Earnest

Protecting Industrial Fasteners from Corrosion & Other Harsh Environments:

The Plating and Coating eBook

21180EMP

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Introduction:
the need for plating and coatings on industrial fasteners

Here at Earnest Machine, we understand the problems that corrosion, chemical exposure, and harsh environments can bring to fasteners used in industrial applications. As a company centered around helping its customers succeed, preventing these issues is a big part of what we do.

Once corrosion begins, fasteners start to break down quickly, reducing their effectiveness and lifespan on any application. Fasteners made from carbon or high strength alloy steels, which are subjected to harsh environments or hazardous chemicals, typically have a plating or coating applied to their surface to protect the steel underneath.

Fasteners that lack this protective layer can become damaged, ultimately compromising their assembly, which can be both dangerous and costly to replace.

Corrosion and wear are the greatest enemies to fasteners.

The solution is simple: plating or coating fasteners with a protective layer.

To choose the most effective solution, you must determine the correct plating or coating needed for your fastener's specific application.

Not only can this help protect against corrosion and harsh environments, but choosing the right plating or coating will also ensure you achieve the correct clamp load at the specified torque, maximizing the life of any assembly.

Typically, fasteners are created out of raw steel and therefore lack any type of corrosion or atmospheric protection when they are first manufactured. These fasteners, which do not have a plating or coating applied to the surface, are referred to as having a Plain Finish or labeled as bare metal.

Some fasteners with a Plain Finish may have a light coating of oil for shipment or shelf-life purposes, but this offers little corrosion or atmospheric protection.

These bare metal surfaces can be used in either indoor or outdoor environments that present little risk of corrosion or exposure. Anything beyond that, such as applications that are subjected to high amounts of saltwater or other highly corrosive environments, will need exploration of the multiple options for plating and coating solutions available.

This eBook will provide a background on the plating and coating processes, the wide range of options available within each category, and how to specify the properties needed for each application.

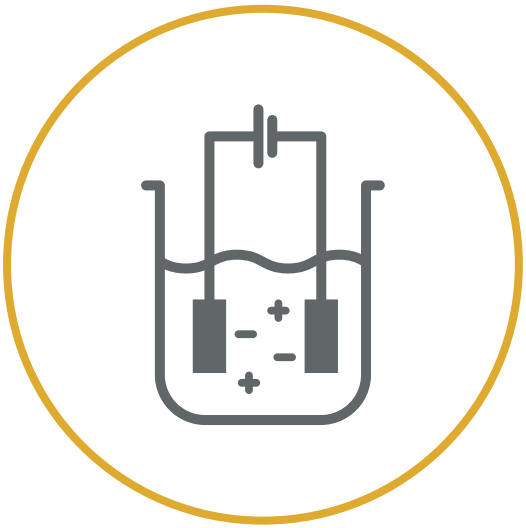
Chapter 1: The difference between plating and coating

Within the world of fasteners, the plating and coating processes are often lumped together and ultimately overlooked as being the same. While each can in fact add corrosion resistance and various other properties to your fasteners, they are two unique operations that differ from each other.

Plating

Plating refers to the process of “electroplating”, where a metallic finish is added through electro-deposition. It involves adhering a metallic finish to the surface of a fastener, which means that the deposited metal becomes fused to the existing product.

Plating is the most common method used to add a surface finish to fasteners. The most common style of plating used is Zinc with a Clear Chromate, which provides good corrosion protection. This style of plating can be applied at a controlled thickness and is cosmetically appealing with its bright silver appearance.



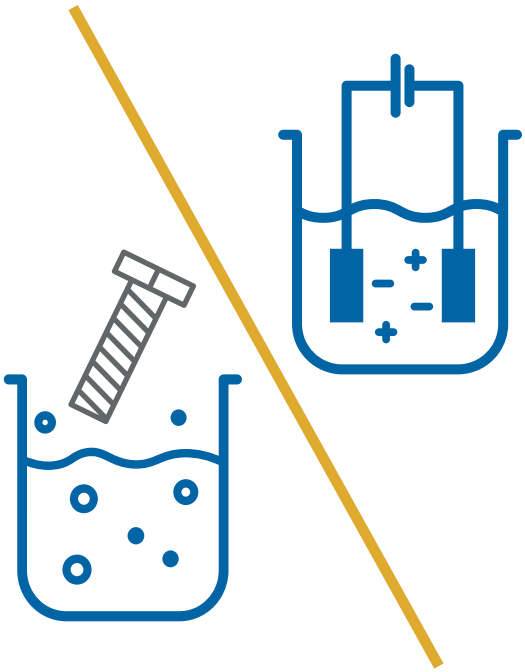
Coating

Coating refers to the use of powder or chemical additions to the surface of the fastener. This process involves dipping the item into a chemical bath, with the product then spun out at high speeds to remove any excess material. This dip and spin process will create the specified thickness of the coating.

Zinc Flake coatings, for example, can offer a coating that is twice as thick when compared to Zinc Electroplated product, leading to superior corrosion protection. However, unlike Zinc Electroplated product, coatings can sometimes result in an uneven coating thickness, which can cause thread interference problems.

Let's focus on the difference

The main differences between the two is that while coating simply adds a powder or chemical layer to the surface of a fastener, plating fuses the new material to the original material the fastener is made from.



The electroplating process is also more controllable; therefore, it can create a more uniformed thickness.

A secondary difference is that while coating can be applied to any surface, the materials being plated must be conductive.

Plating or coating solutions, no matter what the criteria, have hundreds of options available – all of which have been developed as a solution to common industrial problems. In amongst this vast variety of options, each one offers different properties, from corrosion and chemical resistance to aesthetic finishes.

The right choice depends purely on the requirements of the application and the intended use of the fastener.

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Chapter 2: The importance of salt spray testing

There needs to be a way to test and certify any corrosion protection added to industrial fasteners – and that's where salt spray testing comes in.

Also known as salt fog testing this method is the industry-standard for testing corrosion resistance. In this process, a fastener is held in a salt spray cabinet, also known as a closed testing chamber, and subjected to an accelerated corrosive attack with salt water through a spray nozzle.

This mimics exposure to corrosive environments in real life setups, therefore it can help predict how long the plating or coating will last in applications where corrosion is a risk.

During testing, the fastener is observed with the intent of seeing how long it can withstand corrosion. The more resistant the product is, the longer it will take to see the appearance of corrosion on the product. Based on how long it can withstand corrosion in the chamber, a number of hours is then linked to the material, which is effectively its salt spray score.

When browsing options for platings and coatings, you will often see these scores. For example, options within the off-the-shelf Earnest portfolio range from 24 to 1,000 hours of salt spray protection; however, this is by no means a limitation.

Applications needing a high level of corrosion resistance will need a higher "hour" of salt spray protection, but a high number here isn't necessary in all industrial applications. Therefore, it's important to understand what level of protection you need for your usage before specifying the product, as a higher level of salt spray protection will usually come at a higher cost.

Customers needing a higher level of salt spray protection, or a more specific option, can work with their Earnest representative to specify any exotic plating or coating for their specific application requirements.

Salt Spray Testing Methodology

Pros

This is a universal method that's recognized by most manufacturers and distributors

It can produce quick comparisons between expected and actual corrosion protection

It's a quick and cost-effective method of testing

Cons

This method does not test against chemical or harsh environmental exposure

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Chapter 3: Plating styles

Do you need a finish offering corrosion protection that's environmentally friendly and food safe?

Choose Zinc Clear Trivalent

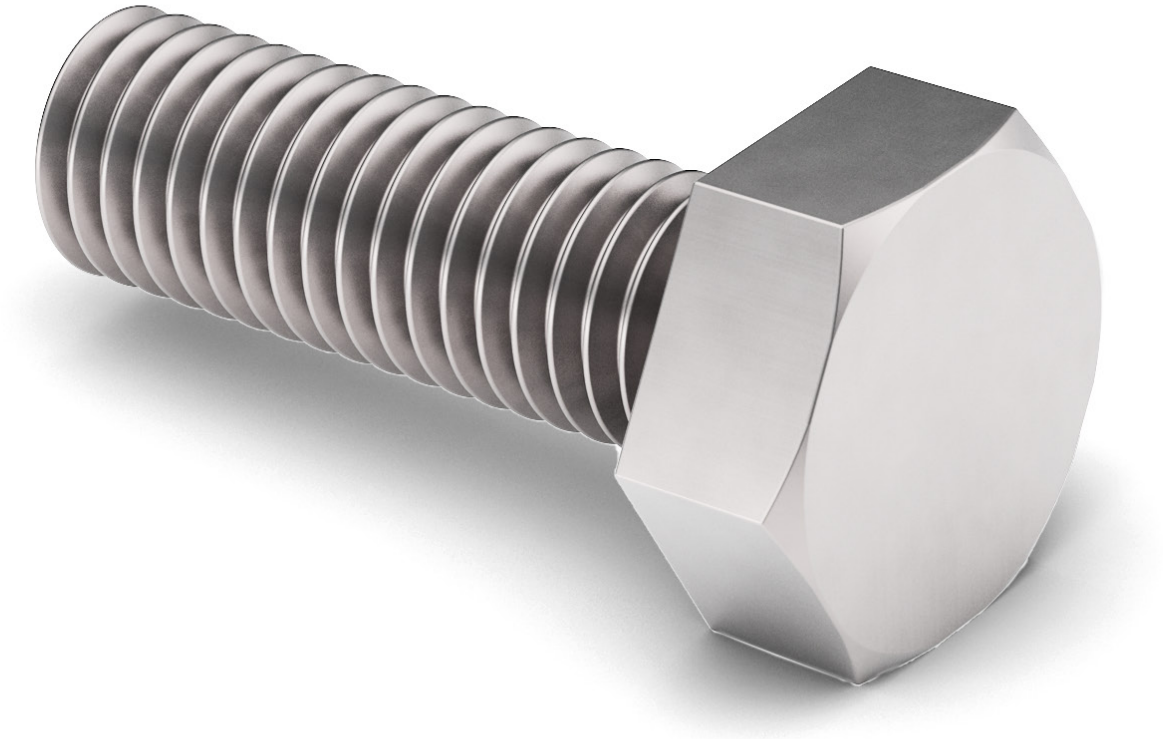
The most common type of plating, Zinc Clear Trivalent is considered an industry standard and is used in a multitude of applications.

This includes the manufacturing of automotive, construction, robotics, and even food processing, thanks to its food safe status and lack of restricted substances.

It's also known to be an economic solution that provides effective corrosion resistance, and is ideal for applications that do not need a high amount of salt spray protection.

With this plating style, metallic zinc is deposited onto the surface of the fastener. On top of this, clear or colorless chromate is applied and adds an additional layer of protection, resulting in fasteners that have up to 72 hours of salt spray protection.

You'll be able to see this finish on fasteners, as it gives a distinct silver appearance with a slight blue tint.



Do you need a finish offering increased corrosion resistance and damage protection?

Choose Zinc Yellow

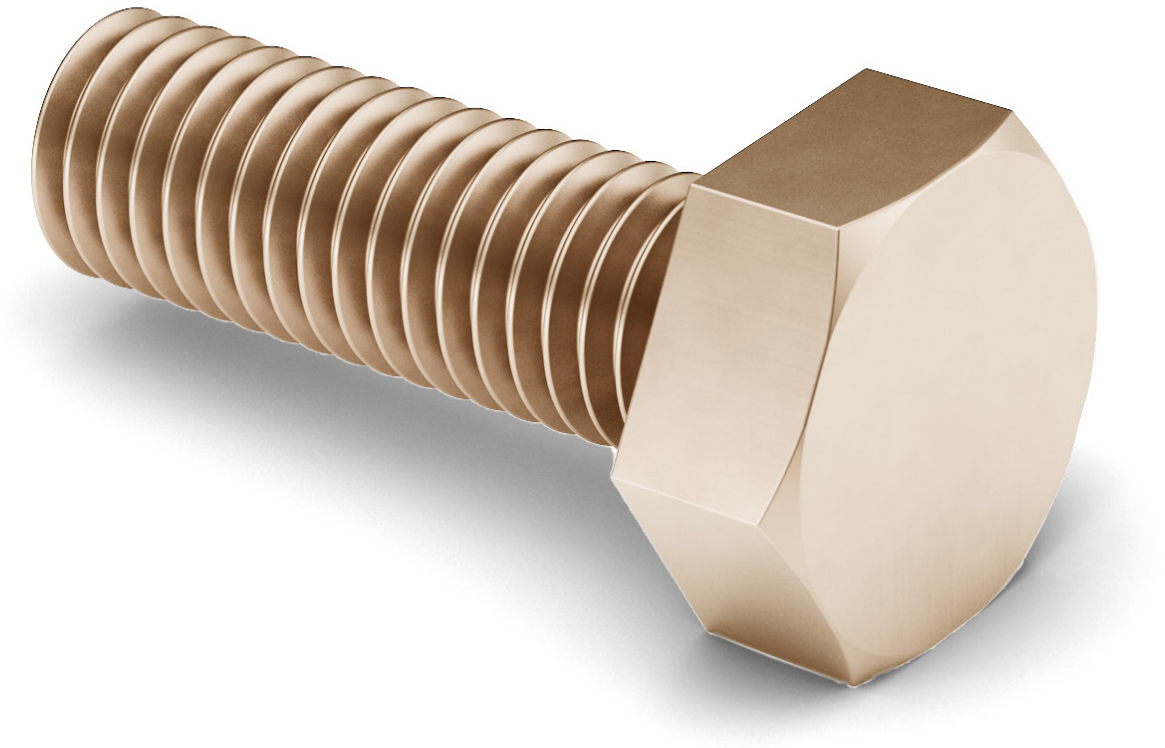
The main difference between Zinc Yellow and Zinc Clear Trivalent plating is that yellow chromate is used instead of clear chromate.

This offers increased corrosion resistance, with up to 120 hours of salt spray protection, and helps to increase the lifespan of any metal fastener.

Thanks to this additional layer of protection, this style of plating is almost exclusively used in applications for harsh environments such as automotive, heavy truck, and with manufacturers of construction equipment.

One thing to bear in mind with this finish is that the European Union's Restriction of Hazardous Substances (RoHS) directive has banned the use of hexavalent chromium. This means that yellow zinc is no longer allowed in products sold by some equipment manufacturers, which is why Trivalent Yellow Zinc is often suggested for a RoHS-compliant application.

Like Zinc Clear Trivalent, you can usually visualize when this plating has been applied, as it adds a bronze or yellow iridescent appearance.



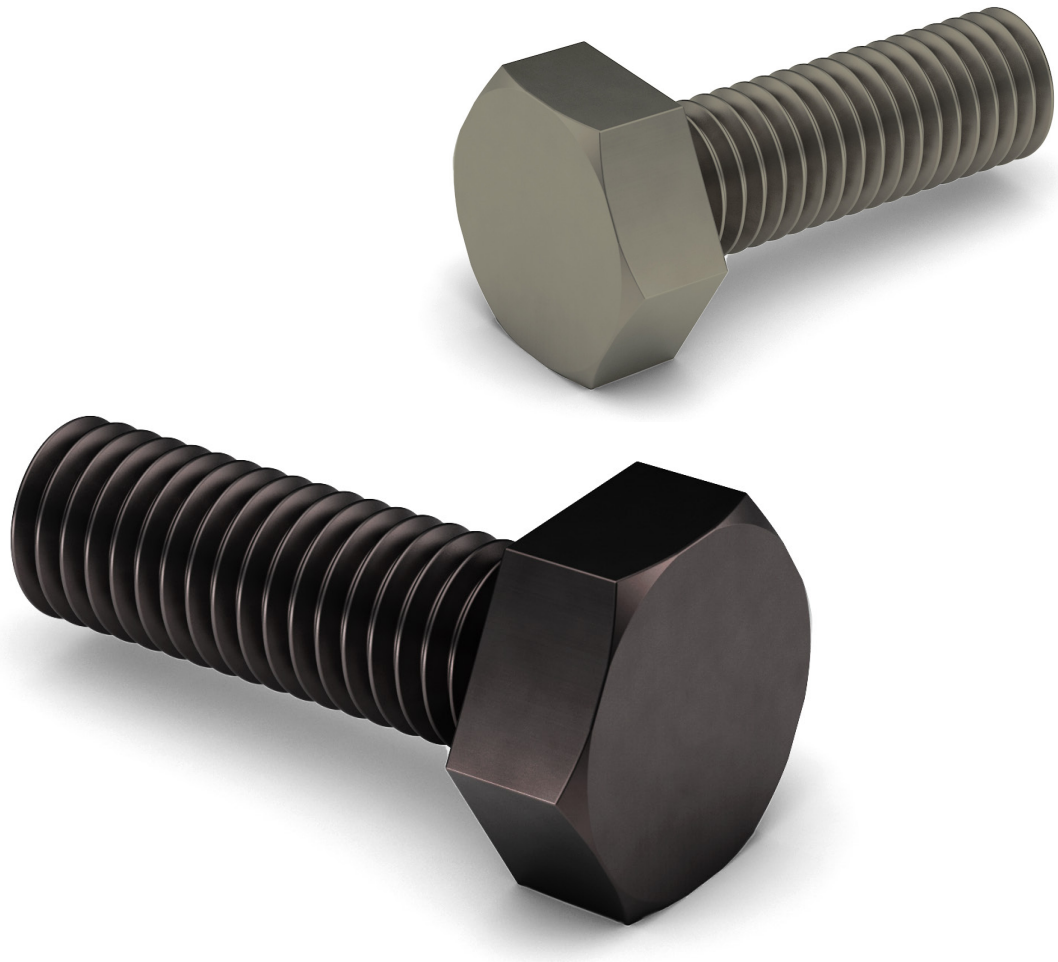
Do you need a chromate plating offering a different aesthetic or increased corrosion protection?

Choose an additional Chromate

Chromates, which are commonly added as a secondary layer of protection following initial plating, are also available in “Black” and “Olive Drab.”

The Black option is similar to clear chromate but offers a darker finish on the fastener, which can give up to 96 hours of salt spray protection. This is frequently used in the interior of trucks and on heavy construction equipment.

Olive Drab offers a further increased level of protection, with up to 140 hours of salt spray protection. This finish is commonly used in military vehicles thanks to its color.



Do you need to plate larger objects like auto or truck frames?

Choose Electrophoretic Coating (aka an E-Coat)

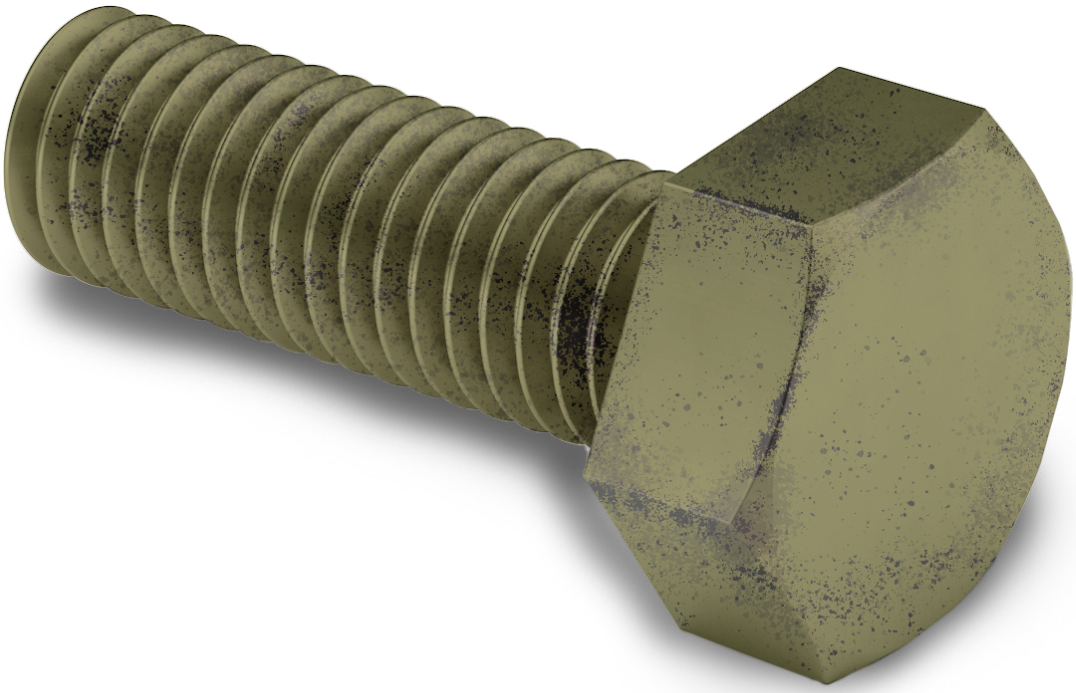
This is an alternate type of electroplating that's used to cover large industrial objects and frames, such as truck frames, food and beverage containers, tractors, and heavy equipment.

The process used to create this finish is more similar to plating than coating, despite its name.

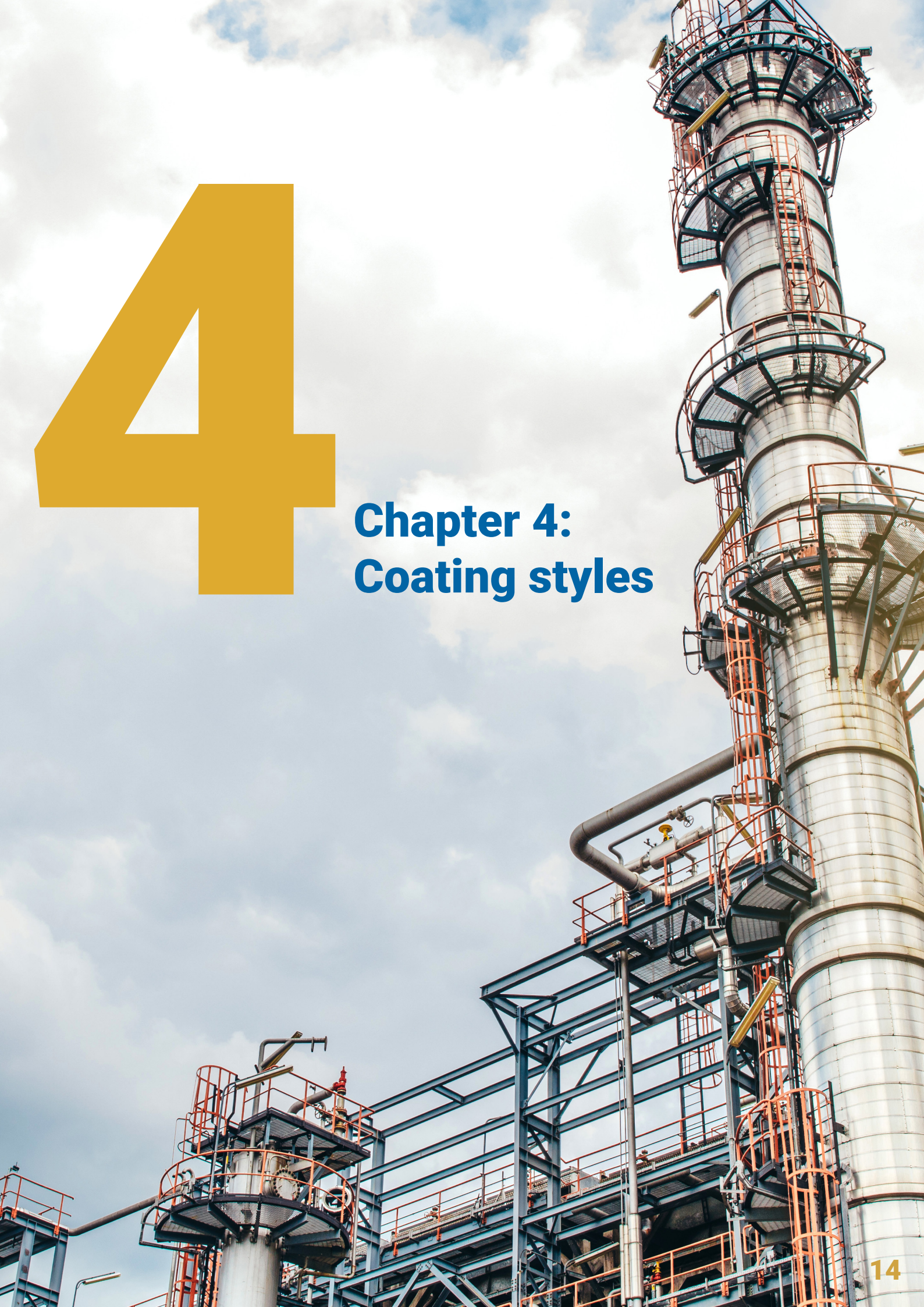
To achieve an E-Coat, parts are dipped into a bath of various water-based components and then exposed to an electric current that deposits particles from the chemical bath onto the surface.

The level of thickness is very well controlled by altering the voltage of the electrical current, which is a big benefit for this method.

Following an E-Coat, the parts are commonly subjected to Cross Linking. This is where the parts are cured in an oven in order to ensure the coating is adhered to the base metal. This method is often done with E-Coats and epoxy coatings.



For more information about plating options,
please contact Earnest Machine
at 1-800-327-6378 (USA) +44 190 271 1041 (UK)
or inquiry@earnestmachine.com (USA) ukenquiry@earnestmachine.com (UK)



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Chapter 4: Coating styles

Do you need a coating that offers better corrosion protection than Zinc Electroplated Products?

Choose Zinc Flake Coatings

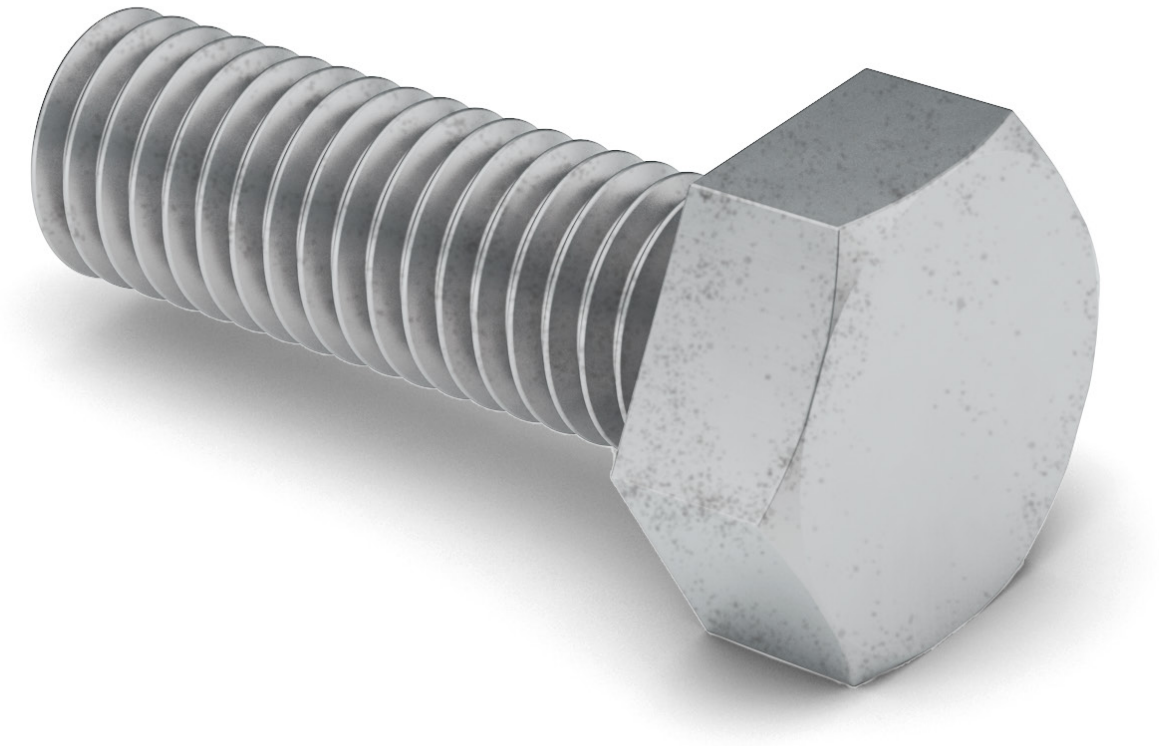
Zinc Flake Coatings offer superior corrosion protection when compared to Zinc Electroplated Products.

It provides up to 1,000 hours of salt spray protection, alongside chemical resistance. Therefore, this finish is a great choice for equipment that is exposed to excessive amounts of moisture, saltwater, or other harsh chemicals. It's commonly used for automotive and industrial parts that warrant a higher level of protection, such as elevated corrosion and chemical resistance.

Two brands dominate the Zinc Flake Coating market. The first being Geomet, which replaced the first version of Zinc Flake Coatings called Dacromet, and Magni. Zinc Flake Magni Coatings are generally followed by a number, e.g., Magni 565 or Magni 511. The number is an indicator of salt spray protection. There are numerous types of Magni, each with a specific application, so consulting sales representative for help determining which style you need is recommended.

Typically, Zinc Flake Coatings contain a mix of zinc and aluminum flakes that are applied in two layers. A base coat and a topcoat, which is then heated so that the new material is baked onto the surface of the fastener, which is a similar process to an E-Coat (mentioned on page 13). This method, however, provides a coating that is twice as thick as Zinc Electroplated Products.

Zinc Flake Coatings are most commonly seen in a muted gray aesthetic, the finish is also available in black, red, blue, and green.



Do you need a simple rust resistance?

Choose Black Oxide

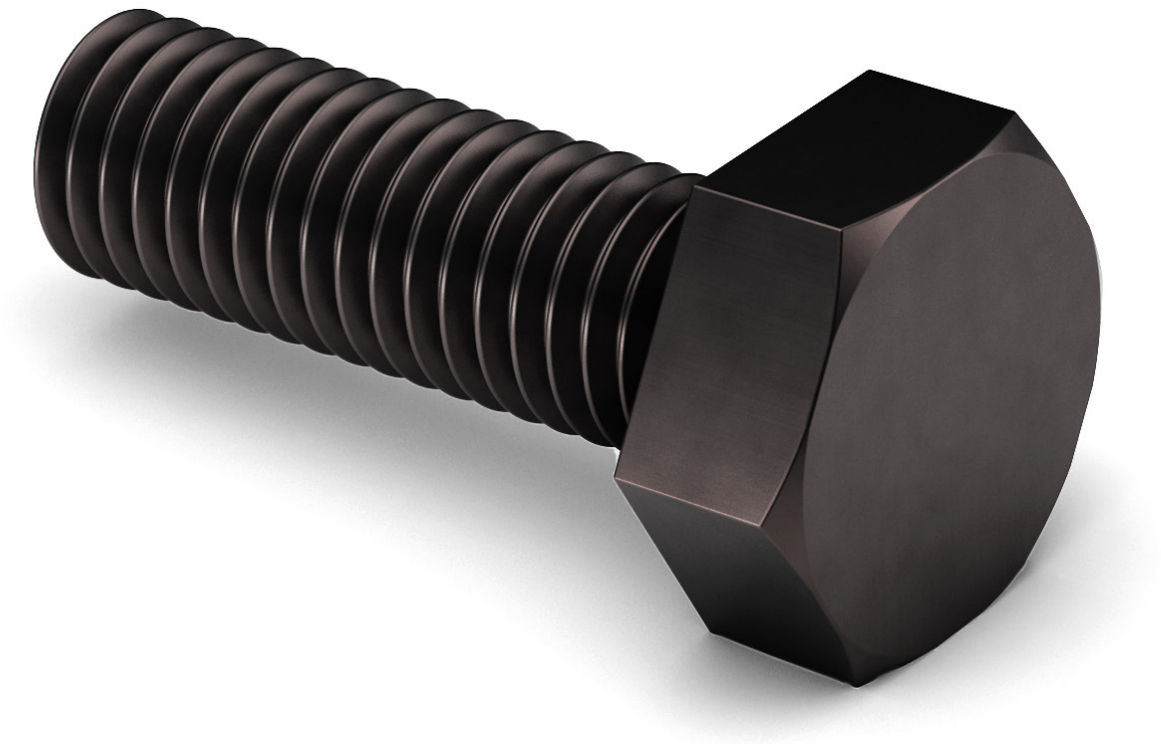
This finish offers 24 hours of salt spray protection and is typically used on indoor applications.

Black Oxide finishes are perfect for applications where a black finish is needed for aesthetic purposes, this includes machinery and stamping presses.

There are two types of methods used to create this finish:

- Chemical Black Oxide, which is a chemical dip and spin process
- and Thermal Black Oxide, which is a baking process

Both result in a consistent, black finish.



Do you need a coating for pressure treated lumber?

Choose Epoxy

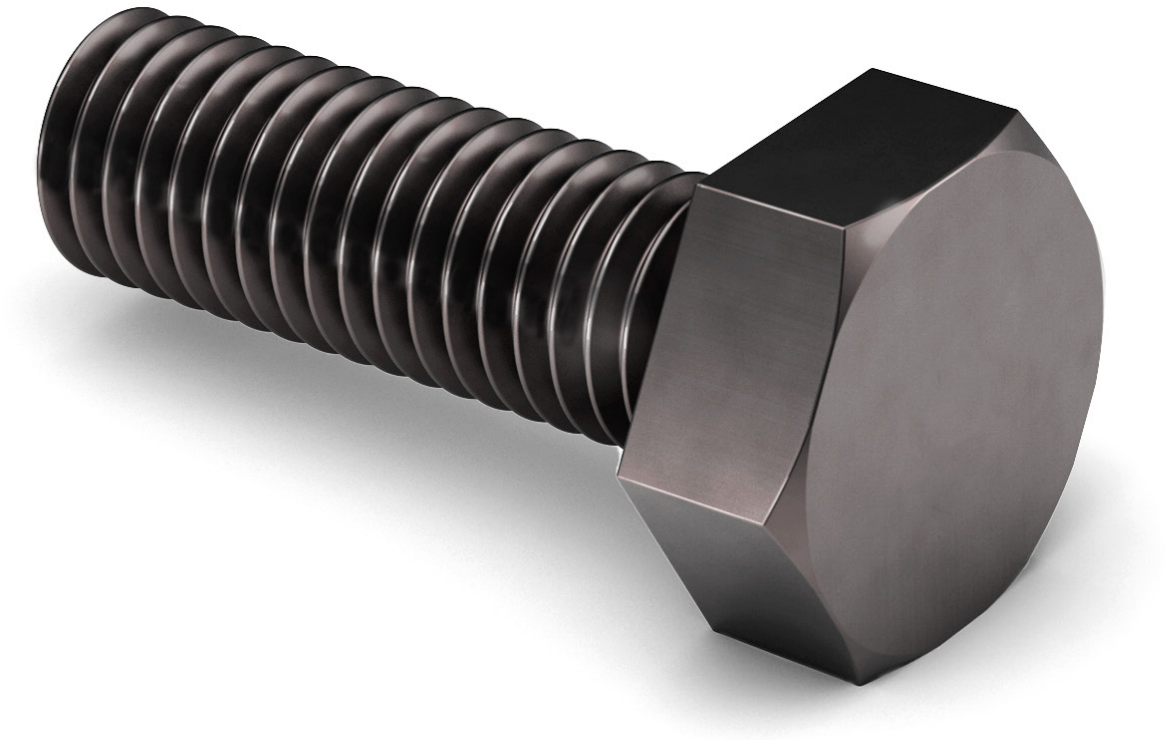
This coating, which is applied through a dip and spin process, offers up to 1,000 hours of salt spray protection.

It can also avoid degradation by minimizing the effects of UV exposure, moisture, oxidation, chemical reactions, and general wear and tear.

The dip and spin application process offers increased corrosion resistance in pressure treated lumber, making it a common choice in refineries and lumberyards.

Those dealing with wood screws can heighten the benefits offered by Epoxy, by considering how the fastener material reacts and cooperates with the material used in the assembly – aka the material that the screw is going to be driven into. For example, Timberjack Premium Timber Screws, which are available at Earnest Machine, can provide lower installation torques when driven into wood. This makes the whole build process easier from start to finish.

The main drawback of Epoxy is that it's very thick, and therefore can occasionally result in thread interference problems.



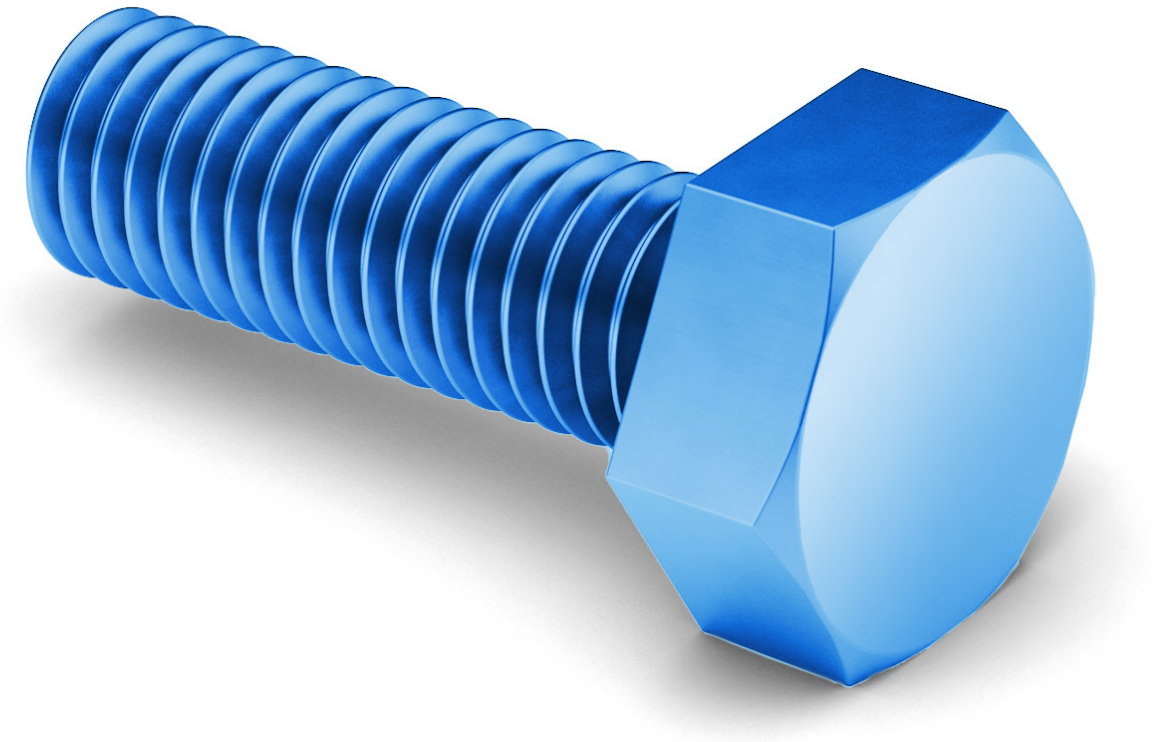
Do you need a better thread fit than with Epoxy? Or perhaps a non-stick or hydrophobic finish?

Choose Teflon (aka PTFE)

Like Epoxy, this finish is also achieved via a dip and spin process.

However, this style of coating is not as heavy as Epoxy style coatings and can therefore provide a better thread fit for fastened components. This style of coating is popular with refineries, as well as distributors of natural oil and gas.

The benefits of Teflon, or PTFE, include up to 1,000 hours of salt spray protection, chemical resistance, and protection against harsh environments - thanks to its hydrophobic, temperature stable, flexible, and electrical resistant properties. It also results in a non-stick finish that provides low surface friction, which can be used to increase a products lubricity.



Do you need a solution for high moisture or saltwater applications?

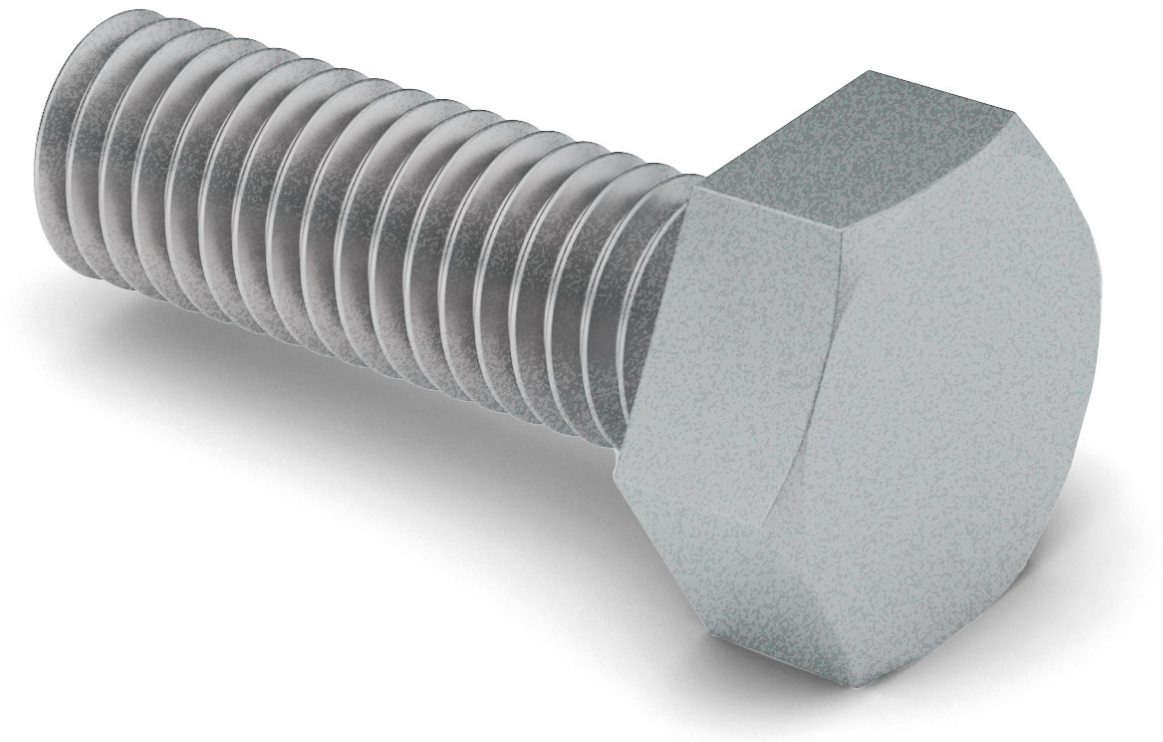
Choose Hot Dipped Galvanized

To achieve this finish, the fastener is submerged into a mixture of molten zinc and then spun at high speeds to remove any excess material.

With a harder and more evenly distributed coating in comparison to other zinc coating methods, Hot Dipped Galvanized fasteners offer up to 500 hours of salt spray protection, as well as resistance to moisture and saltwater exposure. It's also considered to be one the most cost-effective options on the market.

These benefits see this finish widely used in transport and outdoor applications, such as the construction of guard rails, utility poles, bridges, and building construction.

The visual properties of this method are its muted gray and heavily coated appearance.



Do you need a cost-effective solution for corrosion resistance?

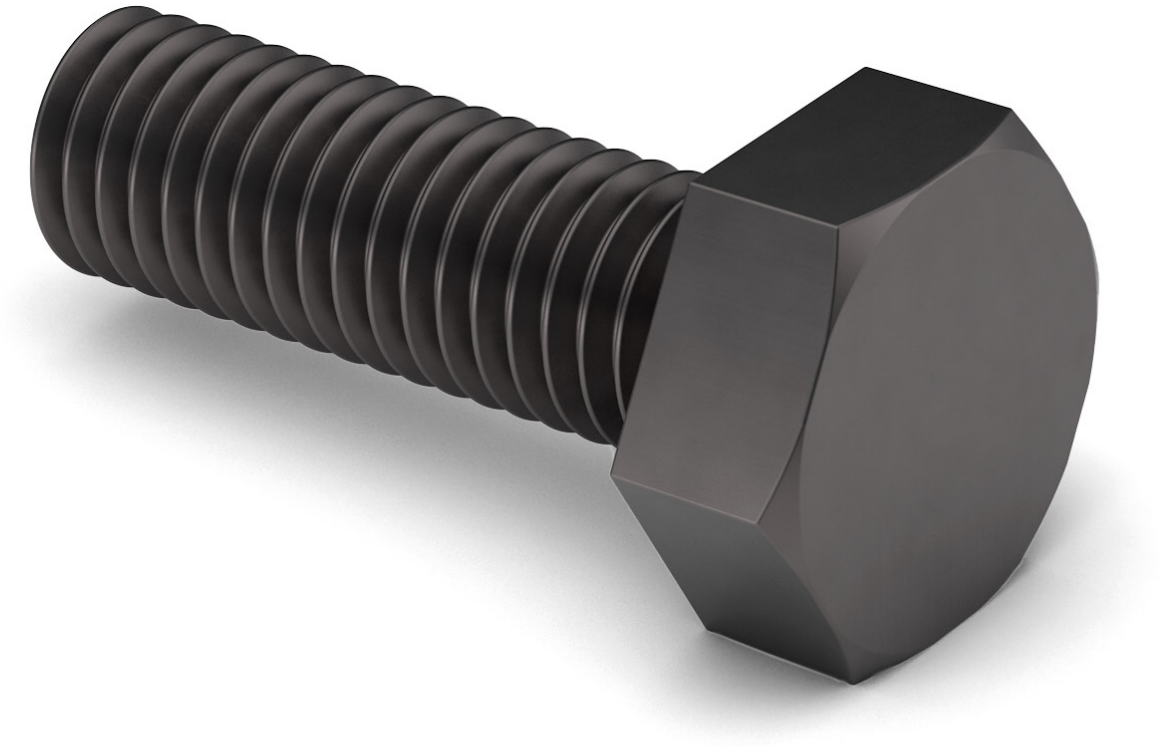
Choose Phos & Oil

Phos & Oil, aka Zinc Phosphate & Oil, is a non-metallic zinc coating that utilizes oil absorption to provide corrosion resistance.

It's a two-part process, where the fastener is first phosphated and then treated with a further coat of oil. Both parts of this process increase corrosion resistance, resulting in between 48-72 hours of salt spray protection.

This is one of the most economical solutions for corrosion resistance. It's often used on steel fasteners and is popular across many different industries, including construction and heavy truck manufacturing.

The aesthetic finish for Phos & Oil can range from a muted gray to dark black.



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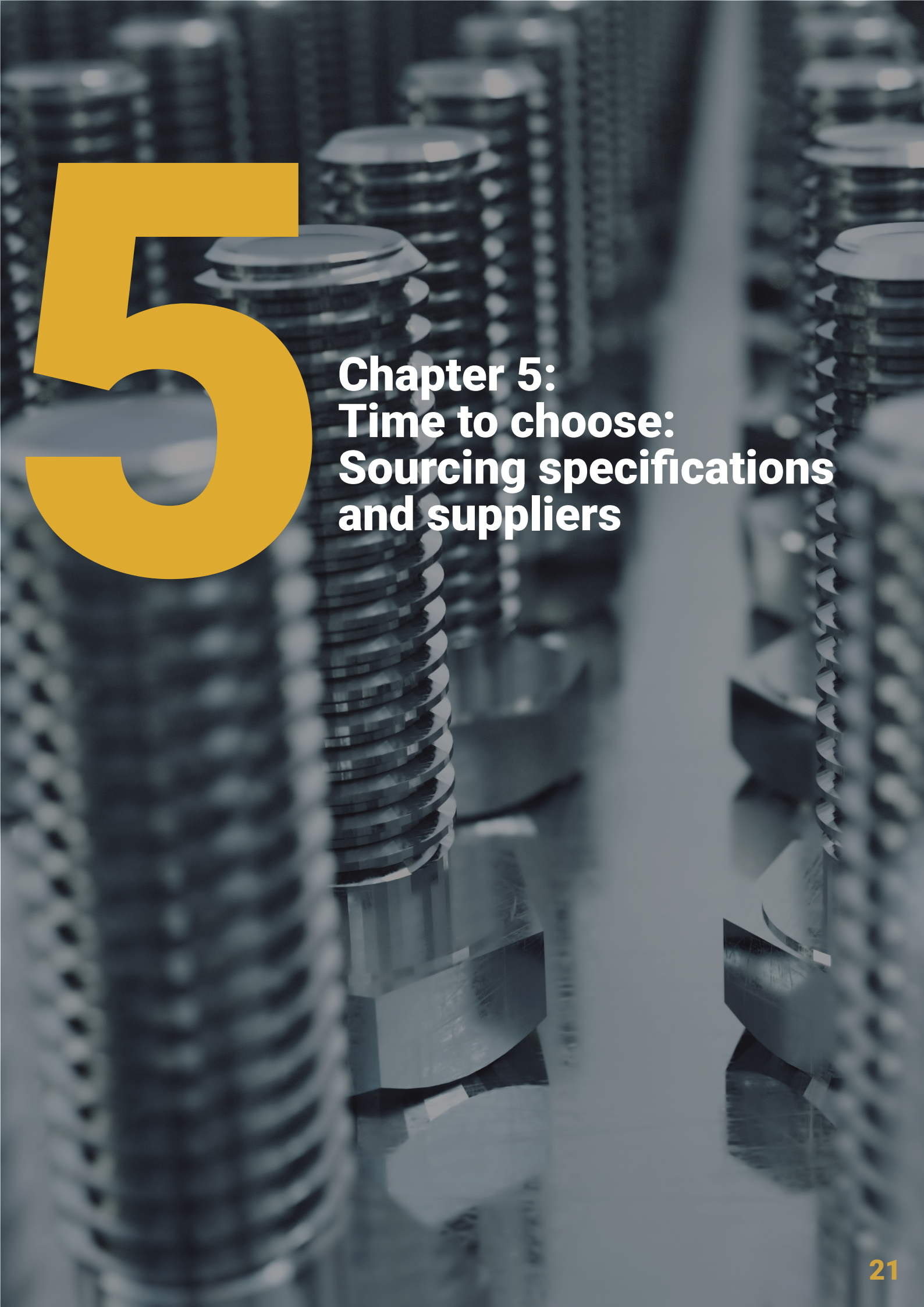
or inquiry@earnestmachine.com (USA) ukenquiry@earnestmachine.com (UK)



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Chapter 5: Time to choose: Sourcing specifications and suppliers

Firstly, choosing your type of plating or coating entirely depends on the end application. If the fastener will be used in an assembly subjected to chemicals and harsh environments, you're more likely to specify a higher cost and higher protection fastener finish.

On the other hand, if a lower level of simple corrosion protection is needed, the cost-effective options, such as Black Oxide, will be more appropriate.

At the beginning of this decision-making process, it pays to understand exactly what you need in your finish. Once that decision is made, it leads to the age-old question: who should I give my business to?

Here's how to find the good ones:

ISO Certification is a must! ISO Certification means the supplier has processes in place to ensure your specifications are met. And if something does go awry, they have processes and corrective actions to fix what went wrong. This will give you the peace of mind you are dealing with a quality supplier.

When working with a reputable distributor or manufacturer, you should be able to have an open conversation about what you need and what the best product fit is.

What will separate a good distributor from a great one is in the off-catalog choices. Master distributors will be able to source your solution, even if it's not something they stock off the shelf, by calling on their network of platers and coaters.

Can your manufacturer of the plain and bare metal fastener add platings and coatings to your order to save costs? A lot of manufacturers do offer this, but asking and knowing if your current partners can do this can keep costs and shipping times to a minimum.

Here at Earnest Machine, not only do we meet all of these requirements, but we also pride ourselves on getting you

the right part, in the right quantity, on time, every time.

A look back at all we've learned: a summary of the eBook

From understanding what a plain fastener offers vs one with plating or coating, to exploring the various protection options available, this eBook has delved into how to specify the level of protection you need and where to source it from.

Three tips for selecting plating and coating options:

1. Make sure you understand the best option available for your specific application in detail– for example, understanding if your application needs to protect against just corrosion or chemical exposure as well. Perhaps you'll need a coating that's food safe.

2. Ensure it's up to specification, as quality is non-negotiable. Make sure you work with a supplier that performs quality checks before they send the parts out to you, as this will save you time and effort in making sure the parts are made to the correct specs.

3. Know your shipping and distribution options to reduce your total cost of parts. Many companies will purchase fasteners from one company and send them elsewhere for further treatment, but many suppliers will offer this as part of their service. For example, at Earnest Machine, we offer a wide range of services for platings and coatings; therefore, our customers can eliminate redundant shipping costs by having one supplier deal with the full package, reducing the overall cost of ownership for their parts.

Earnest

For more information, please get in touch with Earnest Machine:

Email us on:
inquiry@earnestmachine.com

Call us on: 1-800-327-6378

ROCKY RIVER, OH
1250 Linda St., Rocky River, OH 44116

Email us on:
ukenquiry@earnestmachine.com

Call us on: +44 190 271 1041

UNITED KINGDOM
Unit 3A, Millbuck Industrial Estate, Shaw Road Bushbury
Wolverhampton West Midlands, England
WV10 9LA