

INTRODUCTION

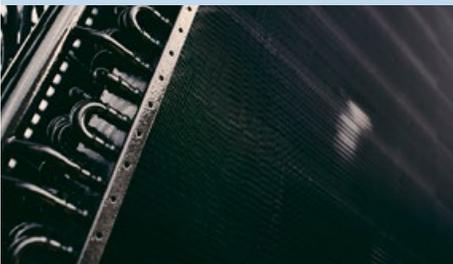
Extending the service life and heat transfer efficiency of HVAC&R systems.

Electro-deposition coating (E-Coat)—a premium alternative to polyurethane and phenolic coatings—provides long-term corrosion protection for outdoor HVAC&R equipment in coastal (marine), industrial, urban, or highly alkaline environments. In addition, E-Coat provides protection for equipment in certain indoor environments, such as swimming pools, industrial process facilities, and waste water treatment plants.

ElectroFin E-Coat protects your equipment investment by extending service life and energy efficiency performance, thereby lowering lifetime operating costs. Unprotected HVAC&R round-tube plate fin (RTPF) and microchannel heat exchangers (MCHE), radiators, condensing units and fans exposed to salt air, corrosives or acid rain will begin to oxidize within the first few months of operation. Corrosive attack typically starts at the copper tube–aluminum fin interface on the RTPF design and at the header extrusion connection on the MCHE design, causing thermal performance to decline swiftly. Performance decreases of up to 30% within 6 months are not unusual.



WITHOUT ELECTROFIN E-COAT



WITH ELECTROFIN E-COAT

UNDERSTANDING THE BENEFITS OF ELECTROFIN[®] E-COAT ON COMMERCIAL HVAC&R AND MECHANICAL SYSTEMS

This document explores the many benefits of ElectroFin E-Coat, how it works, and the importance of having ElectroFin E-Coat specified and applied during the manufacture of HVAC&R equipment purchased and installed on newly constructed or renovated buildings. The content should help answer these questions:

- *What is E-Coat and how does it work?*
- *What is different about ElectroFin E-Coat?*
- *What performance standards does ElectroFin E-Coat meet or exceed?*
- *What kind of costs savings or ROI can be expected?*
- *How should ElectroFin E-Coat be specified for OEM-build HVAC&R units?*

After reviewing this document, you will understand E-Coat systems and be better prepared to discuss their value with your company's management team and with general contractors responsible for overseeing your construction or building renovation projects.

What is E-Coat and how does it work?

ElectroFin E-Coat is an electro-deposition coating process that involves epoxy paint particles evenly suspended in deionized water. When electrically charged, the paint particles migrate to and bond with aluminum, copper, and other conductive metal surfaces that form the heat exchanger coils in HVAC&R systems. After being cleaned and degreased, the metal surface to be coated is grounded electrically and suspended in the E-Coat tank. The paint particles carry a positive electrical charge so they are attracted to the metal surfaces and build up until they have achieved a uniform film. The coated surfaces are then baked until the coating cures, creating a smooth shell designed to resist corrosion, pitting, and flaking. The ElectroFin E-Coated heat exchangers are then incorporated into the manufactured HVAC&R unit.

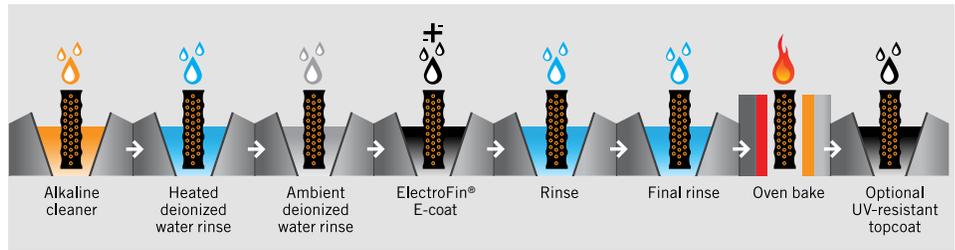
What is different about ElectroFin E-Coat?

Most other coating processes involve manual dipping or spraying, which can create surface imperfections or improper thicknesses. These leave behind microscopic holes that allow salt air or other corrosives to reach the metal, compromising performance and service life.

Manual coating is also susceptible to coverage variances from one component to the next. ElectroFin E-Coat is an automated, computer-controlled process that guarantees complete and uniform encapsulation and 100% coverage. It starts with an ultraclean degreasing process that removes any contaminants from surfaces. This is followed by a water bath that rinses away any residual dust or contamination. The component is then immersed and electro-coated with particles drawn electrically to all surfaces. This produces a thin film with a uniform thickness of 1 mil (0.001 inches) that penetrates deep and covers edges. ElectroFin E-Coat protects up to 30 fins per inch without bridging.

The metal component is then removed from the electro-bath and given a final rinse. During the final rinse bath, residual coating material is removed and recovered, ensuring a smooth coating and minimal process waste. A precisely controlled oven bake at 375°F/190°C cures the coating evenly to ensure consistent adhesion to the surfaces of every coil. Finally, a UV-resistant topcoat is applied to shield the E-Coat finish against ultraviolet degradation and to ensure maximum coating durability and service life.

Factory applied ElectroFin process



Unlike brittle and baked phenolic coatings that can crack, chip, peel, and become lodged in the fins, E-Coatings remain flexible. ElectroFin E-Coat, in particular, can expand and contract as the unit operates, which allows bent fins to be straightened without compromising protection. ElectroFin's formula also features high-edge-build, providing excellent adhesion on sharp surfaces.

Left untreated, condenser coils exposed to salty atmospheres and harsh conditions can be expected to start degrading within a few hundred hours of installation.

When comparing protective coatings, look for the longest warranty available. ElectroFin E-Coat is warranted to be free of defects in materials and workmanship for five years, provided coils and components are properly and routinely maintained, and records demonstrate proper cleaning procedures and approved products were used.

What performance standards does ElectroFin E-Coat meet or exceed?

Protective coatings, whether phenolic, polyurethane or E-Coat, must meet industry minimum standards. However, ElectroFin E-Coat demonstrates exceptional technical properties in ASTM, DIN, and MIL-STD testing for resistance to thermal loss, UV degradation, and moisture intrusion. Continuous testing is carried out to assure that performance continues to meet or exceed established standards.

ElectroFin E-Coat also resists 90 different chemicals—many more than phenolic coating. In addition, ElectroFin E-Coat exhibits excellent adhesion to all of the most common metallic heat transfer surfaces, including copper, aluminum, and galvanized and stainless steel, to assure a long operating life for its protective properties.



Technical Performance – ElectroFin® E-Coat

TEST	STANDARD	QUALIFICATION
Salt Spray	DIN 53167/ASTM B117	Exceeds 6,000 hours
Water Immersion	ASTM D870	3 months
Pencil Hardness	ASTM D3363	HB-F
Crosshatch Adhesion	ASTM D3359	0 (5B)
Humidity	ASTM D2247	1,000 hours
UV Resistance	ASTM D4587	500 hours
Mandrel Bend	ASTM D522	Passed 1/8 inch
Mold Resistance	ASTM G21	Passed
Sand/Dust Resistance	MIL-STD 810F	Passed
C5 Marine & Industrial	ISO 12499	Passed

Why is so much protection needed?

Virtually all condenser coils, as well as the cabinets, controls, and ancillary equipment that reside outdoors in commercial HVAC&R systems, are exposed to harsh conditions from time to time. These include strong, unfiltered UV rays, moisture from rain and humid air, blowing dust and pollutants. All of these conditions can contribute to corrosion of the metal surfaces throughout the HVAC system, with subsequent degradation of coil heat transfer performance and operating life.

The problem is exacerbated in coastal regions, where salt air is the norm. Atmospheric salinity's corrosive properties are well-documented. Left untreated, condenser coils exposed to such an atmosphere can be expected to start degrading within a few hundred hours of installation. By contrast, carefully controlled exposure testing has revealed that, while coils treated with ElectroFin E-Coat have slightly lower Energy Efficiency Ratios (EERs) than



ElectroFin E-Coat is specifically formulated to lengthen equipment service life by four to five times and have less than 1% impact on the thermal efficiency of the coils it protects.

uncoated coils at initial installation, their performance actually improves in the first 500 hours of use and then holds nearly steady out to 2,000 hours of exposure.

Uncoated coils, on the other hand, suffer performance degradation continuously, from the moment of installation. At 3,000 hours of exposure (the test's termination point), the ElectroFin E-Coated coils' EER is still higher than the EER of the uncoated coils measured at 500 hours (see graph).

As one would expect, in applications where condenser coils are continuously exposed to salt air, the superior longevity and performance of E-Coated coils reduce total cost of ownership (first-cost plus operating and maintenance costs) compared to systems with uncoated coils.

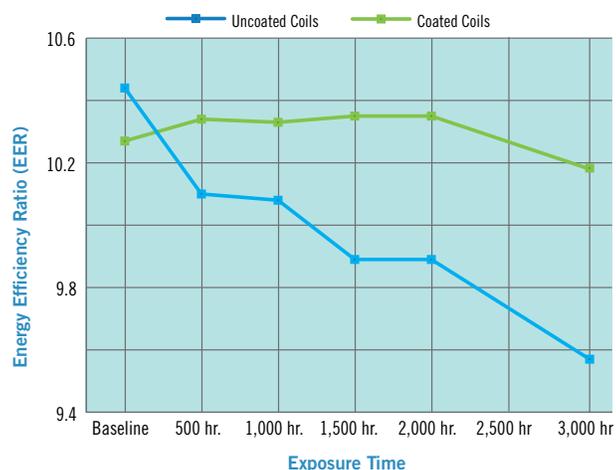
What is not as obvious is that E-Coated coils can provide the necessary protection and performance enhancement to reduce total cost of ownership in a host of other applications where condenser coils are subjected to corrosive micro-environments. For instance, HVAC&R units installed near swimming pools or serving indoor pool areas can be subjected to high-humidity, high-chlorine micro-environments. Wherever high concentrations of vehicle exhaust or industrial contaminants are present, protecting aluminum or copper coil fins with ElectroFin E-Coat is also a wise choice. Coils made of copper are especially susceptible to attack by industrial contaminants.

What kind of costs savings or ROI can be expected?

In mild, non-coastal environments, aluminum-fin coils pre-coated with an epoxy offer a bit more protection than an uncoated coil, and can be more economical than copper or E-Coated coils. Coatings suppliers sometimes hedge on how much their product adds to the service life of equipment, saying their coating extends the life of a coil "several times compared to an uncoated coil." ElectroFin E-Coat is specifically formulated to lengthen equipment service life by four to five times and has less than 1% impact on the thermal efficiency of the coils it protects.

Major HVAC&R OEMs approve the use of ElectroFin E-Coat for their systems. In fact, one OEM saw its coil replacement warranty costs drop substantially after switching to ElectroFin E-Coated coils on its manufacturing lines. ElectroFin E-Coat delivers other benefits as well: It can help to reduce energy consumption and can help new construction projects attain LEED certification by the U.S. Green Building Council.

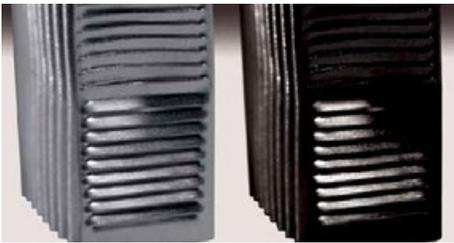
Energy Efficiency Ratio Degradation Over Time



How should ElectroFin E-Coat be specified for OEM-build HVAC&R units?

ElectroFin E-Coat is the number-one choice of OEMs for corrosion protection. All major OEM brands offer it for their customers, who value its extra protection and cooling efficiency. Typically, the inclusion of E-Coat in the manufacturing stage adds about two weeks to the order/delivery cycle.

Key to keeping your company's construction or renovation timetables on schedule is reaching out to your general contractor early on. Have your contractor break out the cost of adding ElectroFin coatings to its overall bid. Some contractors may be



UNCOATED

E-COATED

If you have additional questions or would like to learn more about factory-applied ElectroFin E-Coat, please e-mail us at Coatings@Modine.com

reluctant to do so because they believe that including the cost of any factory-applied coating—even separately—will make their bid less competitive.

Let the contractor know you're aware of the added benefits—longer service life, reduced maintenance, lower energy costs, increased capacity and short payback period—that ElectroFin E-Coat offers. Customers including WalMart, Home Depot, Marriott, K-Mart, Target, and Dillard's already specify it. In fact, ElectroFin E-Coat protects more than 100 million square feet of HVAC&R systems each year, atop thousands of commercial buildings worldwide.

Specifying E-Coat for all-aluminum microchannel heat exchangers (MCHE)

Aluminum microchannel heat exchangers pose a particular challenge for the E-Coat process, because of their high fin densities and consequent potential for bridging.

ElectroFin has developed a specific E-Coat formulation to allow extension of E-Coat protection to MCHE technology. To assure proper coating coverage without bridging, ElectroFin E-Coat with high edge build technology should be specified. ElectroFin has successfully applied high edge build E-Coat to more than one hundred thousand microchannel condensers in service globally, including many in extremely harsh environments. For HVAC systems already in the field, ElectroFin Insitu® coil and cabinet coatings can help.

For systems already installed on rooftops, next to loading docks, on urban-building exteriors subject to high levels of vehicle exhaust, or in other troublesome locations, ElectroFin Insitu protective coatings can be applied via spray systems. These coatings contain embedded stainless steel (ES2) pigment technology to enhance resistance to moisture, corrosion, and UV degradation nearly to the same point as that achieved with ElectroFin E-Coat.

Moreover, spray-on coatings can be applied to system cabinetry and ancillary components, offering the option not only to add protection, but to change the color of visible equipment to improve building aesthetics or to support the building owners.

What to do next?

Now that you're more familiar with the various types of protective coatings for HVAC&R units, and understand their differences, you can speak more knowledgeably with others in your organization about the benefits they bring to your buildings.

