



ELECTROPOLISHING FOR HYDRAULICS & PNEUMATICS

Increase Reliability, Improve Functionality,
and Reduce Failures



Content

- 4** HOW THE HYDRAULIC & PNEUMATIC INDUSTRIES BENEFIT FROM ELECTROPOLISHING
- 6** TECHNICAL SUMMARY
- 8** DEBURRING
- 10** MICRO-FINISHING & ULTRACLEANING
- 12** FATIGUE LIFE IMPROVEMENT
- 15** CORROSION RESISTANCE
- 16** ABOUT ABLE
- 18** INDUSTRY STANDARDS

HOW THE HYDRAULIC AND PNEUMATIC INDUSTRIES BENEFIT FROM ELECTROPOLISHING

Manufacturing components for the hydraulic and pneumatic industries often involve creating the ideal surface finish: neither too rough nor too smooth. When it comes to surface finish, electropolishing can help manufacturers walk that fine line and achieve the ultimate in function.

Since friction is involved in hydraulic applications, oil retention is crucial. Too smooth a finish can lessen a surface's ability to hold onto lubricant. At the same time, too rough of a finish can cause added friction and wear, which eventually lead to a breakdown in function.

Surface finish is important for hydraulic and pneumatic applications, but the level of surface contamination and cleanliness is also crucial. Grinding, honing and mechanical polishing are all forms of surface finish improvement that may also be critical steps in finishing parts for these industries. However, these processes come with the risk of leaving particulate or contaminants behind and often work best in tandem with electropolishing.

Electropolishing is typically the last operation in the metal finishing process. It is important to maintain tight seals in hydraulic and pneumatic applications because functionality of these systems depends highly on keeping fluid or air from leaking.

Electropolishing not only improves surface finish, but also removes the superficial exterior layer at the same time. The process also removes imbedded particulate and other contaminants on or within that layer. Electropolishing minimizes the amount of entrapped or generated particulate, which if present could potentially lead to excess wear, leakage and premature failure.

Electropolishing is a metal removal process, and here at Able we have tight controls over material removal from part to part, within a lot, as well as from one order to the next. As a rule, we can hold tolerances of +/- .0001".

We work with our customers in the early stages of a project to adjust racking methods and stock removal to ensure maximum surface finish improvement in critical areas. In some cases, masking can be employed, but should be avoided if possible. To achieve the best overall finish, it is best to engineer the part ahead of time to allow for the consistent amount of material removal.



Electropolishing, though most commonly employed on stainless steels, can also be used on virtually any metal alloy.

We frequently electropolish various carbon steel alloys for hydraulic/pneumatic applications as well as stainless steel, aluminum, brass and core iron.

The electropolishing process involves relatively low temperatures and does not change the thermal properties, case hardness, or cause warping of a heat-treated alloy.

When you call Able with technical questions, you will speak with an in-house associate that will have the most up-to-date information at hand to accurately

discuss your parts and application. More than 60 years of electropolishing history combined with an equally staffed three-shift operation ensures that your parts will be processed as quickly and accurately as possible.

As an ISO 9001 and 13485-certified company, we keep extensive processing records from the initial sampling/R&D process all the way through production. Once we work with a customer, the customization process for their part or parts, application and detailed engineering records are kept on file electronically. If the customer initiates any changes over the life of the job, those changes are documented and remain permanently on file.

COMMONLY ELECTROPOLISHED PARTS

- Pressure Transducers
- Cylinders
- Heat Exchangers
- Air Compressors
- Filters
- Valves
- Actuators
- Pump Casings
- Gears
- Springs
- Fasteners
- Pistons
- Poppets
- Sleeves
- Plungers
- Manifolds
- Fittings
- Spools
- Spindles
- Couplings
- Brackets
- Mounts

TECHNICAL SUMMARY

Electropolishing is often referred to as a “reverse plating” process. Electrochemical in nature, electropolishing uses a combination of rectified current and a blended chemical electrolyte bath to remove flaws from the surface of a metal part.

Since the development of electropolishing in the 1950s, substantial refinements have taken place. Able has numerous electrolytes to allow for electropolishing on a broad range of metals. These newer electrolytes, combined with advanced parts handling techniques, have improved production yields on a wide range of metal products.

Today, hydraulic and pneumatic equipment manufacturers utilize electropolishing to provide part enhancements in the final step of production.

Following treatment, metal parts have improved micro-finish value, an ultraclean surface, and enhanced corrosion resistance.

ALLOYS WE ELECTROPOLISH

Able specializes in providing electropolishing services for a variety of common and specialty metal alloys. Here is a partial list of alloys we can electropolish:

- 200-300 Series Stainless Steels
- 400 Series Stainless Steels
- Precipitating Hardening Grades
- Unusual Stainless Steels
- Copper Alloys
- Tool Steels
- Aluminum
- Titanium
- Nitinol
- Specialty Alloys
- Nickel Alloys
- Specialty Steels
- Carbon Steels

WHAT IT DOES

While electropolishing is best known for the bright polish left on a surface, there are some important, often overlooked, benefits of this metal finishing method. These benefits include deburring, size control, micro-finish improvement, ultraclean finishing, corrosion resistance, and others. These metal improvement benefits are highly desirable to design and production engineers for cost savings and product lifespan improvement.

HOW IT WORKS

The typical electropolishing installation is deceptively similar to a plating line. A power source converts AC current to DC at low voltages. A rubber-lined tank, usually fabricated from steel, is used to hold the chemical bath.

A series of copper or stainless steel cathode plates are lowered into the bath and installed to the negative (-) side of the power source. A part or group of parts is fixed to a rack made of titanium, copper or bronze. That rack in turn is fixed to the positive (+) side of the power source. As the adjoining illustration depicts, the metal part is charged positive (anodic) and immersed into the chemical bath.

When current is applied, the electrolyte acts as a conductor to allow metal ions to be removed from the part. While the ions are drawn toward the cathode, the electrolyte maintains the dissolved metals in solution. Gassing in the form of oxygen occurs at the metal surface, furthering the cleansing process.

Once the process is completed, the part is run through a series of rinsing and drying steps to remove clinging electrolyte. The resulting surface is ultraclean and bright. In fact, the bright surface is the most identifiable trait and is what helped coin the process name: electropolishing.

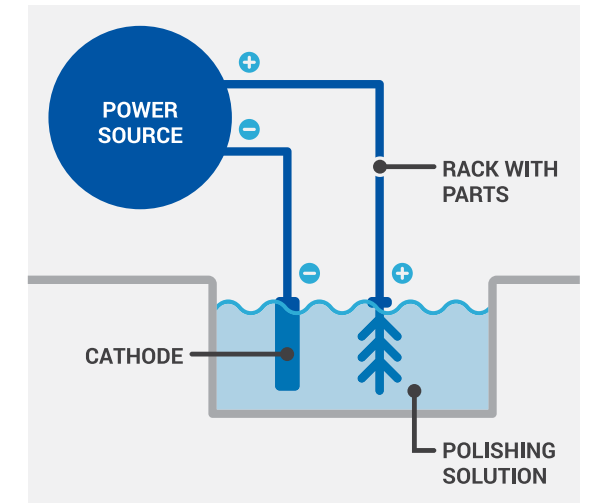


Figure 1

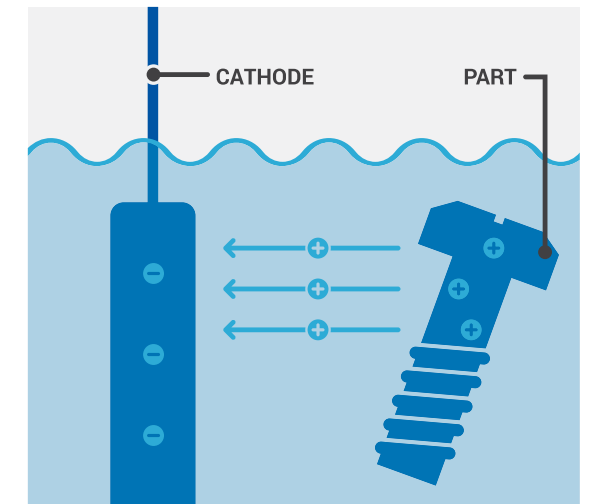


Figure 2

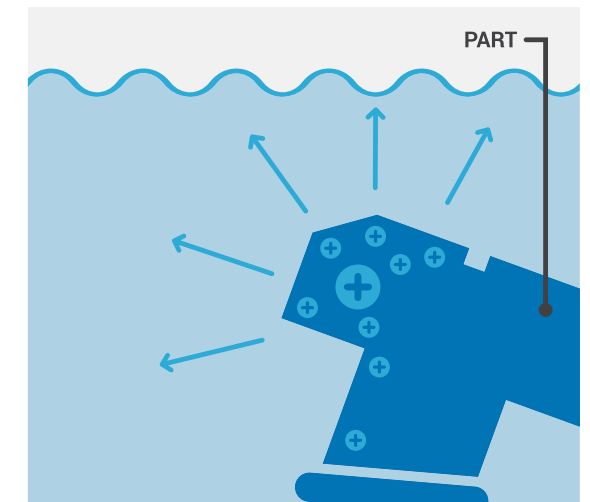


Figure 3

DEBURRING

From robotics to heavy machinery, hydraulic and pneumatic assemblies are being utilized more frequently than ever before. In order to maintain reliable performance and extended life cycles, the components in these assemblies must be precisely manufactured and have an impeccable surface finish.

To achieve that desirable finish, many companies have turned to electropolishing. At Able, we have been electropolishing a variety of parts used in hydraulic and pneumatic applications since the early 1980s. This process can be performed on nearly any alloy and uniformly removes material from the surface, lowering the Ra value.

Electropolishing is an effective deburring process that removes any flecks of metal or contaminants that may be present from machining or manufacturing. It is critical that the components used in these industries be clean so as not to interfere with the functioning of the assembly. Premature failure due to contamination can lead to equipment being idle and lost production time.

We can remove even the most minimal amount of metal from your parts, and adhere to precise specifications—such as keeping corners sharp or preserving grooves and spooling.

Electropolishing is the most effective solution for deburring and part integrity. This advanced metal finishing process improves parts' performance, enhances appearance, and does not alter the shape, warp or distort it in any way.

COMMONLY ELECTROPOLISHED PARTS

- Gears
- Valves
- Springs
- Fittings
- Poppets
- Spools
- Fasteners
- Manifolds

CASE STUDY

We electropolish a sleeve made from 416 SS. This particular part is used in a pneumatic application and our customer was looking for a method for deburring the inside and outside diameters. The part has holes throughout with multiple "o" ring grooves on the exterior. The sleeve is assembled with a spool that fits into the inside diameter. Due to the tight clearance between the two parts, it is imperative that the ID of the sleeve be free of burrs and sharp edges along with other contaminants from machining. Any foreign material present in the ID will cause the valve to malfunction and wear prematurely. When electropolishing their part, we remove approximately .0002" material from the ID. Able constructed the tooling in-house, which included a bipolar rack for placing an electrode through the entire ID.

Due to the critical nature of the part and special handling required, we utilized unique carriers with dividers designed to transport the sleeves from the electropolishing tank through the multi-stage rinsing operation.

MICRO-FINISHING & ULTRACLEANING

In all hydraulic and pneumatic systems, liquids and gases must be readily available and flow easily through pipes, tubes, or hoses to transmit energy to carry out a task. In operations where contact to metal surfaces is critical, improvement of that metal surface becomes essential.

Virtually all metalworking operations such as cutting, stamping, welding and forming, will affect surface quality.

When these metal surfaces are forced to work in critical sealing or friction zones, product performance often suffers.

In order to prevent this, these components must be free of surface defects, residual dust, oils, grinding compounds, imbedded scale, foreign debris, and other impurities. This can be accomplished with electropolishing.



Unlike mechanical or hand-polishing, electropolishing is a precise electrochemical process that dissolves an even layer of surface metal across a metal part. This saves both time and resources by creating a uniform finish when manufacturing parts with complicated or delicate shapes.

The most noticeable result of electropolishing is the transformation from a dull, gray surface to a shiny, chrome-like finish. The smooth, uniform surface texture significantly decreases hand-polishing time, reserving it only for a final buffing. Other benefits include:

- **Elimination of peeling or abrading.** Unlike plating, painting or Teflon coating, electropolished parts will not cause any coating abrasion issues.
- **No surface distortion, weakening or stressing of the part.** This makes electropolishing an ideal choice for even the most fragile of parts.
- **Improved weldability.** Electropolished parts are more conductive, resulting in stronger welds at lower voltage.
- **Resistance to staining and corrosion.** Imbedded impurities are removed, resulting in a finish that is more resistant to corrosion, tarnish and oxidation.

Hydraulic or pneumatic components such as pressure transducers, cylinders, heat exchangers, air compressors, filters, valves, actuators and many others can benefit from electropolishing.



CASE STUDY

Over the years, Able has been successful in electropolishing poppets for multiple customers. One of our customers sends us poppets in various sizes machined from carbon steel. By electropolishing the carbon steel parts after final grinding, we improve the surface finish and remove any loose flecks of material. For this application, our engineering record is set up to remove .0005" from the diameter. As a precautionary measure, after electropolishing, we apply a light rust inhibitor prior to packaging in plastic cell trays for shipping.



COMMONLY ELECTROPOLISHED PARTS

- Cylinders
- Filters
- Actuators
- Valves
- Pump Casings
- Gears
- Pistons
- Poppets
- Sleeves
- Plungers

FATIGUE LIFE IMPROVEMENT

Electropolishing has become a popular metal finishing procedure used to help improve the life of metal parts that bend, rotate, twist and cycle. These components come in many forms, including medical devices, piping and tubing, cylinders, regulators, pumps and valves, compressors, actuators and many more.

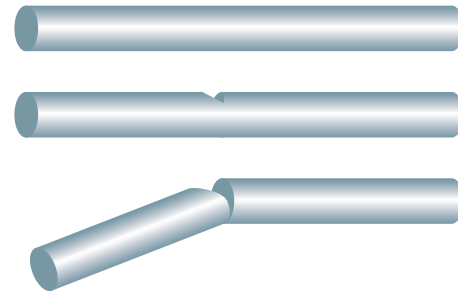
During the manufacturing process, micro-defects on the surface of these components are left behind. These defects, often in the form of micro-cracks or pits, can become initiation sites for crack propagation or corrosion. By removing these imperfections on the surface of metal parts, engineers have found electropolishing to greatly improve the life of components that function as springs, which in turn leads to significant fatigue life improvement.

At Able Electropolishing we understand the importance of meeting stress requirements in critical hydraulic and pneumatic parts. We frequently process stamped parts that must flex and torque as part of regular use. Electropolishing these parts helps them meet their cycle life expectations.

One customer experienced an issue with a part stamped out of heavy gage material, which was not meeting its stress requirements. The stamping process left the part with small cracks and fissures, which compromised the part with repeated use. By electropolishing the part, Able removed enough surface material to eliminate the fissures, enabling the part to pass its rigorous testing and function longer.

Hydraulic and pneumatic components are prone to the same development of cracks and fissures that lead to premature part failure. When electropolishing stainless steel parts like these, we remove a uniform layer of surface material from the entire part, eradicating the surface imperfections and

cracks that threaten the part's functioning. After electropolishing, hydraulic and pneumatic parts meet or exceed their anticipated cycle levels.



The figure above shows how a small crack or notch can create a condition that will result in a failure as stresses are placed along the surface of a part. This "notch effect" can be mitigated by removing a small amount of material from the surface of the metal part, restoring its surface to a smooth, defect-free surface.

COMMONLY ELECTROPOLISHED PARTS

- Springs



CASE STUDY

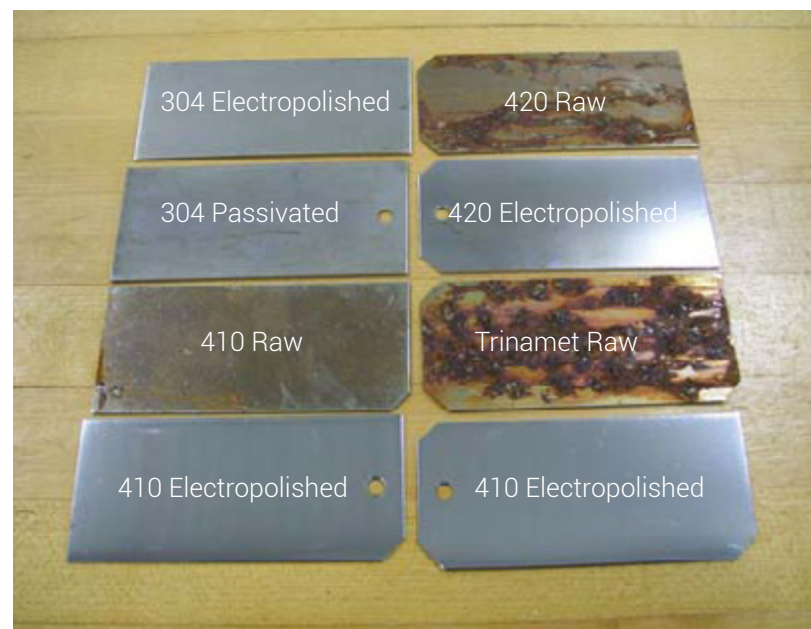
In this case, one of our customer's 17-4ph stainless steel spring was failing, causing a constant maintenance problem. The engineer ran samples of their spring with different levels of material removal. The engineer had the spring's cycle life tested.

One engineer's comment about the results of electropolishing was "phenomenal."

The results of the cycle life test increased well beyond current cycle levels and eliminated costly maintenance. The engineer added electropolishing to the spring manufacturing specification.

CASE STUDY

Our customer manufactures tubes for an automotive application. They were looking to decrease weight by using a lighter gage material. We worked with them by electropolishing different material alloys for testing. The material coupons were submitted to the ASTM B117 salt spray test by an independent laboratory. These photos show how the electropolished stainless steel samples have superior corrosion protection compared to the raw parts. Stainless steel applications that require high resistance to corrosion often specify electropolishing. The electropolished parts show no visible signs of rust even after 888 hours of exposure to salt spray. The customer was able to reduce weight and cost by using a less expensive material, but achieved the required corrosion resistance with electropolishing.



CORROSION RESISTANCE

One of the most valuable benefits of electropolishing is resistance to environmental hazards such as corrosion. Because the process removes a thin, uniform layer of surface material, it creates an ultraclean exterior, free of the iron deposits that can appear after machining or other secondary operations.

The part is left with a chromium-rich, passive surface that is much more resistant to premature corrosion.

While electropolishing is most often used to inhibit corrosion on stainless steel, numerous companies use the procedure to delay or hinder the corrosion properties of aluminum, copper, brass, carbon steel and other alloys.

COMMONLY ELECTROPOLISHED PARTS

- Brackets
- Mounts
- Pump Casings
- Fasteners
- Fittings

ABOUT US



Founder Zen Pokvitis

METAL FINISHING EXCELLENCE SINCE 1954

Production and engineering breakthroughs achieved during WWII led to new and exciting metal finishing technologies as industry shifted from the war economy. Our founder, Zen Pokvitis, was on the leading edge of those developments and focused his chemical background on production applications for electropolishing. That experience in chemical formulation and equipment design led to the founding of Able Electropolishing Company in 1954, which began focusing on the needs of metalworking companies nationally.

A COMMITMENT TO ENVIRONMENTAL SUSTAINABILITY

Able continues to make large investments in our facility to make sure we are in compliance with the stringent environmental guidelines now being enforced by federal, state and local regulatory agencies. Our investment in practices that support environmental sustainability means we're ready to serve our customers today and in the future.

THE NEXT GENERATION OF INNOVATION, SERVICE & EXPERTISE

Today, Able Electropolishing is America's largest electropolishing specialist, employing more than 150 people on three shifts at our 40,000-sq.-ft., state-of-the-art facility in Chicago, Ill. Thousands of companies in nearly every industry worldwide utilize Able technology for their metal parts.

Though our technology plays a vital role in serving customers, the traditions of service and attention to quality are what make Able Electropolishing a unique company.

Our entire company is tuned to the concept of doing the job right the first time. We have long recognized that metal finishing is the "last step" for many companies designing and producing metal parts, and we are often the lifeline for companies faced with assembly line shutdowns due to parts that are late or malfunctioning. Being part of the solution and meeting tough deadlines has established Able as the preferred vendor for so many companies.

OTHER SERVICES WE PROVIDE

While electropolishing is our signature service, we also have other metal finishing capabilities to enhance your parts. In addition to electropolishing, our other services include:

- Passivation
- Contract Cleaning
- Titanium Color Anodizing
- Laser Engraving
- Bake Out
- Custom Packaging

THE ABLE DIFFERENCE: EXPERTISE & EFFICIENCY

Able Electropolishing takes pride in our exceptional, expedited electropolishing process. By providing our signature metal finishing service for hydraulic and pneumatic equipment manufacturers in a timely manner, we assist our customers who need improved fit and function, as well as, corrosion-resistant equipment that meets industry standards.



INDUSTRY STANDARDS

We meet the following industry standards:

- AMS 2700
- ASME BPE
- ASTM A380
- ASTM A967
- ASTM B912
- ASTM F86

We are also an ISO 9001 and ISO 13485 registered company. These standards allow us to provide finishing services for critical parts in industries like pharmaceutical, medical device manufacturing, aerospace, automotive and more.



QUALITY STANDARDS & CERTIFICATIONS

At Able Electropolishing, we strive to satisfy our customers with every metal finishing job we complete. This includes adhering to international standards of excellence, ensuring that we consistently provide a variety of high-quality metal finishing services. We meet standards set by:

- ASTM (The American Society for Testing and Materials)
- ASME (The American Society of Mechanical Engineers)
- SAE (The Society of Automotive Engineers)
- ISO (The International Organization for Standardization)



By meeting or exceeding the various standards and quality management system requirements set by these organizations, we can provide services like electropolishing, passivation and more while giving our clients a sense of true security and consistency in our quality.

When you work with Able Electropolishing, you can enjoy the peace of mind that we are meeting high standards, whether you're sending us one part or thousands.

We continue to add state-of-the-art equipment to keep at the forefront of our industry.



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THE ABLE ELECTROPOLISHING DIFFERENCE

Since 1954, Able Electropolishing has been refining its technology to improve the fit and function of metal parts. No matter whether your part is small or large or the industry you work in, our electropolishing process gives you a unique combination of benefits you won't find with other metal treatments.

Find out more at: ableelectropolishing.com