

AMERICAN GALVANO, INC.  
ELECTROFORMING SERVICES CENTER  
VOICE: 909-307-1840 FAX: 909-307-1805  
E-MAIL: EFORMS@ELECTROFORMS.COM

## HOME

### **Welcome to the Electroform by American Galvano, Inc. The service center for your electroforming needs...**

Within these pages you will find a wealth of information about obtaining industrial electroforms, structural electroformed components and related electroforming services to fill a wide variety of applications.

To learn more about our electroforming services for products such as electroformed reflectors or ophthalmic tooling manufactured by the electroforming process please visit our Optical Electroforming Page.

---

### **Our Mission**

We at American Galvano continually seek to overcome the existing barriers of electroform manufacture and the electroforming technologies available today by developing new methodologies and integrating new sciences into the electroforming arena. The benefits of such planning are most often realized by the customer.

---

### **Company Profile**

With a widely varied customer base, providing electroforms and related electroforming services since 1994 to both governmental and commercial sectors, American Galvano is helping to define the state of the art of Electroforming. We use computer linked metallurgical samplers and automated test equipment grade electroforming power supplies, not only to monitor the desired metal qualities of the electroform, but also to control those qualities.

At American Galvano we have created both sensitive and demanding electroformed components before, however, each new electroform usually presents some interesting deviations from the types of electroforms we have created previously. All successful electroformed components have one inherent basic requirement: Knowledge of the problems before they occur and not hunting for a fix after they do. American Galvano firmly believes in an open line of communication, even though most of our electroforming technology is proprietary – our customers may take an integral and active role in the planning and production of their electroformed component.

With the vast amounts of electroforming knowledge available through American Galvano we can provide you with all aspects of the electroforming process technologies, from single electroform consultation and manufacture to a complete electroforming facility set up.

---

## DESIGN OF ELECTROFORMING

### METALS AVAILABLE FOR ELECTROFORMING

- Nickel
- Nickel Manganese
- Nickel Cobalt
- Nickel Cobalt Manganese
- Copper-OFC
- Copper-Structural
- Copper-Decorative

In addition to the metals listed above, American Galvano offers several secondary coatings to enhance desired properties such as hardness, reflectivity or environmental protection.

---

### ELECTRODEPOSITED COATINGS

- Bronze
- Rhodium
- Palladium
- Palladium-Nickel
- Platinum
- Electroless Nickel
- Gold-Hard
- Gold-Pure
- Copper

---

### MANDREL TYPES

There are four general headings for mandrel types:

#### *REUSABLE*

When the geometry of the part to be electroformed will allow separation of mandrel from electroform without damage to either component. This is the economical choice for multiple copies of the same shape and usually the material choice is Aluminum, Stainless Steel, titanium or a previous generation Nickel electroform.

#### *EXPENDABLE*

When the geometry of the electroform does not allow for removal of the master from the electroform (mechanical locking). The materials of choice are: 6061-T6 Aluminum, High Temperature wax, epoxies and some plastics. In special applications exposed photopolymers, photo resists and SLA's have also been used as mandrel materials.

#### *CONDUCTIVE VS. NON-CONDUCTIVE*

Conductive mandrels are usually metallic and as mentioned Aluminum, Nickel, Stainless Steels and Titanium are the usual choices. While Aluminum is suitable for Nickel Electroforming, it has some problems when used as a mandrel for Copper Electroforming. Bottom line Aluminum should only be used as a onetime mandrel for Copper electroforming. The only conductive non-metallic mandrel materials that we have experience with is Carbon/ Carbon composites or graphite, these are also materials which we can adherently deposit metals onto with goods results.

Non-conductive mandrels cover a large variety of materials. The common thread for this type of material is that it must accept metallization by chemical means only. Usually this is accomplished by either reduction (silvering or mirroring) or autocatalitically (electroless plating). Electroforms with low tolerances or attention to detail may also be metalized by conductive paints or fine ground metal powders such as silver or bronze rubbed into the surface. Once Metalized, the electroform is created by electrodeposition over the now conductive surface.

---

### SOME OF THE MORE COMMON NON-CONDUCTIVE MANDREL MATERIALS ARE:

- Wax
- Epoxies
- Some Plastics
- Ceramics
- Glass
- RTV
- Fiber Glass
- Plaster

---

## EXAMPLES OF SUCH BENEFITS INCLUDE

1. Better electroforms pricing and improved electroformed component reliability for production oriented customers.
2. A jump start in the development of custom electroforms for new item and research oriented customers.

## PRODUCT GUIDE

### PRODUCT AND SERVICES GUIDE

#### ELECTROFORMS

Electroforming is a manufacturing method generally considered an exacting form of replication in metal of a master mandrel, which may or may not be metallic, by electrodeposition. This is indeed a simple definition of a process which can make extremely complicated components when the need presents itself. In Fact some component types can only be made by the electroforming process while other components which may be made by other means are manufactured more economically through the electroforming process.

#### HEAVY DEPOSITION

Unlike electroforming in which the electrodeposit is removed from a master mandrel, heavy deposition is the science of adherently depositing a metallic layer over a metallic or non-metallic substrate. In this case we do not actually create a component, rather we augment the properties of the original surface to make it more suitable for its designated task. Increased surface hardness or an atmospheric barrier layer can be applied in layers over 1" thick, for example.

#### THIN FILM COATINGS

Meeting the same basic design requirement as heavy deposition, thin film coatings are used to augment the properties of the electroformed components base material in some way. The ability of Platinum to stand up to concentrated Hydrochloric Acid, even anodically, to protect a nickel or copper electroform is one example. The application of vacuum deposited Aluminum to enhance the reflectivity of a mirrored surface is another.

#### OUTSIDE PRODUCT DEVELOPMENT

From one time consultation to the creation of a turnkey facility, American Galvano can make your life easier and save you time and money with regard to your electroforming projects.

## ELECTROFORMING

### EXAMPLES OF ELECTROFORMING

- Reflectors and other durable optical surfaces
- Hologram / digital information stampers
- Ophthalmic / intraocular tooling
- Fresnel / lenticular lenses.
- Battery Cans
- Laser light guides
- Cryogenic components
- Heat exchangers / heat shielding
- Rocket engine combustion chambers weighing up to 1 ton
- Flight weight or ground station microwave guides
- Fuel lines or piping which requires no change in i.d. through bends
- Components with intricate or complicated internal geometries
- Seamless duct suitable for most gases
- Molds for injection or casting
- Nickel bellows

- Paint spray masks
- Vacuum or EDM electrodes
- Propeller / rotor abrasion shielding
- Machined cavity closeouts
- Embossing Dies
- Precision connectors

As you can see by the above, our “Examples of Electroforming” list covers a large variety of existing component types and is intended only as a general guide. There is no method available to predict future component types or designs nor could we list every type of electroform we have ever worked on. This list does contain a deeper message however, and that message is- no matter what your electroforming requirement is, you can draw on the vast knowledge at American Galvano to respond to your needs in a direct and intelligent manner.

## HEAVY DEPOSITION

### EXAMPLES OF HEAVY DEPOSITION

- Metal Coating of non-metallic components made of materials such as carbon, various plastics or graphite/graphite composites
- Buildup of worn shafts, bearing races or mold surfaces
- Fill in of improperly machined areas for re-machining
- Bonding of two or more metal components together without the heat associated with traditional welding / brazing operations
- Creating high thermal transfer heating and cooling channels
- The addition of integral or attached structural reinforcements

Unlike electroforming in which the electrodeposit is removed from a master mandrel, heavy deposition is the science of adherently depositing a metallic layer over a metallic or non-metallic substrate. In this case we do not actually create a component, rather we augment the properties of the original surface to make it more suitable for its designated task. Increased surface hardness or an atmospheric barrier layer can be applied in layers over 1” thick, for example. However when you combine electroforming and heavy deposition processes you now have a method of joining two electroforms together to create components which require hidden machined areas. Examples of such components are Integrally cooled heat exchangers with exotic channel designs or reinforcements placed within a component to maintain rigidity while lowering its weight and maintaining its external dimensions.

## THIN FILMS

### METALS AVAILABLE FOR THIN FILM COATING

- Electroless-Nickel
- Gold
- Rhodium
- Monel
- Platinum
- Palladium
- Nickel-Palladium
- Chrome
- Aluminum
- Aluminum-Magnesium-Fluoride
- Silicon-Oxide
- Silicon-Dioxide

Thin film coatings are used to augment the properties of the electroformed components base material in some way. The ability of Platinum to stand up to concentrated Hydrochloric Acid, even anodically, to protect a nickel or copper electroform is one example. The application of vacuum deposited Aluminum

to enhance the reflectivity of a mirrored surface is another.

American Galvano has the capabilities to provide you with both electrodeposited and vacuum deposited thin film coatings. Additionally we have developed our own optical quality coating designed to limit background noise for those components used in electronic imaging or digital information.

## OUTSIDE DEVELOPMENT

### HELPING HANDS

Along with American Galvano's manufacturing capabilities it is our desire to help you manufacture the product you need at your facility. Assistance from us is available in three basic methods.

### CONTRACT CONSULTATION

Contract consultations may be as involved as a startup development program or as a piece work agreement such as helping you attain desired metallurgical properties from your baths or improving your yield ratio.

### INTERNAL DEVELOPMENT FOLLOWED BY A TECHNOLOGY TRANSFER.

Internal development / Technology transfer is probably pretty self-explanatory and we suggest you contact us for more specifics or to have us provide a project overview.

### SET UP OF A TURNKEY FACILITY OR ANY PART THEREOF.

If you wish to create a new facility, upgrade your current facility or improve certain aspects of your production American Galvano can route information to you designed to fill your specific need in an intelligent and cost effective manner.

## OPTICAL

### OPTICAL ELECTROFORMING DIVISION

The Electroformed Optics Division of American Galvano is your one-stop center to fill all your precision optical needs. Simply supply us with your basic requirements such as the type of electroformed component, quantity, focal point(s) and aperture dimensions and we will do the rest.

Optical electroforms fill many voids in manufacturing precise components which in some cases are not attainable by other means or at the very least electroforming is an economical alternative to other methods of manufacture.

American Galvano has an extensive collective knowledge in the area of electroformed optical components for both Military and Commercial use.

Real time electronically controlled electrodeposition techniques afford a degree of both accuracy and repeatability not humanly possible. Electroforms with surface qualities as delicate as 6 wavelengths visible light have successfully been created here. Our typical electroformed reflector surface quality has a 60/40 scratch and dig specification. This specification is determined to be a practical balance between low cost and a maintained high performance.

While the most common metal used to electroform optical components such as reflectors or laser light guides is nickel or nickel cobalt, the inherent reflectivity of these metals is poor and degrades even more within a short period of time. For this reason, American Galvano offers various coatings which when applied to the reflector or mold enhance its capabilities. We offer vacuum deposited coatings designed to increase reflectivity over specific wavelengths of light or electrodeposited coatings designed to extend the unit life under environmental factors such as heat or abrasion. For those optical components used in analysis, such as particle counters, or digital imaging, we also offer a unique coating designed to virtually eliminate background noise generated by the surface of the mirror itself.

## CONTACT US

### **Thank You And Please Visit Us Again !**

We hope you have found your visit with us informative enough to determine if American Galvano can help you with your needs while being structured to not waste your time.

We look forward to your comments.

Sincerely,

*Anthony J. Covey*

### CONTACT INFORMATION

---

#### **Postal Information**

American Galvano, Inc.  
421 Kansas Street  
Redlands CA 92373

#### **Phone Numbers**

Voice 909-307-1840  
Facsimile 909-307-1805

#### **Electronic Mail**

Sales and Support: [eforms@electroforms.com](mailto:eforms@electroforms.com)