

SOLUTIONS

EVAPORATOR BOATS





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EVAPORATOR BOATS

Kennametal specializes in the highly flexible production process that produces boats that meet customers' required specifications.

Kennametal has the expertise in the field of non-oxide ceramic powders and shapes, and our manufacturing locations have achieved the international quality standard ISO 9001:2008.

Our **Center of Competence (CoC)** for evaporator boats is located in Schongau, Germany, and has more than 30 years of experience.



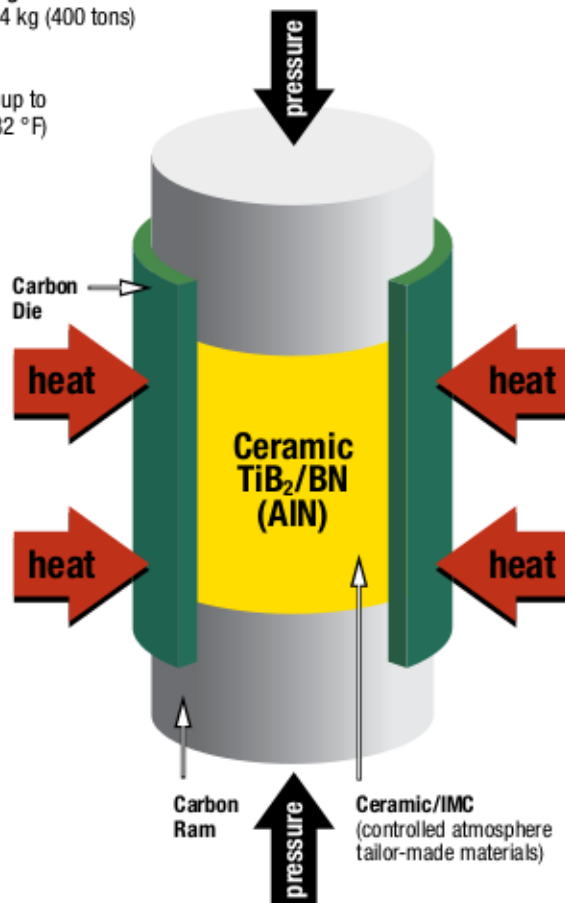
Evaporator Boats Manufacturing Process

Axial Pressing

Up to 362,874 kg (400 tons)

Heating

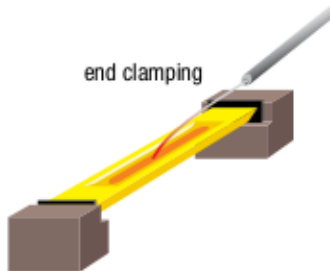
Temperature up to
2000 °C (3632 °F)



1. We manufacture Boron Nitride (BN) and Titanium Diboride (TiB₂). These powders form the 2-component Inter-Metallic Composite (IMC), with Aluminum Nitride (AlN) added for 3 component materials.
2. Materials are very accurately proportioned and mixed to obtain a correct and homogeneous resistivity. They are then charged into a carbon die and pressed at temperatures up to 2000 °C (3632 °F).
3. A billet of material is produced and then machined to the required boat size. Resistivity and homogeneity are carefully checked.
4. After final inspection, boats are sealed and packed for shipment.

Our product knowledge enables us to optimize evaporator boats for each metallizing application.

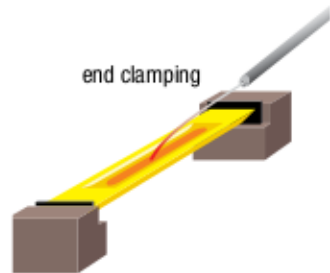
A History of Advancing Technology



2000s

T-VAP™

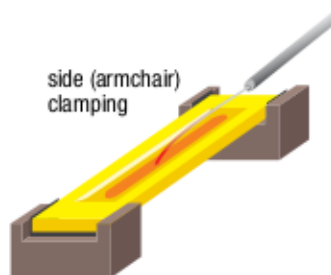
- Product introduced in early 2000s has revolutionized metalizing.
- Designed to maximize surface area for maximum evaporation while improving the temperature uniformity across the usable surface of the boat.
- Increases yield of aluminum to the substrate (lowers aluminum usage), lowers power consumption, and simplifies wetting of the surface compared to standard boats.



1996

ECO-VAP

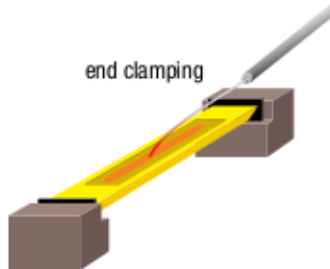
- Developed in 1996 to provide improved wetting and improved cost effectiveness, this product has found its niche where lower evaporation rates are needed and where uniformity, heat generation, and efficiency are crucial.



1980s

Rectangular

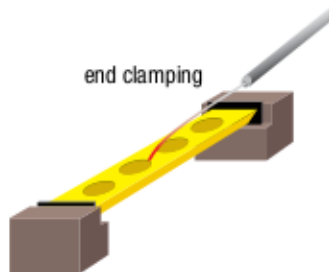
- The original design dates back to the 1960s when all evaporator boats were clamped from the sides.



2005

T-VAP^{plus}™

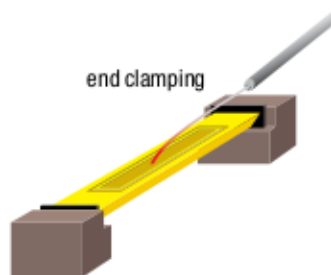
- Product introduced in 2005.
- Developed to deliver improved wetting during the initial heating cycle.
- The coating enables easier wetting on the desired surface of the heater.
- Improved wetting leads to more efficient evaporation and improved life of your heater.



2010

T-VAP Select

- Product introduced in 2010.
- Developed to deliver improved wettability for high evaporation rates.
- All the advantages of the T-VAP™ family with additional select surface to increase wettability, which is unaffected by the initial break in procedure.



2013

T-VAP MAX

- Significantly extends boat life.
- Prevents metal overflow.
- Dramatically reduces spitting.
- Highest boat surface utilization.
- Boosts metallizing productivity.

Additional Product Offering

4-Component Boats

- This unique composition includes additives that promote the use of higher temperatures suitable for specialty applications and copper metallization.

Long Boats

- Specialized for the capacitor industry.

Plus Coatings™

- Plus Coatings were specially developed for copper, tin, silver, aluminum, and gold metallization.

Typical Physical Properties

Properties	Unit	2-comp	3-comp
Specific Electrical Resistivity (1600 °C)	$\mu\text{Ohm}\cdot\text{cm}$ (moc)	1000–4000	1000–4000
Thermal Conductivity (20/1200 °C)	W/mK	115/40	110/35
Thermal Expansion (20–1500 °C)	K^{-1}	$9\cdot 10^{-6}$	$10\cdot 10^{-6}$
Flexural Strength (20/1500 °C)	MPa	110/30	115/30



Service Products for Metallizers

- Graphite Tape/Foil
- Boron Nitride Release Agent
- Graphite Release Agent
- Boron Nitride Spray
- BN Paint G

EVAPORATOR BOATS

TECHNICAL DATA

General Properties

The unique thermal shock resistance and chemical inertness against liquid aluminum are basic requirements of the boats qualified for the production of metalized films, papers, textiles, and other substrates. The general properties of Kennametal Sintec evaporator boats are as follows.

- Long term stability.
- Consistent electrical properties.
- Adjustable electrical resistivity.
- High thermal shock resistance.



Applications

Resistance-heated boats or crucibles used in vacuum chambers at approximately 1500 °C to evaporize metals, such as aluminum.

Product Information

Property	Data
Color	Gray
Boron Nitride	Approximately 50%
Titanium Diboride	Approximately 50%
Carbon (Max)	0.3%
Oxygen	0.6–1.7%
Theoretical Density	Approximately 3.00 g/cm ³

Specific Electrical Hot Resistivity ρ (rho) at 1600 °C

Hot Resistivity Group	ρ [$\mu\text{Ohm}\cdot\text{cm}$] or [moc]
1	800–1200
2	1200–1600
3	1600–2000
4	2000–2400
5	2400–2800
6	2800–3200
7	3200–3600
8	3600–4000

Typical Physical Properties

Property	Unit	2-comp
Specific Electrical Resistivity (1600 °C)	$\mu\text{Ohm}\cdot\text{cm}$ (moc)	1000–4000
Thermal Conductivity (20/1200 °C)	W/mK	115/40
Thermal Expansion (20–1500 °C)	K ⁻¹	9*10 ⁻⁶
Flexural Strength (20/1500 °C)	MPa	110/30
Young's Modulus (20 °C)	GPa	65

NOTE: This data shows typical values and does not represent a specification.

Kennametal™ manufactures sophisticated materials in the form of castings, powders, coatings, consumables, and machined parts that resist wear, corrosion, and abrasion. Information provided in this document is intended only for general guidance about Kennametal™. Selection and purchase of Kennametal™ products is the sole responsibility of the product user. Individual applications must be fully evaluated by the user, including compliance with applicable laws, regulations, and non-infringement. Kennametal™ cannot know or anticipate the many variables that affect individual product use and individual performance results may vary. For these reasons, Kennametal™ does not warrant or guarantee information in this document and assumes no liability regarding the same. Kennametal™ makes no warranties regarding this information and disclaims all express or implied warranties with respect to this information, including, without limitation, all implied warranties of merchantability and fitness for a particular purpose and warranties of patent non-infringement. Kennametal™ will not be responsible for special, incidental, exemplary, or consequential damages that may be incurred pursuant to the use of the information provided in this document.

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kennametal.com

Evaporator Boat Recycling



Reduce or Eliminate Disposal Fees!

It's easy for your company to be environmentally conscious with Kennametal Evaporator Boat Recycling.

By sending us your used Evaporator Boats, you help preserve and protect the environment and ensure these products are recycled responsibly, while also saving on disposal costs.

Kennametal currently accepts any T-VAP™ or ECO-VAP used Evaporator Boats

By utilizing Kennametal Evaporator Boat Recycling, you will:

1. Reduce disposal fees.
2. Improve profitability.
3. Create more shop space.
4. Help the environment.



To learn more, please contact your local Kennametal sales office.

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Boats for the Metallizing Industry

Intermetallic composites are unique in their thermal shock and chemical inertness against liquid aluminum. This combination makes them ideal for metallization of films, papers, and other components (CRT, fasteners, and decorative parts).

General Properties

- Long-term stability.
- Consistent electrical properties adjustable to desired resistance levels.
- High thermal shock resistance.

Applications

Resistance-heated boats or crucibles are used in vacuum chambers at ~1500–1650 °C (2732–3002 °F) to evaporate various metals, primarily aluminum.

Metallized films and papers are used in the packaging, capacitor, decorative, and electronic industries.

Recommended Operating Procedure

1. Clean and smooth contact surfaces.
2. Achieve proper positioning in clamp with the use of graphite tape for uniform electrical and thermal contact.
3. Adjust wire for proper puddle formation (touch point of wire 1/3 standard boats and 1/2 T-VAP™ from the end of the cavity).
4. Follow preprogrammed heating cycle for optimum results. Contact your local Kennametal Representative with questions.
5. Start wire feed at 75% to ensure proper wetting conditions. Prevent wetting back to clamp area.
6. Slowly adjust wire feed rate and temperature over the initial 15,000 m (50,000 ft) of film to build proper puddle.
7. Upon completion of metallizing, stop wire to allow the surface to evaporate excess aluminum, allow proper start up for subsequent rolls (~1 minute), and facilitate easy cleaning. Afterwards, shut off power to the boats and allow a minimum of 2 minutes prior to breaking vacuum.

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to place an order contact:

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