluminium | 8,000Å/min @ 6kW with a source to substrate distance of 250mm |
| Beam spot size | 7mm |
| Crucible material | OFHC Copper |
| Bakeout temperature | 150°C |
| Materials | HV compatible |
| Compatible vacuum | 2x10 ⁻⁸ Torr |
| Water flow | 2gpm and/or 65psig inlet/outlet differential |
| Dimensions | 135l x 130w x 62h |
| Weight | 4.5kg |

Frame 4

Specifications

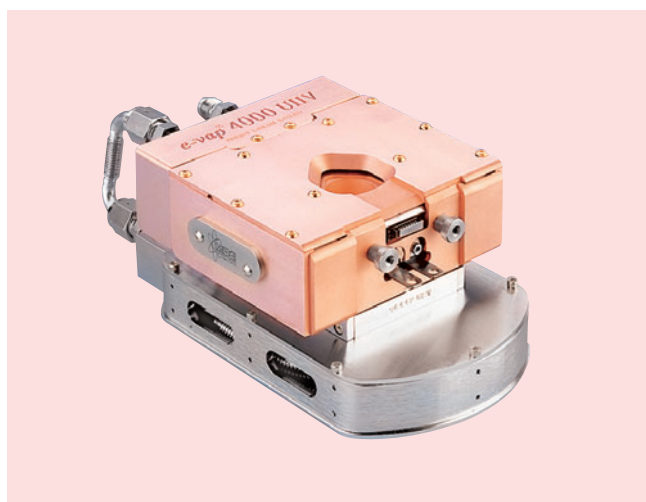
| | |
|-------------------------------|--|
| Source size | Small |
| Source type | UHV Rotary pocket |
| Maximum power | 6kW |
| Operating voltage | 6kV to 10kV |
| Filament | 12V AC |
| Crucible geometry | Multi-pocket |
| Crucible volume | 4 x 6cc |
| XY sweep frequency | 200Hz |
| Evaporation rate of aluminium | 8,000Å/min @ 15kW with a source to substrate distance of 250mm |
| Beam spot size | 7mm |
| Crucible material | OFHC Copper |
| Bakeout temperature | 200°C |
| Materials | UHV Compatible |
| Compatible vacuum | 2x10 ⁻¹¹ Torr |
| Water flow | 1.75gpm and/or 65psig inlet/outlet differential |
| Dimensions | 212l x 136w x 85h |
| Weight | 8kg |

Small / rotary-pocket



| Crucible volume | Maximum power | Reference | Part number |
|-----------------|---------------|------------|---------------|
| 4 x 6cc | 6kW | EV-4000-66 | 991600 |
| 6 x 3cc | 6kW | EV-6000-66 | 992166 |

Large / UHV rotary-pocket



| Crucible volume | Maximum power | Reference | Part number |
|-----------------|---------------|---------------|---------------|
| 4 x 6cc | 6kW | EV-4000-66UHV | 991700 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Modular evaporation sources

Custom sources and assemblies



Frame 5

Specifications

| | |
|-----------------------------------|---|
| Source size | Large |
| Source type | HV Rotary pocket UHV Rotary pocket |
| Maximum power | 10kW |
| Operating voltage | 6kV to 10kV |
| Filament | 12V AC |
| Crucible geometry / volume | |
| Multi-pocket | 4x 15, 25, 30cc and 6x 12cc |
| Carousel | 360° 150cc |
| Combination | Custom designs available |
| XY Sweep frequency | 200Hz |
| Evaporation rate of aluminium | 30,000Å/min @ 10kW with a source to substrate distance of 250mm |
| Beam spot size | 7mm |
| Crucible material | OFE Copper |
| Bakeout temperature | 150°C |
| Materials | HV Compatible |
| Compatible vacuum | 2x10 ⁻⁸ Torr |
| Water flow | 3gpm and/or 65psig inlet/outlet differential |
| Dimensions | 157 x 143w x 82h |
| Weight | 12kg |

Large / HV and UHV rotary-pocket



| Crucible volume | Maximum power | Cooling | Reference | Part number |
|-----------------|---------------|----------|-----------------|---------------|
| 4 x 15cc | 10kW | Direct | EV-4000-1050 | 991900 |
| 4 x 15cc | 10kW | Direct | EV-4000-1015UHV | 992700 |
| 4 x 25cc | 10kW | Direct | EV-4000-1025 | 991800 |
| 4 x 30cc | 10kW | Direct | EV-4000-1030 | 992408 |
| 6 x 12cc | 10kW | Direct | EV-6000-1012 | 992100 |
| 4 x 15cc | 6kW | Indirect | EV-4000-615i | 992525 |
| 4 x 25cc | 6kW | Indirect | EV-4000-625i | 992500 |
| 4 x 30cc | 6kW | Indirect | EV-4000-630i | 992585 |
| 1 x 150cc | 6kW | Indirect | EV-4000-150CARi | 992502 |
| 1 x 150cc | 10kW | Direct | EV-4000-150CAR | 992523 |

Frame 6

Specifications

| | |
|-----------------------------------|---|
| Source size | Extra-large |
| Source type | Rotary pocket |
| Maximum power | 15kW |
| Operating voltage | 6kV to 10kV |
| Filament | 12V AC |
| Crucible geometry / volume | |
| Multi-pocket | 4x 40, 60 and 75cc and 6x 40cc |
| Carousel | 360° 400cc |
| Combination | Custom designs available |
| XY sweep frequency | 200Hz |
| Evaporation rate of aluminium | 50,000Å/min @ 15kW with a source to substrate distance of 250mm |
| Beam spot size | 7mm |
| Crucible material | OFE Copper |
| Bakeout temperature | 150°C |
| Materials | HV Compatible |
| Compatible vacuum | 2x10 ⁻⁸ Torr |
| Water flow | 3gpm and/or 65psig inlet/outlet differential |
| Dimensions | 216l x 174w x 89h |
| Weight | 18kg |

Extra large / rotary-pocket

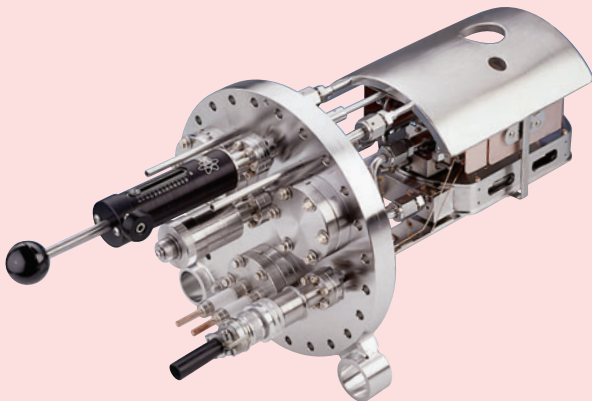


| Crucible volume | Maximum power | Cooling | Reference | Part number |
|-----------------|---------------|----------|-----------------|---------------|
| 4 x 40cc | 15kW | Direct | EV-4000-1540 | 992405 |
| 4 x 60cc | 15kW | Direct | EV-4000-1560 | 992400 |
| 4 x 75cc | 15kW | Direct | EV-4000-1575 | 992406 |
| 6 x 25cc | 15kW | Direct | EV-4000-1525 | 992599 |
| 6 x 40cc | 15kW | Direct | EV-6000-1540 | 993100 |
| 1 x 400cc | 6kW | Indirect | EV-4000-400CARi | 992720 |
| 1 x 400cc | 15kW | Direct | EV-4000-400CAR | 993101 |
| 6 x 40cc | 6kW | Indirect | EV-6000-640i | 992674 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Modular evaporation sources

Horizontal source assembly



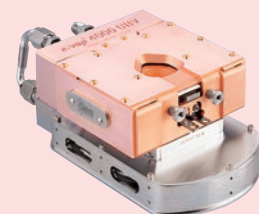
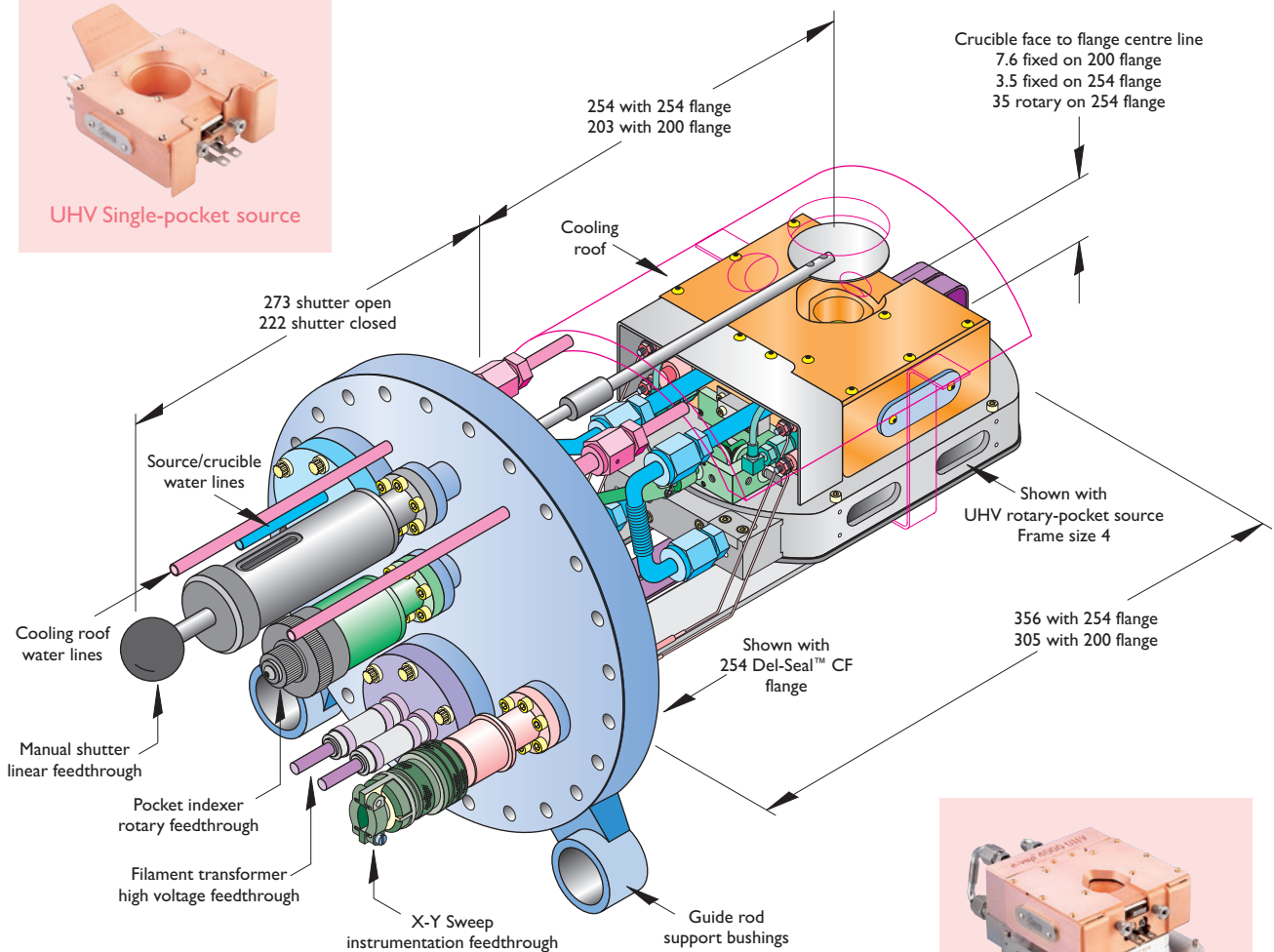
Horizontal flange-mounted system

Features

- UHV-compatible system
- 200 or 254mm Del-Seal™ CF flange mount
- Assembly includes rotary, linear and electrical feedthroughs, clamps, linkages, water flow switch and water connections
- Manual, push/pull shutter
- High-temperature (300°C) manual rotary drive on four-pocket models; blanked off on single-pocket
- Flange seal surface to crucible centreline is 203mm on a 200mm Del-Seal™ CF
- Systems available with or without water-cooled roofs



UHV Single-pocket source



UHV Rotary-pocket source

All dimensions are nominal in millimetres unless specified

Modular evaporation sources

Horizontal source assembly



Horizontal flange-mounted source

Caburn-MDC has eliminated the difficulties of flange mounting electron beam sources. Problems associated with designing and fitting sources into coating systems have been solved with the introduction of standard, horizontal flange-mounted evaporation sources. The compact footprint of these flanged evaporation systems allows installation of up to three individual sources onto one 254mm chamber. The flanged assemblies include an electron beam source with all water and electrical connections. A guide rod option provides a drawer-like sliding action, ideal for installation and system maintenance.

Horizontal flange-mounted assemblies come ready to accept this guide rod kit. Another option includes a water-cooled roof, which mounts directly above the e-Vap® source. The water-cooled roof acts as a heat barrier between the source and substrate and also prevents vapour condensation on chamber walls. The water-cooled roof is fitted with a deposition port, angled towards the substrate, which aids in deposition uniformity, even when source and substrate centrelines are offset. Horizontal systems purchased with a source control module will be fitted with flange-mounted filament transformers.

| Description | Option Number |
|---------------------------------|---------------|
| Pneumatic shutter, two position | -01 |
| Auto indexer and drive | -02 |
| Guide rods | -03 |
| Custom source position | -04 |
| Custom cooling roof ports | -05 |
| 15cc Crucible | -06 |
| 25cc Crucible | -07 |
| 40cc Crucible | -08 |

When ordering e-Vap® assembly options, please add the option number(s) to the end of the desired assembly part number listed on the opposite page

For example: **992515-01-02-03-04-05-08**

Optional accessories

Option -01



Pneumatic shutter

Pneumatic shutters are an excellent tool for precise control of film thickness onto a substrate. The air actuated shutter masks off the vapour stream between source and substrate at the beginning and finishing stages of the evaporation/deposition cycle. The shutter also allows premelt or soak prior to deposition by blanketing the evaporation material. This is a two-position shutter with a 24V AC solenoid.

Option -02



Crucible indexer and driver

The Auto-Indexer is a stepper motor drive unit with optical encoding for rotating and positioning multi-pocket eVap® sources. The unit can drive sources up to eight pockets in either an unidirectional or bidirectional manner. It can also drive continuous carousel-type sources at eight speed settings. Includes mounting bracket for external drive.

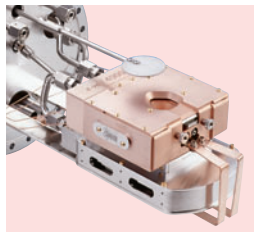
Option -03



Guide rods

Two linear bearing guide rods allow the flange mounted e-Vap® systems to be routinely maintained by simply sliding in and out, in drawer-like fashion. A weldable support bracket kit is provided to secure the guide rods onto the user's port flange. Installation is simple and self explanatory.

Option -04 to -08



Custom source position and volume

The standard distance from the source centre to the mounting flange seal face is 254 or 203mm for horizontal systems. For custom positions, between 203 and 305mm add option 04. Standard, single-pocket crucible volume is 7cc. For pocket volumes of 15, 25 or 40cc, add option 06, 07 or 08 respectively.

Option -05



Custom roof parts

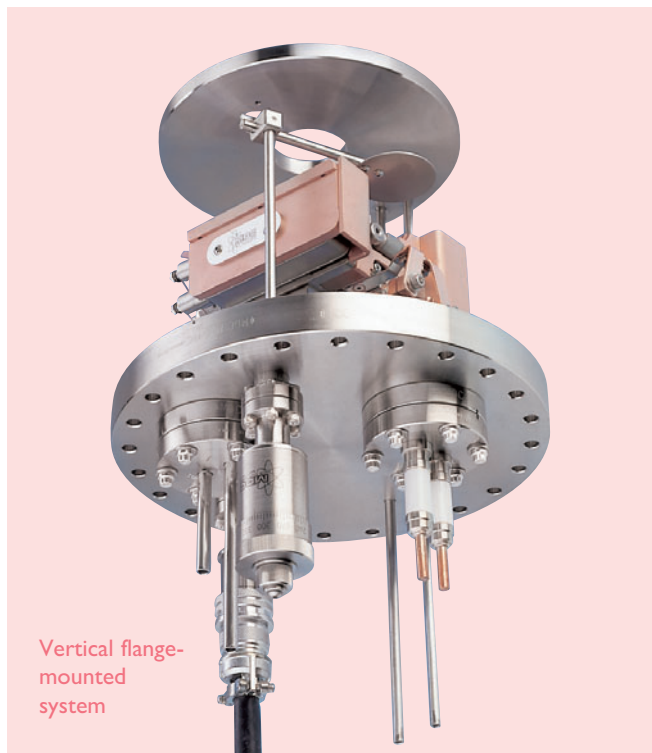
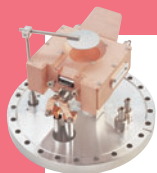
Water-cooled roofs have three ports. A main port directly over the source, which is used for the deposition process. A second port for the crystal sensor is used to monitor the deposition rate. A third port provides direct visual inspection of the source and beam through a chamber viewport. Each of these port locations can be specified by the customer.

| Mounting flange | Frame size | Source type/volume | Cooling roof | Source number | Wt. kg | Reference | Part number |
|-----------------|------------|--------------------|--------------|---------------|--------|----------------|---------------|
| 200 Del-Seal™ | I | One-pocket, 7cc | No | 990598 | 23 | EV-FMP-8H | 992515 |
| 200 Del-Seal™ | I | One-pocket, 7cc | Yes | 990598 | 23 | EV-FMP-8RH | 992516 |
| 254 Del-Seal™ | I | One-pocket, 7cc | No | 990598 | 34 | EV-FMP-10H | 992499 |
| 254 Del-Seal™ | I | One-pocket, 7cc | Yes | 990598 | 34 | EV-FMP-10RH | 992541 |
| 254 Del-Seal™ | 4 | Four-pocket, 6cc | No | 991700 | 43 | EV-FMP-10HUHV | 992498 |
| 254 Del-Seal™ | 4 | Four-pocket, 6cc | Yes | 991700 | 43 | EV-FMP-10RHUHV | 992540 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Modular evaporation sources

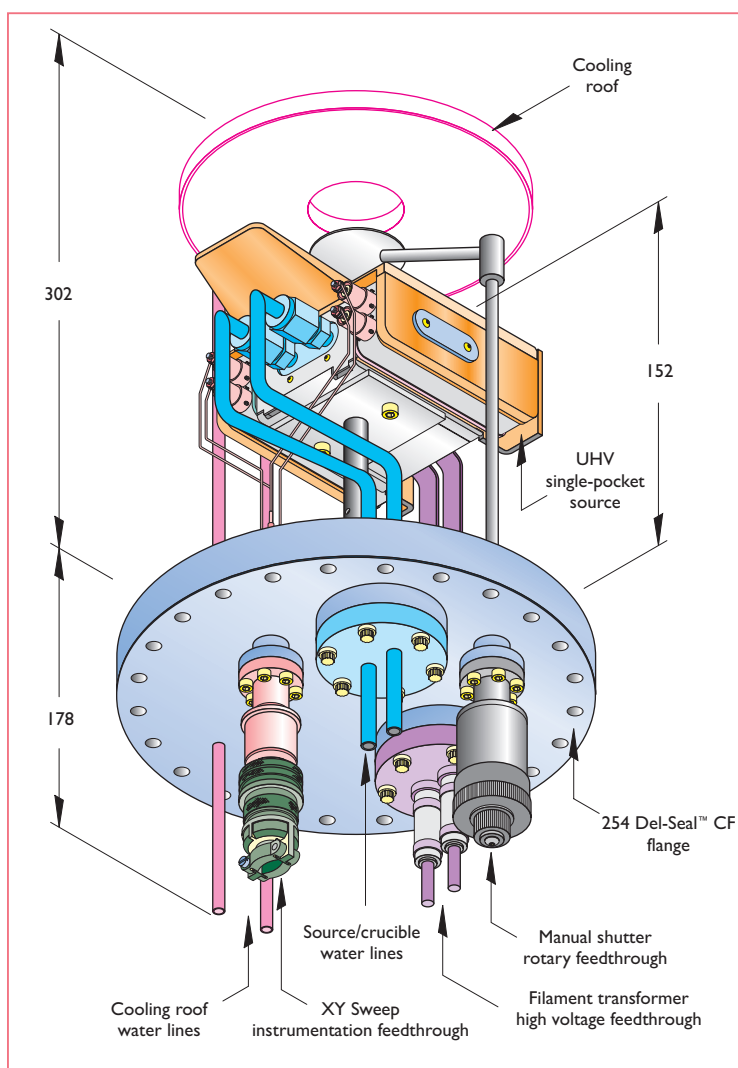
Vertical source assembly



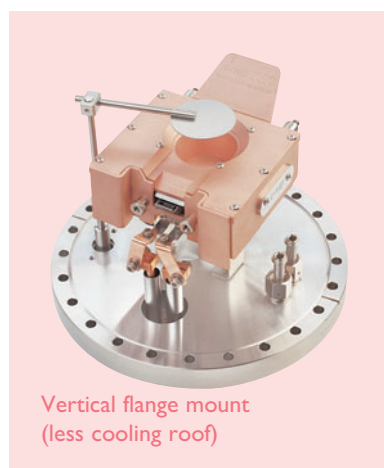
Vertical flange-mounted system

Features

- UHV-compatible system
- 254mm Del-Seal™ CF flange mount
- Assembly includes rotary, linear and electrical feedthroughs, clamps, linkages, water flow switch and water connections
- Shutter is fitted with a high-temperature (300°C) manual rotary drive
- Flange seal surface to crucible centreline is 152mm as standard
- Systems available with or without water-cooled roofs



UHV Single-pocket source



Vertical flange mount (less cooling roof)

All dimensions are nominal in millimetres unless specified

Modular evaporation sources



Vertical source assembly

Vertical flange-mounted source

Caburn-MDC has eliminated the difficulties of flange mounting electron beam sources. The effort that goes into designing and fitting a source to a vacuum coating chamber has been done for you with the introduction of standard, vertical flange-mounted evaporation sources. The flanged assembly includes one 7cc electron beam source with all water and electrical connections.

This type of flange-mounted system is typically installed vertically through the bottom side of a chamber. The compact footprint of these flanged evaporation systems requires only one port flange for installation. A popular option commonly ordered with these systems is a water-cooled roof, which mounts directly above the e-Vap® source. The water-cooled roof acts as a heat barrier between the source and substrate, as well as preventing vapour condensation on chamber walls.

The water-cooled roof is fitted with a deposition port, angled towards the substrate, which yields excellent deposition uniformity, even when source to substrate centrelines are offset.

The single-pocket source comes standard with a 7cc capacity crucible. The same assembly can be fitted with larger capacity sources, including 15, 25 and 40cc versions. To order the larger volume crucible option, add the relevant option number to the end of the assembly part number.

Vertical systems purchased with a source-control module will be fitted with flange-mounted filament transformers.

Optional accessories

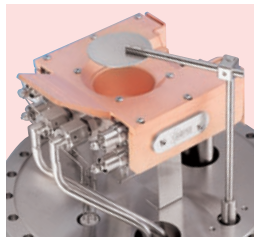
Option -01



Pneumatic shutter

Shutters mask off the vapour stream between the source and substrate. Shutters are ideal for pre-melt or soak prior to deposition by blanketing the evaporation material. Pneumatic shutters for vertical flanged assemblies cannot be mounted on source flange, but can be installed through a secondary 34mm Del-Seal™ CF port. This shutter is a two-position shutter which includes a 24V AC solenoid.

Option -04



Custom source position

Source position is the distance from the source face to mounting flange seal face. This dimension is standard at 152mm for all vertical systems. Customer chamber layout of specifications may dictate a custom distance. Source positions between 152 and 254mm are optional and pricing information for these is available from your local sales office.

Option -05



Custom roof parts

Two linear-bearing guide rods allow the flange-mounted e-Vap® systems to be routinely maintained by simply sliding in and out, in drawer-like fashion. A weldable support bracket kit is provided to secure the guide rods onto the user's port flange. Installation is simple and self explanatory.

Option -06 to -08



Custom crucible volume

The standard volume for a single-pocket crucible is 7cc. For single-pocket volumes of 15, 25 or 40cc, add the relevant option listed to the right.

| Description | Option number |
|---------------------------------|---------------|
| Pneumatic shutter, two position | -01 |
| Custom source position | -04 |
| Custom cooling roof ports | -05 |
| 15cc Crucible | -06 |
| 25cc Crucible | -07 |
| 40cc Crucible | -08 |

When ordering e-Vap® assembly options, please add the option number(s) to the end of the desired assembly part number listed below

For example: **992515-01-02-03-04-05-08**

| Mounting flange | Frame size | Source type/ volume | Cooling roof | Source number | Wt. kg | Reference | Part number |
|-----------------|------------|---------------------|--------------|---------------|--------|-------------|---------------|
| 254 Del-Seal™ | I | One-pocket, 7cc | No | 990598 | 23 | EV-FMP-10V | 992511 |
| 254 Del-Seal™ | I | One-pocket, 7cc | Yes | 990598 | 23 | EV-FMP-10RV | 992513 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Modular evaporation sources

Power supplies



CVS-6 power supply

Features

- 6kW, 10kW and 15kW models
- High-frequency switching technology
- Excellent regulation
- Low stored energy
- Power efficiency greater than 85%
- Low ripple
- Rugged IGBT switches
- CE compliant
- Sequential or simultaneous operation of up to three electron beam evaporation sources

Specifications

Metering Digital voltage and emission current

Cooling Air cooled

Input power 208V \pm 10%, three-phase, 50/60Hz, 30, 40, 60A
400V \pm 5%, three-phase, 50/60Hz, 15, 20, 30A

Voltage

Output 1 to 10kV DC, negative polarity

Ripple less than 1% RMS

Regulation \pm 0.25% of full-scale output

Efficiency 85%

| Cables | From – To | Length |
|---------------------|--------------------------------|--------|
| Input power cord | Facilities outlet/power supply | 3.66m |
| 8-gauge ground wire | Power supply/ground | 3.66m |

Current outputs

6kW 0 to 0.6A

10kW 0 to 1.0A

15kW 0 to 1.5A

Dimensions 483w x 260h x 533l
see the table below for weights

| Power supply | Voltage | Wt. kg | Reference | Part number |
|--------------|---------|--------|------------|---------------|
| 6KW | 208 | 34 | CVS-6-2CE | 991240 |
| 10KW | 208 | 41 | CVS-10-2CE | 991275 |
| 15KW | 208 | 45 | CVS-15-2CE | 991242 |
| 6KW | 400 | 34 | CVS-6-4CE | 991193 |
| 10KW | 400 | 41 | CVS-10-4CE | 991245 |
| 15KW | 400 | 45 | CVS-15-4CE | 991246 |

e-Vap® CVS series power supplies are constructed using state-of-the-art, solid-state, high-frequency switching technology. They are offered in three standard models, rated for 6kW, 10kW and 15kW. CVS series power supplies are for use with the horizontal and vertical flange-mounted systems detailed on the previous four pages, as well as the e-Vap® modular sources as detailed in the opening pages of this section. These power supplies are also compatible with most commercially available electron beam sources and are recommended as upgrade power supplies in existing electron beam evaporation systems.

Power supply enclosures are fully interlocked for operator safety. e-Vap® CVS series power supplies can power and control up to three electron beam sources. Source controls and XY sweeps are not included with power supplies and must be purchased separately.

The e-Vap® source control module also employs solid-state, high-frequency switching technology and is designed to precisely control emission current when used with e-Vap® power supplies. MDC recommends the use of a high-voltage grounding hook when servicing or working with all high-voltage power supplies. Grounding hooks are detailed in this catalogue on page 592.

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Controls and measurement

Source control module



Source control module

Features

- High-frequency switching technology
- Improved emission stability over 60Hz SCR circuits
- Compact filament transformer
- Electrically isolated from high-voltage unit
- Grounded and shielded filament transformer offers improved safety over conventional designs
- Self-contained emission current monitoring for independent operation
- CE compliant
- Full remote control capability
- Touch screen programming
- PS/2 hand-held mouse/trackball
- Rack mount brackets included

e-Vap® CVS source control modules are designed for use with e-Vap® CVS series power supplies. The source control module unit includes filament transformer assembly, hand-held mouse control and all necessary cables for hook up with an e-Vap® CVS power supply. A maximum output current of 70A assures sufficient power to drive virtually any commercially-available electron beam source.

e-Vap® CVS source control modules are available in three installation packages, direct flange mount and two remote cable mounts. Direct flange mount packages are used on all Caburn-MDC flange mounted evaporation systems. This package allows mounting of the filament transformer to a high-voltage feedthrough fitted with a 70mm Del-Seal™ CF flange. Filament transformer attachment is accomplished by bolting the transformer housing via two of the flange's .250-28 bolts positioned 180° apart.

The remote cable mount packages provide 914mm of high-voltage cable with OFE copper connector lugs and an acrylic high-voltage shield. This package is typically used with modular source installations where high-voltage electrical feedthroughs are fitted with 70mm Del-Seal™ CF flanges, but limited space does not allow direct installation. The second remote package is used on installations where high voltage are two 25mm feedthroughs.

The source control module's compact size occupies only half the width of a standard 483mm electronics rack. To facilitate the installation into a standard 483mm electronics rack, Caburn-MDC offers half-rack spacers. However, if the source control module is purchased in conjunction with an e-Vap® programmable XY sweep controller, the two units can be fastened together to form the standard 483mm rack width, thus eliminating the need for a spacer.

Specifications

| | | |
|--------------------------------------|---------------------------------------|---------------|
| Metering | Digital emission current | |
| Cooling | Air cooled | |
| Input power | 220V ± 10%, single-phase, 50/60Hz, 8A | |
| Voltage | | |
| Output | 12V AC | |
| Efficiency | 85% | |
| Current output | 0 to 70A | |
| Cables | From – To | Length |
| Input power cord | Wall outlet/source control module | 2.3m |
| Interface cable ¹ | Power supply/source control module | 1.8m |
| Secondary cable ¹ | Transformer/e-Vap® source | 0.9m |
| Control cable ² | Source control module/transformer | 3.6m |
| Transformer input cable ² | Source control module/transformer | 3.6m |
| High voltage cable ² | Power supply/transformer | 3.6m |
| Dimensions | 216w × 133h × 356l | |
| Weight | 9kg | |

¹ Fixed-length cables; not available in other lengths

² A 7.62m cable kit may be purchased separately; three cables are included per kit

| Description | Wt kg | Reference | Part number |
|---------------------------------|-------|-------------|------------------|
| Direct package | 4.5 | SCM-DFM-CE | 991364-01 |
| remote package | 4.5 | SCM2-RCM-CE | 991364 |
| Remote mount with 2 × 25mm bolt | 4.5 | SCM2-RCM-CE | 991364-02 |
| Half-rack spacer | .57 | EV-HRS | 991062 |
| 7.62m cable kit | 1.42 | SCM-25FC-CE | 991287 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Controls and measurement

XY Programmable sweep controller



e-Vap® Programmable sweep controller with mouse

Description

The next-generation e-Vap® programmable sweep controller has taken electron beam sweep capabilities to a higher level in versatility and practicality. It combines years of customer feedback with the latest advances in electronics technology. It possesses profound advancements from its predecessor in terms of functionality and ruggedness. It is designed with both the coating engineer and coating operator in mind.

Electron beam control is dynamically precise, allowing the user optimum ability to deposit dielectrics and metals in the most demanding of applications. The strength of the sweep controller lies in its ability to easily adapt to different evaporation process requirements, using its many expandable sweep patterns.

Four predefined sweep patterns and up to 95 user-defined patterns may consist of up to 208 XY points with a different beam dwell time for each beam point. The user interface includes a large, vibrant colour LCD display with six function keys and a smooth rolling adjustment knob.

A hand-held PS/2 device (trackball) is provided, allowing beam manoeuvrability for crucible material preparation and evaporation. For computer-automated vacuum systems, a detailed rear panel digital I/O port, along with a standard RS-232 interface, allowing access to the most important sweeper functions and status signals. An optional interactive Windows® programme is available allowing desktop sweep pattern design and virtually unlimited sweep pattern storage.

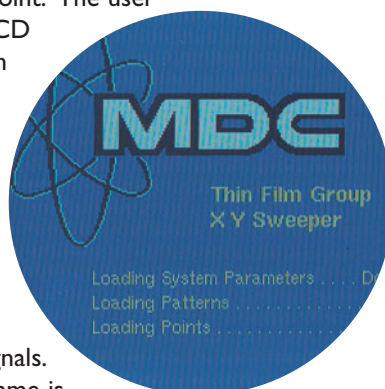
All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Features

- Use with virtually any electron beam source
- Large colour LCD display
- Store up to 99 sweep patterns (95 user programmable)
- PS/2 hand-held mouse/trackball control included
- An audible alarm warns of possible fault conditions
- Ability to custom name each sweep pattern
- Ability to choose a crucible pocket number to correspond to specific sweep patterns and/or parameters such as beam centring or evaporation material specification.
- Ability to custom name the sweep controller itself for coating machine identification
- Expanded beam power profile capabilities allow the user to control erosion of difficult-to-evaporate materials
- Customizable display colour (foreground and background) to match your company colours or coating machine colours
- Password option – requires a four-digit code to access functions
- RS-232 interface
- Safety interlocked
- All cabling included
- CE compliant
- Rack mounting brackets included

Specifications

| | |
|--|------------------------------------|
| Graphic display | Colour LCD |
| Input power | 100-200/200-240V, 50/60Hz, 3A |
| Max coil output Sweep + DC bias | 5A |
| Max sweep frequency | 200Hz |
| Programming interface | Push-button, digital I/O or RS-232 |
| Mouse remote input | PS/2 |
| Max cable length 18AWG | 7.62M |
| Weight | 5kg |
| Dimensions | 216w x 133h x 356d |





Controls and measurement

XY Programmable sweep controller

Sweep pattern types

All of these patterns may have their sweep characteristics and parameters highly modified. These parameters include speed, phase and power profile.

Speed is defined as the speed at which the beam travels to complete one cycle of a given pattern. The fundamental frequency of beam sweep is speed. Speed settings are fast, medium and slow. Fast is considered the base time, medium takes twice as long and slow takes five times longer.

PHASE is defined as angular pattern rotation per cycle. The pattern is rotated a few degrees after each sweep pattern cycle. PHASE settings are fast (50 degree steps), medium (20 degree steps), slow (10 degree steps) and none.

Power profile is defined as the speed of the beam based on its distance from the centre of the crucible. It allows the beam to sweep faster through the centre of the crucible than at the outer edges. The parameter of a pattern crossing the crucible too many times, thus resulting in tunnelling of the material, may be adjusted to obtain even beam temperature distribution across the crucible surface. Power profile settings range from 1 to $1/R^2$. A setting of 1 is considered as the beam dwell time being the same for all points. a setting of $1/R^2$ is considered the beam dwell time being four times greater on the outer edges of the crucible. Adjusting the profile between 1 and $1/R^2$ (20 possible adjustments) is a new feature for the sweep controller and adds coating process optimization to this already valuable parameter.

Select pattern

| MDC Sweeper Pattern 5 | |
|--------------------------|---------------------------|
| Main Screen | |
| Prev Menu | Scroll Patterns with Knob |
| Edit Points | 1. Pattern 1 -- Circle |
| Edit Params | 2. Pattern 2 -- Spiral |
| | 3. Pattern 3 -- Figure 8 |
| Edit Name | 4. Pattern 4 -- Line |
| | 5. Pattern 5 -- User |
| Delete Pattern | 6. Pattern 6 -- User |
| | 7. Pattern 7 -- User |
| | 8. Pattern 8 -- User |
| | 9. Pattern 9 -- User |
| | 10. Pattern 10 -- User |
| | 11. Pattern 11 -- User |

The select pattern screen allows the user to view patterns one through 99. All patterns may be started and/or edited from this screen as well.

Circle pattern

| Pattern 1: Circle | | | |
|-------------------|----------|-----------------|-------|
| Sweep is Off | | | |
| DC is Off | | | |
| Edit Amplitude | | | |
| Select Pattern | | | |
| Save Changes | X Offset | Sweep Amplitude | Phase |
| | -0.2 | 1.5 | None |
| Next Menu | Y Offset | Power Profile | Speed |
| | -1.8 | 1 | Fast |

The circle pattern makes the beam sweep in concentric circles beginning at the outer edge of the crucible and steps closer to the centre of the crucible with each revolution. Upon reaching the centre, a reverse cycle begins and the beam sweep pattern continues.

Spiral pattern

| Pattern 2: Spiral | | | |
|-------------------|----------|-----------------|--------|
| Sweep is Off | | | |
| DC is Off | | | |
| Edit Amplitude | | | |
| Select Pattern | | | |
| Save Changes | X Offset | Sweep Amplitude | Phase |
| | -0.2 | 0.5 | Medium |
| Next Menu | Y Offset | Power Profile | Speed |
| | -1.8 | 1 | Slow |

A spiral pattern makes the beam sweep in a continuous spiral, beginning at the outer edge of the crucible and advancing toward the centre and then back out again.

The figure-eight pattern

| Pattern 3: Figure 8 | | | |
|---------------------|----------|-----------------|-------|
| Sweep is Off | | | |
| DC is Off | | | |
| Edit Amplitude | | | |
| Select Pattern | | | |
| Save Changes | X Offset | Sweep Amplitude | Phase |
| | -0.2 | 2.5 | Fast |
| Next Menu | Y Offset | Power Profile | Speed |
| | -1.8 | 1 | Fast |

The figure-eight pattern makes the beam sweep in a well-defined figure-eight path across the crucible.

All dimensions are nominal in millimetres unless specified

Controls and measurement

XY Programmable sweep controller

Sweep pattern types

Line pattern

| Parameter | Value |
|-----------------|--------|
| X Offset | -0.2 |
| Sweep Amplitude | 3.5 |
| Phase | Medium |
| Y Offset | -1.8 |
| Power Profile | 1 |
| Speed | Medium |

A **line** pattern makes the beam sweep in a straight line across the crucible. As in all the predefined patterns (circle, spiral, figure eight and line), the sweep amplitude, speed, phase, power profile and XY offset can be readily adjusted. There is also easy access to selecting patterns and scrolling through different screen

System parameters

| Parameter | Value |
|-------------------|-------------|
| X Offset | -0.2 |
| Y Offset | -1.8 |
| Gun Type | T |
| Linear Amplitude | 0 |
| Linear Rotation | 0 |
| Contrast | 9 |
| Foreground Color | Yellow |
| Background Color | Blue |
| Maximum Amplitude | 5.0 |
| Machine Name | MDC Sweeper |
| Mouse Sensitivity | 10 |

The **system parameter** screen allows the XY offset to be adjusted and stored. Linearity and contrast adjustments can be implemented from here as well. Foreground and background colour selections can also be made from this screen and will affect all subsequent patterns. The maximum allowable sweep amplitude current can be set here for the pattern. You can also designate the coating machine's name, as well as adjust the sensitivity of the mouse from this screen.

User pattern

| Point | X | Y | Dwell |
|-------------------|----|----|-------|
| Edit Point | -8 | 2 | 10 |
| Delete Point | -8 | -2 | 10 |
| Delete Point | -5 | -2 | 20 |
| Delete Point | -2 | -2 | 20 |
| Delete Point | -2 | -5 | 10 |
| Delete All Points | -2 | -8 | 10 |

User pattern: 95 user-defined patterns, completely customizable by the user, can be designed and stored into the sweep controller for instant access. Each of the user-defined patterns can contain up to 208 beam location points. Each point can possess its own dwell time ranging from 1 to 100ms. Patterns can be designed via the front panel of through RS-232. If designed via the front panel, a colour, interactive-matrix panel is displayed for user feedback.

User pattern

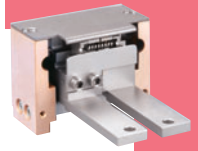
| Parameter | Value |
|-----------------|--------|
| X Offset | -0.2 |
| Sweep Amplitude | 0.1 |
| Phase | Medium |
| Y Offset | -1.8 |
| Power Profile | N/A |
| Speed | Slow |

It displays a crucible-shaped area showing all selected points (see the interactive matrix panel shown on the left). Custom naming of the generated pattern, adding and deleting points/patterns and modifying dwell times can all be done on the same screen. A new feature of the sweep controller allows the user to access the speed function as well. Choices for the speed setting are fast, medium and slow.

All dimensions are nominal in millimetres unless specified

Controls and measurement

XY Programmable control sweeper



Customise the pattern/controller name

The sweep controller has the ability to custom name each individual sweep pattern, whether pre-defined or user-defined. For example, when you choose a specific pattern for a specific evaporation material, it may be desirable to name the pattern after the evaporation material, such as QuartzPattern or TitaniumPattern.

The sweep controller also has the ability to store a name for itself. If your coating machine is called Coating Machine One you can customise the name of the sweep controller as CoatingMachineOne.

The sweep controller also has the ability to assign a specific pattern number 1 to 99 to a specific crucible number or pocket. This is advantageous for users who always have a certain evaporation material in a certain crucible pocket. This allows the user to save custom sweep and beam parameters for a given crucible pocket. This is beneficial since most deposition controllers have the ability to invoke crucible pockets during a coating cycle.

Handheld PS/2 mouse/trackball

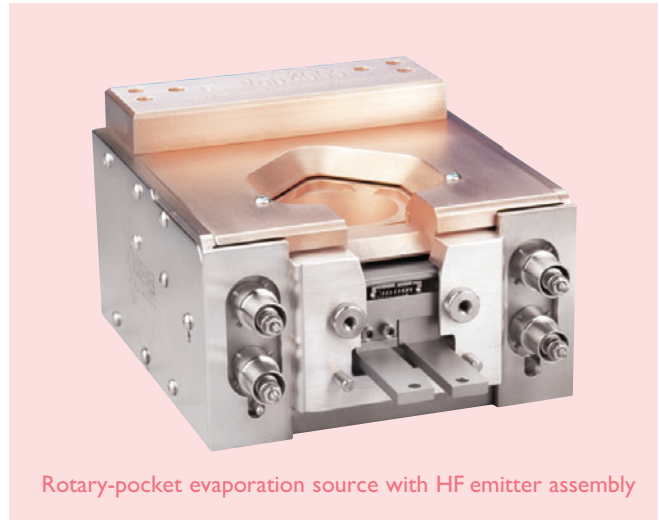


The XY programmable sweep controller comes equipped with a hand-held PS/2 mouse/trackball which allows activation and XY offsets and sweep amplitude adjustments from up to 1.8m away.

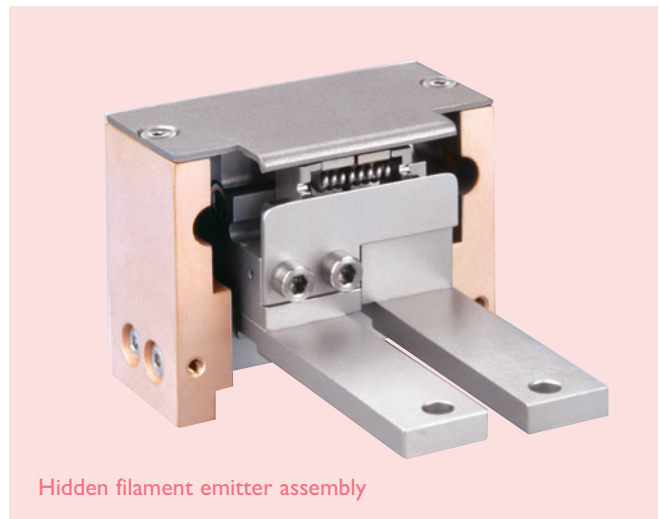
Functions

- Sweep on/off click left mouse button
- DC on/off click right mouse button
- Edit XY offset roll the trackball in the desired direction
- Edit amplitude highlight amplitude and roll trackball up or down

Optical coating uniformity solutions

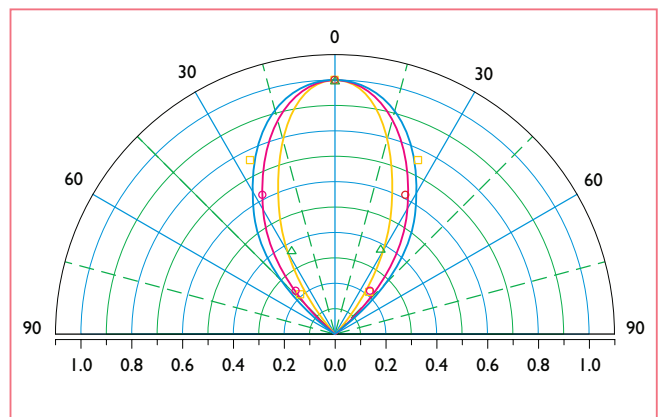


Rotary-pocket evaporation source with HF emitter assembly



Hidden filament emitter assembly

Maximized coating distribution with optimal sweep patterns



Description

XY programmable sweep controller
Half-rack spacer

Reference

XYS2-CE
EV-HRS

Part number

991344
991062

All dimensions are nominal in millimetres unless specified

Controls and measurement

Deposition monitoring and control



SQM-160 rate/thickness monitor

Description

Caburn-MDC offers a choice of four units with a range of capabilities from monitoring the deposition process to controlling multiple deposition processes or controlling co deposition processes. The choices are tailored from introductory/economical thin film deposition to full process control for a production process. Co deposition of materials from multiple sources allows easier fabrication and investigation of complex material compositions and layers. All of the monitors and controllers utilise proven 6MHz quartz crystal sensor technology to measure the thin film deposition process.



SQM-222C co deposition controller

SQM-160

The SQM-160 measures thickness and deposition rate of the thin film deposition process. The base unit can monitor from two independent measurement channels. Four relays are available to control source and crystal shutters during the deposition process. Up to nine films can be stored in memory the SQM-160's memory, active film can be easily changed from the front panel. All parameters can also be set from the front panel of the monitor. The SQM-160 is a monitor only and is not capable of controlling the rate during deposition.

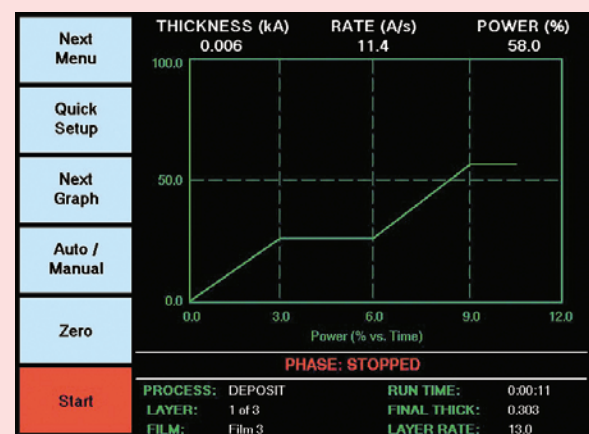
All dimensions are nominal in millimetres unless specified. Weights given are approximate.



SQC-122C two-channel deposition controller

SQC-122

The SQC-122 controls deposition rate and thickness in multilayer thin film deposition processes. The controller was designed for ease of use with six content sensitive softkeys, providing rapid access to frequently used data. The 122C memory will hold up to 25 processes, consisting of 250 layers and 25 materials. Cut, copy and paste capabilities make it easy to modify or duplicate processes and layers. The controller has inputs for two crystal sensors, two 0 to 10V outputs are available to control the evaporation rate. Eight relays and digital inputs can be independently assigned to over 40 possible events, including pocket rotation and external process controls. A Windows® programme for setup and data acquisition is also included with the controller.



SQC-122C screen example

SQC-222C

The SQC-222C model of the controller includes software for co deposition control. The two crystal sensors and two outputs to control the deposition rate, along with special software features, allow for co deposition capability.

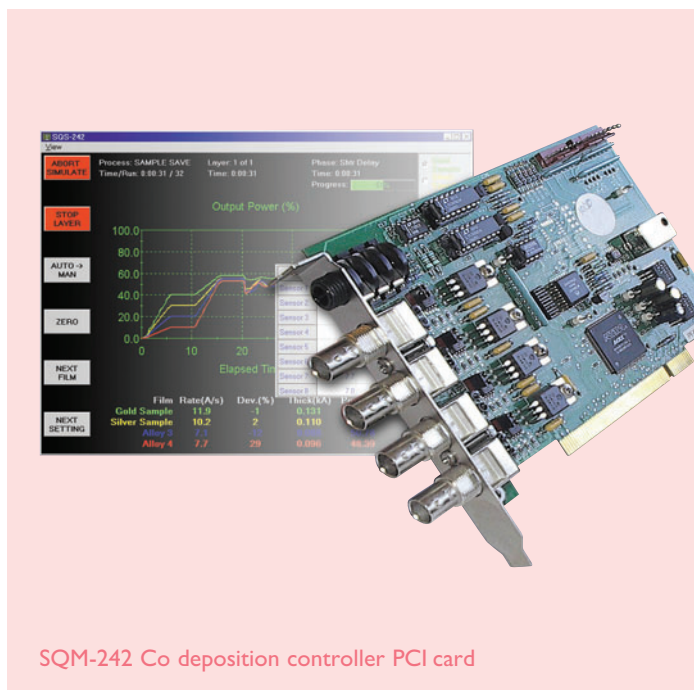


Controls and measurement

Deposition monitoring and control

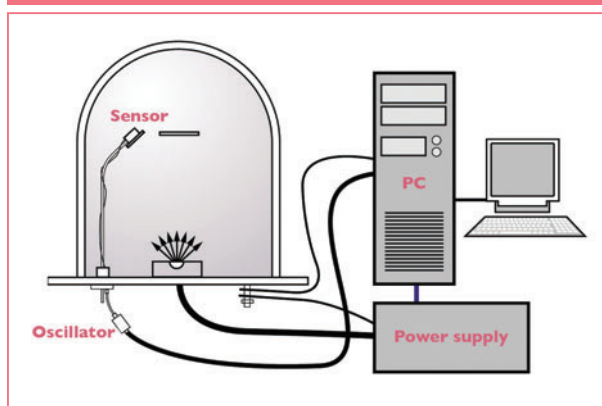
SQM-242

The SQM-242 is a thin film deposition controller and a standard PCI expansion card. Each SQM monitors from one to four crystal sensor inputs, and provides two control voltage outputs. A typical single-sensor deposition system is shown, the SQM-242 card is installed in a computer, a quartz crystal sensor is connected to the input and the output is connected to a power supply. The card will control the deposition rate and adjust the output of the power supply for constant deposition rate. The basic SQM-242 card includes software that is easily modified to communicate with digital I/O cards. The SQS-242 software package supports multiple cards, co deposition, digital I/O, graphing and data logging.



SQM-242 Co deposition controller PCI card

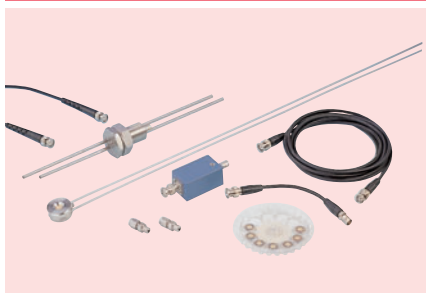
SQM-242 Co deposition controller software



| Description | Reference | Part number |
|---------------------------------------|-----------|---------------|
| SQM-160 2-Channel deposition monitor | SQM-160 | 991366 |
| SQM-122C 2-Channel deposition monitor | SQM-122C | 991309 |
| SQM-222C 2-Channel deposition monitor | SQM-222C | 991367 |
| SQM-242 2-Channel deposition monitor | SQM-242 | 991327 |
| SQS-242 Co deposition software | SQS-242 | 991328 |

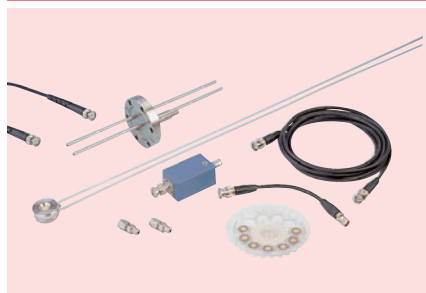
Crystal sensor packages

25mm Baseplate Low profile



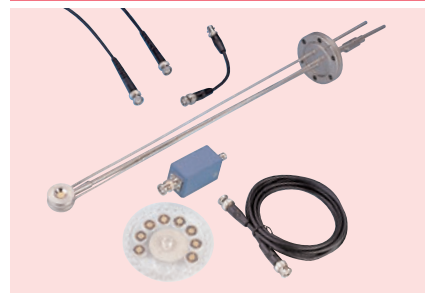
Low-profile sensor packages include a sensor head, oscillator, 762mm in-vacuum cable, 152mm BNC cable, 254mm BNC cable, a box of five gold-coated sensor crystals, two Swagelok® compression fittings and a 25mm baseplate sensor feedthrough. Bakeable to 180°C.

70mm Del-Seal™ CF Low profile



Low-profile sensor packages include a sensor head, oscillator, 762mm in-vacuum cable, 152mm BNC cable, 254mm BNC cable, a box of five gold-coated sensor crystals, two Swagelok® compression fittings and a 70mm Del-Seal™ CF sensor feedthrough. Bakeable to 180°C.

70mm Del-Seal™ CF Bakeable to 400°C



Bakeable sensor packages include a 400°C bakeable sensor head, oscillator, 762mm in-vacuum cable, 152mm BNC cable, 254mm BNC cable, and a box of five gold-coated sensor crystals. The sensor head is pre-installed on a 70mm Del-Seal™ CF flange, which includes the sensor feedthrough.

| Description | Mount | Wt. kg | Reference | Part number |
|-----------------------------|-------------------|--------|-------------|---------------|
| Low-profile sensor pack | 25mm baseplate | 2.3 | LSP-1 | 991310 |
| Low-profile sensor pack | 70mm Del-Seal™ CF | 2.3 | LPSP-275 | 991311 |
| Bakeable sensor pack | 70mm Del-Seal™ CF | 2.3 | LPSP-HT-275 | 991637 |
| Sensor crystals, gold rated | Box of 10 | 2.3 | CRP-500-117 | 991131 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Controls and measurement

Deposition monitoring and control



Features

- Reliable
- Small footprint
- Minimal shadowing
- Ease of installation
- Works with present Thin Film controllers
- One-third the price of leading competitors' units

XL12 Multi-crystal sensor head package

- Multi-crystal sensor head
- Controller
- 25mm Bolt feedthrough or 70mm Conflat®
- 762mm In-vacuum cable
- 12 Quartz crystals
- 15 Crystal carriages
- Two sensor shields

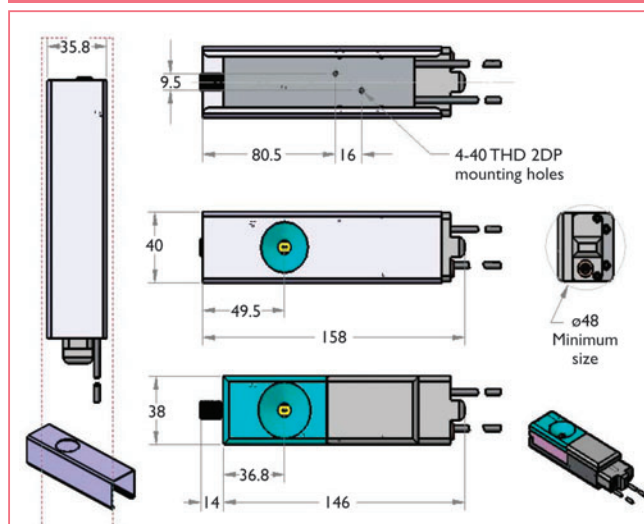
Description

The XL12 Multi-crystal sensor head can hold up to 12 6MHz crystals at one time. With the XL12, the customer can take financial advantage of longer deposition runs. This instrument is an exclusive, patent-pending design, ready to meet industry needs.

This revolutionary design is small sensor head, just 38w x 146l x 35h, that uses slide technology to transfer the crystals. Crystals are seated in carriage assemblies in order to provide guaranteed exchange during process. When the crystal in use expires, an operator can manually signal the next crystal to move into position, or the operator can send a signal via the thin film monitor/controller. After a signal is given, the XL12 transfers the next crystal into position and moves the expired crystal into a holding compartment.

To reload the XL12, you simply remove the self-aligning crystal cartridge from the main body. You then remove two screws and the top plate; reload with 12 new crystals; replace the top plate and screws; then, reinstall the cartridge to the main body. This process takes less than five minutes.

Figure 1 XL12 Multi-crystal sensor head specifications



Crystal loaded in cartridge



| Description | Wt. kg | Reference | Part number |
|--------------------------------|--------|-----------|-------------|
| XL12 Multi crystal sensor head | 9 | EV-XL12CS | 991375 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Controls and measurement



Crucible indexer



e-Vap® crucible indexer

Description

The e-Vap® crucible indexer is a microstepper-controlled motor drive unit used to position and rotate a multihearth electron beam source. The crucible indexer will rotate and position up to eight pocket positions; additionally, eight preprogrammed configurations can be selected via dip switch settings at the back of the controller.

These include: two-, four- and six-pocket, 180° banana, three-pocket 90° banana, three-pocket 120° banana, three-pocket 135° banana, three-pocket 145° banana and continuous 360° rotation.

An additional dip switch lets the user select the following modes: bi-direction (shortest path between pockets), counter-clockwise rotation, UHV source type, high speed range, BDC I/O, and enable ethernet communications. In addition, the indexer can be user-configured for any pocket/banana crucible layout. The indexer also eliminates mechanical adjustment of the home or first pocket location, the 'home' position can be defined electronically.

The e-Vap® crucible indexer can be controlled either manually or remotely, it can be configured to interface with most deposition controllers equipped to select pockets on a multilayer deposition. A Windows®-based configuration screen can be used to customise the pocket layout. The drive motor comes with a bracket to attach a 70mm Del-Seal™ rotary feedthrough or a 25mm bolt-type rotary feedthrough. The indexer is supplied with a coupling to connect the 6.35mm drive shaft to the 6.35mm feedthrough shaft. The e-Vap® crucible indexer is designed to be one of the most flexible methods to customise or fine tune crucible rotation and control for multihearth electron beam sources.

Features

- Direct drive – no pulleys or belts to set or adjust
- Electronic calibration of position
- Eight predefined pocket configurations included
- User-configurable feature allows for custom or special pocket configurations
- Can be operated manually or by external controller
- Two speed ranges for a total of 20 speed settings
- 1.8° Resolution
- CE Compliant

Specifications

Motor drive

| | |
|------------------------------------|--|
| Motor type | Micro-stepper |
| Torque | 1.4N-m(200oz-in) |
| Speed RPM | |
| Low | 0.05, 0.06, 0.08, 0.10, .012, .015, .019, .024, 0.30, .037 |
| High | 0.5, 0.6, 0.8, 1.0, 1.2, 1.5, 1.9, 2.4, 3.0, 3.7 |
| Resolution | 1.8° |
| Repeatability | 0.25° |
| Size height x width x depth | 89 x 89 x 122 |
| Weight | 1.5kg |
| Power | 12W |

Controller

| | |
|------------------------------------|-----------------------------------|
| Pockets | up to 8 |
| Digital inputs | Binary or BCD-encoded |
| Low | 0 to 2V DC |
| High | 4 to 24V DC, non-isolated |
| Communications | RS-232 or Ethernet |
| Size height x width x depth | 88 x 213 x 197 |
| Weight | 2.7kg |
| Power | 100-120/200-240V AC, 50/60Hz, 20W |
| Compliance | CE (LVF & ECD) |
| Interconnecting cable | 3M standard DB25 |

| Description | Reference | Part number |
|------------------|---------------|-------------|
| Crucible indexer | EV-CI-INDEXER | 991400 |

All dimensions are nominal in millimetres unless specified. Weights given are approximate.

Evaporation source accessories

Safety accessories and shutters

High-voltage safety accessories



Grounding hook Caburn-MDC recommends the use of a grounding hook prior to service or maintenance of any high-voltage equipment. Connections which were previously energised should be discharged with a grounding hook solidly connected to a low-impedance earth ground. Hook installation is made easy with the supplied 1.63M insulated cable.

High-voltage shield To prevent accidental contact with exposed high-voltage leads, Caburn-MDC recommends the use of high-voltage acrylic shields. These shields are available for both 70mm Del-Seal™ CF flange mounted and 25mm baseplate mounted feedthroughs. Strain relief will accept cables from 5.8 to 12mm in diameter.

| Description | Reference | Part number |
|---------------------------------|-----------|---------------|
| High-voltage safety ground hook | EV-SGH | 991106 |
| Acrylic shield, 70mm Del-Seal™ | HVE-2 | 640051 |
| Acrylic shield, 25mm baseplate | BHVE-2 | 640057 |

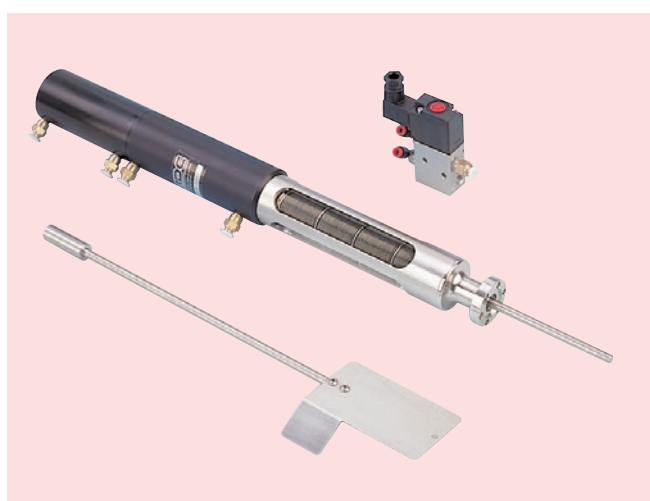
Pneumatic shutter Two-position



Pneumatic shutters are an excellent tool for precise control of thin film thickness onto a substrate. The air actuated shutter masks off the vapour stream between source and substrate at the beginning and finishing stages of the evaporation/deposition cycle. The shutter also allows pre-melt or 'soak' prior to deposition by blanketing the evaporation material. Shutters with a 50mm diameter and a 50mm stroke are used on sources with crucible volumes of less than 40cc. Shutters with a 75mm diameter and a 100mm stroke are used on sources with crucible volumes of 40cc and greater. These shutters come standard with a 120V AC solenoid valve.

| Nominal flange | Shutter diameter | Stroke length | Reference | Part number |
|----------------|------------------|---------------|------------|------------------|
| 34 | 50 | 50 | PS-2P2-133 | 991796-02 |
| 34 | 75 | 100 | PS-2P3-133 | 991796-01 |
| 70 | 50 | 50 | PS-2P2-275 | 991794-02 |
| 70 | 75 | 100 | PS-2P3-275 | 991794-01 |

Pneumatic shutter Three-position



Three-position pneumatic shutters offer greater process flexibility than other shutters. In position one, the shutter will close the deposition and rate monitoring ports on a horizontal e-Vap® system fitted with a water-cooled roof. In position two, the shutter continues to block the deposition port, but opens the rate-monitoring port. In position three, all ports are open and the system is ready to begin a coating cycle. This shutter includes a 120V AC solenoid air control valve.

| Description | Reference | Part number |
|------------------------|------------|---------------|
| Shutter Three-position | PS-3PW-133 | 996343 |

All dimensions are nominal in millimetres unless specified

Evaporation source accessories



Shutters, rods and switches

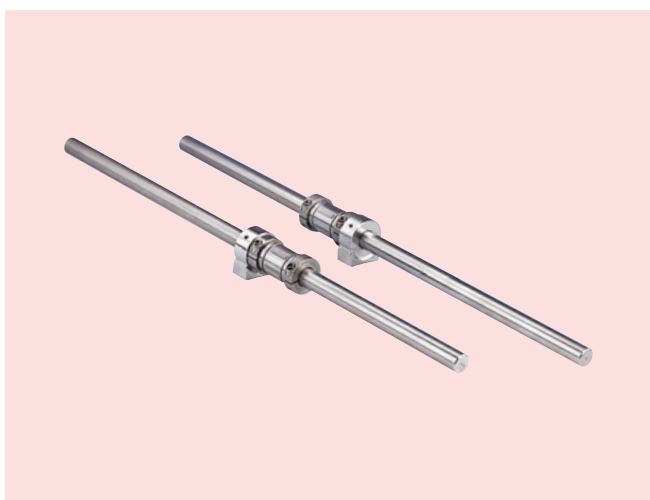
Manual shutter push-pull



Manual shutters are an excellent tool for control of thin film thickness onto a substrate. The manually-operated shutter masks off the vapour stream between source and substrate at the beginning and finishing stages of the evaporation/deposition cycle. The shutter also allows pre-melt or 'soak' prior to deposition by blanketing the evaporation material. Shutters with a 50mm diameter by 50mm stroke are used on sources with crucible volumes of less than 40cc. Shutters with a 75mm diameter by 100mm stroke are used on sources with crucible volumes of 40cc and greater.

| Nominal flange | Shutter diameter | Stroke length | Reference | Part number |
|----------------|------------------|---------------|-----------|------------------|
| 34 | 50 | 50 | MS-2-133 | 991793-01 |
| 34 | 75 | 100 | MS-3-133 | 991793-02 |
| 70 | 50 | 50 | MS-2-275 | 991792-01 |
| 70 | 75 | 100 | MS-3-275 | 991792-02 |

Linear guide rods



Linear bearing guide rods allow horizontal flange mounted e-Vap® systems to be routinely maintained by simply sliding in and out, in drawer-like fashion. Two linear ball bushings provide the smooth gliding action required for ease of movement. Weldable support brackets secure the guide rods onto the user's port flange. The bracket installation procedure is simple and self-explanatory.

| Description | Reference | Part number |
|-------------|-----------|---------------|
| Guide rods | EV-LGRA | 991791 |

Water flow switch



e-Vap® electron beam sources rely on water-cooling to dissipate the large amounts of heat generated by an electron beam. Proper water flow is essential for normal system operation as well as for safety. The water flow switch will turn off all power to the e-Vap® source when and if a present water flow rate drops below its set point.

| Description | Reference | Part number |
|--------------------------|-----------|------------------|
| Water flow switch 24V DC | EV-WF240 | 991031-01 |

All dimensions are nominal in millimetres unless specified

Evaporation source accessories

Crucible liners



Crucible liners

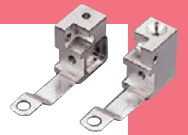
We recommend using crucible liners with all e-Vap® sources. Crucible liners provide thermal isolation between a target material and a source's water-cooled crucible. These liners offer improved thermal stability while reducing the transfer of heat to the crucible. Liners provide the ability to easily and quickly switch evaporant materials without removing the source for cleaning. They also reduce power requirements to achieve specific evaporation rates. Graphite and vitreous carbon are the most popular liner materials, due to their low cost and favourable thermal properties. Vitreous carbon is produced using a patented glazing process, then baked above 1400°C to eliminate any porosity in the carbon.

| Linear material | Crucible size | Reference | Part number |
|-----------------|---------------|------------|------------------|
| Graphite | 2cc | EV-CL2G | 992584-01 |
| Graphite | 6cc | EV-CL6G | 990586-01 |
| Graphite | 7cc | EV-CL7G | 990587-01 |
| Graphite | 15cc | EV-CL15G | 990588-01 |
| Graphite | 25cc | EV-CL25G | 990589-01 |
| Graphite | 30cc | EV-CL30G | 992484-01 |
| Graphite | 40cc | EV-CL40G | 990590-01 |
| Graphite | 60cc | EV-CL60G | 992571-01 |
| Graphite | 75cc | EV-CL75G | 992572-01 |
| Graphite | 100cc | EV-CL100G | 992573-01 |
| Vitreous carbon | 2cc | EV-CL2VC | 992584-02 |
| Vitreous carbon | 6cc | EV-CL6VC | 990586-02 |
| Vitreous carbon | 7cc | EV-CL7VC | 990587-02 |
| Vitreous carbon | 15cc | EV-CL15VC | 990588-02 |
| Vitreous carbon | 25cc | EV-CL25VC | 990589-02 |
| Vitreous carbon | 30cc | EV-CL30VC | 992484-02 |
| Vitreous carbon | 40cc | EV-CL40VC | 990590-02 |
| Vitreous carbon | 60cc | EV-CL60VC | 992571-02 |
| Vitreous carbon | 75cc | EV-CL75VC | 992572-02 |
| Vitreous carbon | 100cc | EV-CL100VC | 992573-02 |
| Molybdenum | 2cc | EV-CL2M | 992584-03 |
| Molybdenum | 6cc | EV-CL6M | 990586-03 |
| Molybdenum | 7cc | EV-CL7M | 990587-03 |
| Molybdenum | 15cc | EV-CL15M | 990588-03 |
| Molybdenum | 25cc | EV-CL25M | 990589-03 |
| Molybdenum | 30cc | EV-CL30M | 992484-03 |
| Molybdenum | 40cc | EV-CL40M | 990590-03 |
| Molybdenum | 60cc | EV-CL60M | 990571-03 |
| Molybdenum | 75cc | EV-CL75M | 990572-03 |
| Molybdenum | 100cc | EV-CL100M | 990573-03 |
| Tungsten | 2cc | EV-CL2TU | 992584-04 |
| Tungsten | 6cc | EV-CL6TU | 990586-04 |
| Tungsten | 7cc | EV-CL7TU | 990587-04 |
| Tungsten | 15cc | EV-CL15TU | 990588-04 |
| Tungsten | 25cc | EV-CL25TU | 990589-04 |
| Fabmate | 2cc | EV-CL2FM | 990584-10 |
| Fabmate | 6cc | EV-CL6FM | 990586-10 |

| Linear material | Crucible size | Reference | Part number |
|-----------------|---------------|------------|------------------|
| Tungsten | 30cc | EV-CL30TU | 992484-04 |
| Tungsten | 40cc | EV-CL40TU | 990590-04 |
| Tungsten | 60cc | EV-CL60TU | 992571-04 |
| Tungsten | 75cc | EV-CL75TU | 992572-04 |
| Tungsten | 100cc | EV-CL100TU | 992573-04 |
| Boron nitride | 2cc | EV-CL2BN | 992584-05 |
| Boron nitride | 6cc | EV-CL6BN | 990586-05 |
| Boron nitride | 7cc | EV-CL7BN | 990587-05 |
| Boron nitride | 15cc | EV-CL15BN | 990588-05 |
| Boron nitride | 25cc | EV-CL25BN | 990589-05 |
| Boron nitride | 30cc | EV-CL30BN | 992484-05 |
| Boron nitride | 40cc | EV-CL40BN | 992590-05 |
| Boron nitride | 60cc | EV-CL60BN | 992571-05 |
| Boron nitride | 75cc | EV-CL75BN | 992572-05 |
| Boron nitride | 100cc | EV-CL100BN | 992573-05 |
| Alumina | 2cc | EV-CL2A | 992584-06 |
| Alumina | 6cc | EV-CL6A | 990586-06 |
| Alumina | 7cc | EV-CL7A | 990587-06 |
| Alumina | 15cc | EV-CL15A | 990588-06 |
| Alumina | 25cc | EV-CL25A | 990589-06 |
| Alumina | 30cc | EV-CL30A | 992484-06 |
| Alumina | 40cc | EV-CL40A | 990590-06 |
| Alumina | 60cc | EV-CL60A | 992571-06 |
| Alumina | 75cc | EV-CL75A | 992572-06 |
| Alumina | 100cc | EV-CL100A | 992573-06 |
| Copper | 2cc | EV-CL2CU | 992584-08 |
| Copper | 6cc | EV-CL6CU | 990586-08 |
| Copper | 7cc | EV-CL7CU | 990587-08 |
| Copper | 15cc | EV-CL15CU | 990588-08 |
| Copper | 25cc | EV-CL25CU | 990589-08 |
| Copper | 30cc | EV-CL30CU | 992484-08 |
| Copper | 40cc | EV-CL40CU | 990590-08 |
| Copper | 60cc | EV-CL60CU | 992571-08 |
| Copper | 75cc | EV-CL75CU | 992572-08 |
| Copper | 100cc | EV-CL100CU | 992573-08 |

All dimensions are nominal in millimetres unless specified

Evaporation source accessories



270° Emitter consumable accessories

The spare parts detailed below are a list of e-Vap® consumable components which may require periodic replacement.

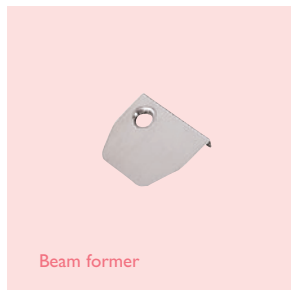
These components have been specifically designed for use with Caburn-MDC e-Vap® electron beam evaporation sources and systems



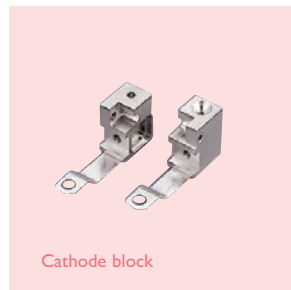
Anode



Beam deflector shield



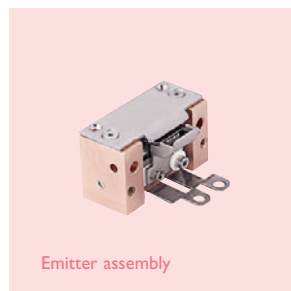
Beam former



Cathode block



Non-galling fasteners



Emitter assembly



Filament clamps



Filament set



Insulators

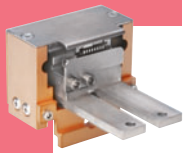
| Description | Used with frame size | Reference | Part number |
|---------------------------|----------------------|-------------|------------------|
| Anode | 1 – 6 | EV-EA | 990537 |
| Beam deflector shield | 1, 2, 5, 6 | EV-BDS1256 | 992201 |
| Beam deflector shield | 3, 4 | EV-BDS34 | 990534 |
| Beam former | 1 – 6 | EV-BF | 990533 |
| Cathode block LH | 1, 2 | EV-LCB12 | 990525-01 |
| Cathode block RH | 1, 2 | EV-RCB12 | 990526-01 |
| Cathode block LH | 3 – 6 | EV-LCB36 | 990525-02 |
| Cathode block RH | 3 – 6 | EV-RCB36 | 990526-02 |
| Emitter assembly | 1, 2 | EV-EA-1000 | 990630-01 |
| Emitter assembly, old | 51 | EV-EA-4010O | 990630-02 |
| Emitter assembly | 6 | EV-EA-4015 | 990630-03 |
| Emitter assembly | 3 | EV-EA-4066 | 990630-04 |
| Emitter assembly | 4 | EV-EA-4UHV | 990630-06 |
| Emitter assembly,new | 51 | EV-EA-4010N | 990630-05 |
| Fasteners, non-galling | 1 – 6 | EV-FK | 990585 |
| Filament clamp LH | 1 – 6 | EV-LFC | 990531 |
| Filament clamp RH | 1 – 6 | EV-RFC | 990532 |
| Filament set, 5 each | 1, 2, 6 | EV-FIL126 | 992330 |
| Filament set, 5 each | 3, 4, 5 | EV-FIL345 | 990527 |
| Insulator, high voltage | 1 – 6 | EV-IHV | 990530 |
| Insulator, filament block | 1 – 6 | EV-IFB | 990528 |
| Insulator, beam detector | 1 – 6 | EV-IBDS | 990535 |
| Insulator, beam former | 1 – 6 | EV-IBFS | 990529 |

Note Older, frame-five emitter assemblies are fitted with short design anodes as pictured at left

New frame-five emitter assemblies are fitted with new, extended-design anodes as shown at the top of the 'Anode' figure

Evaporation source accessories

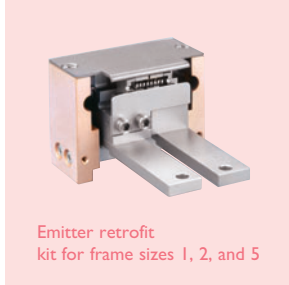
HF Emitter assembly consumables



The spare parts detailed below are a list of e-Vap® consumable components which may require periodic replacement. These components have been specifically designed for use with MDC e-Vap® electron beam evaporation sources and systems equipped with the HF emitter assembly.

Retrofit kit includes:

- One HF emitter assembly
- One filament installation tool
- One faceplate for emitter
- Permanent magnets: frame sizes five and six only
- Two installation screws
- Detailed instructions



Emitter retrofit kit for frame sizes 1, 2, and 5



Emitter retrofit kit for frame size 6

Components may be purchased individually or as a complete retrofit kit.



Anode



Beam deflector shield

| Description | Used with frame size | Reference | Part number |
|------------------------------|----------------------|--------------|---------------|
| Emitter retrofit kits | | | |
| Emitter retrofit kit | 1, 2, 5 | EV-EAHFI-KIT | 992908 |
| Emitter retrofit kit | 6 | EV-EAHFG-KIT | 992909 |

| Emitter assemblies | | | |
|---------------------------|---------|----------|------------------|
| Emitter assembly | 1, 2, 5 | EV-EAHF1 | 992850-02 |
| Emitter assembly | 6 | EV-EAHF6 | 992850-01 |



Filament installation tool



Cathode blocks

| Replacement parts | | | |
|----------------------------------|-------|----------|------------------|
| Anode | 1 – 6 | EV-AHF | 992845 |
| Beam deflector shield | 1 – 6 | EV-BDSHF | 992846 |
| Filament installation tool | 1 – 6 | EV-FIT | 992534-01 |
| Cathode Block LH | 1 – 6 | EV-LCBHF | 992853 |
| Cathode block RH | 1 – 6 | EV-RCBHF | 992852 |
| Fasteners, non-galling, set of 8 | 1 – 6 | EV-FKHF | 993042 |
| Filament clamp LH | 1 – 6 | EV-LFCHF | 992847-01 |
| Filament clamp RH | 1 – 6 | EV-RFCHF | 992847-02 |

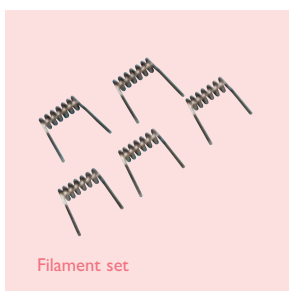


Non-galling fastener set



Filament clamps

| Consumables | | | |
|------------------------|-------|----------|---------------|
| Filament set, 5 each | 1 – 6 | EV-FILHF | 990527 |
| Insulator high voltage | 1 – 6 | EV-IHVHF | 992414 |



Filament set

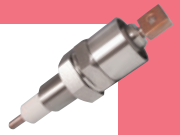


High-voltage insulator

All dimensions are nominal in millimetres unless specified

Evaporation source accessories

Installation hardware



Listed here are the essential components required for a typical installation of stand-alone modular eVap® electron beam sources. Included are feedthroughs for source water cooling and all electrical interfaces.

Manual and auto-indexer type rotary feedthroughs are available for the installation of multi-pocket sources. All components are fitted with industry-standard vacuum mounts to facilitate source installation onto existing coating systems.

Standard mounts include: Del-Seal™ CF metal seal flanges and 25mm baseplate O-ring seal mounts. Customers with Balzers systems with 32mm baseplate ports can use MDC's 32mm to 25mm baseplate port adaptor.

| Description | Reference | Part number |
|--|-----------|------------------|
| Feedthroughs, water and electrical | | |
| Water, dual 8mm tubes, 70mm Del-Seal™ | EV-LF275 | 991534 |
| Water, dual 8mm tubes, 25mm baseplate | EV-LF1 | 991726 |
| Sweep coil, 4-pin 1.4mm, 34mm Del-Seal™ | EV-IF133 | 991531 |
| Sweep coil, 4-pin 1.4mm, 70mm Del-seal™ | EV-IF275 | 991532 |
| Sweep coil, 4-pin 1.4mm, 25mm baseplate | EV-IF1 | 991727 |
| TC-Crimp contacts for 1.4mm pin, 5 each | TC-CRIMP | 991538 |
| High voltage, 2-pin 6.35mm, 12kV, 70mm Del-Seal™ | EV-HC275 | 640005 |
| High voltage, 1-pin 8mm, 12kV, 25mm baseplate | EV-HC1 | 992940 |
| Connector, right-angle power, 6.35mm pin | RAPC | 991537 |
| Connector, in-line power, 6.35mm pin | ILPC | 991536 |
| Connector, right-angle, 8mm pin | REHVHC | 992818-03 |

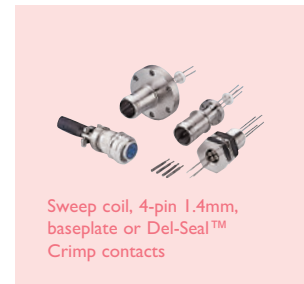
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|---|-------------|---------------|
| Feedthroughs, rotary bellows seal | | |
| Rotary manual, 6.35mm shaft, 34mm Del-Seal™ | HTBRM-133 | 670004 |
| Rotary manual, 6.35mm shaft, 70mm Del-Seal™ | HTBRM-275 | 670005 |
| Rotary 6.35mm shaft both ends, 34mm Del-Seal™ | EV-BRMI-133 | 991731 |
| Rotary 6.35mm shaft both ends, 70mm Del-Seal™ | EV-BRMI-275 | 991730 |

| | | |
|---|-------|---------------|
| Feedthroughs, rotary O-ring seal | | |
| Rotary 6.35mm shaft both ends, 25mm baseplate | FRM-1 | 652000 |

| | | |
|---|----------|------------------|
| Assembly equipment | | |
| Baseplate adaptor balzers 32mm to MDC 25mm | EV-BAI | 991813 |
| VCR® gland 6.35mm modified 5.5mm bore | EV-MVCR | 990610 |
| VCR® gland 6.35mm to 8mm tube adaptor | EV-TAVCR | 991809 |
| Waterflow switch, 110V | EV-WF110 | 991031 |
| Waterflow switch, 240V | EV-WF240 | 991031-01 |
| High voltage safety ground hook | EV-SGH | 991106 |
| High voltage acrylic shield, 70mm Del-Seal™ | HVE-2 | 640051 |
| High voltage acrylic shield, 25mm baseplate | BHVE-2 | 640057 |



Water, dual 8mm tubes, 70mm Del-Seal™ or 25mm baseplate



Sweep coil, 4-pin 1.4mm, baseplate or Del-Seal™ Crimp contacts



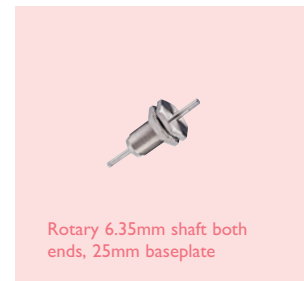
High-voltage, 2-pin 6.35mm, 12kV for 70mm Del-Seal™, connectors



Rotary manual, 6.35mm shaft 34 or 70mm Del-Seal™



Rotary, 6.35mm shaft both ends, 34 or 70mm Del-Seal™



Rotary 6.35mm shaft both ends, 25mm baseplate



High voltage – 1 pin



VCR® gland, 6.35mm modified 5.5mm bore and 6.35mm to 8mm tube adaptor



Waterflow switch



Baseplate adaptor – balzers



High-voltage grounding hook



High-voltage acrylic shield

All dimensions are nominal in millimetres unless specified

