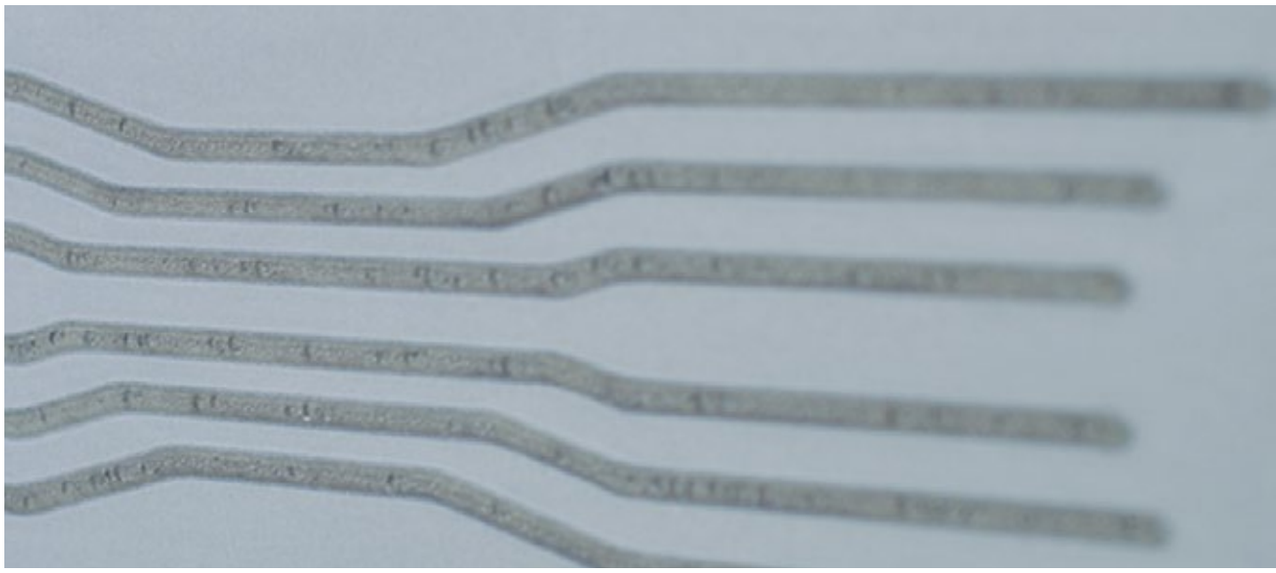
# EVAPORATION BOATS



DiMet® · LaserMet® · TriMet®

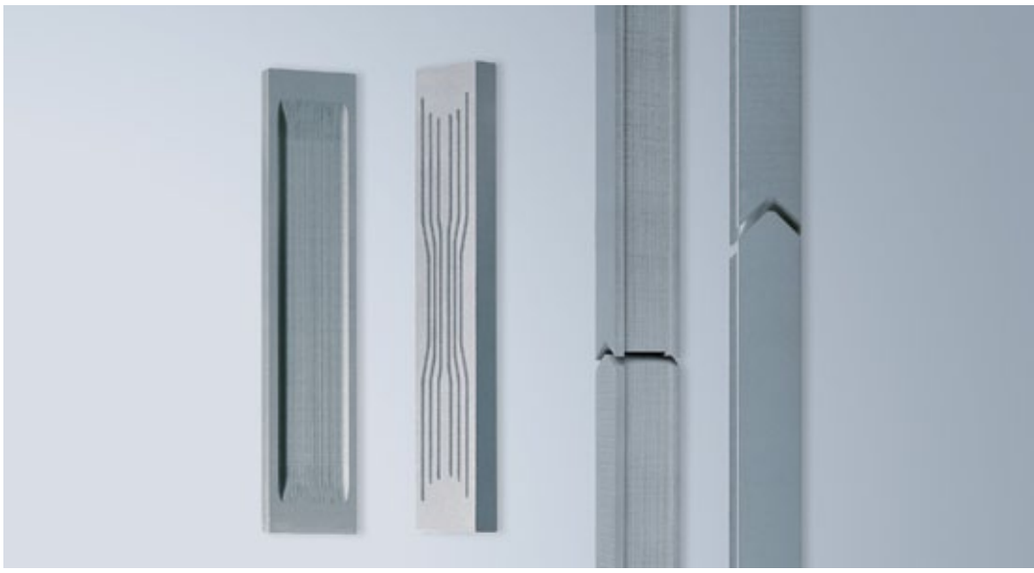
a ceradyne company

FOR OVER 80 YEARS, OUR EXPERIENCED APPLICATIONS SPECIALISTS HAVE BEEN SUCCESSFULLY DEVELOPING TECHNICAL CERAMIC MATERIALS TAILORED TO OUR CUSTOMERS' NEEDS.

ESK – MASTERING COMPLEXITY.

# ESK EVAPORATION BOATS
# THE BOAT DOES MATTER

We develop advanced solutions for high performance and operator friendly boats – the boat does matter.



One of the most ambitious goals for the metallizing industry has been the combination of high efficiency and constant product quality of the coated substrate.

Consequently, ESK has always had a focus on these requirements. Based on a deep understanding of the metallizing process, ESK has identified the following other important challanges for your benefit: excellent performance, excellent economy and operator friendly handling.

ESK's advanced evaporation boats are the result of intensive research and development, the use of modern processing and manufacturing techniques, close cooperation with equipment makers and customers, and finally, consistent realization of market and customer needs. We will continue this way.

Our application engineers

- Ensure that our evaporation boats meet your requirements regarding long boat life time and excellent boat stability
- Support you with your specific metallizing challenges
- Are developing new solutions to improve the service life and decrease costs
- Will advise you how to integrate the newest products in your process

Material Characteristics

Our materials are electrically conductive ceramic composites. ESK offers two-component material that consists of titanium diboride ($TiB_2$) and boron nitride (BN) and three-component material containing also aluminum nitride (AIN). These materials are characterized by an unique combination of chemical, mechanical and electrical properties:

- High chemical resistance to molten metals
- Excellent resistance to thermal shock
- Service temperature up to 2000°C in an inert atmosphere

# ESK EVAPORATION BOATS AT A GLANCE

With our expertise in ceramic composite materials as well as in the metallizing industry we provide boat solutions for your benefit.

Our materials are available for a wide variety of applications in accordance with customer specifications. In addition evaporation boats our ceramic composites are used under extreme operating conditions as crucibles for vaporizing metals. The material specification is according to hot resistivity as this ensures the highest accuracy of resistance at working temperature. Therefore we offer you the highest process consistency and full reliability.

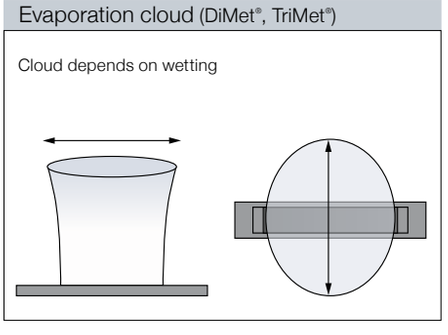
ESK developed a wide product range and is a well known supplier both for standard evaporation boat solutions and for specialities, such as long boats and boats for ultra thin films. All our boats feature a long service life and an excellent wetting behavior. Depending on the machine and process parameters our engineers define the optimum boat type and dimension for your application.

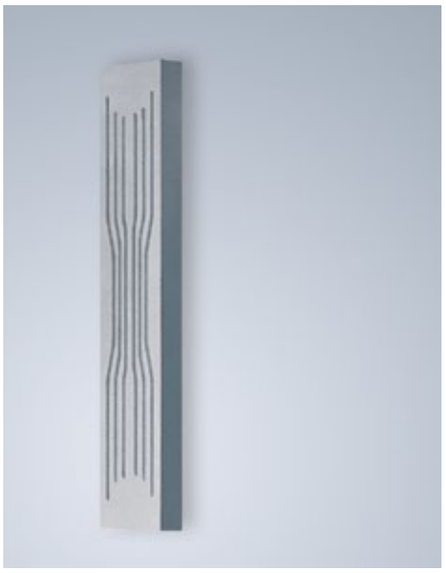
## DiMet®

Our DiMet® boat is the perfect all-round solution for all metallization processes. This two-component boat can be used at high web speed on all modern vaccum coaters.

- High evaporation rate
- Excellent temperature resistance
- High optical density
- High web speeds

Evaporation cloud (DiMet®, TriMet®)





## LaserMet®

The patented surface treatment facilitates the break-in of the boat. Aluminum will wet this two-component boat along the whole lasered surface, where there is a higher titanium diboride content.

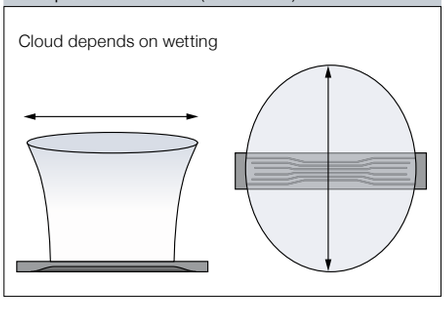
- Superior initial wetting behavior
- Larger wetted surface for increased evaporation rate
- Shorter initial heat-up cycle
- High web speeds

## TriMet®

TriMet® boats are made from our three-component material. They can be used on all generations of vacuum coaters and are very easy to handle even for inexperienced operators.

- Suitable for all machine generations
- Good wetting behavior
- Easy control of operating parameters
- Only possible alternative for boats longer than 200mm

Evaporation cloud (LaserMet®)




Metallizing Parameters

| | DiMet®/TriMet® | LaserMet® |
|---|---|---|
| Power consumption | 100 % | 100 % |
| Heat radiation | 100 % | 100 % |
| Break-in time | 100 % | 60 % |

# TECHNICAL INFORMATION

## Hot Resistivity Types

| 2-component | hot resistivity [moc] |
|---|---|
| Type 2 | 3700 ± 300 |
| Type 3 | 3200 ± 300 |
| Type 4 | 2700 ± 300 |
| Type 5 | 2300 ± 200 |

| 3-component | hot resistivity [moc] |
|---|---|
| Type C | 3600 ± 400 |
| Type D | 2800 ± 400 |
| Type E | 2000 ± 400 |
| Type F | 1400 ± 300 |

## Material Characteristics

| | | | 2-component | 3-component |
|---|---|---|---|---|
| Density | ρ | [g/cm³] | > 2,75 | > 2,80 |
| Porosity | P | [%] | < 3 | < 6 |
| Max. water uptake at 38°C, 90% rH | | [%] | < 1,5 | < 1,0 |
| Phase composition | | | $TiB_2$, BN | $TiB_2$, BN, AlN |
| Electrical properties | | | | |
| Resistivity[1] at 1,600°C | $R_{el}$ | [$10^{-4}$ Ω cm] | 1300 - 4800 | 350 - 4800 |
| Mechanical properties at room temperature* | | | | |
| Brinell hardness | | [HB 2,5/40] | 45 | 95 |
| Flexural strength, 4-point bending | σ | [MPa] | 70 | 90 |
| Weibull´s modulus | m | | >20 | >20 |
| Young´s modulus | E | [GPa] | 55 | 66 |
| Fracture toughness[2] | $K_{IC}$ | [MPa √m] | 1,8 | 2 |
| Thermal properties* | | | | |
| Max. thermal expansion at 20 - 1,600° C | | [%] | <1,2 | <1,5 |
| Coefficient of thermal expansion at 20 - 1,600°C | α | [$10^{-6}$/K] | 5,5 | 7 |
| Specific heat at 20° C | $C_P$ | [J/g K] | 0,68 | 0,67 |
| Thermal conductivity at 20° C | l | [W/m K] | 80 | 55 |

# BENEFIT FROM ESK EVAPORATION BOATS IN MULTIPLE WAYS

## PROVEN EXPERTISE

For over 80 years, ESK has been a competent development partner and reliable supplier of series products for challenging applications worldwide.

## A ONE-STOP SUPPLIER

All production processes are performed at ESK's own plant. Outstanding quality and maximum flexibility are thus ensured at each production stage.

## CERTIFIED QUALITY

Each processing stage occurs in line with very rigorous checks at ESK's own plant. We are ISO 9001 and ISO 14001 compliant.

## HIGH STANDARDS

Our experts are not just satisfied with finding a first-rate solution to today's challenges, but go a step further by thinking of your future needs. So you benefit from solutions that develop innovative production capability, make processes more dynamic and reduce costs.

## OUR CUSTOMERS – OUR PARTNERS

Our top priority is close collaboration with you – our partner. This is the only way to develop ideas that make your company cutting edge and let us open up novel applications.

# ACCESSORIES


EKamold® WS Boron Nitride Suspension

ESK Graphite Tape

## Added value by using the right accessories

Using the right accessories ensures the efficiency of your metallization process and helps to save time.

## EKamold® WS Boron Nitride Suspension

This suspension acts as a release agent for aluminum. Painted with EKamold® WS, parts exposed to stray aluminum can be easily cleaned without damaging parts of the equipment.

## ESK Graphite Tape

A layer of graphite tape between the clamp and the evaporation boat ensures good electrical contact. The graphite tape is inserted before the boat is clamped.

ESK collaborates with you to develop solutions customized to meet your needs. Please don’t hesitate to get in touch.

ESK Ceramics GmbH & Co. KG
Max-Schaidhauf-Straße 25
87437 Kempten, Germany
www.esk.com, info@esk.com

a ceradyne company

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