ANALYZING METAL FAILURE:

CORROSION DAMAGE

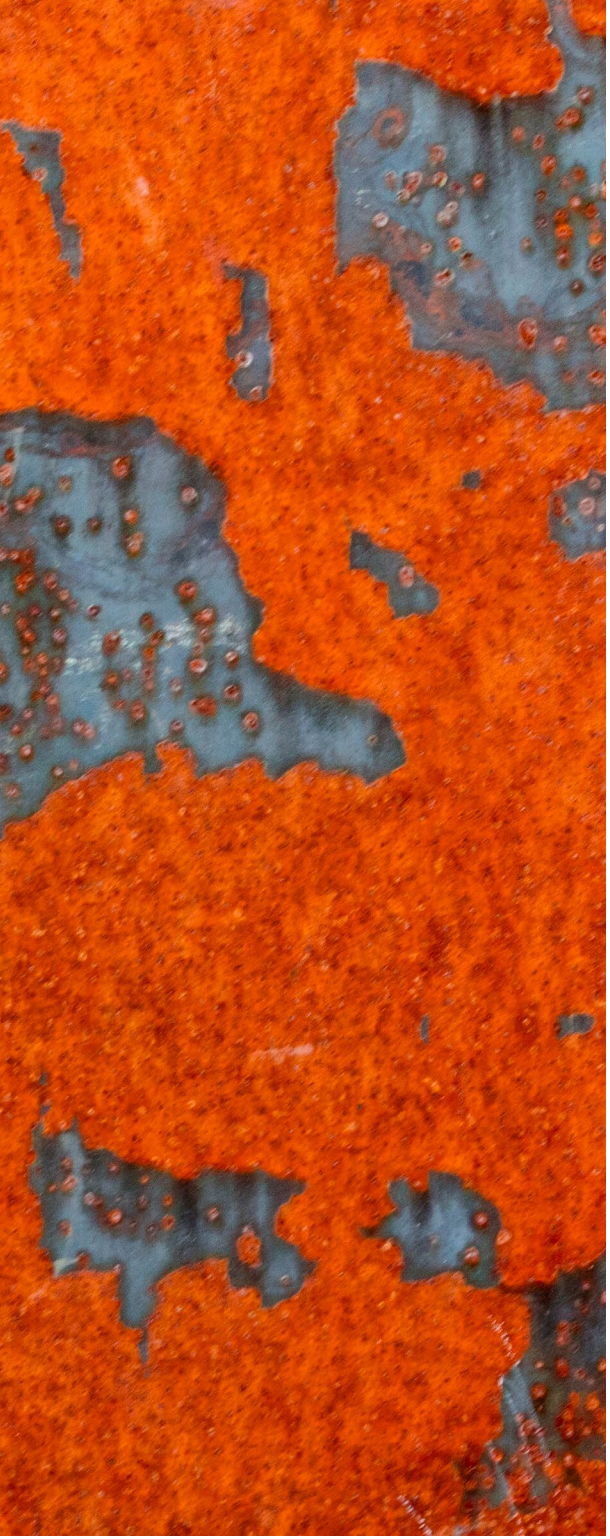
ELECTROLIZING
PROVIDENCE, RI

TABLE OF CONTENTS

HOW AND WHY METAL ITEMS FAIL

When people think of durable materials, one of the first that comes to mind is metal. While there are certain types, like gold, that are soft and malleable in their natural state (or liquid, in the case of mercury), metals and alloys intended for use in tools and machines display tremendous strength and resistance to the forces they're subjected to.

Still, even the strongest metals used in industrial applications are not indestructible. They can, and do, degrade over time. Metals can be broken down by four main types of forces.



CORROSION

In this natural process, a refined metal converts to a more chemically stable state, like an oxide or sulfide. Corrosion tends to occur gradually but continually in a metal exposed to a corrosive chemical, for example.

EROSION

This is a process in which material is removed from a surface as a result of being struck by other materials. This can include liquids, as well as particles in fast-moving gases. Erosion can also be caused by the shock waves produced by cavitation.

ABRASION

This is the removal of material by scratching, scuffing, rubbing, or other mechanical actions.

CONTACT FATIGUE

Called metal fatigue when it occurs in metals, this process is the development and propagation of cracks caused by the material having weight or pressure applied and removed repeatedly over time.

Understanding these four forces and being able to counteract them is essential to keeping tools, machines, and systems working well and as designed.

This guide, the first of a series of four guides to cover each type of metal failure, addresses corrosion and how advanced coatings can be used to protect metal items from the damage it causes.

THE HIGH COST OF UNCHECKED CORROSION

Typically, metal corroding is referring to electrochemical oxidation. This is a reaction between metal and an oxidizing agent like oxygen, water, acids, or solvents.

One example of this process is the formation of iron oxides on metal, or what is commonly referred to as rusting. Anyone who has owned a car in an area where they use various types of salt on the roads in winter knows how quickly metal can develop this orange/brown substance under certain conditions.

Another type of corrosion is what is called galvanic corrosion. It occurs when two different metals are in physical or electrical contact with one another and are immersed in an electrolyte. In this scenario, the more active metal degrades faster than the more stable metal.

Whatever their cause, corrosion on tools and equipment can be very costly. This includes:

DECREASED EFFECTIVENESS AND ACCURACY

Devices and machines that develop corrosion on key components tend not to work as designed or as well as expected.

DECREASED LONGEVITY AND INCREASED REPLACEMENT COSTS

If corrosion continues unabated, it can ultimately make a tool or machine unusable and require that it be replaced. While even the best-protected items wear out eventually, an accelerated decline means more money spent on new assets.

INCREASED DOWNTIME

In some cases, corrosion in a component of a manufacturing system or process can be removed and the item fixed. However, depending on the item and the system it's in, those repairs can result in downtime and all that comes with it—missed deadlines, lost revenue, frustrated customers, etc.

REPUTATION DAMAGE

Having customers, business partners, vendors, and other stakeholders see that tools or equipment are corroded sends a bad message that can cost a company current and/or future business and tarnish its reputation.

Corrosion can occur on a wide variety of tools, machines, and systems used in many areas. This includes the food processing, manufacturing, plastic injection molding, oil and gas, aerospace, and medical industries, just to name a few.

PREVENTING CORROSION-DRIVEN METAL FAILURE

While the science behind the development and application of advanced metal coatings is complex, the solution they provide is simple: Corrosion is caused by contact with a corroding substance of some kind, and coatings seal the surface and prevent that contact from occurring.

For instance, if the biggest risk of corrosion for a particular type of metal surface is saltwater, the protective coating applied is one not affected by that liquid. It serves as a barrier between the metal and the water, and prevents the corrosion chemical reaction from occurring.

There are many types of protective coatings, including:

THIN DENSE CHROME (TDC)

This material is often used in situations where tight tolerances and high precision are involved.

AL-COAT®

Engineered specifically for Aluminum protection, AL-COAT® outperforms anodizing in nearly every metric.

MICRO-E®

When even tighter tolerances are needed, MICRO-E® can by applied at a surface deposit as low as 0.000050”

5 BENEFITS OF ADVANCED COATINGS

There are many benefits of applying advanced coatings to metal surfaces, and thereby preventing or greatly delaying the onset of metal failure.

FIVE OF THE MOST CONSEQUENTIAL ADVANTAGES ARE:

1. Full protection with no significant change in dimensions Electrolizing coatings achieve outstanding strength with extremely thin layers. Consequently, companies can continue using existing items—no design modification is necessary.

2. Increased useful life

Properly coated items resist damage and have greater lubricity, so they last longer. As a result, businesses spend less on repairing or replacing tools and equipment.

3. Reduced downtime

In business, time is money. When a process is halted, revenue plummets. Coated metal surfaces are less prone to failure, so the systems they are part of stay online more consistently.

4. Improved performance

Whether the measure is consistency, accuracy, or some other metric, coated items perform better.

5. Enhanced business reputation

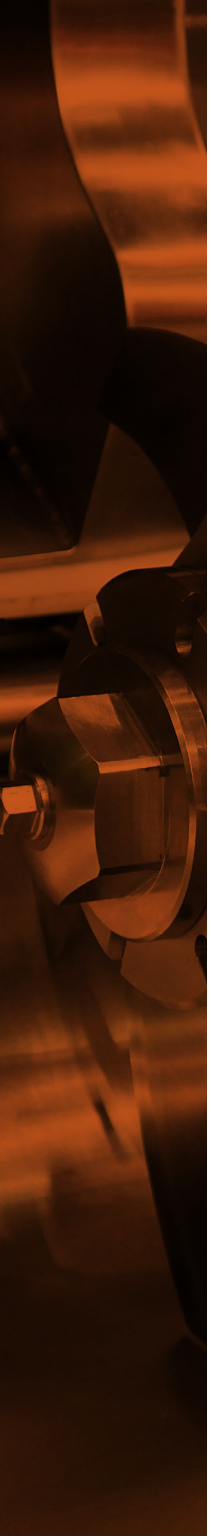
From the visual appearance of tools and equipment, to the increased efficiency, effectiveness, and productivity of processes, metal assets that are protected produce positive outcomes that reflect well on a company.

CORROSION PREVENTION IN ACTION

Designers, manufacturers, and other stakeholders all come to Electrolizing with some version of this question:

> **“What can you do to solve my corrosion and wear problem?”**

And in most cases, they need a solution that doesn’t affect part tolerances. Fortunately, Armoloy can apply coatings with effective deposits as little as .000050”, ensuring component design integrity is maintained.



With the project parameters established, the Electrolizing team then goes into action, learning about the application where the problem exists, including the role played by the items in question, their composition, the environment where they are used, and more. Of particular importance is how the customer defines “failure” in their process.

For example, an aerospace organization came to Electrolizing with a problem they felt was the galling of metal parts. In the course of conversations about the functional requirements of the parts, the materials they are made of, and the hazards they face, it was determined that the problem was actually *corrosion*, which could lead to serious deterioration in space.

That revelation proved to be pivotal when the customer’s engineering team then engaged further with Electrolizing engineers, sharing additional information and collaborating on a successful solution.

While Electrolizing has the distinct capability to solve a fast failure, it’s important to build in researching the right coating in the design phase to be applied to the piece as it’s made.

Making the effort to pinpoint a problem’s precise cause—and also to ensure that Electrolizing and a client are “speaking the same language”—is vital to solving the current problem and maintaining a productive relationship going forward.

To learn more about Electrolizing or connect with an applications engineer, visit **electrolizing.com**

ELECTROLIZING
PROVIDENCE, RI

THE ORIGINAL THIN DENSE CHROME

For over 77 years Electrolizing®, Inc. of Providence, RI has provided the highest quality coating technologies to industrial markets. Our coating technology has been developed and refined over the years giving the Electrolizing® coatings a distinct advantage in the marketplace. As a result few comparisons can be made with conventional plating products.

Providing a full range of Thin Dense Chrome surface coatings, Electrolizing serves the greater manufacturing community in both North America and internationally.

As part of the Armoloy Corporation, Electrolizing serves as one of two Innovation Centers within the ecosystem of Armoloy's 18-location fulfillment network. Along with the Innovation Center located at Armoloy of Illinois in DeKalb, IL, Electrolizing engineers solutions to the most difficult coating challenges and empowers our fulfillment network to deliver them anywhere in the world. Armoloy is often the first place customers in the oil and gas, nuclear power, aviation, food-manufacturing and other sectors turn to for solutions to “impossible” coatings challenges.

Electrolizing ISO 9001:2015 certified.

electrolizing.com