

# Clad Materials



**Engineered  
Materials Solutions**

Wickeder Group



## A History of Solutions

Engineered Materials Solutions, headquartered in Attleboro, MA (USA) with production sites in Hamburg, PA (USA) and Baoying (China) traces its origins back to 1916. We have been manufacturing Clad Materials since our founding company, General Plate Company, was established 100 years ago. Today, we are experts in metallurgically bonding dissimilar metals.

At EMS, we produce a variety of “laminated” materials that can offer distinctive properties, where one material alone could not. Most notably, we have developed substitutes for Nickel and Copper Alloys in a new multi-layer composite, SIGMA<sub>CLAD</sub><sup>®</sup>.

Clad metal designs can present a myriad of advantages including weight savings, increased corrosion resistance, better thermal performance, improved electrical conductivity, or a more appealing cosmetic appearance, all while being cost-effective. With our expertise and technology we can help you reach various desired goals, such as safety, regulation and control solutions for electrical, appliance and many other markets.





# Clad Materials of EMS... ...a Composite of Benefits!

## Get Started with Clad

A clad material combines two or more metal strips by bonding them together. By bonding different combinations of metals, the advantages of the individual metals are combined into a composite that is tailored to your specific product needs and requirements.

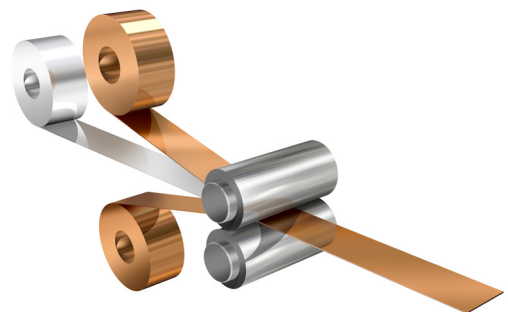
Clad Materials, with their unique ability to match virtually any need of a specific product design, offer design engineers some highly desirable benefits. "Clad" not only can allow you to expand your design possibilities, but can provide significant improvements in product performance and manufacturability. It may even yield meaningful reductions in product costs as well.

At EMS, we've bonded well over a thousand different combinations of metals and alloys, in all shapes and sizes; some with fifteen different metal layers in a single strip. The bonding technique we've developed is so effective that intermediate brazing alloys or adhesives aren't necessary. That's the genius of Clad - it's simple, it's clean, and it's permanent.

For centuries, cladding remained virtually unchanged until EMS revolutionized the process in the mid-1960's. Today, with our modern cladding machinery and highly sophisticated heat-treating, rolling, and finishing techniques, we can produce materials that provide singular performance characteristics for hundreds of products.

### // Advantages

- › Wide variety of composite combinations are available
- › Development of new products with enhanced properties tailored to your specific needs
- › Combination of seemingly incompatible materials are possible
- › Economical solutions for achieving composites that address your obstacles



# Open the Doors of Design to an Exciting New World of Possibilities

Do what you thought you couldn't. There are a myriad of ways that Clad can help you increase performance, as well as improve your bottom line.

EMS Clad Materials are used in a number of sectors including, Appliance, Automotive, Cookware, Electrical Distribution, Energy Storage, Exhaust Catalyst, and Heat Transfer.

[How can Clad Materials be a cost effective solution in your own products?](#)

We can help you determine your needs and offer Clad solutions to enhance the performance of your existing products or offer the exciting opportunity to create new ones.

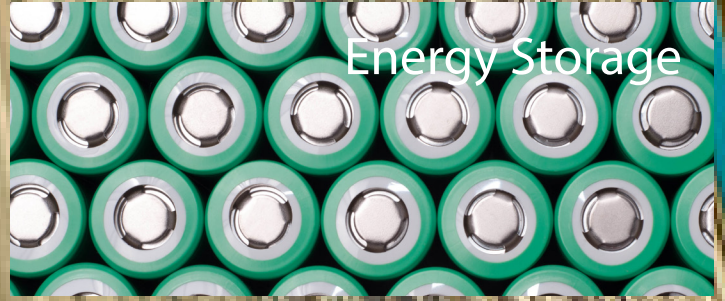
No matter what design limitations you've faced in the past, it is absolutely possible that one of the hundreds of Clad combinations are already available to fit your requirements, exactly.

We will work together with you in the event you require a tailored system. Tailored Clad Metal solutions, created through close working relationships, can give you a competitive edge - and in most cases, allow you to trim manufacturing costs.





Appliance



Energy Storage



Automotive / Transportation



Exhaust Catalyst



Cookware



Heat Transfer



Electrical Distribution

# Appliance

## Stainless Clad Aluminum Soleplate

The beauty and durability of metallic surfaces is more appealing than ever. Our shimmering, scratch resistant and stainless soleplates with their thermal spreading aluminum layer outlast traditional ceramic type coatings and ensure a perfect surface for traditional steam irons.



Aluminum

Stainless

2-layer

## Knowledge You Can Count On

It's simple. Customer satisfaction is our priority. At EMS, we place a strong emphasis on the concept of a strategic alliance with our customers. By working together, we can create products that perfectly match your application needs. It is our goal to provide you with the best support and solutions possible.

### Forms

- Master Coils
- Slit Coils
- Sheets
- Parts
- Assemblies
- Cookware Discs
- Coils

### Testing Services

- Metallurgical Lab
- Bulk Analysis Lab
- Surface Analysis Lab
- Non-Destructive Lab
- Welding & Brazing Lab
- Corrosion

### Clad Designs

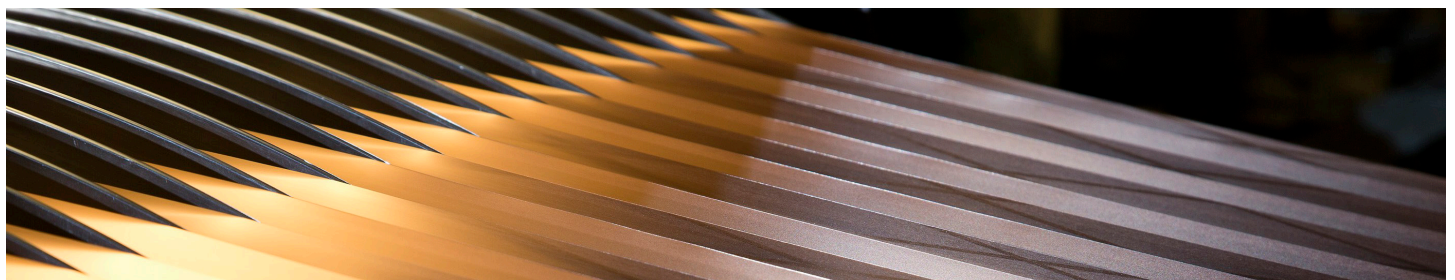
- Overlay
- Inlay
- Corelok
- Edgelay

### Bimetal Designs

- Discgrade
- Electrical Grade
- Stamped Parts, Coils & Assemblies

### Production Services

- Cladding
- Rolling
- Annealing
- Strip Cleaning
- Slitting
- Brazing
- Parts Fabrication
- Flattening and Cut-to-length
- Polishing

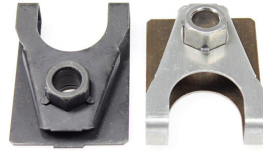




# Automotive / Transportation

## Transition Material

The increasing use of aluminum in vehicles has led to problems with traditional materials like steel. Crevice corrosion or difficult welding techniques in particular have led to the development of innovative joining and welding solutions. Our steel clad aluminum solves these problems.



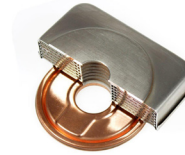
Aluminum

Steel

2-layer

## Oil Cooler

Clads are the ideal alternative to using thin braze foils or paste. As decades of design experience have shown they even offer lower assembly costs and higher manufacturing yields and can be used in off-road equipment, HDD trucks or passenger cars.



Copper

Stainless

2-layer or 3-layer

## Roller Bearing Cage

Bearing rings made from Brass or Bronze Clad Steel guarantee a smooth and safe operation and thus provide a combination of good wear resistance and high strength.



Brass

Steel

2-layer or 3-layer

## Bumper Material

Stainless Clad Aluminum is a highly reflective, corrosion resistant and formable material which combines S301 austenitic stainless with a A3003 aluminum. It is 50% lighter than chrome or painted steel due to stainless thickness ratios of about 25 to 32 %, thicknesses up to 0.200" and widths up to 26". It has been used in the class 8 truck industry for over 30 years as a superior bumper material and is produced both in coil and in sheet.



Stainless

Aluminum

2-layer

## IGBT Modules

Increased heat and thermal dissipation requirements demand new cooling solutions designed around current automotive systems. Copper Clad Aluminum up to 7mm in thickness can solve many of these needs.



Copper

Aluminum

2-layer



### Copper Clad Aluminum

Whether it is for cooking or for baking: EMS offers the perfect solution for your individual needs. Our combinations of copper or aluminum and stainless steel are available in many shapes, widths and thicknesses and guarantee food compatibility and stainless quality.



2-layer

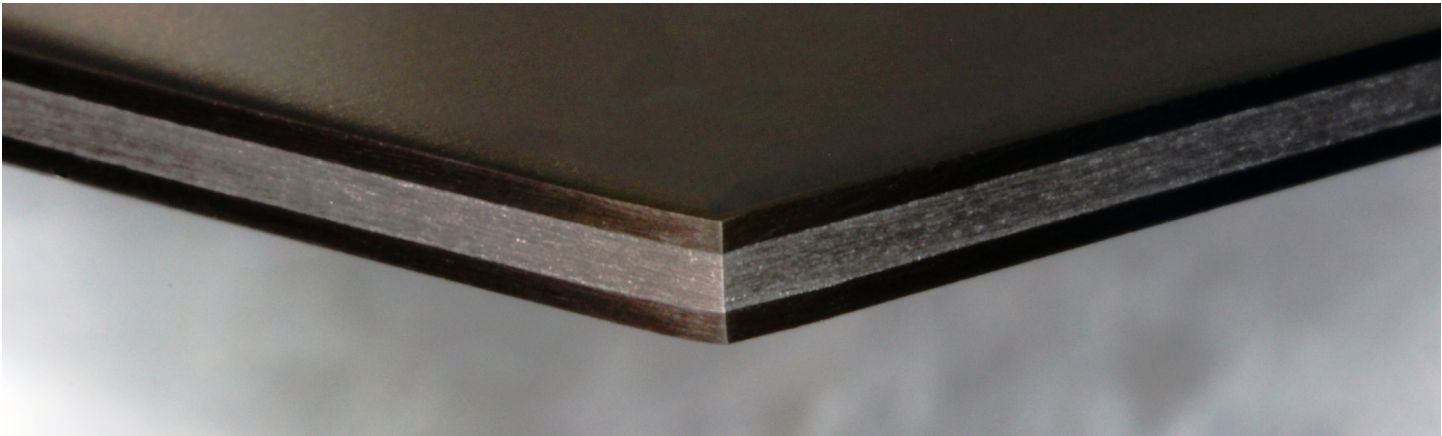
### Stainless / Aluminum / Stainless

Factors like even heat conduction, light weight and easy clean up make our Stainless Steel Clad Aluminum cookware the favorite of many chefs. Our cookware is produced in a precise and cost effective roll-to-roll cladding process which holds tolerances as tight as 0.001". It provides an overall cladding - not just at the bottom- which improves overall thermal performance. Clad designs are also compatible with induction heated ranges.



3-layer

## Did You Know?...



EMS has developed **Unique Material Systems** for exclusive use by specific customers in the cookware market.

These clad metal systems incorporate a range of metals including; Ferritic Stainless Steel, Austenitic Stainless Steel, Copper Alloys, Aluminum Alloys, and Titanium Alloys.

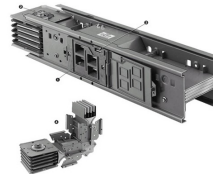
EMS provides cookware products in coil and blanked disc forms.



# Electrical Distribution

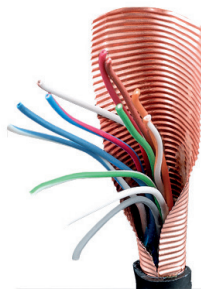
## Busbars and Busways

Copper Clad Aluminums can be used for a variety of applications in the electrical distribution market. It unites the light weight benefits of Aluminum with the exceptional electrical and thermal characteristics as well as the heat dissipation of copper.



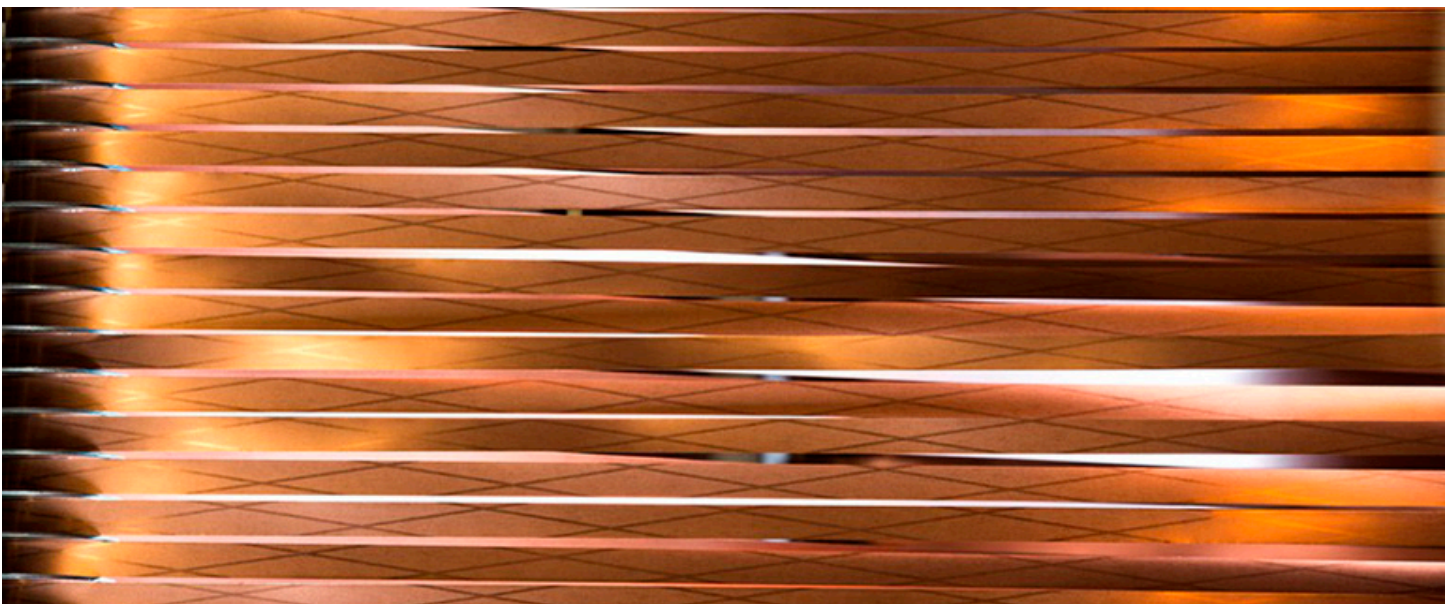
## Cable Shielding

EMS is one of the pioneers in the field of clad shielding in order to protect buried telephone wire from mechanical and rodent damage as well as errant electrical strikes. This is achieved through a low alloy steel core which offers superior strength and a low carbon core, which is a cost effective substitute for copper alloys.



## Fuse Clip

Copper Clad Steel is a combination of the physical attributes of steel and the high conductivity of copper and thus can be used in applications such as fuse clips, connectors, terminals, and circuit breakers. It can also be used for flat to canterlever-type springs or parts.

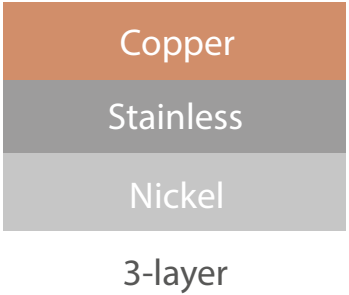




# Energy Storage

## Button Cell Batteries

An important application for clad materials is in the button cell battery industry for use as both the anode lid and cathode cup. In each case, clad is the preferred choice because of its unique multi-layer properties especially as performance demands increase for higher energy, smaller cells for hearing aids and other electronic devices.

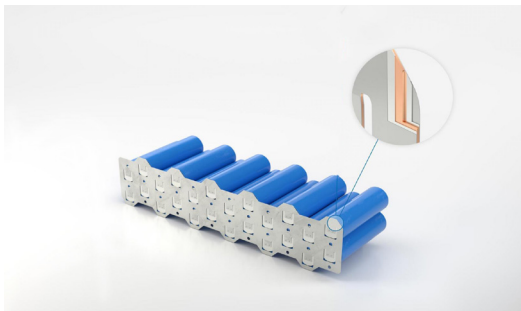
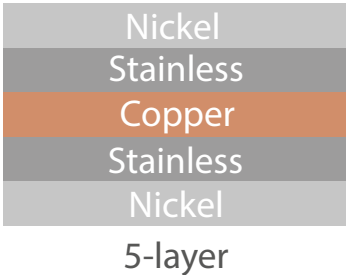
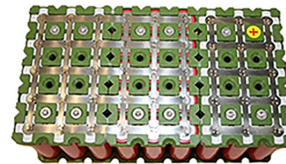
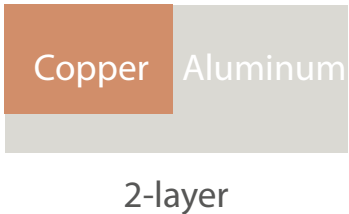


## Li-Ion Batteries

EMS CoreLok, Inlay, and Corelay Materials are used for joining Li-Ion pouch and prismatic cells. Various clad solutions are used to simplify joining dissimilar anode and cathode battery terminals.

Corelok is an edge bonded Copper-Aluminum product used to join pouch cell terminals made from Copper and Aluminum. It can also be used to simplify bussing by replacing cathode or anode tabs.

SIGMA<sub>CLAD</sub><sup>®</sup> was designed to replace pure Nickel with a higher conductivity clad design. This five layer material system of Nickel-Stainless-Copper-Stainless-Nickel provides lower resistivity, excellent contact corrosion resistance, excellent weld and solder characteristics, all at a lower cost to pure Nickel.

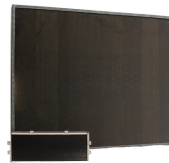




# Exhaust Catalyst

## Catalyst Foil

EMS DuraFoil and DieselFoil are a great alternative to Fe-CrAlloy materials in catalytic converter applications. They are high temperature oxidation and creep resistant alloys and are manufactured using our patented cold bonding/diffusion annealing process. Their aluminum rich surface and strength make them very receptive to wash coating and well suited to very large stationary applications or engine applications where durability is essential.



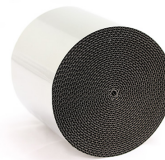
Aluminum

Stainless

Aluminum  
3-layer

## Catalyst Substrates

EMS can cater to any custom substrate geometries your application requires. Whether you need brazed or oxidized, round or rectangle, or other custom substrate geometry, in cell density ranging from 50-600 CPSI, we have the capability to manufacture to any specification you may have.



Aluminum

Stainless

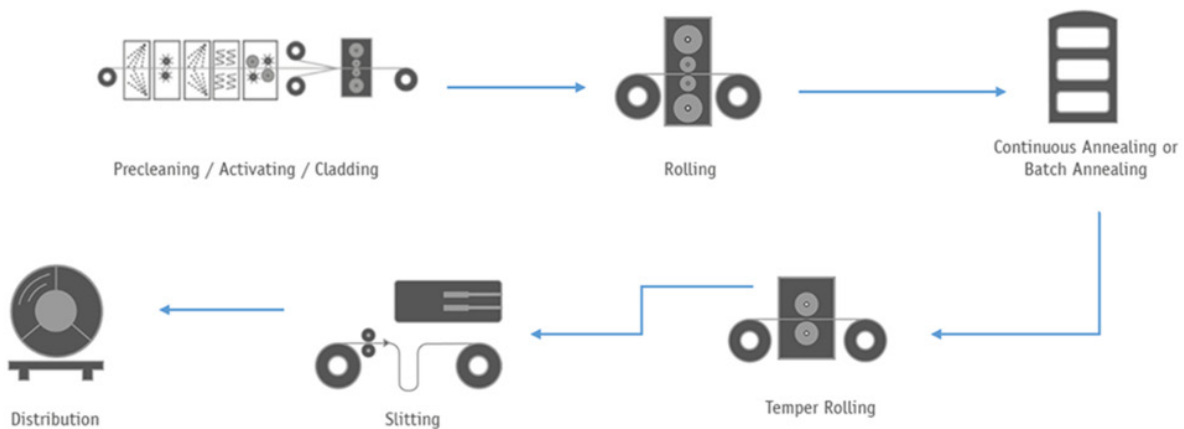
Aluminum  
3-layer

## How Clad Becomes Clad

The most common method is by continuous roll bonding process that combines two or more strips of metal. Cleanliness is paramount. First, the individual strips are either chemically or mechanically cleaned to provide contaminant-free surfaces. The strips then pass through a highly customized rolling mill which is designed specifically for cladding.

As they pass through the mill, the rolls exert immense pressure that reduces strip thickness and creates a metallurgical bond as the atomic lattices of the different metals merge into a common structure. The resulting composite material – a clad metal – derives its integrity from this shared electron interface.

Heat is then applied to induce diffusion, which improves bond strength and provides stress relief for cold processing. This results in a clad metal devised of precisely the right properties for its specific application. And that is the key benefit of cladding: the ability to combine the most desirable characteristics from different metals into a unique new metal composite that allows you do things you couldn't do before.

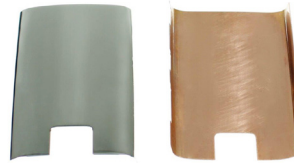


# Heat Transfer



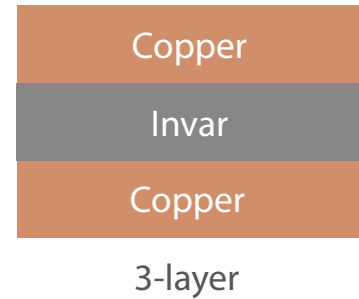
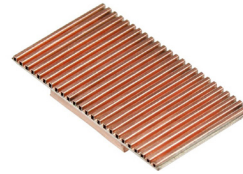
## Handheld Device Heat Spreading

Heat sink technology is facing new challenges as cell phones and other hand held devices encounter increasing heat concerns. Copper or aluminum clad stainless can provide a solution to these concerns as they offer better thermal performance with a good weldability and aesthetic looks.



## Printed Circuit Boards

Cladding copper to an Invar (36 Ni, balance Fe) core produces a constraining metal layer which is used by demanding industries such as electronics packaging, heat sink and printed wiring boards. The material is mil certified and a solution for many demanding electronic applications.





# Locations



## Attleboro, MA USA (EMSA)



This manufacturing facility is the oldest and largest facility within Engineered Materials Solutions and serves as our global headquarters. From over 500,000 square feet of manufacturing space we produce Thermostatic Bimetal and Specialty Clad Materials and are able to supply markets all around the world.

39 Perry Avenue Attleboro, MA 02703 | Phone: +1 508 342 2100 | Fax: +1 508 342 2538

## Hamburg, PA USA (EMSH)



Formerly the headquarters for Hood & Co., this facility was acquired by Engineered Materials Solutions in 2008. With extensive experience and parts production capabilities, the Hamburg facility serves as the center of excellence for Thermostatic Bimetal parts fabrication and assembly. From this facility we supply hundreds of millions of parts annually for Electrical, Automotive, and Industrial applications.

600 Valley Road Hamburg, PA 19526 | Phone: +1 610 562 3841 | Fax: +1 610 562 5800

## Baoying, China (WGA)



EMS broke ground on this wholly owned facility in 2005 and began production shipments in 2007. From its convenient location in Jiangsu Province, just 4 hours North of Shanghai, we can efficiently supply our many customers in China and the Asia Pacific region. The Baoying facility has extensive strip and parts processing capabilities. EMSC is able to offer our customers high quality products with local service and technical support.

No.8 Suzhong Bei Lu, Baoying County, Postal Code 225800 | Phone: +86 514 8891 6888 | Fax: +86 514 8891 6889

# Clad Materials

Nearly any combination of metals is possible

## Copper Clad Aluminum

	Aluminum Copper Aluminum	Copper Aluminum	Copper Aluminum Copper	Aluminum Copper
Width (in)	0.125 – 25.000	0.125 – 25.000	0.125 – 25.000	0.125 – 25.000
Thickness (in)	0.005 – 0.120	0.005 – 0.280	0.005 – 0.120	0.005 – 0.280
Outer layer ratio %	5% – 30%	5% – 50%	5% – 30%	5% – 50%
Core material	Copper Alloy	Aluminum Alloy	Aluminum alloy	Copper Alloy
Layer material	Aluminum Alloy	Copper Alloy	Copper alloy	Aluminum Alloy

Typical materials:  
Copper: C11000, C10200  
Aluminum: A91100, A95052

## Copper Clad Steel

	Copper Steel Copper	Copper Steel	Steel Copper Steel	Steel Copper
Width (in)	0.125 – 25.000	0.125 – 25.000	0.125 – 25.000	0.125 – 25.000
Thickness (in)	0.003 – 0.187	0.005 – 0.187	0.005 – 0.187	0.005 – 0.187
Outer layer ratio %	5% – 30%	5% – 50%	5% – 40%	5% – 50%
Core material	Carbon Steel	Carbon Steel	Copper Alloy	Carbon Steel
Outer Layer material	Copper Alloy	Copper Alloy	Carbon Steel	Copper Alloy

Typical materials:  
Copper: C11000, C10200, C12200  
Steel: G10080, G10650, G41300

## Nickel Clad

	Copper Stainless steel Nickel	Nickel Stainless steel Nickel	Nickel Stainless steel	Nickel Copper Nickel	Nickel Copper	Nickel Stainless steel Copper Stainless steel Nickel
Width (in)	0.062 – 13.000	0.125 – 13.000	0.125 – 13.000	0.125 – 13.000	0.125 – 13.000	0.125 – 13.000
Thickness (in)	0.004 – 0.060	0.004 – 0.060	0.004 – 0.060	0.002 – 0.060	0.004 – 0.060	0.004 – 0.060
Outer layer 1 ratio	3% – 15%	3% – 20%	3% – 20%	10% – 50%	3% – 50%	3%
Outer Layer 1 material	C10100	N02201	N02201	N02201	N02201	N02201
Layer 2 ratio	3% – 15%					27%
Outer Layer 2 material	N02201					S30400, S43000
Core material	S30400	S30400, S43000	S30400, S43000	C10200	C10200	C10200

## Clad Aluminum

	Stainless steel Aluminum Stainless steel	Stainless steel Aluminum	Steel Aluminum	Aluminum Steel Aluminum
Width (in)	4 – 24.000	4 – 25.000	0.125 – 25.000	0.125 – 25.000
Thickness (in)	0.070 – 0.160	0.010 – 0.160	0.010 – 0.160	0.003 – 0.187
Outer layer ratio %	10% – 20%	10% – 50%	5% – 50%	5% – 30%
Core material	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy
Outer Layer material	Stainless Steel	Stainless Steel	Carbon or HSLA	Carbon or HSLA

Typical materials:  
Stainless: S30100, S30400, S43000  
Aluminum: A91100, A93003, A95052  
Carbon: G10080

## Copper Clad Stainless Steel

	Copper Stainless steel Copper	Copper Stainless steel	Stainless steel Copper Stainless steel	Stainless Steel Copper
Width (in)	0.125 – 25.000	0.125 – 25.000	0.125 – 25.000	0.125 – 25.000
Thickness (in)	0.003 – 0.187	0.003 – 0.187	0.003 – 0.120	0.003 – 0.187
Outer layer ratio %	10% – 30%	10% – 50%	20% – 40%	10% – 50%
Core material	Stainless Steel	Stainless Steel	Copper Alloy	Copper Alloy
Outer Layer material	Copper Alloy	Copper Alloy	Stainless steel	Stainless Steel

\*Other materials and combinations possible including but not limited to titanium, magnesium, Ni-Fe alloys



# Best of metal.





[www.emsclad.com](http://www.emsclad.com)



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