What is Surface Finishing?

Surface finishing is the process of altering the surface on an object (e.g., polishing, buffing, electropolishing, chemical etching, plating, coating) for the purpose of enhancing its appearance or functional property.

The purpose of finishing can be for economic reasons, material conservation, to change the surface of the base material to provide certain desirable properties, or a combination thereof, such as:

- CORROSION RESISTANCE
- ABRASION RESISTANCE
- WEAR RESISTANCE
- IMPROVED LUBRICITY
- NON-TOXICITY
- DIMENSIONAL ALTERATION
- LIGHT REFLECTIVITY
- INSULATION OR CONDUCTIVITY
- IMPROVED ELECTRICAL PROPERTIES
- SOLDERABILITY
- TEMPERATURE RESISTANCE
- MAGNETISM/NON-MAGNETISM
- IMPACT RESISTANCE
- WIRE BONDING
- RUBBER BONDING
- LIGHT ABSORPTION

Apart from its decorative uses on a wide range of consumer and industrial products, surface finishing provides essential functional applications.

Natural resources are conserved by the use of coatings to preserve products, or when a rare, costly surface coating can provide its own desired physical properties on a more abundant and less costly base material.

Without surface finishing, a new car would be coated with rust within two weeks, and the engine/transmission would be unable to function at all.
The Surface Finishing Industry

The job-shop surface finishing industry involves more than 4,000 surface finishing firms across the United States, with total annual sales exceeding $4 billion. Their work is an essential part of the production of virtually all manufactured durable goods, ranging from nuts and bolts and surgical instruments to computer circuits and aerospace components.

There is not one piece of metal in our homes, businesses, or on our persons that has not passed through a surface finishing plant somewhere. Without surface finishing, the entire U.S. economy would grind to a halt.

Examples of major industries serviced by surface finishers include:

AUTOMOBILES
AIRLINES
COMMUNICATIONS
COMPUTER EQUIPMENT
CONSTRUCTION EQUIPMENT
DEFENSE HARDWARE
DEFENSE ELECTRICAL HARDWARE
FURNITURE JEWELRY
MOTORCYCLES & BICYCLES

Household Appliances & Accessories
Tools & Dies
Oil Drilling Equipment
Steel Mill Products
Food
Medical
Pharmaceuticals
Toys
Sporting Equipment

Although there are many manufacturers who have their own surface finishing facility in house, there is a growing trend to subcontract such work to independent firms as a result of the high cost of starting and operating such business—in some instances at less than full capacity—and the expensive government-mandated pollution abatement programs and other environmental and worker safety statutory regulations.

Since surface finishing operations consume large amounts of energy, spiraling costs have become another important factor leading to the growth of independent surface finishing firms.

The surface finishing industry continues to make positive contributions to many other industries and to the general economy with new research, new equipment and new processes necessary to keep pace with the development of space-age products and more demanding coating specifications. Look around and you will discover more than just a handful of items that have been served by this vital industry.

... and the Environment

The continued demand for finishing services makes us aware of not only our bright future, but also our responsibility to conduct our operations with a serious concern for environmental considerations. We are working side-by-side with the Government and the Environmental Protection Agency (EPA) to make sure that coexistence with our environment is possible. Like other industries, we want to be known as people who are concerned with the total environment. In striving to achieve this difficult balance, the surface finishing industry continues to explore waste minimization and pollution prevention techniques, and to work in a cooperative manner with all appropriate government agencies.

As a result of this effort, the surface finishing industry is now one of the most environmentally protective of any industrial group in America.
**Metal Finishing**

**Coatings & Surface Treatments**

**ELECTROPLATING** is an electrochemical process used to deposit a metallic coating on the base material of an object by immersing it in an electrically charged solution so that a suitable low voltage electric current flows through it, causing the metallic coating to be attracted to the object being plated.

A typical basic electroplating sequence looks something like this:

**CLEANER**

**RINSE**

**ACID DIP**

**RINSE**

**ELECTROPLATE**

**RINSE**

**POST FINISH**

**RINSE**

Some of the more common electroplated coatings and their functions include:

**BRASS** — Plated mostly for decorative purposes on such items as household lamps, furniture, accessories and builders' hardware, either as a bright or satin finish, or oxidized to obtain various antique effects.

**CADMIUM** — A silver-white deposit used to minimize galvanic corrosion on parts or assemblies consisting of dissimilar metals such as brass and steel, and for its corrosion protection properties in certain harsh environments.

**CHROMIUM** — The bright, shiny, mirror-like finish so common on everything from automobiles and motorcycles to bicycles and toys, furniture, appliances large and small, plumbing fixtures, right down to the knobs on the TV set. This versatile finish provides corrosion protection and good wear life, as well as beauty.

**HARD CHROMIUM** — A heavy, dense deposit of chrome used to provide wear resistance on such parts as pistons, cylinders, aircraft engine parts, cutting tools, dies, oil tool parts and valves. Also used on printing plates for printing everything from money to catalogs.

**COPPER** — A reddish deposit used for plating through holes on circuit boards in the electronics industry, on steel wire used in making high-strength electric cable, and as a stopoff to prevent case hardening on selected areas of iron and steel surfaces. All pennies made since 1981 are copper-plated zinc. Copper is also the first layer in “triple chrome” plating.

**GOLD** — A yellow deposit heavily relied upon in the electronics industry to provide long-term, dependable electrical contact, solderability, temperature resistance and corrosion protection in all kinds of devices including telephones, pagers, cellular phones, printed circuit boards, televisions, satellites, rockets, and so on. Gold is also a common deposit on jewelry, pens and optical products.
NICKEL — A silver-white deposit used generally on industrial products for corrosion protection, and in the chemical and food processing industries to prevent iron contamination.

SILVER — Used on tableware and hollowware because of its resistance to foods, as well as in jewelry. Functional uses include preventing galling or seizing of metal surfaces under high loads, such as on bearings, threads on stainless steel bolts and on titanium compressor blades. It is also used in the electrical and electronics industries because of its outstanding conductivity.

TIN — A white, non-toxic, solderable, soft deposit useful for its resistance to corrosion and tarnish. Since tin is non-toxic, it is used as a coating on sheet steel for making “tin cans” as well as on food handling equipment.

ZINC — A bluish-white deposit which serves as an inexpensive decorative and sacrificial protective coating against atmospheric corrosion of iron and steel parts. It is commonly used on nuts, bolts, wire goods, fasteners, stampings and sheet metal parts.

A non-electroplating coating or surface treatment of a base metal can also be used to obtain certain desired properties.

ANODIZING — An electrochemical process which converts an aluminum surface to a coating of aluminum oxide. This coating can be transparent, making it suitable for dyeing a wide variety of colors for decorative or utilitarian purposes; or dull gray, for protection of hardware, nuts, bolts, and aircraft parts.

COLORING ANODIZED ALUMINUM — Accomplished by immersing previously anodized aluminum in a desired color dye bath, then sealing by immersion in a hot water bath, which closes the microscopic pores in the colored coating. A wide variety of colors give this finish broad appeal as a decorative finish for giftware, novelties, automotive and appliance trim, nameplates and exterior architecture.

ELECTROLESS PLATING — The chemical deposition of a metal coating on a substrate by immersion in the appropriate plating solution. Electricity is not involved in this process; therefore, heavy and uniform deposits can easily be obtained which possess unique mechanical, chemical or magnetic properties. The process can be applied to properly treated non-metallic objects such as plastic and glass.

♦ ELECTROLESS NICKEL provides better corrosion and chemical resistance, greater hardness, wear resistance and lubricity than electroplated nickel.
♦ ELECTROLESS COPPER is applied on non-conductors to provide a conductive layer, and also in the printed circuit industry for crossover connections.
♦ ELECTROLESS GOLD is commonly used in integrated circuit applications.

ELECTROPOLISHING — An electrochemical process — the reverse of plating. Instead of a coating or plating, electropolishing removes metal from the surface, leaving a very smooth, clean, bright finish. Electropolishing is most often performed on stainless steel, but can also be performed on aluminum and copper alloys. It provides a surface that is less porous, allowing for reliable sterilization in the medical and food industries.

ORGANIC COATING — The process of depositing a pigmented coating on the surface of an object by dipping, flow coating, conventional spraying, electrostatic spraying, electrocoating and powder coating. With the exception of powder coating, all of these techniques involve application of paint as a liquid.
Generally, organic coating processes require curing to form a solid dry paint film, either by air drying, or in ovens using gas, fuel oil, electricity, steam infrared, ultraviolet or electron beams as the source of energy.

CONVERSION COATINGS

PHOSPHATE COATINGS — Porous crystalline coatings of zinc, iron or manganese phosphate produced on ferrous metal surfaces by the reaction of the surface metal to the phosphate solution. These coatings are widely used for a number of reasons:

♦ Prolonging the life of organic coatings
♦ Providing good paint bonding
♦ Improving corrosion resistance by providing a good base for absorbing and retaining rust preventative materials.
♦ Providing an excellent base for holding lubricants and drawing compounds.

BLACK OXIDE — A conversion coating formed by a chemical reaction with the metal surface (e.g., steel, stainless steel, copper, brass) to form an integral protective surface. The process is typically applied to ferrous alloys when oxidizing salts react with the iron to form magnetite (Fe3O4), the black oxide of iron. Black oxide is used for a number of reasons: corrosion protection, dimensional stability, improved lubricity, anti-galling, decorative finish, reduced light glare, and pre-treatment to paint. Advantages include absence of hydrogen embrittlement, toxins or welding fumes.

PASSIVATION — The use of an acid solution to render the surface of stainless steel in a “passive” state that enhances its corrosion resistance.

Coating Application Techniques

DIP COATING — Accomplished by immersing parts to be coated in a tank of paint, with the excess paint draining back into the tank as the parts are withdrawn, followed by drying or baking.

FLOW COATING — Involves flowing paint over the object to be coated as it is held over a tank.

CONVENTIONAL SPRAYING — Compressed air is supplied to the spray gun and to the paint container. The pressurized air mixes with the liquid paint, causing it to be atomized at the gun, and then propels the atomized paint from the gun nozzle to the object to be coated.

ELECTROSTATIC SPRAYING — Electrostatically charged paint is directed by air and attracted to the grounded parts to be coated. Advantages include minimal overspray and a “wrap around” of the paint in which the paint is attracted to the back side of parts as well as sharp edges.

POWDER COATING — One of the newest and most environmentally sound innovations in the industry. Applied electrostatically or by fluidized bed, these plastic coatings come in an unlimited range of colors. As there are no volatile thinners used, all of the oversprayed materials are recovered and reused. The coatings are applied dry, melted, flowed, and fused, making a pin-hole-free finish for beauty, long wear, and superb corrosion protection.

There are hundreds of finishing processes that deal with specific issues. For all of your plating/finishing needs, consult an NAMF representative to find the right solution for your application.
The Coating Process

A typical sequence of a coating operation involves:

1. Surface preparation (to insure a smooth, clean and dry surface)
2. Coating application
3. Curing

Selection of Coatings

Important considerations in the selection of coatings include purpose, use, cost, expected useful life and environmental exposure.

The Finishing Touches

Now that you have learned how the surface finishing industry touches the lives of so many people, it is important to remember some key points emphasized in this brochure.

- We are an industry of small businesses, and the services we provide are an essential part of the production of virtually all manufactured durable goods.
- Natural resources are conserved by the use of coatings for preserving products, or when a rare, costly surface coating will provide its desired physical properties on an abundant and less costly base material.

- We serve every industry, large and small, none of which would survive without surface finishing.
- Our commitment to a clean environment and a safer work place is as strong as our commitment to the overall success of our industry. We know we cannot have one without the other.
- We believe our industry is an important part of the business backbone of this country. We are small, independent organizations that make large contributions to the economy.

NAMF . . . Playing a Vital Role

This brochure is one of many NAMF projects designed to represent our membership in the most skillful and professional manner possible. NAMF is the ONLY official representative of custom job-shop surface finishers-together with its suppliers affiliate, the Metal Finishing Suppliers’ Association (MFSA)-with its members playing a vital role in the industrial world. NAMF is an organization of management executives who are leaders within the industry.

NAMF membership is worldwide and open to companies engaged in various surface finishing activities, as well as associations representing such businesses. Contributing sponsor affiliation is offered to other interested parties not directly involved in surface finishing.

The Association is administratively headquartered in northern Virginia, with government relations staff based in nearby Washington, DC. Each year NAMF sponsors an annual convention, various management seminars, surveys and an industry-wide business seminar. In addition, NAMF offers comprehensive group insurance programs to members, and regularly publishes periodicals and manuals to help members increase their management skills and knowledge of the industry.