PRODUCT APPLICATION

A technical bulletin for engineers, contractors and students in the air movement and control industry

Coatings Application Guide - Commercial and Industrial Fans

Greenheck offers customers a wide variety of coatings for specific applications. We have developed several coating formulations meeting the requirements for 98% of all HVAC applications, although the information in this paper primarily addresses commercial and industrial fan products. These coating formulations have been thoroughly tested to assure they meet the demands our products see in the field.

Coating Types

Coatings have many uses. Some protect; others provide aesthetic qualities, while some coatings offer both protection and aesthetics. Greenheck uses electrostatically applied thermosetting powder coatings and traditional liquid paint coatings. Both coating types have benefits, however, powder coatings offer more advantages over liquid "enamel" coatings in most applications. Greenheck has standardized the use of powder coatings on the majority of its products.

Powder Coating Benefits

- Environmentally friendly paint process
  - Eliminates hazardous volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) into the atmosphere
  - Limited amount of inert waste produced (safe for landfill disposal)
- Cost effective
- Ability to produce high performance at low film builds
- Consistent film builds throughout product
- Improved edge coverage
- Robust integrity immediately after curing "thermoset" (by comparison, liquid coatings generally remain soft for some time after application, creating the potential for damage during transport/handling)
- Dual purpose
  - Can provide both a functional protective coating and aesthetic appearance
- Can be formulated to meet AAMA specifications

Coating Types Used by Greenheck

Industrial Epoxies – Industrial epoxy coatings have use as a base coat under a top coat or as a stand-alone functional coating. Its primary purpose is corrosive protection. Epoxies withstand harsh chemical exposures.

- Excellent chemical resistance
- Excellent mechanical properties
- Not recommended without topcoat when exposed to UV light
  - Any exposure will subject the coating to premature chalking
- Continuous-duty* service temperatures up to 250° F

However, this coating type performs best in applications that are indoors or outside with no ultraviolet (UV) exposure from the sun. UV exposure quickly breaks down the epoxy coating, leaving the product vulnerable for corrosion.

High-Temperature Coating – This coating is available in both high temperature powder and liquid paint. These coatings are suitable for continuous-duty use at elevated temperatures.

- High-temperature powder paint (silver) – Rated for continuous duty* up to 500° F
- High-temperature liquid paint (silver) – Rated for continuous duty* up to 850° F
- Good chemical resistance
- Good mechanical properties

Permatector – Permatector™ is a Greenheck trademarked protective coating. The base resin of this coating is polyester, formulated to provide a solid coating that resists abrasion, impact, UV and chemical resistance in a visually appealing package. Permatector is available in both liquid and powder formulations, but most often applied as a powder because of the benefits offered by an electrostatic coating. This coating is only available for applications as a single-coat in Greenheck Concrete Gray.

- Good chemical and corrosion resistance
- Good mechanical properties
- Very good gloss and color retention properties
- Continuous-duty* service temperatures up to 250° F

Hi-Pro Polyester – Hi-Pro Polyester is another Greenheck coating specifically formulated to offer improved performance in abrasion, impact, UV and chemical resistance. This coating represents a class of coatings called super durables.

Hi-Pro is superior to Permatector in UV resistance significantly reducing color / fade and chalking. As coatings fade they lose their ability to protect. This formulation has also been modified to improve edge protection where coatings are the weakest due to reduced thickness.

It is a high-quality coating because of its UV and color fade resistance.

- Very good chemical and corrosion resistance
- Good mechanical properties
- Improved edge protection
- Superior gloss and color retention
- Continuous-duty* service temperatures up to 250° F

Another benefit of the Hi-Pro coating is its improved paint coating coverage on the edges where most coatings are the weakest because of the nature of how paint covers edges. (Figure 1)

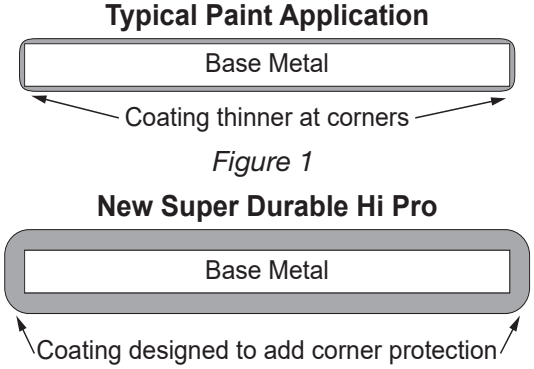

Figure 1

LabCoat™ – LabCoat is Greenheck's premium coating. The two-part process (Figure 2) includes a base coat of our best industrial epoxy with the premium Super Durable Hi-Pro applied as a topcoat. LabCoat will withstand the harshest coastal environments while offering superior chemical resistance.

- Excellent chemical resistance
- Superior corrosion resistance
- Excellent edge protection
- Superior gloss and color retention
- Continuous-duty* service temperatures of the system up to 275° F
  NOTE: Base coat epoxy will withstand higher service temperatures as noted for epoxy.

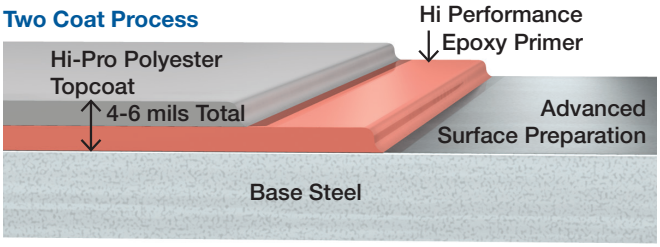

Figure 2 – LabCoat's two-step process includes advanced surface preparation followed by a layer of industrial epoxy and one of Hi-Pro Polyester.

***Continuous duty is defined as the ability of the coating to withstand the specified temperature without loss of adhesion to the substrate over a 24-hour period.**

NOTE: All coatings experience changes at higher temperatures. These changes may affect the coating's performance as temperature increases beyond set limits. High temperatures may permanently affect some qualities without losing all performance characteristics. This is completely dependent on the duty cycle of the elevated temperature and accurate predictions on quality are not possible.

Typical Cleaning / Pretreatment Process

Cleaning Stage → Rinse → Conversion Coating Stage → Final Rinse Sealer

Typical impacts of temperature to coating performance may include, but are not limited to:

- Color change
- Loss of gloss (Most applications never go beyond this point and only affect the aesthetics)
- Loss of mechanical properties
- Loss of adhesion

Greenheck uses the highest quality ingredients in its paint coatings. Third-party laboratories including Express Testing, Atlas/Ametek and Element Labs test and verify the quality of these coatings. These coatings undergo a battery of tests prior to approval. Information on specific tests used is available by contacting Greenheck.

Protection – It's not all about the Paint!

No coating will perform as expected without a thorough cleaning of the base material or metal first. Proper cleaning promotes appearance, adhesion and corrosion protection. Every Greenheck product goes through a multi-step wash process (Figure 3) to achieve the performance required.

- The first step removes all dirt and oils on the surface of the metal. This step removes surface contaminants and prepares it for the next step.
- The next critical step is the application of a "conversion coating." This conversion coating forms a micro-thin crystalline layer that promotes adhesion and resists corrosion creep under the paint surface.
- The final step is an application of a non-chrome sealer that assists in paint adhesion and corrosion resistance.

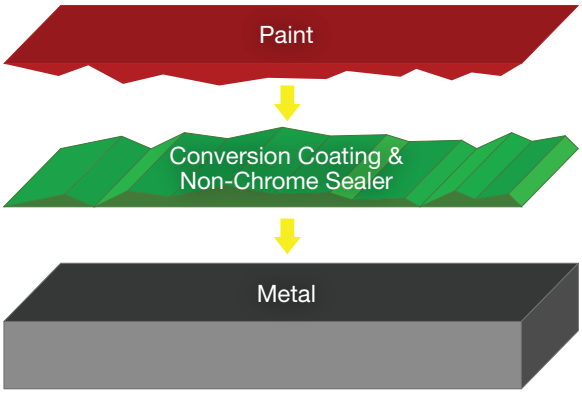

Figure 3

Paint Application Questionnaire

1. Is this an outdoor application?
2. Is the jobsite less than 10 miles from a body of salt water (coastal areas)?
   a. If yes approximately how many miles?
3. Will the airstream of the unit contain particulates?
   a. If yes what type of particulates and the approximate concentration.
4. What temperature will the airstream see?
5. Are there chemicals in the airstream?
   a. If yes what type of chemical will it be exposed to?
      i. Include a SDS safety data sheet.
   b. What is the approximate concentration in the airstream—low, medium, or high?
   c. How often will the fan be operating?

Provide any additional information regarding the project.

Help us help you!

Chemical Resistance Chart

To understand how every chemical would impact our coatings would not be plausible so we have tested some common industry chemicals listed below. Testing involves applying a drop of the concentrated chemistry directly on the surface and observing the results. This is not how our products experience chemical exposure in the field.

Our products entrain large volumes of air reducing chemical exposure by design, so the coatings perform well in most applications. To extend the performance of a coating, a two-coat system always is recommended in extreme-duty applications such as one would see in coastal / chemical applications.

Stainless steel or fiberglass ductwork also are good indicators to use an extreme-duty coating.

NOTE:

This chart should only **serve as a guide** when it comes to chemical resistance. The following factors will decrease a coating's ability to resist chemical attack.

- Exposure time > 8 hours daily
- Airstream moist with chemical concentrate
- Elevated temperatures > 125°F
- Location < 10 miles to coastal or marine environments

Available Coatings:

Resistance to Corrosive:

1. Permatector™
2. Hi-Pro Polyester
3. Hi-Pro-Z (LabCoat™)
4. High Temperature Silver
5. Industrial Epoxy
6. High Temperature

Resistance to Corrosive:

E = Excellent
G = Good
F = Fair
P = Poor
NR = Not Recommended
ND = No Data Available

Alkalis (Bases)	1	2	3	4	5	6
Ammonium Hydroxide	G	E	E	G	E	NR
Calcium Hydroxide	G	E	E	E	E	NR
Calcium Oxide (Caustic Lime)	G	E	E	E	E	NR
Potassium Hydroxide (Caustic Potash, Coal Dust)	G	E	E	G	E	NR
Sodium Hydroxide (Caustic Soda)	G	E	E	G	E	NR

Oxidizing Agents	1	2	3	4	5	6
Bleaching Compounds	G	G	G	E	G	NR
Calcium Hypochlorite	G	G	G	E	E	NR
Chlorine	F	E	E	ND	E	NR
Hydrogen Peroxide	G	E	E	ND	E	ND
Hypochlorites	G	G	G	G	E	NR
Sulfur Dioxide	ND	ND	ND	E	E	NR

Available Coatings, continued

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Acids	1	2	3	4	5	6
Acetic	G	E	E	G	E	NR
Boric	G	E	E	G	E	F
Carbolic (Phenol)	G	G	G	NR	G	ND
Chloric	G	G	G	ND	G	NR
Chloracetic	G	G	G	G	E	NR
Chromic	G	G	G	NR	G	NR
Citric Acid	ND	ND	ND	ND	ND	NR
Ethyl Sulfuric	G	G	G	ND	G	NR
Formic	G	E	E	NR	E	NR
Hydrochloric (Huriatic)	G	E	E	G	E	NR
Hydrocyanic	ND	ND	ND	ND	ND	NR
Hydrofluoric	P	F	F	NR	ND	NR
Hypochlorous	G	G	G	E	E	NR
Lactic	G	E	E	E	E	NR
Napthenic	G	G	G	G	G	ND
Nitric	G	G	G	G	G	NR
Nitrous	ND	ND	ND	ND	G	NR
Oleic	ND	ND	ND	G	E	ND
Oxalic	G	E	E	G	E	NR
Perchloric	ND	ND	ND	ND	E	NR
Phosphoric	G	E	E	G	E	NR
Picric	ND	ND	ND	E	E	ND
Stearic	G	E	E	E	E	G
Sulfuric	G	G	G	NR	E	NR
Sulfurous	ND	ND	ND	E	E	NR
Tannic Acid	E	E	E	E	E	P
Tartaric	G	E	E	E	E	NR

Salts	1	2	3	4	5	6
Aluminum Chloride	G	E	E	E	E	ND
Aluminum Fluoride	G	E	E	ND	E	ND
Aluminum Sulfate	G	E	E	E	E	ND
Ammonium Chloride	G	E	E	G	E	NR
Ammonium Nitrate	G	E	E	E	E	ND
Ammonium Sulfide	G	E	E	E	E	ND
Calcium Chloride	G	E	E	E	E	NR
Calcium Cyanamide	G	E	E	E	E	ND
Calcium Sulfate	G	E	E	G	E	ND
Cupric Nitrate	G	E	E	E	E	ND
Cupric Sulfate	G	E	E	E	E	NR
Ferric Chloride	G	E	E	G	E	NR
Ferric Sulfate	G	E	E	E	E	ND
Ferrous Sulfate	G	E	E	E	E	ND
Lithium Chloride	G	ND	ND	E	E	ND
Magnesium Chloride	G	E	E	E	E	ND
Magnesium Sulfate	G	E	E	E	E	ND
Manganese Chloride	G	E	E	E	E	ND
Manganese Sulfate	G	E	E	E	E	ND
Potassium Carbonate (Potash)	G	E	E	G	E	NR
Potassium Chlorate	G	E	E	E	E	ND
Potassium Chloride	G	E	E	E	E	ND
Potassium Nitrate	G	E	E	E	E	ND
Potassium Sulfate	G	E	E	E	E	ND
Potassium Sulfide	G	E	E	E	E	ND
Salt Spray	G	E	E	E	E	F
Sodium Carbonate	G	E	E	ND	E	ND
Sodium Chloride	G	E	E	E	E	F
Sodium Nitrate	G	E	E	E	E	ND
Trisodium Phosphate	G	E	E	ND	E	ND
Zinc Chloride	G	E	E	ND	E	ND
Zinc Sulfate	G	E	E	ND	E	ND

Available Coating, continued

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E = Excellent
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Solvents	1	2	3	4	5	6
Acetaldehyde	ND	ND	ND	ND	ND	ND
Acetone	G	G	G	F	G	G
Alcohols	G	E	E	E	E	G
Aldehyde	F	G	G	NR	G	ND
Benzene and Methyl Alcohol Mix	G	G	G	G	E	G
Benzol	G	G	G	G	E	P
Butanol (Butyl Acetate)	G	E	E	NR	E	G
Carbon Disulfide	ND	ND	ND	NR	ND	ND
Carbon Tetrachloride	P	F	F	ND	E	ND
Ethanol (Ethyl Alcohol)	G	G	G	G	E	G
Ethyl Acetate	G	G	G	NR	E	G
Ethylene Glycol	G	E	E	ND	E	G
Formaldehyde	F	G	G	ND	E	ND
Gasoline	G	G	G	G	E	G
Glycerol (Glycerin)	G	G	G	ND	E	ND
Jet Fuel	F	G	G	ND	E	G
Kerosene	G	G	G	E	E	G
Ketones	G	G	G	NR	G	G
Methanol (Methyl Alcohol)	G	G	G	ND	E	G
Methyl Acetate	G	G	G	NR	E	G
Methyl Ethyl Ketone (MEK)	G	G	G	F	G	ND
Methyl Isobutyl Kentone	G	G	G	F	G	P
Naphthalene	G	G	G	ND	E	ND
Sulfuric Chloride	ND	ND	ND	ND	ND	NR
Toluol (Toluene)	G	E	E	G	E	G
Trichloroethylene	F	F	F	ND	E	G
Turpentine	G	E	E	NR	E	G
Water, Fresh	E	E	E	E	E	F
Xylol (Xylene)	G	E	E	G	E	G

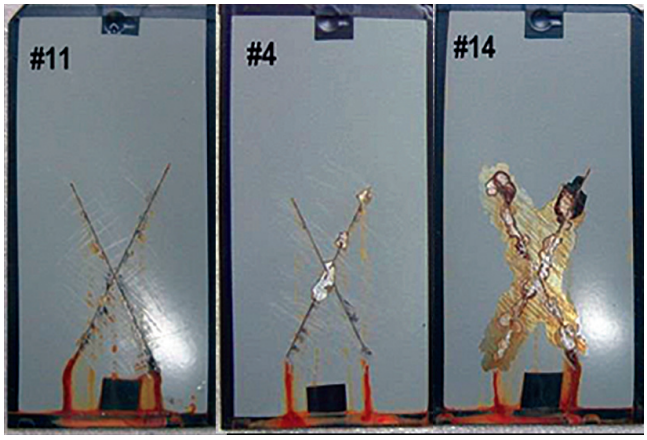
Miscellaneous	1	2	3	4	5	6
Abrasion	G	E	E	G	E	F
Ammonium Gas	E	E	E	G	G	ND
Animal Oils	E	E	E	G	E	ND
Carbon Dioxide	E	E	E	E	E	E
Carbon Monoxide	E	E	E	E	E	ND
Creosol	G	E	E	NR	E	ND
Detergents	G	E	E	ND	E	ND
Ether	G	G	G	NR	E	G
Fish Oil	E	E	E	ND	E	G
Hydrogen Sulfide	ND	G	G	G	G	ND
Methane	E	E	E	ND	E	G
Nitrogen Fertilizer	E	E	E	E	E	NR
Nitrogen Oxides	E	E	E	E	E	ND
Oils	E	E	E	E	E	ND
Outdoor (Except Marine)	G	E	E	G	F	F
Outdoor (Marine)	G	G	E	F	F	F
Ozone	ND	ND	ND	ND	E	ND
Phosgene (Carbonyl Chloride)	ND	ND	ND	ND	ND	ND
Phosphorous Trichloride	ND	ND	ND	ND	ND	NR
Propane	E	E	E	ND	E	G
Saturated Steam Vapor	ND	ND	ND	ND	E	NR
Sunlight	G	E	E	E	NR	G

An Explanation of B117 Salt Spray Performance

What is the B117 Salt Spray Performance Test?

The B117 Salt Spray Performance test is an ASTM standard describing parameters for proper setup of a salt spray chamber for accelerated corrosion testing. This standard is the most widely recognized corrosion standard dating back to 1939. The standard, however, does not address the quality of the outcome. The test only verifies how a product is tested and how long it was tested. Other ASTM standards such as D1654, D714 and D610 accurately measure the results for criteria such as quality or grade. Another part of the testing allows manufacturers to choose a single scribe, "X" scribe or no scribe the panel depending on how they prefer to rate their coating. This option changes the outcome of the results.

Many in the industry confuse the value of this test. The B117 Salt Spray Performance does not indicate the performance of the product tested or the extent of rusting/corrosion during that period; only the process used for testing.



The images marked #11, #4 and #14 show the results of three different B117 1000-hour salt spray test examples, but do not indicate the success or failure of the coatings tested.

What is the purpose of this test? Manufacturers need ways to test their processes and products in an accelerated timeframe. They cannot wait for ten years to determine if a better process or product is required.

What is the problem with B117 testing? The B117 Salt Spray Performance test is comparative not correlative. Predicting how well a coating performs in the field is difficult using this test by itself. For example, consider three factories. Each one has the same fan product **with the same coating finish. One is in Wisconsin and two are located in Florida, several blocks** from each other. Two factories (one in Wisconsin and one in Florida) exhaust factory air. The second factory in Florida uses its fan to exhaust acid fumes at elevated temperatures. The finish coating that is the same on each fan will perform differently at each location because of location, application and weather conditions.

Why does the industry use it? Change is difficult. Many consider the test as the gold standard. It has been this way for years. Industries such as automotive, farm implements and construction moved away from B117 to use tests more relevant to their products. Our industry is slow to make the change.

Why doesn't Greenheck create a better test? Greenheck does use other tests for corrosion and perform these as needed. However, these do not help when specifications call for B117 testing. Therefore, we provide that information and when possible, share other relevant test information.

Why do manufacturers still use the B117 standard? B117 is an easy test to apply. It is fast and inexpensive to perform. The test is a helpful, comparative test when testing different coating formulations. The test also is helpful for manufacturers to benchmark process performance. Greenheck routinely salt spray tests all paint processes to control our quality.

Summary. Performance standards are beneficial tools if all parties understand the standard and its use. The most important consideration is having a good understanding of the application and applying the proper coating. Greenheck understands and has coatings that perform well in most applications. We also can deliver other specialty coatings for unique applications. Powder paint performance is more than the paint. The application is equally important, and we make sure the application process performs at a high level all the time.

Tips to Prolong Coatings Integrity

The coating on our products provide the end user years of protection and beauty. Some additional preventative maintenance will extend the integrity of the coating.

- Wipe down flat surfaces that may collect chips or shavings resulting from installation.
- Check for areas of corrosion annually and repair with a Greenheck touch-up kit. Knicks and scratches from the installation, maintenance or wind abrasion may allow corrosion to start. Touching up these spots will stop further damage.
- Wipe down the fan's exterior with a mild detergent and rinse annually.
- If the product was subject to road salt during transport, immediately wash off all visible white residue from exterior surfaces.

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