AMETEK®
SPECIALTY METAL PRODUCTS

THERMAL MANAGEMENT MATERIALS

SAFE-GUARDING MISSION CRITICAL ELECTRONICS WHEN IT MATTERS THE MOST.

- Molybdenum - Copper and Tungsten - Copper Composites
- Clad Materials
- Solder and Brazing Preforms
- Silver Sintering

AMETEK®
SPECIALTY METAL PRODUCTS
WALLINGFORD

COINING™

WALLINGFORD / AMETEK
SPECIALTY METAL PRODUCTS

Our **Molybdenum - Copper** and **Tungsten - Copper** composites deliver unique thermal management properties to protect critical electronic applications including heat sinks, thermal spreaders and electronic packages.

Highly Controlled Thermal Expansion to Prevent Failure

Controlling heat dissipation in hermetically sealed devices that house electronic components is a major challenge in the electronics sector.

Our Molybdenum-Copper (AMC) and Tungsten-Copper (AWC) composites are engineered through wrought powder technology to deliver improved thermal conductivity and highly controlled thermal expansion.

Exact Coefficient of Thermal Expansion (CTE) Match

We have the expertise to manufacture custom engineered products with tailored compositions to ensure an exact Coefficient of Thermal Expansion (CTE) match. These heat sink materials are engineered to align with the CTE of semiconductors, preventing cracking caused by uneven expansion.

Turnkey Solutions for Production Ready Pedestals

Our advanced thermal management materials are offered as raw material in sheet or block form. We also maintain the capabilities to vertically integrate for turnkey solutions customers in much the same way as our blended matrix products.

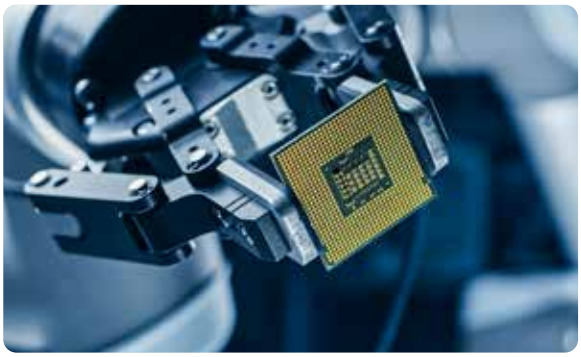
- Custom sized pedestals via Electrical Discharge Machining (EDM)
- High tolerance machining
- Nadcap™ accredited plating
- Pick & place packaging options such as waffle packs
- Burr-free edges

High Power Electronic Applications

Our thermal management materials are used extensively for copper heat sinks and pedestals for integrated circuits (I/C) as well as the supporting cases for I/C packaging. We offer heat spreader material in cross-rolled sheet form for excellent x-y expansion properties as well as in pre-machined block form for I/C packaging.

Other electronic packaging applications include:

- Chip mounting
- Circuit board cores
- Lids or covers
- Heat spreader for semiconductors
- Microwave packages
- High RF applications
- 5G mobile internet network
- Nickel-Gold plated external power amplifiers

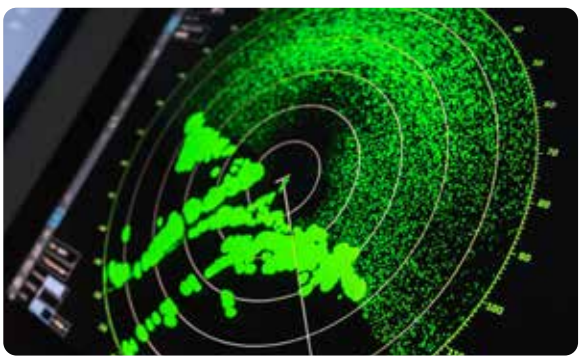


Trusted Materials for GaAs and GaN Products

Due to their excellent thermal conductivity and controlled thermal expansion, our Molybdenum-Copper and Tungsten-Copper composites are the preferred materials for Gallium Arsenide (GaAs) and Gallium Nitride (GaN) semiconductors for the defense industry.

Our heat spreader materials are trusted in sensitive defense applications such as:

- Advanced active radars
- Electronic countermeasures
- Jamming equipment



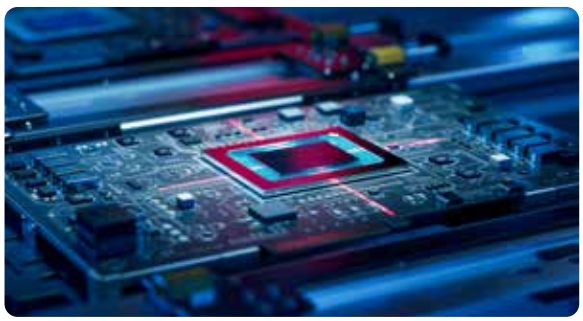
Molybdenum-Copper Composites

Customizable thermal expansion and high thermal conductivity

Our molybdenum-copper composites (AMC) combine the unique properties of molybdenum with the high thermal conductivity of copper, resulting in a powerful metal matrix composite for thermal management. Molybdenum provides a very high melting point, low thermal expansion, and notable thermal conductivity, while copper's exceptional heat transfer efficiency makes it ideal for dissipating heat.

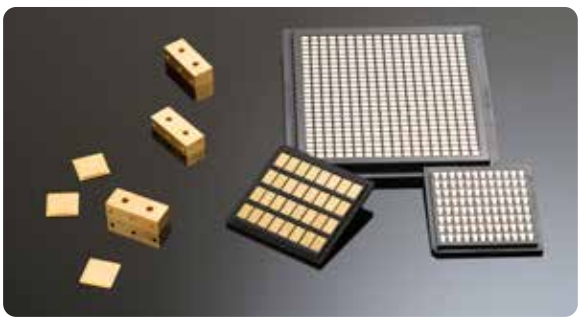
ADVANTAGES

With a unique blend of mechanical and chemical properties, molybdenum-copper offers exceptional benefits for thermal management applications, including:



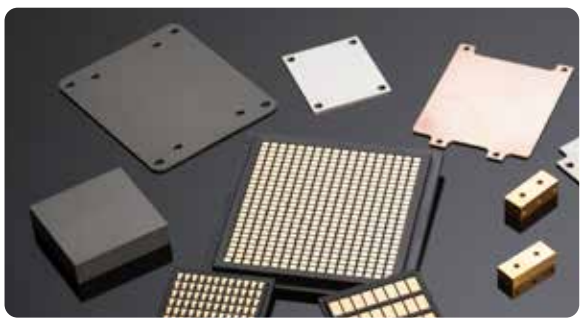
High Thermal Conductivity

Our advanced powder metallurgy composites deliver superior through-thickness thermal conductivity, outperforming competitive materials.



Excellent Dimensional Stability

With its excellent dimensional stability and corrosion resistance, our material ensures long product service life.



Customized Thermal Expansion

AMC materials are available in standard compositions, but we also offer custom-engineered formulations to meet specific thermal expansion requirements.

High Ductility

Excellent ductility allows precise machining into complex shapes without compromising strength, making AMC ideal for intricate heat dissipation components. Our composites are also readily plateable.

Tungsten-Copper Composites

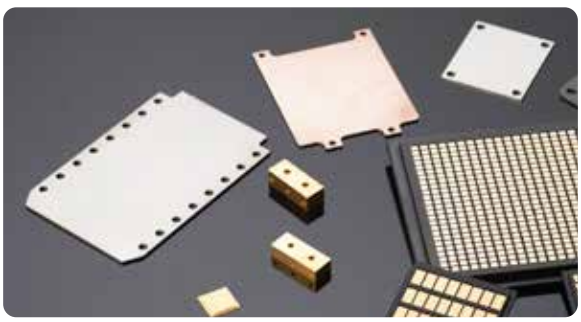
High temperature resistance and controlled thermal expansion

Tungsten-copper composites (AWC) combine the special properties of tungsten and copper for exceptional performance. Tungsten's extremely high melting point and low thermal expansion ensure stability at high temperatures, while copper adds superior thermal conductivity and ductility.

Together, they form tungsten-copper composites with unmatched properties for advanced thermal management applications.

ADVANTAGES

Produced through wrought powder metallurgy, our tungsten-copper composites deliver significant advantages for thermal management.

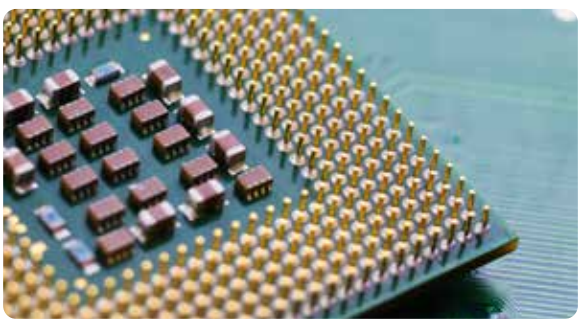


High Temperature Resistance

With the highest melting point among all metals, tungsten ensures durability and stability at extreme temperatures.

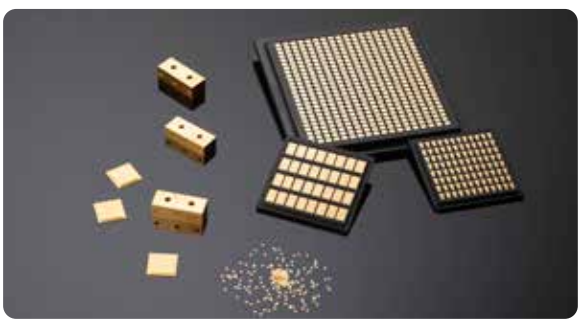
Outstanding Thermal Conductivity

Copper's conductivity provides efficient heat dissipation, making AWC suited for applications requiring effective thermal management.



Controlled Thermal Expansion

Customizable compositions allow us to control the coefficient of thermal expansion (CTE) for exacting requirements.



Excellent Machinability

High ductility enables precise shaping and machining, enabling the production of complex, high-precision parts.

COINING™ / AMETEK® SPECIALTY METAL PRODUCTS

COINING's Solutions for Thermal Management

Our precision metal stampings are used primarily to dissipate heat or provide an interface for electronic circuit or component. We work with **Molybdenum**, **Tungsten**, **Copper**, **pure Silver**, **Gold Tin Solder Preforms**, **Gold Copper** and **Silver Copper Braze Preforms**, **Silvar**™ and **Silvar-K**™ and various other metallic materials commonly found in metal and ceramic packages.

We also offer Silver Sintering Paste for Thermal Management Applications.

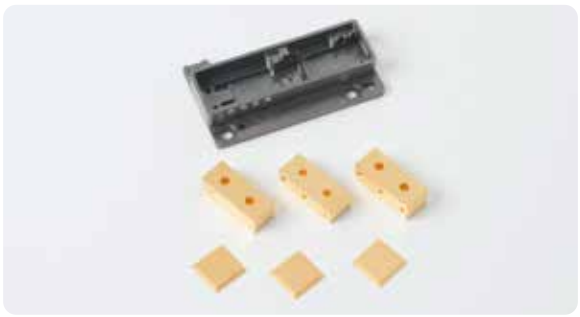
Some of these parts are supplied after nickel plating or gold plating. Other COINING stampings are manufactured from cladded strip consisting of two or more metal layers bonded together in a specialty rolling operation, also called metallic bonding. We run two thin layers of strip through a roll-compacting mill that bonds the two layers of metal together.

TECHNOLOGY & MICROSTRUCTURE

Silvar™ and Silvar-K™ are composite materials with microstructure consisting of two inter-penetrating metallic phases: pure silver and granule form Invar™ or Kovar™ alloys. To manufacture Silvar™, a porous Invar™ or Kovar™ preform made via powder metallurgy is infiltrated with liquid silver. After infiltration, the material is rolled in a type of microstructure.

Advantages

Compared to Cu/Mo and Cu/W, Silvar™ and Silvar-K™ are lighter, which can be beneficial in applications where weight is a critical factor.

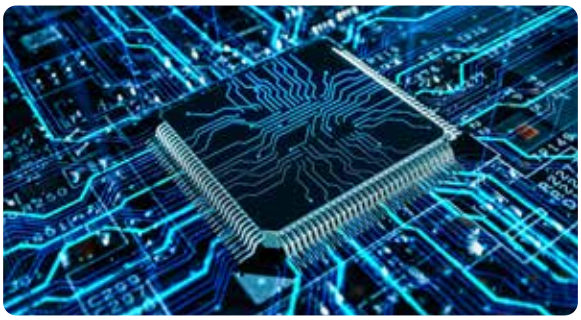


High Thermal Capacity

Enables efficient heat dissipation, thermal stability, and enhanced performance.

Controlled Thermal Expansion

Controlled Thermal Expansion CTE up to 400°C for precise requirements.



Excellent Thermal Conductivity

Silvar™ and Silvar-K™ have high conductivity making this material ideal for applications that demand effective thermal management.

Precise Machinability

Materials can be readily stamped (in many cases to net-shape), machined, and plated.

High Thermal Conductivity

Silver Sintering Paste is a thick paste of silver powder in an organic binder formulation. It is an ideal solution for pressure-free bonding of small to large chips for powder devices, power modules, high power and RF power devices.

Silver Sintering Paste

High-Performance Sintering Paste for Advanced Electronic Applications

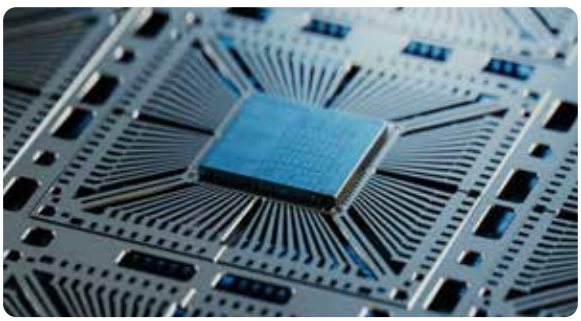
Our Silver Sintering Paste is designed to meet the rigorous demands of modern power electronics, offering a combination of precision, efficiency, and reliability. Whether you're working with high-power modules, LEDs, or RF devices, this material delivers consistent results and long-term performance.

ADVANTAGES

The material exhibits outstanding electrical and thermal conductivity, making it a reliable choice for applications where performance and durability are critical. These properties are essential for maintaining efficiency and stability in high-current or high-frequency environments.

Uniform Dispersion for Consistent Application

The consistency of the paste ensures even coverage and reliable bonding across the entire substrate, reducing the risk of defects and improving overall yield.



Minimizes Thermal Stress

Controlled cooling to room temperature (25 °C) helps reduce thermal stress, preventing damage to the die or substrate.

Facilitates Strong and Reliable Bonds

Heating the substrate to 200 °C – 250 °C at a controlled ramp rate and soaking for 10 to 90 minutes promotes effective sintering, which enhances the mechanical strength of the bond.

Enables Precise Application

Dispensing or stencil-printing the paste onto the substrate allows for controlled and accurate placement, improving the consistency of the bond.

Technical Specifications

This series of composites – **Molybdenum-Copper** and **Tungsten-Copper** – developed by AMETEK using its wrought powder metallurgy technology, has unique properties for use in: heat sinks, substrates, and thermal spreaders.

The material is available as finished parts with the following maximum dimensions depending on overall size:

Width:	4 inches	(102 mm)
Thickness:	3 inches	(76 mm)
Length:	24 inches	(610 mm)

MOLYBDENUM-COPPER COMPOSITES (AMC SERIES)

COMPOSITIONS	
AMC 6040	60% molybdenum - 40% copper
AMC 6535	65% molybdenum - 35% copper
AMC 7525	75% molybdenum - 25% copper
AMC 8020	80% molybdenum - 20% copper
AMC 8515	85% molybdenum - 15% copper

Other compositions can be produced upon request

DENSITY		
	g/cm³	lb./in.³
AMC 6040	9.68	0.349
AMC 6535	9.74	0.352
AMC 7525	9.87	0.356
AMC 8020	9.94	0.359
AMC 8515	10.01	0.361

THERMAL CONDUCTIVITY		
	W/mK³	BTU/hr. ft.°F
AMC 6040	215	125
AMC 6535	205	119
AMC 7525	185	108
AMC 8020	175	102
AMC 8515	165	96

THERMAL EXPANSION (in./in. x 10^{-6}/°C)			
	30-150° C	30-400° C	30-800° C
AMC 6040	9.5	10.2	10.5
AMC 6535	9.0	9.4	9.8
AMC 7525	7.8	8.0	8.4
AMC 8020	7.2	7.5	7.9
AMC 8515	6.8	7.0	7.4

These composites of molybdenum-copper and tungsten-copper have many applications in electronic devices. The excellent thermal conductivity and low thermal expansion makes them ideal for:

- Chip mounting
- Heat sinks
- Circuit board cores
- Lids or covers
- Thermal spreaders
- Electronic packages

The material can be machined into shapes and readily plated if required.

AMETEK's wrought powder metallurgy composites have superior through-thickness thermal conductivity versus other products.

TUNGSTEN-COPPER COMPOSITES (AWC SERIES)

COMPOSITIONS	
AWC 7525	75% tungsten - 25% copper
AWC 8020	80% tungsten - 20% copper
AWC 8515	85% tungsten - 15% copper
AWC 8812	88% tungsten - 12% copper
AWC 9010	90% tungsten - 10% copper

Other compositions can be produced upon request

DENSITY		
	g/cm³	lb./in.³
AWC 7525	14.98	0.541
AWC 8020	15.68	0.567
AWC 8515	16.45	0.594
AWC 8812	16.95	0.612
AWC 9010	17.3	0.625

THERMAL CONDUCTIVITY		
	W/mK³	BTU/hr. ft.°F
AWC 7525	186	107
AWC 8020	175	101
AWC 8515	162	93
AWC 8812	155	90
AWC 9010	150	86

THERMAL EXPANSION (in./in. x 10^{-6}/°C)			
	30-150° C	30-400° C	30-800° C
AWC 7525	9.06	9.55	9.68
AWC 8020	8.21	8.60	8.63
AWC 8515	7.36	7.65	7.58
AWC 8812	6.78	7.00	6.86
AWC 9010	6.51	6.70	6.53

Technical Specifications

Typical Physical, Thermal, and Mechanical Properties

Property, (Unit of Measure)	Silvar™	Silvar-K™
Coefficient of Thermal Expansion, (µm/m/c)	7.2 (20C - 225C)	7 (20C - 400C)
Thermal Conductivity, (W/mk)	130	110
Thermal Capacity, (J/cc C)	3.19	3.19
Density, (g/cm^3)	8.9	8.8
Young's Modulu's (GPa)	110	125
Electrical Conductivity, (%IACS)	35	18.5

Silver Sintering paste SP-1000

Properties	
Physical Data Before Sintering	
Color	Silver gray
Solid loading	75 – 91%
Density	> 3.0 g/cm^3
Viscosity[1]	~ 300,000 cps
Sintering temperature	< 250°C
Shelf life[2]	~ 12 mo.

Properties	
Physical Data After Sintering (see the recommended heating profiles below)	
Porosity	< 30%
Density	> 7.9 g/cm^3
CTE (coefficient of thermal expansion)	19.6 x10^{-6} /°C
Melting temperature	961°C
Elastic modulus	~ 10 to 30 GPa
Electrical resistivity	< 2.6x10^{-6} Ω.cm
Thermal conductivity[3]	> 2.0 watt/cm.°C
Chip bonding strength	> 30 MPa

1 Adjustable to customer's specification.
2 If stored in sealed containers at room temperature; we recommend refrigeration to slow down segregation.
3 Calculated from electrical measurement.

ABOUT AMETEK SPECIALTY METAL PRODUCTS

AMETEK Specialty Metal Products consists of six leading manufacturers of advanced metal products based in the USA and UK: Fine Tubes, Superior Tube, AMETEK Eighty Four, COINING, Hamilton Precision Metals, and AMETEK Wallingford.

Our extensive product range includes thermal management materials, metal tubes, strip, shaped wire, clad plate, powder, bonding wire and ribbon, solder preforms, and bond pads.

From powering aircrafts and space rockets, to advancing medical care, and accelerating the transition to renewable energy – our precision materials enable technological innovations.

AMETEK Specialty Metal Products is a business of AMETEK Inc., a leading global provider of industrial technology solutions serving a diverse set of attractive niche markets.

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V1-05-25