

High-Performance Coatings for Industrial Applications

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High-Performance Coatings for Industrial Applications

Presented By: Benjamin Moore Paints
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Description: Provides an overview of high-performance coatings for industrial applications, including a discussion of various types of industrial coating products, surface preparation techniques, primer selection, and specification issues.

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Learning Objectives

Upon completing this course, you will be able to:

- state the purposes and the common industrial applications of high-performance coatings
- list and define the types of high-performance coatings
- explain how the use of industrial coatings helps protect against damage, enhance appearance, and improve the durability of the substrate
- summarize the proper surface preparation techniques for high-performance coatings, and
- discuss the selection criteria and the importance of proper specification of high-performance coatings for industrial applications.

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Industrial Coatings

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Industrial Coatings

Introduction

- Industrial coatings are primarily used to protect substrates from corrosion, improve appearance, and ensure durability and safety.
- Industrial coatings are designed for environments that require improved chemical and/or abrasion resistance.
- Industrial coatings are commonly used to paint bridges, structural steel, storage tanks, floors, walls, stairs, railings, walkways, and equipment.

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Industrial Coatings

What is an Industrial Project?

- Industrial projects typically involve exposure to extreme conditions, such as factories, processing plants, and exterior steel structures.
- Some architectural projects may require industrial coatings due to chemical exposure or abrasion.
- Operating rooms, surgery suites, research laboratories, or busy restaurant or cafeteria kitchens are examples of architectural projects that use industrial coatings.

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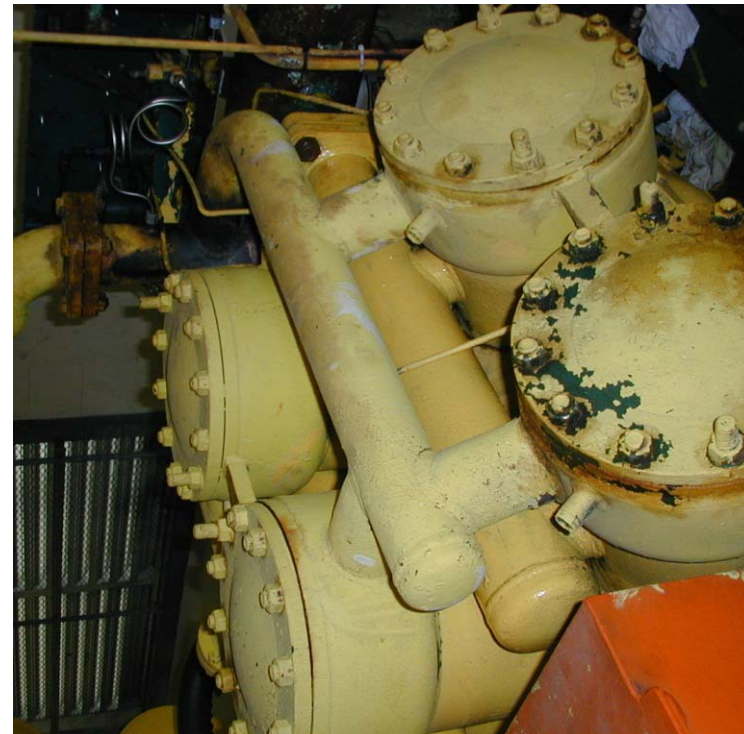
Industrial Coatings

Why Use an Industrial Coating?

There are three primary reasons that industrial coatings may be used:

- Protection: To protect substrates from corrosion and damage.
- Appearance: To enhance the appearance of a substrate.
- Safety: To ensure the durability and safety of a substrate.

Protection and appearance are also reasons for using architectural coatings.

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Industrial Coatings

Protection

- Industrial coatings help protect substrates from corrosion, chemical attack, and physical abuse caused by exposure to severe service environments.
- Industrial coatings are also used as containment liners to protect the environment from contamination.
- Several industrial coatings have been used to protect this offshore oil rig from the damaging effects of water, salt spray, impact, and chemicals.



Offshore Oil Rig

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Industrial Coatings

What is Corrosion?

- Corrosion is an electrochemical process that involves the destruction of a material (e.g. metal) due to interaction with its environment.
- Corrosion is a natural process by which a metal substrate wants to return to a more stable form.
- For example, when steel rusts, it is changing into iron oxide, which is more similar to the steel's original stable state of iron ore.

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Industrial Coatings

Corrosion Cells

There are four general components that must be present for corrosion to occur:

- Anode: The anode consists of the more active metal or section of metal.
- Cathode: The cathode is the more stable (noble) metal or section of metal.
- Metallic Pathway: A direct contact or wire connection between metal surfaces.
- Electrolyte: A nonmetallic conductor that carries current via ion movement.

If all components are present, ions flow from the more active to the less active metal.

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Corrosion Rate

The rate of corrosion of a substrate will be influenced by several factors, including:

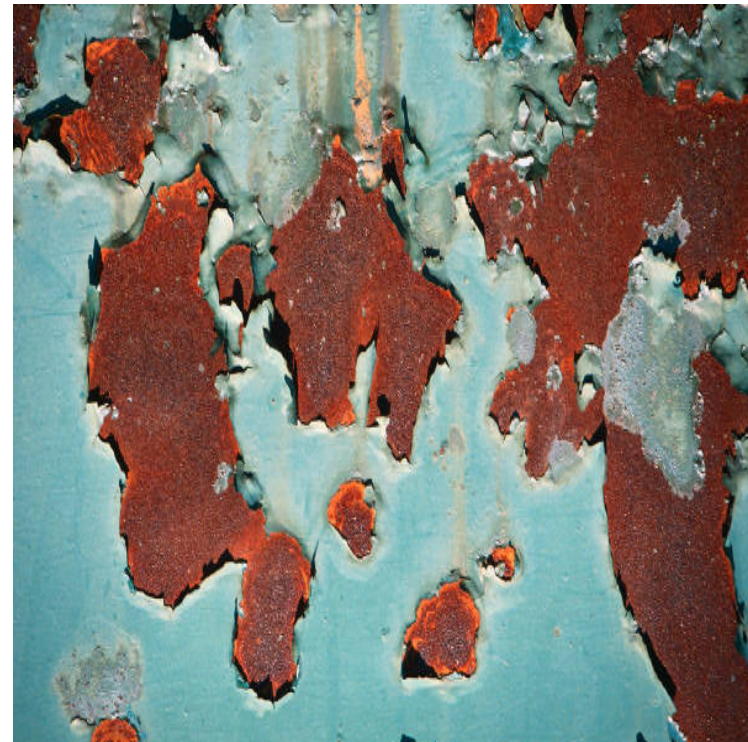
- Chemicals: Exposure of the metal substrate to chemicals such as acids, alkalis, and salts will affect the rate of corrosion.
- Temperature: Ambient temperatures will also influence the rate of corrosion. Higher temperatures usually result in a faster corrosion rate.
- Moisture: Liquid water (rain, washing, etc.), water vapor (humidity, steam, etc.), and condensation all act as the electrolyte in the corrosion cell.
- Substrate Design: Poor substrate design (e.g. dissimilar metals, designs that trap water, surfaces that are difficult to prepare and coat) often lead to corrosion.

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Industrial Coatings

Corrosion and Coatings

- Coatings are used to slow and/or reduce corrosion by insulating the surface from the electrolyte and interrupting the corrosion cell.
- Coatings also reduce corrosion by protecting the metal surface from exposure to chemicals.
- Coatings can also be used to provide a corrosion-resistant layer over the surface by adding zinc or other rust-inhibiting substance to the paint.

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Industrial Coatings

Appearance

- Industrial coatings are also used to make surfaces attractive and, in some cases, to minimize the visual impact of a structure on the environment.
- Here, an industrial coating was used to make this garage floor durable and tough, as well as attractive to visitors.
- In terms of visual impact, industrial coatings can be used to make the surfaces of water towers and utility junctions blend with the environment.



NASCAR Garage Floor, Charlotte, NC

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Industrial Coatings

Safety

- Industrial coatings are also used to enhance safety by reducing the effects of corrosion on steel structures and providing anti-slip floor surfaces.
- If left uncoated, this steel walkway may be weakened by corrosion, exposing owners and workers to risk.



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Industrial Coatings

When Are Industrial Coatings Used?

- Industrial coatings are typically used to provide chemical resistance and abrasion resistance, and enhance the durability of a surface.
- Any surface exposed to chemicals, such as harsh cleaners, oils, or salts, requires an industrial coating.
- Industrial coatings are also required for surfaces exposed to abrasion via excess foot traffic, harsh cleaning, or increased vehicle traffic.

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Industrial Coatings

Industrial Applications

High-performance industrial coatings can be used for a variety of applications:

- Bridges
- Storage Tanks
- Concrete Floors
- Railings
- Grates
- Piping
- Equipment
- Walkways
- Machinery
- Operating Rooms
- Garage Floors
- Common Areas
- Bathrooms
- Storage Areas
- Stairways
- Structural Steel
- High Abuse Walls
- Fencing

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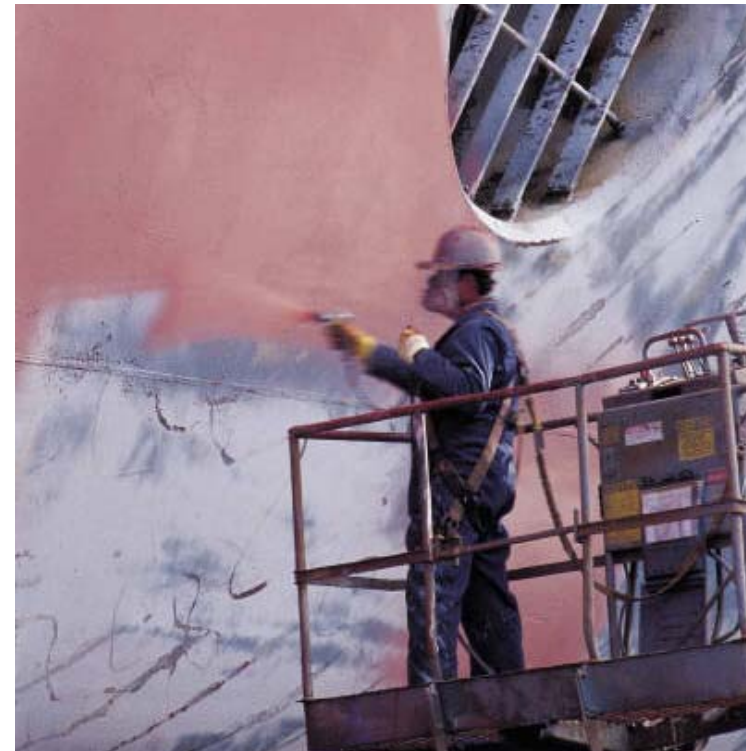
Industrial Coatings

The Painting Process

The process of preparing and painting industrial surfaces involves several steps:

- Pre-Cleaning
- Cleaning
- Priming
- Intermediate/ Finish Coats

The process is similar for any application, only the techniques and equipment vary.



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Industrial Coatings

The Painting Process, Cont'd...

- Pre-Cleaning: Surfaces are cleaned as per standard SSPC-SP1 for solvent cleaning in order to remove all grease, oils, soil, and other visible contaminants.
- Cleaning: Depending on the substrate and job requirements, grinding, sand blasting, or water jetting may be used to create a surface texture or profile for the coating to adhere to. Once the substrate has been abraded, any loose dust or debris should be removed using either a blower or a vacuum system.
- Priming: Surfaces are coated with the specified primer. Depending on the type of substrate, primers may be latex, alkyd, modified alkyd, or epoxy coatings.
- Intermediate/Finish Coats: Once the surface is primed, a first coat and second coat are applied. Care must be taken to ensure that primers and intermediate/ finish coatings are compatible.

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Types of Industrial Coatings

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Types of Industrial Coatings

Introduction

There are a variety of coatings that are applicable for industrial applications:

- Latex / Acrylic Coatings
- Alkyd / Oil Coatings
- Epoxy Coatings
- Urethane Coatings
- Specialty Coatings

Each type may be considered "industrial" depending on its formulation and use.

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Types of Industrial Coatings

Latex / Acrylic Coatings

- Although not typically considered an "industrial coating", latex paints may be used on industrial projects in areas where their benefits and limitations meet project requirements. Part of the reason these coatings are so commonly used is that they are water-based, fast-drying, and typically low-odor.
- Latex or acrylic coatings offer good color retention, good gloss retention, and are easy to apply, although they may freeze in extreme weather conditions and offer relatively poor chemical resistance and abrasion resistance.
- As a result of these performance limitations, the use of latex or acrylic coatings in real industrial environments is relatively limited. They are typically utilized on handrails, walkways, equipment, and light-duty flooring. There are also specific latex formulations that can be used for slip resistance and safety markings.

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Types of Industrial Coatings

Latex / Acrylic Coatings, Cont'd...

Characteristics

Water-Based
Fast-Drying and Low-Odor
Good Color Retention
Good Gloss Retention
Easy Application
May Freeze
Poor Chemical Resistance
Poor Abrasion Resistance

Applications

Interior
Exterior
Walls
Trim
Handrails
Walkways
Equipment
Light Duty Floors

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Types of Industrial Coatings

Alkyd / Oil Coatings

- Alkyd or oil coatings are solvent-based and, as a result, are typically slower drying and release more odor than latex coatings. These types of coatings are commonly used on projects where a latex or acrylic paint may not provide the required protection, while an epoxy or urethane would be overkill.
- Alkyd or oil coatings offer limited chemical resistance and should not be used on applications where they will be immersed in water. For exterior applications, chalking of alkyd or oil coatings may be an issue.
- Alkyd or oil coatings can be used for handrails, walkways, equipment, light-duty floors, bathroom partitions, and structural steel. These types of coatings can also be modified to withstand a more demanding industrial service environment using special additives, such as epoxy resins, silicones, and urethanes.

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Types of Industrial Coatings

Alkyd / Oil Coatings, Cont'd...

Characteristics

- Solvent-Based
- Slow-Drying
- Some Odor
- Harder Than Latex
- Limited Chemical Resistance
- Not For Immersion
- Exterior Chalking
- Special Additives

Applications

- Interior / Exterior
- Walls and Trim
- Handrails
- Walkways
- Equipment
- Light Duty Floors
- Bathroom Partitions
- Structural Steel

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Types of Industrial Coatings

Epoxy Coatings

- Epoxy coatings are generally misunderstood by those who do not regularly work with these types of coatings. It is often believed that epoxy coatings are the best type of coating, however they are not always the best product to use. As with all coatings, it is important to understand the benefits and limitations of epoxies.
- Generally speaking, epoxy coatings offer great adhesion and resistance to a wide variety of chemicals. However, most epoxies tend to yellow and chalk when exposed to UV light and this limitation restricts their use on exterior surfaces.
- In terms of industrial applications, epoxy coatings can be used on floors, high-abuse walls, equipment, structural steel, and internal and external storage tanks. Epoxy coatings offer excellent abrasion resistance and, unlike alkyd coatings, epoxy coatings can be used on surfaces that will be immersed in water.

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Types of Industrial Coatings

Epoxy Coatings, Cont'd...

Characteristics

Two-Component Product
Limited Pot Life
Excellent Chemical Resistance
Excellent Abrasion Resistance
Immersion Service
Odor (Solvent Based)
Yellowing with UV Light
Chalking with UV Light

Applications

Floors
Equipment
High-Abuse Walls
Structural Steel
Internal Storage Tanks
External Storage Tanks

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Types of Industrial Coatings

Urethane Coatings

- Urethane coatings are similar to automotive-grade paints and are typically used where chemical resistance, color retention, and gloss retention are required. In addition to excellent chemical resistance, urethane coatings also offer excellent abrasion resistance.
- Urethanes are often used over epoxy primers and intermediate coats. One of the limitations of urethane coatings is that they are not suitable for industrial applications where they will be immersed in water.
- Like epoxy coatings, urethane coatings are suitable for use on industrial floors, equipment, high-abuse surfaces, structural steel, and internal and external storage tanks. Because of their excellent color retention and gloss retention properties, they are often used as finish coats on exterior projects.

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Types of Industrial Coatings

Urethane Coatings, Cont'd...

Characteristics

Two-Component Product
Limited Pot Life
Excellent Chemical Resistance
Excellent Abrasion Resistance
Excellent Color Retention
Excellent Gloss Retention
Odor

Applications

Floors
Equipment
High Abuse Surfaces
Structural Steel
Internal Storage Tanks
External Storage Tanks
Vehicles

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Types of Industrial Coatings

Specialty Coatings

Manufacturers also offer a variety of specialty coatings for industrial applications:

- Inorganic Zinc Coatings: Inorganic zinc coatings consist of zinc metal powder mixed with inorganic silicate paint binders to provide a "galvanizing" coating.
- Heat Resistant Coatings: Heat resistant coatings are typically used on industrial surfaces exposed to extreme temperatures, ranging from 350°F to 1,000 °F.
- Gunnite: Gunnite coatings essentially consist of a specific type of concrete that is sprayed on surfaces, such as pools, tanks, and domes.
- Polyurea Coatings: Polyurea coatings are extremely fast drying and are often used as a primary or secondary containment liner.

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Surface Preparation and Priming

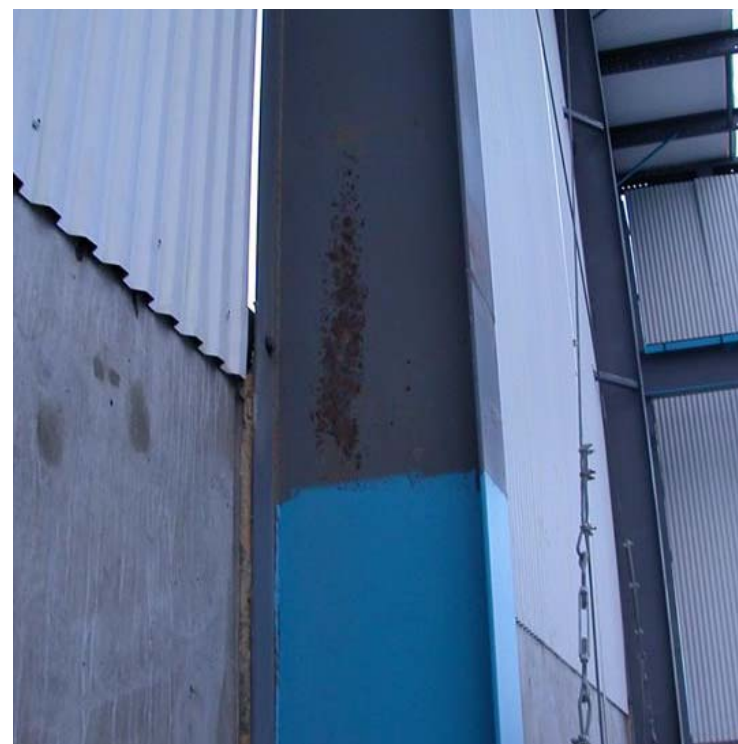
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Surface Preparation and Priming

Introduction

- Proper surface preparation is the key to a successful coating job: 90% of premature coating failures can be traced to improper or incomplete surface preparation.
- The appropriate surface preparation technique will depend on the type of coating and the service environment.
- The choice of primer (e.g. latex, alkyd, epoxy) will also depend on the service environment, the type of substrate, and the type of finish coat required.

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Surface Preparation and Priming

Standards

There are two organizations generally recognized as the primary sources for detailed surface preparation standards:

- SSPC: The Society for Protective Coatings www.sspc.org
- NACE: The National Association of Corrosion Engineers www.nace.org

The standards that are prepared by these organizations are usually included in industrial painting project specifications.



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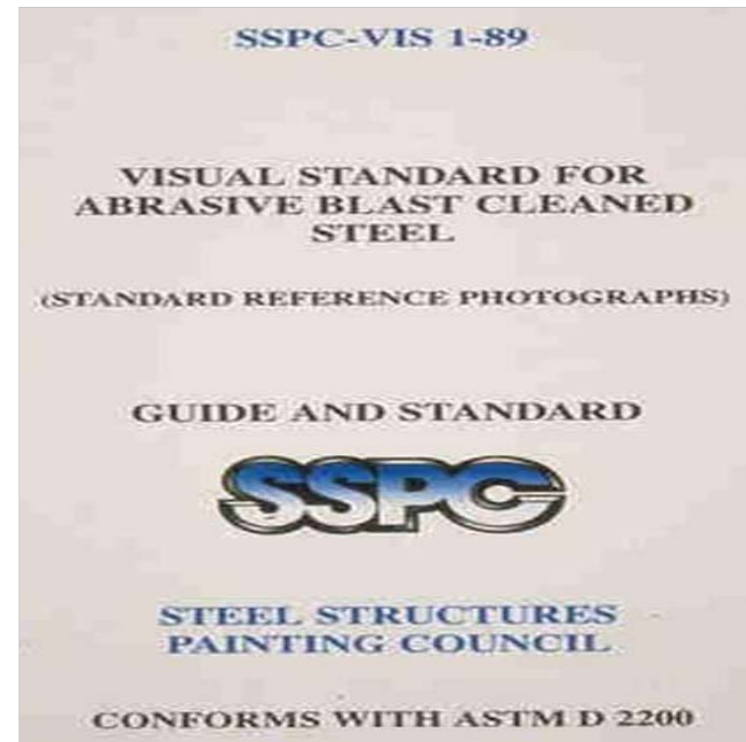
Surface Preparation and Priming

Surface Preparation

There are several surface preparation techniques for industrial applications:

- Solvent Cleaning
- Hand Tool Cleaning
- Power Tool Cleaning
- Abrasive Blast Cleaning
- Water Jetting

Preparation techniques are not limited to pressure washing and sandpaper!

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Surface Preparation and Priming

Solvent Cleaning (SSPC-SP1)

- Solvent cleaning is used to remove grease, oil, soil, and other visible contaminants prior to further surface preparation or painting.
- Solvent cleaning is typically the first step in the cleaning process, followed by hand tool cleaning, power tool cleaning, or abrasive blast cleaning.
- Solvent cleaning should always be conducted in accordance with the Society for Protective Coatings SSPC-SP1 "Solvent Cleaning" standard.

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Surface Preparation and Priming

Hand Tool Cleaning (SSPC-SP2)

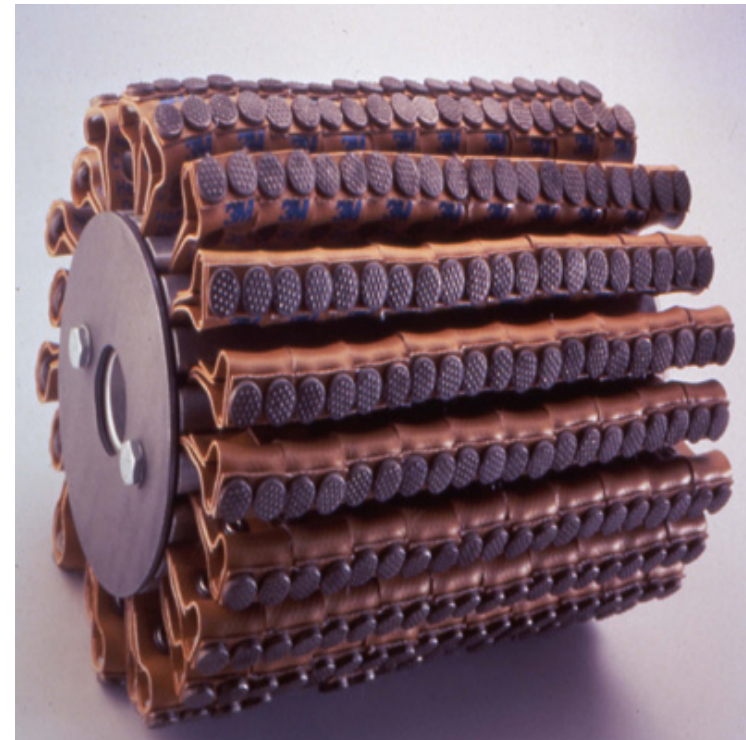
- Hand tool cleaning is used to remove loose mill scale, rust, paint, and any other loosely adhering contaminants from steel substrates.
- Hand tool cleaning involves the use of tools such as scrapers, peening hammers, and wire brushes.
- Hand tool cleaning is covered by standard SSPC-SP2 and is a common and economical surface preparation method for small industrial projects.

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Surface Preparation and Priming

Power Tool Cleaning

- Power tool cleaning involves the use of heavy-duty impact and abrasion tools, such as rotary scalers and diamond blade grinders.
- Rotary scalers, similar to the one shown at right, can be used to clean and profile metal surfaces.
- These types of scalers can be used to prepare concrete substrates, however care should be taken not to pit or dig holes into the concrete surface.

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Surface Preparation and Priming

Power Tool Cleaning, Cont'd...

- Grinders, such as the one pictured here, can also be used to prepare substrates for coating. The type of surface will determine the blade.
- Diamond blades are typically used to prepare concrete, whereas other blades are available for steel.
- Standards SSPC-SP3, SSPC-SP11, and SSPC-SP15 are the recognized standards for power tool cleaning on metal surfaces.

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Surface Preparation and Priming

Abrasive Blast Cleaning

- Abrasive blast cleaning is primarily used on steel surfaces, but may also be an effective technique for masonry, and even wood surfaces.
- The type of abrasive used (e.g. slag, steel shot, grit, sand) is determined by the surface being cleaned and the coating being used.
- Abrasive type and size determine the surface profile or texture, while the time spent on a given area determines its level of cleanliness.

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Surface Preparation and Priming

Abrasive Blast Cleaning, Cont'd...

- Abrasive blast cleaning can be used to remove rust, old coatings, and mill scale, however it is not effective for grease or oil contamination.
- The steel beam shown here has been prepared for painting using abrasive blast cleaning methods.
- Cleaning substrates using abrasive blasting can be a dangerous process and should only be carried out by experienced contractors.

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Surface Preparation and Priming

Abrasive Blast Cleaning, Cont'd...

The following abrasive blast standards detail the level of cleanliness required.

Cleanliness Standard	Standard Number
Brush-Off Blast Cleaning	SSPC-SP7 / NACE 4
Industrial Blast Cleaning	SSPC-SP14 / NACE 8
Commercial Blast Cleaning	SSPC-SP6 / NACE 3
Near-White Blast Cleaning	SSPC-SP10 / NACE 2
White Metal Blast Cleaning	SSPC-SP5 / NACE 1

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Surface Preparation and Priming

Water Jetting

- Water jetting involves using water at operating pressures between 15,000 PSI and 40,000 PSI to remove rust, old coatings, and chlorides or salts.
- Water jetting is popular because it can be used to clean steel without removing metal or creating sparks.
- Water jetting is used primarily in the marine and oil industries. It can be dangerous and should only be completed by trained professionals.

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Surface Preparation and Priming

Selecting a Technique

- Decisions regarding the appropriate surface preparation technique will be determined by the type of coating and the service environment.
- Certain types of industrial coatings require cleaner surfaces in order to ensure adherence and protection.
- Some techniques may not be suitable for certain environments. Abrasive blasting, for example, is probably not suitable for a food processing plant.

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Surface Preparation and Priming

Primer Selection

There are several types of primers available for industrial applications:

- Latex Primers
- Alkyd Primers
- Modified Alkyd Primers
- Epoxy Primers

Selection will be determined by service environment, substrate, and finish coat.

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Surface Preparation and Priming

Primer Selection, Cont'd...

- Latex Primers: Water-based acrylic/latex primers offer a fast-drying and easy-to-apply coating that may be applied to many substrates. Latex primers can be applied to metal, including galvanized metal, or poured or cast concrete surfaces. Latex primers are not suitable for immersion service and should not be used to prime surfaces that will be exposed to strong chemicals, acids, or alkalis.
- Alkyd Primers: Alkyd primers offer good rust inhibition and good adhesion and are suitable for use under many generic types of finish coats. Alkyd primers can be used for structural steel, equipment, stairs, railings, catwalks, conveyers, and general maintenance painting. They perform well for interior or exterior shop or field painting, however they are not suitable for immersion service and will not protect against exposure to acids and alkalis.

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Surface Preparation and Priming

Primer Selection, Cont'd...

- Modified Alkyd Primers: Alkyd primers can be modified to produce quick-dry, rust-inhibitive primers that allow for same day finish coat application. Modified alkyd primers provide good corrosion control with good adhesion properties. They can be used for structural steel, railings, catwalks, equipment, and general maintenance. They are not suitable for immersion service and should not be top coated with coatings containing strong solvents.
- Epoxy Primers: Epoxy primers are typically two-component systems formulated to protect substrates exposed to corrosive environments. They can be used to protect ferrous and nonferrous metals on interior and exterior surfaces, such as tanks, equipment, structural steel, roof decks, catwalks, and piping. Zinc-rich epoxy primers are designed to provide galvanic protection for steel surfaces. Low-odor, low-VOC waterborne epoxy primers are also available for use in applications where odor is an issue.

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Specifying Industrial Coatings

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Specifying Industrial Coatings

Specific vs. Generic Specifications

- Due to the nature of the surfaces, environments, surface preparations, and the costs involved in coating industrial projects, great care must be taken when specifying coating systems to these projects. The specification should be written to meet the requirements of the individual project.
- By working with experienced inspectors and coating manufacturers you can prepare specifications that will meet the needs of the project and provide a system that will offer optimum protection given the requirements of the job.
- Generic specifications often result in problems on the job. Whenever possible, have an experienced coatings inspector visit the site, examine the surfaces to be coated, and work with the coating manufacturer to make a solid, job-specific coating system recommendation.

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Specifying Industrial Coatings

Points to Consider

There are several important points to consider when writing a paint specification:

- Service Environment: What is the real service environment? It is important to consider the temperature, humidity, and ultraviolet light conditions at the site.
- Exposure: What will the coating be exposed to? Will the coating be exposed to harsh or corrosive chemicals? Will the coating be exposed to impact or abrasion?
- Job Type: Does the project involve a new coating or a repaint? What type of primers are required? Is the compatibility of new and existing coatings an issue?



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Specifying Industrial Coatings

Points to Consider, Cont'd...

There are several important points to consider when writing a paint specification:

- Substrate Type: What type of substrate will be coated? It is important to consider whether the substrate is wood, steel, masonry, or plastic. Different types of substrates may require different types of coatings.
- Applicator Experience: Although this is something that is not generally controllable by specifiers, it is an important factor to consider. Some types of industrial coatings require a great deal of experience to apply correctly.
- Surface Preparation: Some methods of surface preparation may not be allowed for your particular application. Dust from blasting, fumes from acid, or water from power washing may cause issues at certain job sites.

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Course Summary

Industrial Coatings

- Industrial projects typically involve exposure to extreme conditions, similar to those found in factories, processing plants, and offshore oil operations. Some architectural projects may require industrial coatings due to chemical exposure or high impact. For instance, surgery suites, laboratories, or restaurant kitchens.
- Industrial coatings are primarily used to protect substrates from damage, improve appearance, and ensure durability and safety. Industrial coatings can be used to provide increased chemical resistance and abrasion resistance.
- Industrial coatings are commonly used to paint bridges, structural steel, storage tanks, concrete floors, high-abuse walls, stairs, railings, walkways, equipment, piping, machinery, and fencing. Any surface exposed to chemicals, such as harsh cleaners, oils, or salts, requires an industrial coating.

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Course Summary

Types of Industrial Coatings

- Industrial coatings are available in latex, alkyd, epoxy, urethane, and specialty formulations. The relatively poor chemical and abrasion resistance of latex coatings limits their use on industrial applications. Alkyds are more resistant and can be used for handrails, walkways, equipment, and light-duty floors.
- Epoxy coatings offer good chemical and abrasion resistance and, unlike alkyds, can be used for immersion service. Urethane coatings are typically used where chemical resistance, color retention, and gloss retention are required.
- Manufacturers also offer specialty coatings for industrial applications, such as inorganic zinc coatings, heat-resistant coatings, gunnite coatings, and polyurea coatings. Inorganic zinc coatings provide a "galvanizing" effect, while polyurea coatings are typically used as primary or secondary containment liners.

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Course Summary

Surface Preparation and Priming

- There are a variety of surface preparation techniques that may be employed depending on the specified coating and the service environment. Preparation typically begins with solvent cleaning, followed by hand tool cleaning, power tool cleaning, abrasive blast cleaning, or water jetting as required.
- Once a surface has been prepared, it must be primed. Primers are available in several formulations, including latex, alkyd, modified alkyd, and epoxy. Primer selection will be affected by the service environment, substrate, and finish coat.
- Proper surface preparation is the key to a successful coating: 90% of premature failures can be traced to improper or incomplete surface preparation. Improper surface preparation can lead to a variety of problems, including poor galvanized metal adhesion, blistering and imperfections, and peeling from concrete floors.

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Course Summary

Specifying Industrial Coatings

- Due to the nature of the surfaces, environments, surface preparation, and the costs involved, great care must be taken when specifying industrial coatings. The specification should be written to meet the requirements of the individual project: generic specifications often result in problems on the job.
- Whenever possible, have an experienced coatings inspector visit the job site, examine the surfaces to be coated, and work with the coating manufacturer to make a solid, job-specific coating system recommendation.
- There are several points to consider when writing an industrial coating specification, including the type of service environment, what the coating will be exposed to, whether the job involves a new coating or a repaint, the type of substrate, the applicator's experience, and allowable surface preparation.

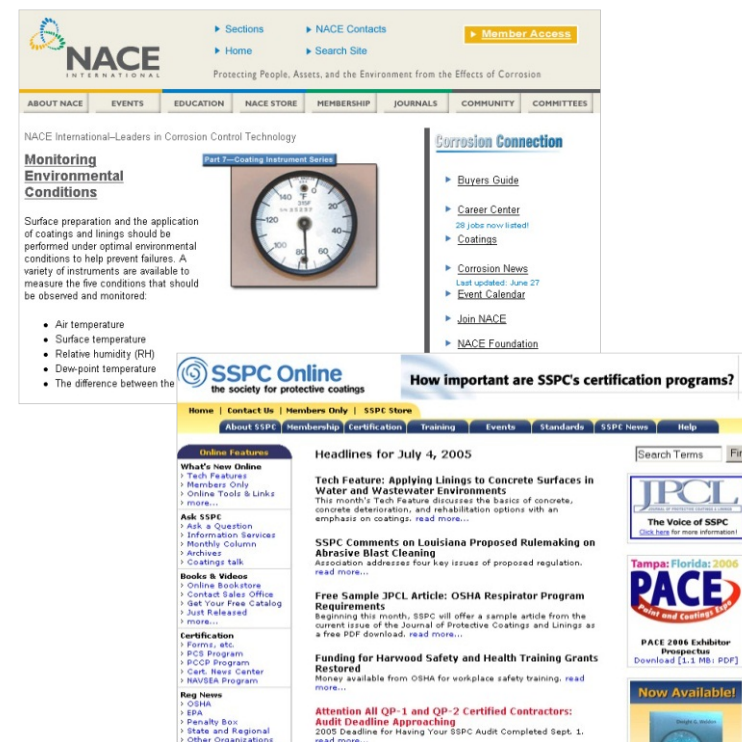
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Additional Information

For additional information on industrial coatings, please refer to the following:

- Master Painters Institute
www.paintinfo.com
- NACE International
www.nace.org
- National Paint & Coatings Association
www.paint.org
- Society for Protective Coatings
www.sspc.org



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