

Considerations about

PAINT

For Metal Surfaces

Due to the vulnerability of unprotected metal surfaces to the corrosive effects of moisture and the atmosphere, architects must take different considerations into account when specifying paints for these substrates, compared to substrates such as wood and masonry. This module focuses on those considerations, ranging from the choice of primers and paints to the importance of the topcoat.

The coating of metal surfaces in industrial and commercial facilities is commonly referred to as maintenance painting. Maintenance painting itself is usually divided into two categories: industrial and light.

Industrial maintenance painting is the "heavy duty" side of the process. Metal structures such as storage tanks and bridges are coated to protect the surfaces from highly hostile atmospheres that can corrode the surface and degrade conventional architectural paints not designed specifically for this type of application.

Light maintenance painting usually involves painting metal surfaces with corrosion-resistant coatings in much milder environments. Architects are generally more

involved with this type of application than they are with industrial.

The main components of a maintenance coating are the same as those in a conventional architectural coating: namely, pigment, binder, liquid and additives. (See Module #1: "The Ingredients of Paint and Their Impact on Paint Properties," *Architecture*, October, 1999.)

However, their formulations differ because of differing objectives. Architectural coatings are formulated more with decorative purposes in mind, while maintenance coatings are formulated for functional purposes, including corrosion inhibition and adhesion to metal.

PAINTING METAL SURFACES TRAINING COURSE LEARNING OBJECTIVES

At the end of this course, you will:

- Understand why it is so important to know what metal substrate is being coated, and the conditions under which that coating must perform.
- Know what to look for in corrosion-inhibiting water-based primers.
- Know the differences between solvent-based and water-based metal coatings.
- Know when to specify direct-to-metal water-based coatings.
- Understand the importance of film formation in inhibiting corrosion.

To take the Painting Metal Surfaces training test, log on to www.architecturemag.com. Upon successful completion of the test, you will earn 3 AIA learning credits.



OXIDATION: ENEMY OF METAL

Maintenance coatings are designed primarily to protect metal surfaces from oxidation. Oxidation refers to the loss of electrons by a substance during a chemical reaction that results in the formation of a new compound. The rusting of ferrous metals is a common example. In this electro-chemical process, iron combines with oxygen to form iron oxide, which in turn combines with water to form rust. Rusting not only corrodes the surface, but also weakens the metal.

Fortunately, if there is an interruption in any of the steps, the entire process stops. A way to accomplish this is to cover the metal surface with a protective coating that will block moisture from reaching the metal substrate.

A number of different coating technologies can be used to attain this objective, including waterborne acrylic coatings, alkyds, epoxies, polyurethanes and polyesters. This module will focus on waterborne acrylic systems.



KNOW YOUR APPLICATION

BEFORE SPECIFYING A COATING FOR ANY METAL SURFACE, MAKE A THOROUGH ASSESSMENT OF THE APPLICATION. WHEN SELECTING A COATING FOR A PROJECT, THREE OF THE MOST IMPORTANT CONSIDERATIONS ARE:

THE SUBSTRATE	THE ENVIRONMENT	SURFACE PREPARATION
<ul style="list-style-type: none"> • What is the surface that needs to be coated? • A wide variety of metals can be painted. Most common: <ul style="list-style-type: none"> • Ferrous metals • Galvanized metals • Aluminum • Make sure the coating you specify will inhibit corrosion and adhere to the substrate. 	<ul style="list-style-type: none"> • Under what conditions will the coating have to perform? • Interior or exterior? • Aggressive environment (e.g., salt spray near coast) or non-aggressive? • It makes a difference when specifying coating, film thickness, etc. 	<ul style="list-style-type: none"> • Proper surface preparation is vital to the success of any paint job. • It's especially important when specifying coatings for metal because of substrate vulnerability. • Guidelines on preparing metal for painting are available from the Steel Structures Painting Council (SSPC).

CORROSION-INHIBITIVE METAL PRIMERS



DIRECT-TO-METAL WATER-BASED COATINGS

Direct-To-Metal (DTM) coatings are all-purpose light maintenance coatings that are designed for direct application to metals without the use of a primer. They function as both primer and topcoat in just one coating.

DTM coatings can be used for a variety of interior and exterior applications, are available in semigloss or gloss formulations, and are now offered in high performance latex products. To insure proper protection of the substrate, two coats are usually recommended.

When specifying a DTM coating, look for one that is acrylic-based. DTM acrylic coatings are VOC-compliant and offer good flexibility and durable long-term protection. They also feature the same fast-drying properties as other waterborne coatings do.

Compared to a primer-topcoat system, DTMs usually offer cost savings, both in terms of materials (only one coating needs to be purchased rather than two) and labor (only two coats need to be applied rather than three...one primer and two topcoat).

In terms of performance, however, a primer-topcoat system generally provides a better appearance and better protection of the metal substrate than a DTM, especially in more aggressive environments. DTMs work well as a primer and as a topcoat, but not as well as an individual primer and topcoat.

Thus, when choosing between a direct-to-metal coating and a primer-topcoat system, the decision often narrows down to one of cost savings versus performance.

Primers used in general-purpose maintenance finish systems for metal surfaces perform two vital functions: they provide the bond between the topcoat(s) and the underlying substrate, and they protect the metal from corrosion. The key to fulfilling these roles is a binder that both provides good adhesion and forms a tight continuous film, thereby preventing moisture from reaching the substrate.

For decades, the coatings industry relied almost entirely on solventborne resins, primarily alkyds, to satisfy metal primer binder needs. In the last two decades, however, the growing concern over the high levels of emissions produced by these solvent-based chemistries has generated a steadily increasing demand for alternatives that pose fewer problems in this regard.

In response, paint chemists have now developed advanced, hydrophobically modified acrylic binders that make it possible for the formulation of high-quality waterborne primers that can match or exceed solventborne primers in performance with considerably lower levels of volatile organic compounds (VOCs).

In addition to these specially designed binders, water-based primers for use on metal contain a number of other ingredients intended specifically to inhibit corrosion.

INGREDIENTS THAT INHIBIT CORROSION

REACTIVE PIGMENTS

- Usually in the form of borates, phosphates, molybdates or chromates.
- Interrupt the oxidation process.
- Do so by pacifying active metal surface or by acting as a sacrificial agent.

FLASH RUST ADDITIVE

- Flash rusting: temporary problem that occurs on bare ferrous metal when water-based coating dries slowly.
- This additive protects metal while water evaporates.



LIGHT MAINTENANCE TOPCOATS

PRIMERS AND TOPCOATS EMPHASIZE DIFFERENT ATTRIBUTES.

While adhesion and corrosion protection are principal requirements for primers, features such as exterior durability, lack of dirt pickup, chemical resistance, and gloss carry a higher priority in topcoats.

As with water-based primers, the use of water-based acrylic topcoats on metal has also grown tremendously. Three of the main reasons are:

1 The compelling advantages of waterborne acrylic maintenance coatings from the standpoints of health, safety and protection of the environment. High quality water-based coatings have considerably lower levels of VOCs than solvent-based products. Plus, there is no need to deal with toxic and flammable solvents.

2 The ever-improving performance of water-based acrylic maintenance coatings. For example, high quality acrylic systems can last as much as two to four times longer than commonly used alkyd systems. Water-based maintenance coatings are also very stable. Unlike alkyds, latex coatings do not cross-link over time, which means they do not tend to yellow, crack or become brittle. Cracks in a metal coating are a nemesis, because they allow water to penetrate the film. This difference translates into longer repaint cycles and reduced maintenance costs.

3 The coating's favorable application characteristics, including quick drying time. Painters can often apply a second coat within hours after application of a first coat. In comparison, solvent systems commonly used for metal may require a full day's cure before another coat can be applied.

When it comes to application, maintenance paints should always be applied to metal surfaces in thick coats for optimum durability and corrosion resistance. That's because the thicker the coat, the less chance of moisture penetrating the paint through pinholes in the film.

Similarly, two coats of a topcoat are generally recommended rather than a single coat for two reasons: increased overall thickness of the coating, and elimination of the possibility of pinholes extending through the coating.

Brushes may be used for smaller applications, while rollers or airless sprayers are better for covering large areas.



FILM FORMATION: A KEY TO CORROSION RESISTANCE

Maximum protection against corrosion requires a uniform, highly continuous hydrophobic film. There must be no microscopic channels that allow access for moisture and oxygen to the metal substrate.

One of the components necessary to produce such a film in a waterborne coating is an appropriate rheology modifier or thickening agent.

In the past, the only thickeners generally available to coating manufacturers were "non-associative" cellulosic products. These

products had drawbacks for waterborne finishes. Among these was the fact that they could produce non-uniform, flocculated films. Cellulosics created random "domains" scattered throughout the body of the coating film through which moisture could attack a metal substrate. (See Figure 1.)

Today, however, there is a new generation of urethane-containing rheology modifiers that interact or "associate" with other paint components. These form

a series of interlocking structures and generate a uniform, highly continuous film that is far more resistant to the passage of moisture than a cellulosic-thickened coating. (See Figure 2.) The continuity of the film also ensures more consistent gloss and hiding power.



Figure 1



Figure 2

CONCLUSION

Specifying paint for metal surfaces is not difficult as long as you know the substrate, the environment and the coating system. In the past, architects may have been reluctant to specify a latex system because they were not totally confident that a water-based coating could be applied to metal and provide good corrosion resistance.

As a result of advancements in binders and rheology modifiers, that concern should no longer exist. Today's waterborne maintenance coatings for metal provide corrosion resistance comparable to, or better than, that imparted by solventborne coatings. In addition, they also provide all the benefits of conventional acrylic latex coatings, including durability, rapid drying, low toxicity and ease of handling and cleanup.