

# EonCoat™ CR Alloyed Coating for Steel

*Alloyed, Corrosion-Resistant, Ceramic Coating*



GENERAL PURPOSE COATING  
SURFACE BURNING CHARACTERISTICS  
FLAME SPREAD 0  
SMOKE DEVELOPED 0  
4MP8  
R27144



EonCoat™ CR waterborne ceramic coating

# EONCOAT™



### Executive Summary for EonCoat™ CR Coating

- What is it?** EonCoat™ CR coating is a fundamentally new technology for alloying metal oxides to non-alloy steel or iron to form an inert layer that can no longer react to oxygen or moisture. The water-based, two-part spray coating then forms a dense, protective ceramic over the corrosion-resistant alloy. The coating is both a primer for bare metal and a topcoat. Coated equipment can be returned to service in about one hour, regardless of thickness applied.
- Why use it?** To achieve the corrosion resistance of an alloy and the abrasion resistance of a ceramic. The coating withstands long periods of immersion in liquids with pHs ranging from 6 to 11 including aggressive solvents like MEK, acetone and xylene, and shorter term (splash) exposure to an even wider range of chemicals. This fire-retardant (0 flame spread and 0 smoke generation) coating is typically applied at 20 mils for corrosion protection, but can be built to thicknesses of between 12 and 36 mils in one application using multiple passes of a dual-component spray gun.
- How applied?** A SSPC-SP6/NACE 3 (commercial blast) cleaning and removal of dust, debris, oil and other contaminants is recommended for full bonding strength. EonCoat CR coating chemically (covalently) bonds to steel, even oxidized steel. Apply on surfaces with temperatures from 50° to 110° F/10° to 43° C, 30% to 95% humidity. Apply using plural systems with stainless steel lowers and A/B mixing in the spray gun. Matte finish, with a standard color of white. Can be topcoated with EonThane™ urethane top-coat or any quality coating, including high-gloss.
- Where used?** Hundreds of industrial and OEM applications requiring alloyed corrosion protection and abrasion resistance. In addition to corrosion protection, EonCoat CR is also a zero flame-spread and zero smoke-generation fire retardant, with zero off-gassing during application, curing, or flame exposure. EonCoat CR coating is water resistant and can be used to create washdown areas capable of withstanding steam and high-pressure cleaning.
- When?** Available now, directly from the manufacturer.

### Developed by U.S. D.O.E. to Encapsulate Nuclear Wastes

During the 1990s, Argonne National Laboratory/University



of Chicago developed chemically bonded phosphate ceramics (CBPCs) to be a long-term (thousands of years) binder for radioactive and hazardous wastes. The ceramics' applications were mostly at nuclear power plants and military facilities until serial-entrepreneur Tony Collins read Dr. Arun Wagh's book, "Chemically Bonded Phosphate Ceramics." Collins contracted with Argonne, directing the research towards commercial applications while purchasing its commercial technology rights. The ongoing research led to the creation of EonCoat CR coating.

### Exclusively from EonCoat, LLC



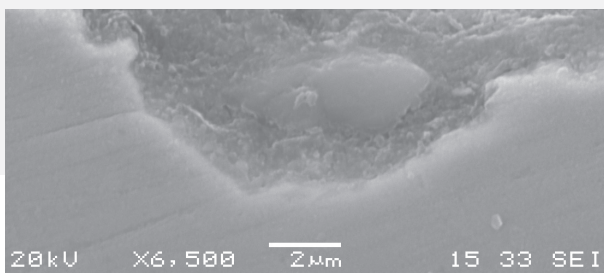
EonCoat CR coating is manufactured by EonCoat, LLC, in their 28,000 ft<sup>2</sup> / 2600 m<sup>2</sup> R&D and production facility in Pompano Beach, Florida.

In 1986, Tony Collins founded and ran Turbine Generator Maintenance, Inc. (TGM) a leading independent service provider for gas and steam turbines. In 2007, when he sold TGM to a private equity firm, it had customers in 47 states and 15 countries. Collins is now CEO of EonCoat, LLC, concentrating his time on the commercial applications of the Ceramicrete™ technology. From his power plants days, Collins knows firsthand the challenges of protecting critical equipment from corrosion, chemical attacks, abrasion, and extreme temperatures.



## Alloyed Corrosion Protection for Steel

EonCoat™ CR coating is fundamentally different technology, not just a modestly improved polymer. Conventional polymers protect in one of two ways: by shielding the surface from corrosion catalysts or by creating a sacrificial layer. By contrast, a single application of EonCoat CR coating converts the steel's surface into a corrosion-resistant alloy which is then coated with layers of self-firing, abrasion-resistant ceramic.



A dual-component spray gun mixes Part A (acid phosphate) with Part B (base minerals and metal oxides, in a water slurry). The mixture creates an exothermic reaction, causing the sprayed coating to rise 2° to 15° F (1° to 8° C) within a few minutes (ambient condition dependent).

The reaction incorporates the iron from the steel substrate. Metal oxides from part B, along with potassium and phosphate from part A, combine with the metal substrate to form a chemically bonded layer of hard stable oxides. This alloy layer becomes a stable metal complex. It is virtually insoluble, permanently inert, and unable to further react to oxygen and moisture.

**SEM photo of true oxide passivation layer on steel.**

### Chemical Bonding Creates Covalent Layers

The EonCoat CR reaction creates chemical bonds that are covalent, meaning there's a sharing of the electrons between atoms. Any additional layers (e.g., spray passes) will also chemically bond to each other, with covalent bond strength. (Grit blasting is needed to remove EonCoat CR coating.)

Multiple passes of the spray gun build protective ceramic layers on top of the alloyed layer. For severe abrasion protection, you can simply spray on more coating — up to 36 mils thick.

### How It Protects...Even If Removed

Traditional polymer coatings create a film structure which mechanically bonds to substrates that have been extensively prepared (e.g., SSPC-SP 5/NACE 1). If gouged, moisture and oxygen will migrate under the coating's film from all sides of the gouge. Moisture and heat are then trapped by the film, creating a "greenhouse effect," promoting corrosion and blistering.

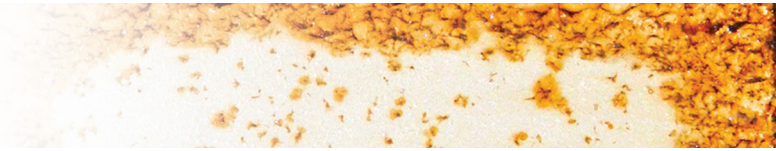
By contrast, the same damage to an EonCoat CR coated substrate will not spread corrosion. That's because the steel is alloyed: surface oxides have been converted into an inert metal incapable of supporting oxidation. To see this demonstrated, turn to page 4 for our NASA-designed corrosion tests.

### Quickly Repaired or Reconditioned

Typically, all that's needed is a quick cleaning to remove surface contaminants. As both primer and topcoat, even bare metal can be fully repaired in one application, using multiple spray passes to match the thickness of the surrounding coating. EonCoat CR coating can also be ground, torched, or cut without creating off-gassing fumes or noxious odors and without clogging grinding or cutting equipment.



**For Your Own Field Tests**  
Apply now: [EonCoat.com](http://EonCoat.com)

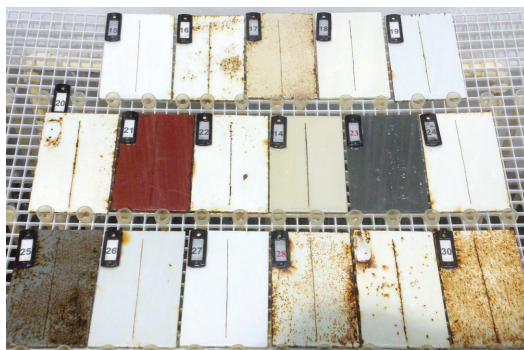


### NASA-Designed Corrosion Tests



The NASA Seawater Splash Test: Coated samples are “scribed” — deeply gouged to remove all coating, including the EonCoat™ CR alloy layer. Then the samples are exposed to 4 hours of salt spray, followed by 4 hours of simulated sunlight (UV lamps with 426 nm wavelengths).

Most industrial corrosion protection coatings we tested failed in 45 days or less: see the sample on the right side of each photo above. (Note the severe “edge lift” corrosion.) The EonCoat CR sample is on the left side. Except for the rust on its gouge line, the EonCoat CR sample looks the same as day one, even after 120 days.



Our lab testing is modeled after NASA’s Seawater Splash Test, a very aggressive corrosion test.

### “Forgiving” Corrosion Protection

Sometimes even the best painters miss a spot. With conventional polymer coatings, missed spots can quickly lead to widespread corrosion, as oxidation “lifts” the polymer film, allowing additional migration of moisture under the film.

EonCoat CR coating is much more forgiving in its application. The alloyed corrosion protection layer is a *passive layer of hard metal oxides* that becomes part of the substrate. Once the steel is alloyed, it will be inert to oxidation. Even if a nearby spot is completely missed, corrosion will not migrate to the coated areas. “Edge lift” is not possible since there is no film structure to crawl underneath. Corrosion stops when it hits the alloy.

### Order Your Own Tests

EonCoat, LLC is committed to a program of worldwide industrial field tests. We encourage you to rigorously test EonCoat CR coating...at our expense. Either:

- 1) Tell us the type of third-party testing you need for your specific application, or
- 2) We’ll supply EonCoat CR samples for your own tests, or will coat something in your facility for your evaluation.

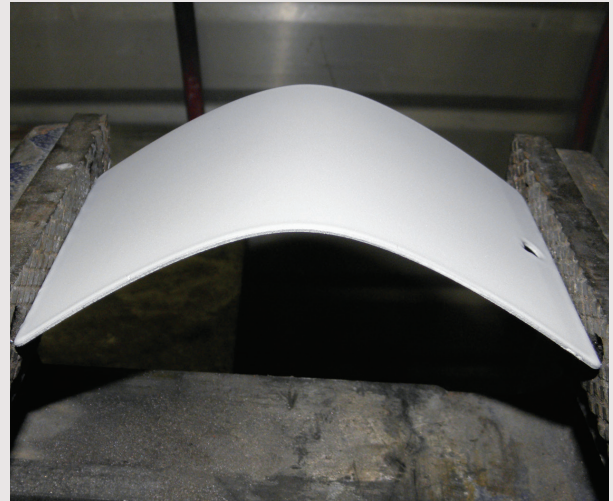
## 19% Ceramic Flexibility

Ordinary ceramics are inflexible; they flex less than 1%. Steel flexes 7% to 38% before failure, but can only flex to 1% before it permanently deforms, so most structures are designed for flexing of 1% or less.

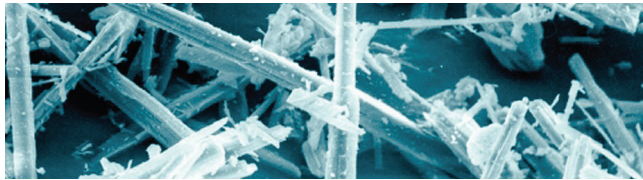
Independent tests done by Dwight Weldon of Weldon Labs (author of the book “Failure Analysis of Paints and Coatings”) show that EonCoat™ CR coating flexes 19% prior to failure.



So EonCoat CR coating has many times the flexibility (or ductility) needed to handle the typical movements of steel. This includes the flexing, expansion and contraction found in bridges, storage tanks, pipelines, and so on.



*Although we don't recommend it, your coated metals could be bent 19% before permanently damaging (cracking) the EonCoat CR coating.*



## How EonCoat CR Coating Flexes

EonCoat CR coating has additive fibers and fillers with an acicular structure to create toughness and ductility (flexibility). This isn't possible with traditional ceramics because fibers cannot withstand high-temperature firing. But the EonCoat CR exothermic reaction creates a heat rise of only 2° to 15° F (1° to 8° C), so a wide range of materials can be used for performance enhancement. EonCoat CR coating also has good impact resistance: 140-160 in. lbs./16-18 Nm.

## What EonCoat CR Coating is NOT

EonCoat CR coating is not simply pre-fired ceramic beads mixed into a paint. The EonCoat CR exothermic reaction is “self-firing,” meaning it creates ceramics on-the-spot (in situ). Its ceramic mineral structure dries to the touch in about 5 to 10 minutes, but continues to gain strength for years, similar to the chemical hardening process of natural stone.

Columbia Analytic Services (now part of ALS Environmental) confirms that EonCoat CR coating has no VOCs and no HAPs. It also has no flash point, no hazardous disposal issues, and zero flame-spread and smoke generation ratings.



### Regulatory Compliant From Their Discovery

Argonne National Laboratory didn't set out to create a VOC-free coating. Their task was to create binders for the long-term encasement of nuclear wastes (see page 2).

The scientists' discovery — the chemical foundation for subsequent EonCoat™ CR developments — just happens to be extremely regulatory-friendly. No VOCs, no HAPs, no flash point, no odors. It's also LEED-compliant and takes 1/10 the amount of carbon to make compared to typical polymer coatings.



Contrast this fundamentally new chemistry to the on-going struggles of manufacturers of traditional polymer coatings. They mostly have been trying to meet new VOC regulations by doing incremental “tweaks” to their decades-old formulas.

EonCoat, LLC has tested many of these low or “no” VOC formulations. The results agree with the industry's consensus: their performance is substandard — far below their pre-regulatory levels.

#### How Can A VOC-free Coating Bond Well?

VOCs are used in traditional coatings to keep components (binders, pigments, and additives) separate so they won't react until the VOCs evaporate. EonCoat CR coating simply doesn't need VOCs because it uses dual-component mixing sprayers and inorganic components. The reaction starts the moment the components — acid phosphates, inorganic minerals, and water — mix in the spray gun.



The spray gun is mixing an acid (pH 3 to 5, equivalent to strawberry juice) with a base (pH 9 to 11, equivalent to Milk of Magnesia). The differential of seven pH levels causes an exothermic reaction 2° to 15° F (1° to 8° C), self-firing the ceramic layers.

The exothermic reaction is also indicative of the chemical bonding of the alloy and the ceramic layers. To see how that bonding action translates into adhesion and resistance to abrasion, please see our current Product Data Sheet.



#### “Too Good To Be True”

66% of the coating experts we've interviewed had that initial response. They tell us they're fatigued by ungrounded marketing claims for every new permutation of VOC-reduced polymer coatings.

Yet by the end of our focus groups, **70% of the coating experts wanted to run tests on the EonCoat CR coating.** We encourage you to rigorously test this coating...at our expense.

And we want you to publicly share your test results — good or bad — either on [blog.eoncoat.com](http://blog.eoncoat.com) or in your favorite LinkedIn™ groups (SSPC, Corrosion, etc.). If you're encouraged by the test results and want to specify the coating on a larger scale, make note of the EonCoat CR Warranty:

*If our coating is applied by an EonCoat Certified Contractor and the coating fails within 5 years, we will fix the coating or replace it at our cost.*



## EonCoat™ CR Advantages

Factors	Conventional High Performance Industrial Coatings	EonCoat™ CR Coating
Dries to Touch	1 to 8 hours typical	5 to 10 minutes
Return to Service	2 to 4 days (3 coats)	≈ 1 hour (1 coat)
Labor	significant prep time + 3 coats	reduced prep time + just 1 coat
Application Temperature Range	varies	50° to 110°F 10° to 43°C
Application Relative Humidity Range	typically 85% max.	30% to 95%
Pot Life	varies from 20 minutes to a few hours	n/a: Plural spray gun eliminates pot life issues & resulting waste
Corrosion Protection	conventional: dependent on integrity of coating's film structure	superior: converts steel to corrosion-resistant alloy covered by layers of flexible ceramic
Alkaline Resistance	varies	immune to most alkalis (except sodium hydroxide)
Acid Splash Resistance	varies	good
High Build on Vertical Surfaces	requires numerous coats and drying times to avoid runs; limitations to total film thickness	builds up to 36 mils on vertical surfaces are possible in one application by multiple passes of the spray gun
Total Applied Costs	conventional costs	lower than other coating technologies



### Recommended Thicknesses

The EonCoat™ CR coating's passive oxide/alloy corrosion layer is actually just microns thick. Our spray system applies between 2 to 6 mils (50 to 150 microns) of the ceramic per pass, depending on the tip used. We recommend a total application of between 12 and 36 mils thick, with 20 mils being our typical specification. Call us: we can provide guidelines for your application.



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2012 Top-10  
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**For Your Own  
Field Tests**

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