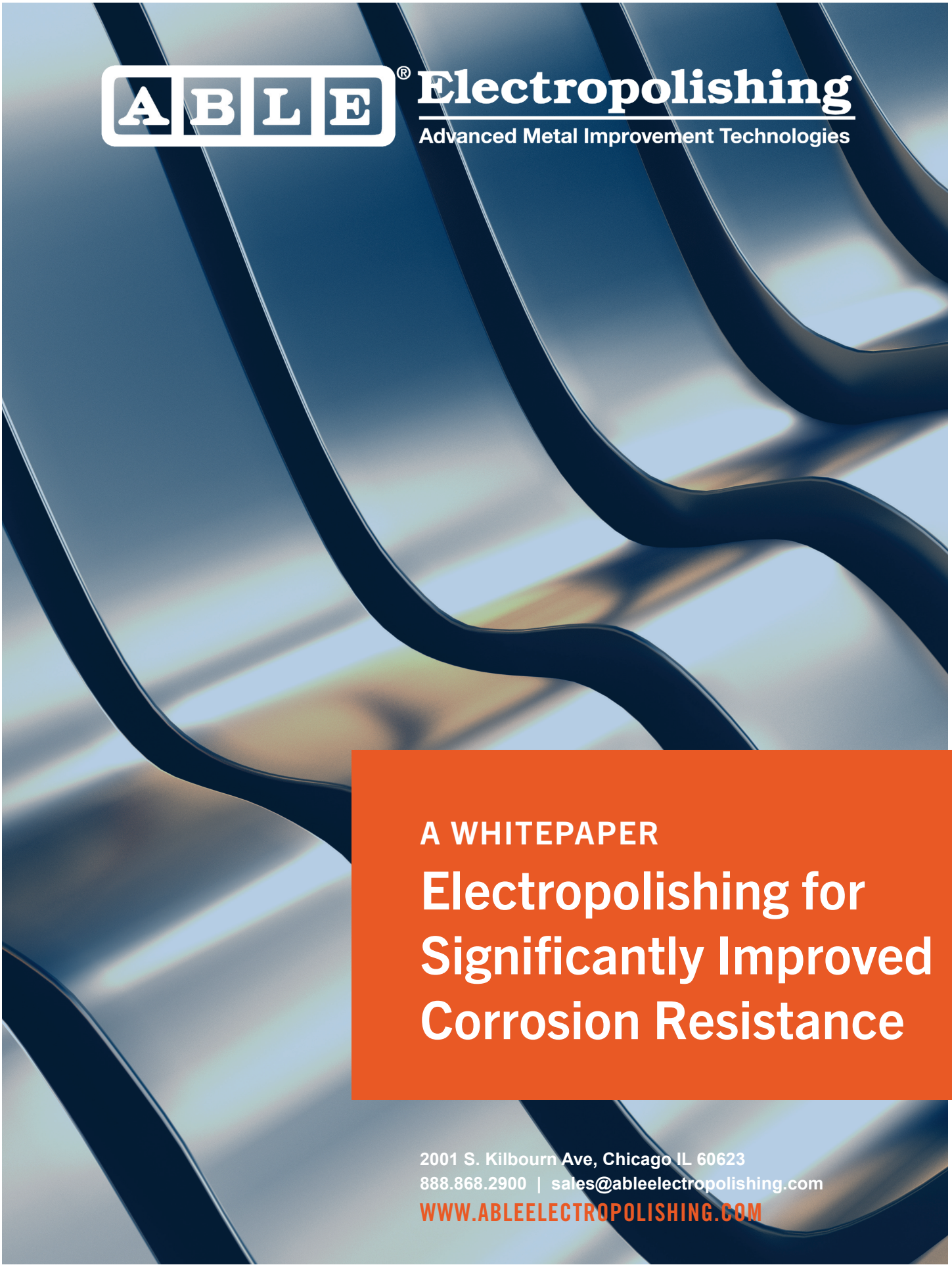

ABLE® Electropolishing

Advanced Metal Improvement Technologies

A WHITEPAPER

Electropolishing for Significantly Improved Corrosion Resistance

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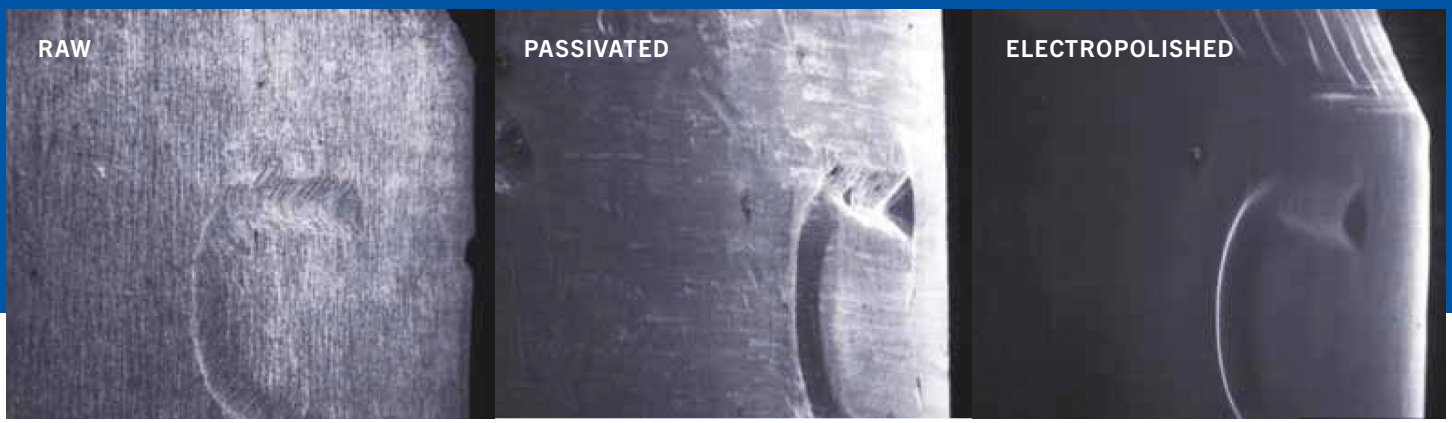
Electropolishing for Significantly Improved Corrosion Resistance

The parts pictured below are made from type 303 stainless steel. After a series of machining operations, the parts needed to be decontaminated to remove embedded particulates and other impurities. Under 40X magnification using the scanning electron microscope, you can see the passivated part is actually rougher, due to chemical attack on the 303 stainless steel caused by normal passivation. In contrast, the electropolished part is smooth and clean.



One of the most common applications for electropolishing is to enhance corrosion resistance in parts made from a wide variety of metal alloys, especially stainless steel.

Over the years, electropolishing has come to surpass passivation as the metal finishing process of choice and improved corrosion resistance is one common reason.

While passivation is a chemical process used to restore contaminated stainless steel to original specifications, testing has shown that electropolishing leaves metal parts with 30x more corrosion resistance than passivation alone.

Today's OEMs, particularly in industries where part failure is not an option, like aerospace, medical device manufacturing, automotive and marine, often specify electropolishing for the corrosion resistance it provides, along with enhanced fit, finish and durability. Engineers looking to pass stringent salt spray and humidity tests turn to electropolishing for its ability to remove a precise layer of surface material, removing imperfections and contaminants that can become initiation sites for corrosion.

Beyond improved corrosion resistance and appearance, electropolishing offers all-in-one, cost-effective results with numerous surface improvement benefits, including:

- DEBURRING
- IMPROVED MICROFINISH
- ULTRACLEAN SURFACE
- CLEANABILITY ANTIBACTERIAL AND PATHOGEN RESISTANCE
- IMPROVED CYCLE LIFE

ADVANTAGES OF
Electropolishing

Unlike passivation, 300 series, 400 series and precipitating grade stainless steels can be electropolished **without distortion, flash attack or hydrogen embrittlement.**

For parts with surface defects and contamination left behind by machining, welding or brazing, electropolishing **provides a reliably high-quality surface finish** with unmatched precision.

Electropolishing, which is **effective within extremely tight tolerances,** can remove corrosion from critical metal parts whose size and structure eliminates the option of mechanical polishing.

Electropolishing's ability to **eliminate embedded contamination** and other defects that can trap surface moisture leaves parts with unmatched corrosion resistance.

Electropolishing **delays the oxidation for non-ferrous metals** while also deburring and providing a microfinish for optimal function and appearance. Non-ferrous metal parts can then be anodized, plated, and clear-coated after electropolishing is complete.

Electropolishing provides **superior results** and corrosion resistance for other metal alloys as well, retarding the corrosive properties of copper, brass, aluminum and carbon steels.

Electropolishing **works where passivation does not,** including 416 and 440 stainless steel that cannot be passivated due to low levels of chromium and nickel that creates the risk of flash attack. Another issue is that carbon steels and non-ferrous metals (aluminum, brass, copper) will react adversely to nitric or citric passivation baths and will burn or even disintegrate.

Electropolishing can be used for **light corrosion resistance** for components that cannot justify an expensive plating operation or for parts where the surface is too rough or contaminated and plating is likely to peel and wear under stress.

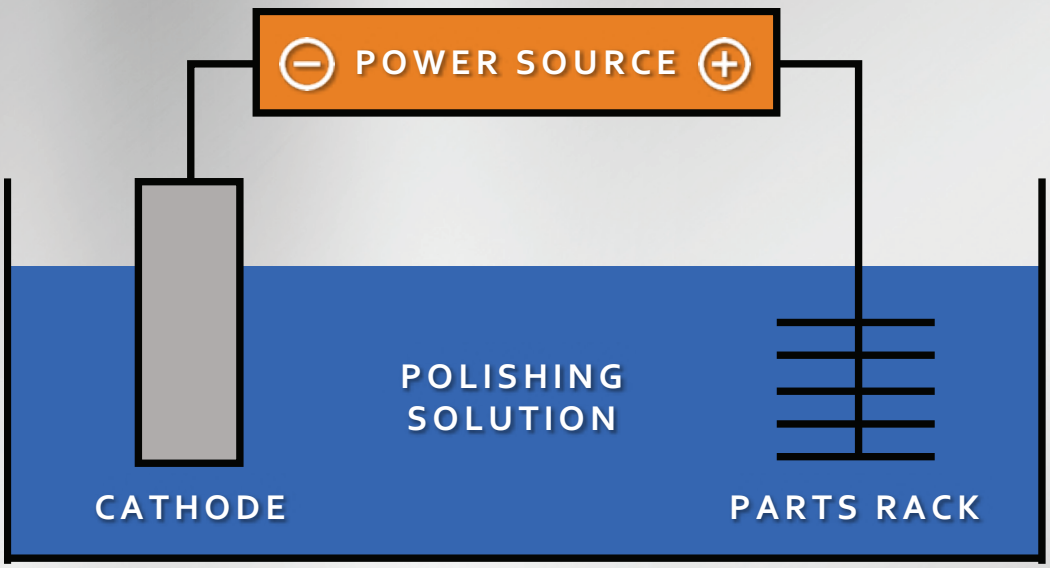
Electropolishing is **effective in treating the carbide precipitation condition** that occurs in the heat-affected zone during welding. It also improves the chrome to iron ratio on the surface, which greatly improves corrosion resistance.

METAL REMOVAL = METAL IMPROVEMENT

The reverse of electroplating

Uses a combination of chemicals and electrical current

A controlled surface metal removal process



The resulting bright surface is what helped give electropolishing its name

METAL REMOVAL = METAL IMPROVEMENT

How Electropolishing Works

Electropolishing uses a modified electrical current and a chemical bath to dissolve a precise and even layer of surface material.

A power source converts AC current to DC at low voltages within a rubber-lined steel tank containing a chemical bath. A series of copper or stainless steel cathode plates is lowered into the bath and installed on the negative side of the power source. A part, or group of parts is fixed to a rack made of titanium, copper or bronze. The rack, in turn is fixed to the positive side of the power source and immersed in the chemical bath.

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

Once the process is completed the parts are run through a series of cleaning and drying steps to remove clinging electrolytes. The resulting surface is ultraclean and bright.

Electropolishing Case Studies Using Salt Spray Testing

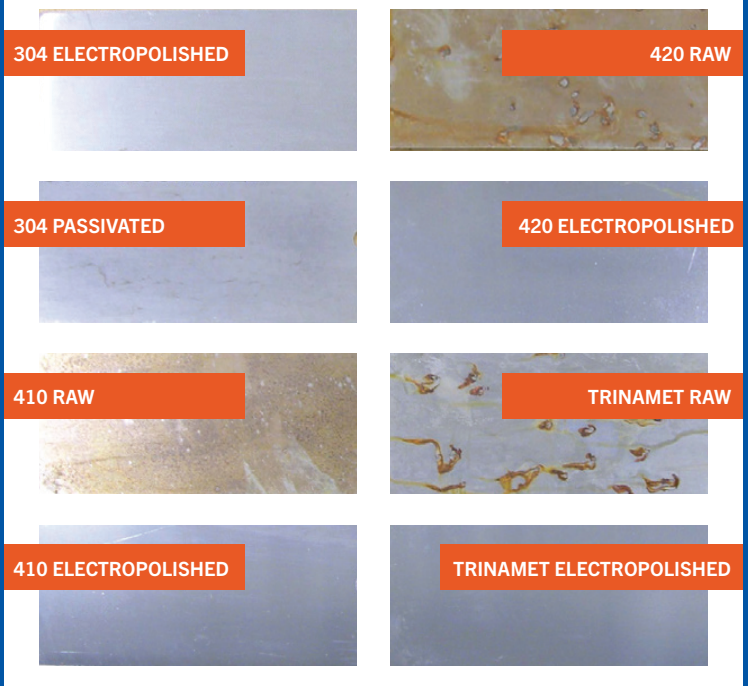
Case Study 1: Electropolishing versus passivation on Stainless Steel Samples

The samples shown below were submitted to the ASTM B-117 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 for food, semiconductor and biopharmaceutical equipment often specify electropolishing. The electropolished parts shown here have no visible signs of rust even after 888 hours of exposure to salt spray.

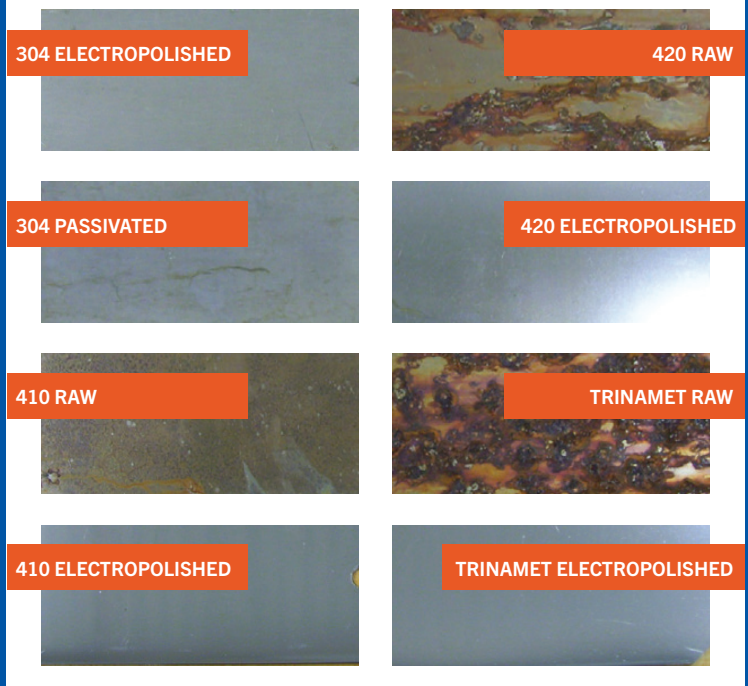
Multiple Stainless Steel Samples compared for corrosion resistance:

- Independent Lab tested per ASTM B-117 Salt Spray Test
- Electropolished parts show no signs of rust after 888 hours of testing

AFTER 24 HOURS



AFTER 888 HOURS

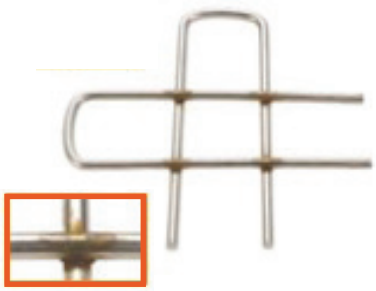
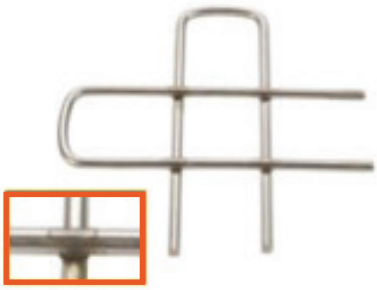
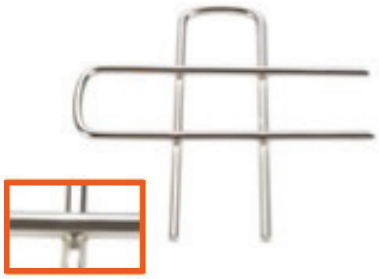


Electropolishing Case Studies Using Salt Spray Testing

Case Study 2: Electropolishing versus passivation of auger and wire weldment

To portray the benefits of electropolishing versus passivation, we subjected two sets of parts to the ASTM B-117 salt spray test at an independent testing facility. The test parts included a formed auger made from 430 stainless steel and a wire weldment fabricated from 304 stainless steel. The testing was performed on each part in the raw, passivated and electropolished state.

Salt Spray Test

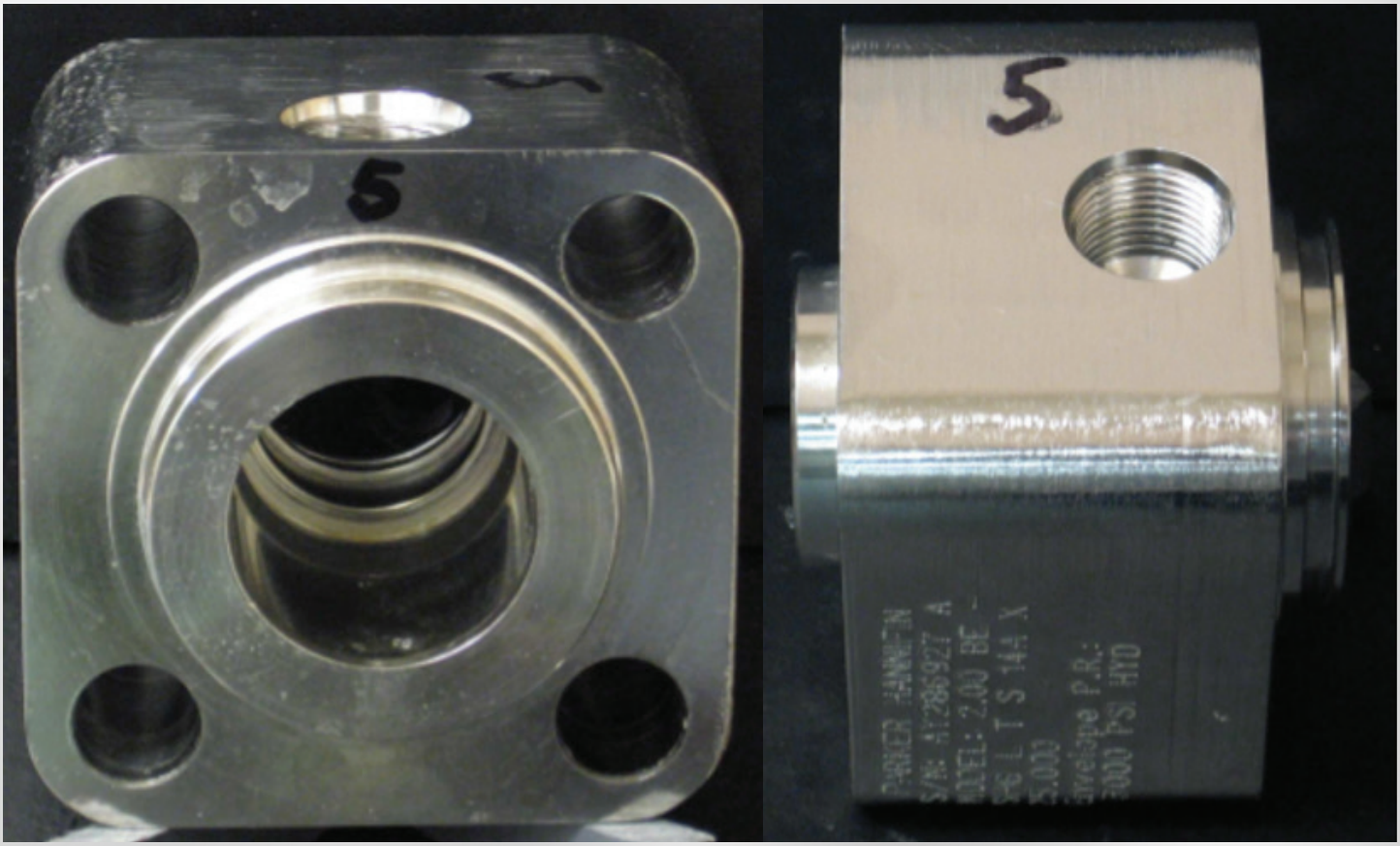
	RAW	PASSIVATED	ELECTROPOLISHED
72 HOURS			
144 HOURS			

AFTER 72 HOURS

After 72 hours of exposure to the salt spray, the raw and passivated wire weldment parts developed red corrosion in the resistance welded areas. The electropolished part showed no visible corrosion after 72 hours of testing.

AFTER 144 HOURS

After 144 hours of exposure in the salt spray cabinet, the raw and passivated parts show advanced red corrosion on the extremities and in the hole. The electropolished part exhibits light red corrosion at the extremities and shows the superior corrosion resistance gained with the use of Able's electropolishing process.



2" Bore SH Head Machined and Electropolished (1000 Hours)

Case Study 3: Salt spray corrosion tests on food processing parts

In developing a hydraulic cylinder product for the food processing industry, Able conducted salt spray corrosion tests to verify the improvement in corrosion resistance post electropolishing. Due to the washdown environment found in most food processing applications, corrosion resistance is critical to part function.

Given other constraints in the food processing market (no coatings, no paint, etc…), 316 stainless steel was chosen as the best material for cylinder construction. Electropolishing of stainless steel was seen as an option that would have value-added benefits for food processing customers – one of which is an improvement in corrosion resistance.

The ASTM B117 salt spray corrosion test was run for 1000 hours:

AT 24 HOURS
a part cold drawn with Technifor displayed corrosion, whereas a metal part cold drawn and electropolished did not display signs of corrosion until 165 hours.

THE SAME PART,
milled and electropolished, displayed no corrosion at any point during the test.

The image above shows
1000 HOURS
of salt spray testing with different views of the part after electropolishing.

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ABOUT ABLE ELECTROPOLISHING INC.

Able is America's largest electropolishing specialist, employing over 220 people on three shifts at its state-of-the art facility in Chicago. Literally thousands of companies, in every industry worldwide employ Able technology for their metal parts. Our process meets industry standards like ASTM B912 and is customized to meet the individual specifications of each customer. Throughout more than six decades of innovation and collaboration, Able has earned the trust of engineers and manufacturers in the world's most challenging industries. Our attention to detail includes unmatched customer service.

Our processes also include consultation in the design phase to ensure that parts are designed free of defects that can trap liquids or other materials and impede finishing results. *Learn more about our Finish First Methodology.*

nqa ISO 9001 QUALITY MANAGEMENT — ANAB ANSI National Accreditation Board ACCREDITED ISO/IEC 17021-1 MANAGEMENT SYSTEMS CERTIFICATION BODY

nqa ISO 13485 MEDICAL DEVICES — ANAB ANSI National Accreditation Board ACCREDITED ISO/IEC 17021-1 MANAGEMENT SYSTEMS CERTIFICATION BODY

nqa AS9100 AEROSPACE & DEFENSE — ANAB ANSI National Accreditation Board ACCREDITED ISO/IEC 17021-1 MANAGEMENT SYSTEMS CERTIFICATION BODY

SEND US YOUR PART TO PROCESS FOR FREE

The best way to determine if electropolishing is the best solution for YOUR part is to send us a sample. We will electropolish it for FREE and send it back to you in a few days.

Click here to take advantage of our free sample offer.

ABLE®

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