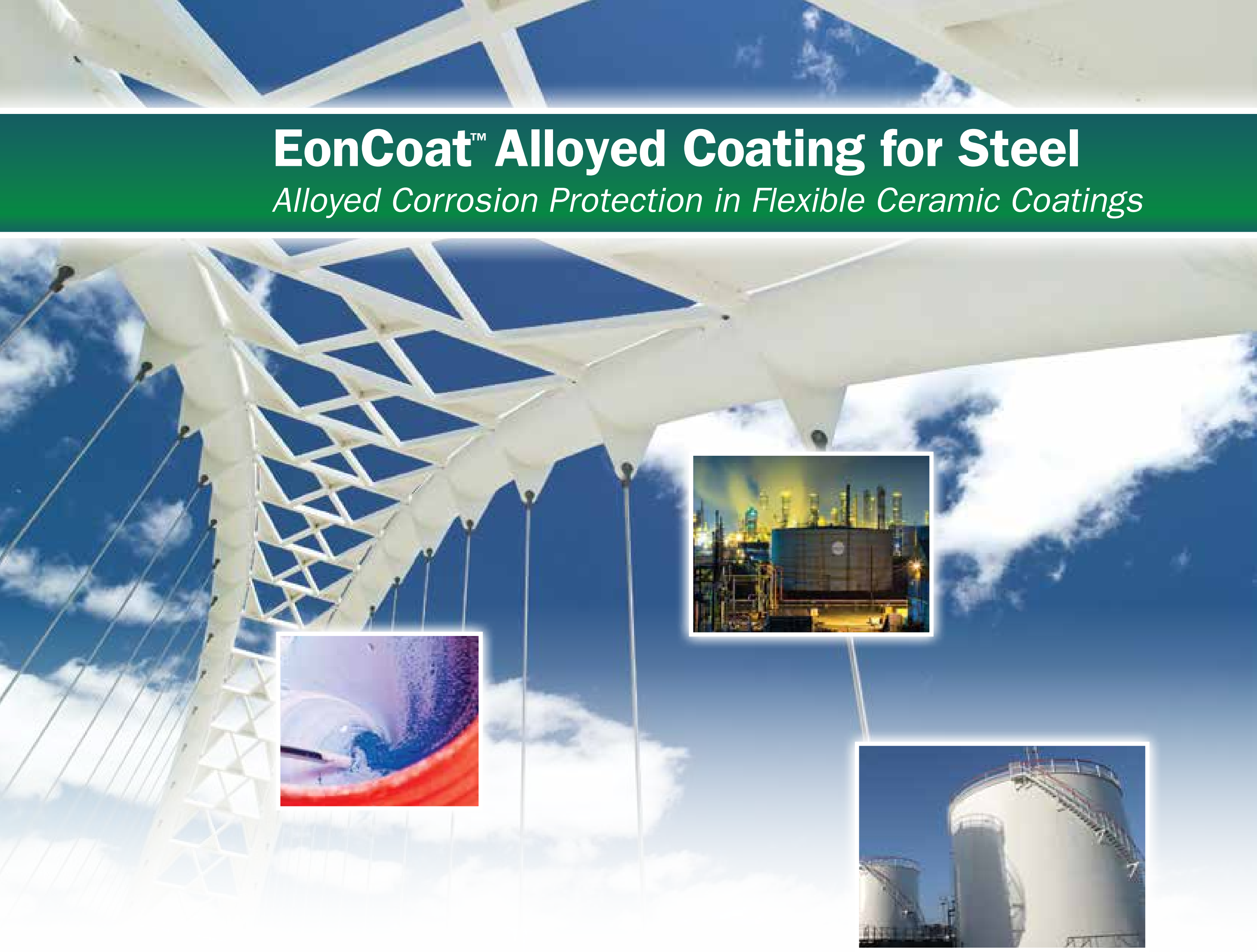
EonCoat™ Alloyed Coating for Steel

Alloyed Corrosion Protection in Flexible Ceramic Coatings



CLASSIFIED UL

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

NSF®

Certified to NSF/ANSI 61

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EonCoat waterborne ceramic coating

EONCOAT™

Executive Summary for EonCoat™ Alloyed Coatings

What are they? EonCoat™ coatings are 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 coatings then form a dense, protective ceramic over the corrosion-resistant alloy. The coatings are 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 them? To achieve the corrosion resistance of an alloy and the abrasion resistance of a flexible ceramic. The coatings withstand 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. These fire retardant (0% flame spread) coatings are 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 ceramics chemically (covalently) bond to steel, even oxidized steel. Apply on surfaces with temperatures from 50° to 120°F/10° to 48°C, 0% 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 off-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. Performance also includes 0% flame-spread fire retardant with 0% off-gassing during application, curing, or flame exposure. These coatings are water resistant and can be used to create wash-down 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 had mostly nuclear plant and military applications 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 coatings.

Exclusively from EonCoat, LLC

EonCoat coatings are manufactured by EonCoat, LLC, in their 28,000 ft²/ 2600 m² R&D and production facility in Pompano Beach, Florida.

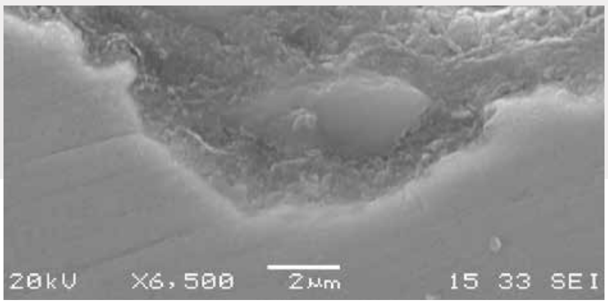
In 1986, Tony Collins founded and ran Turbine Generator Maintenance, Inc. (TGM) a leading independent service provider for gas and steam turbines. In 2007, when he sold TGM to a private equity firm, it had customers in 47 states and 15 countries. Collins is now CEO of EonCoat, LLC, concentrating his 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™ coatings are fundamentally different technology, not just modestly improved polymers. 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 coating converts the steel's surface into a corrosion-resistant alloy which is then coated with layers of self-firing, abrasion-resistant, flexible 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 5° to 15°F (3° to 8°C) within a few minutes.

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 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 these coatings.)

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.

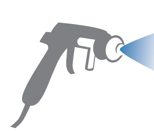
How It Protects…Even If Removed

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.

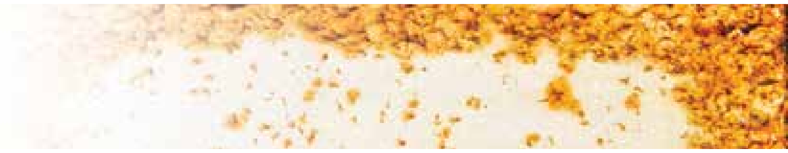
By contrast, the same damage to an EonCoat coated substrate will not spread corrosion. That's because the steel is alloyed: surface oxides have been converted into an inert metal incapable of supporting oxidation. To see this demonstrated, turn to page 4 for our NASA-designed corrosion tests.

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. The coatings can also be ground, torched, or cut without off-gassing fumes or noxious odors and without clogging grinding or cutting equipment.



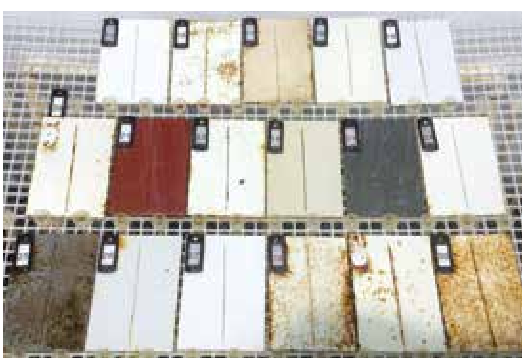
For Your Own Field Tests
Apply now: **EonCoat.com**



NASA-Designed Corrosion Tests

The NASA Seawater Splash Test: Coated samples are "scribed" — deeply gouged to remove all coating, including the EonCoat™ 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 sample is on the left side. Except for the rust on its gouge line, the EonCoat 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 coatings are much more forgiving in their 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 these coatings…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 samples for your own tests, or will coat something in your facility for your evaluation.

19% Ceramic Flexibility

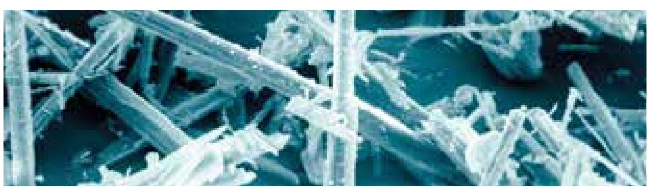
Ordinary ceramics are inflexible; they flex less than 1%. Steel flexes 7% to 38% before failure, but can only flex to 1% before it permanently deforms, so most structures are designed for flexing of 1% or less.

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

WELDON LABORATORIES, INC.

So EonCoat ceramics have 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 coating.



How EonCoat Ceramics Flex

EonCoat ceramics have 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 exothermic reaction creates a heat rise of only 5° to 15°F (3° to 8°C), so a wide range of materials can be used for performance enhancement. These coatings also have good impact resistance: 140-160 in. lbs./ 16-18 Nm.

What EonCoat Ceramics are NOT

EonCoat coatings are not simply pre-fired ceramic beads mixed into a paint. Their exothermic reaction is "self-firing," meaning it creates ceramics on-the-spot (in situ). Their 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's analysis confirms that EonCoat coatings have no VOCs and no HAPs. They also have no flash point, no hazardous disposal issues, and a zero flame spread rating.

Columbia Analytical Services

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Regulatory Compliant From Their Discovery

Argonne National Laboratory didn't set out to create VOC-free coatings. 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™ 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.

Argonne NATIONAL LABORATORY

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 coatings simply don't need VOCs because they use dual-component mixing sprayers and inorganic components. Their reaction starts the moment their 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 5°F to 15°F / 3°C 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 EonCoat.™** We encourage you to rigorously test these coatings… at our expense.

And we want you to publicly share your test results — good or bad — either on 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 coatings on a larger scale, make note of the EonCoat 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™ Advantages

Factors	Conventional High Performance Industrial Coatings	EonCoat™ 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 120°F 10° to 48°C
Application Relative Humidity Range	typically 85% max.	0% 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™ 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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Live Safer:
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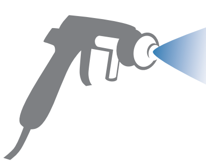

For Your Own Field Tests
Apply now: **EonCoat.com**

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