

SELECTING THE RIGHT FINISH FOR METAL ROOFING

Part I: Metallic Coatings

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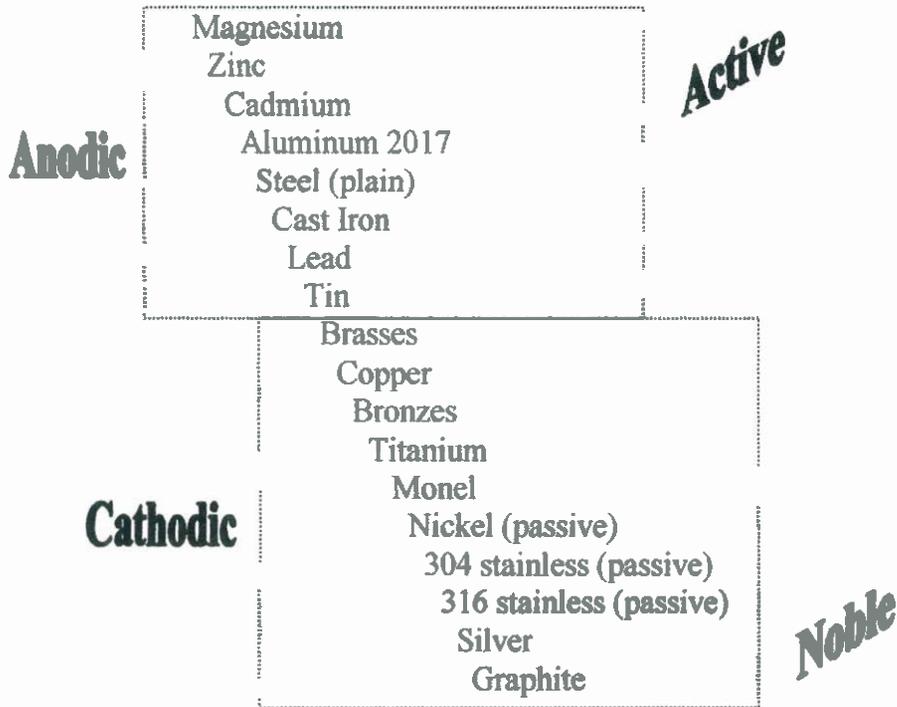
With so many finish options available for metal roof panels, choosing the right one can be somewhat difficult. This article is intended to guide the reader through the selection process by providing basic information on the most popular finishes. In order to provide sufficient detail, I have elected to devote this article to metallic coatings on steel base sheets. I intend to provide similar information on paint systems, coating systems and unpainted metals in later articles.

The primary function of a metallic coating is to provide protection of the base metal. Protection of the base metal (typically carbon steel) is typically accomplished in one of two ways: (1) the base metal can be protected by providing a sacrificial metal (galvanic protection), and/or (2) the base metal can be protected by a physical barrier (barrier protection). These concepts are discussed in further detail below. A metallic coating may also be painted to provide further protection and/or to add color to a building. However, unpainted metallic finishes have also gained popularity on steep slope residential applications, where the roof provides an architecturally pleasing feature for the building.

Galvanic Protection

Galvanic protection refers to the process by which the base metal acts as the cathode and a sacrificial metal serves as the anode. In the presence of an electrolyte (water), the less noble metal (anode) will be compromised, leaving the more noble metal (cathode) intact.¹ The potential for this process to occur is proportional to how far apart the two metals are on the galvanic series (often referred to as the galvanic scale). This series is the simplest way to illustrate the relative electrode potentials of various metals. Zinc is the most common anode due to its relative position on the galvanic series. The disadvantage of galvanic protection is that the sacrificial metal must always be present. If the sacrificial metal is used up, the base metal will begin to corrode. Roof contractors are well advised to be familiar with the galvanic series, so as not to introduce conditions that will result in galvanic corrosion. A simplistic version of the galvanic series is provided below for reference.

Galvanic Series



The galvanic series shown above includes an approximate grouping of metals based on their anodic and cathodic potential. Again, the further apart two metals are in the galvanic series, the higher the potential for galvanic corrosion to occur. For this reason, roofing contractors should try to use components fabricated from the same metal. If this option is not available, the dissimilar metals should be as close together on the galvanic series as possible. As a last resort, when dissimilar metals are used with moderate or significant potential for corrosion, great care should be taken to provide a physical separation between the two metals using an inert material (i.e. nylon washers or a rubber membrane).

Barrier Protection

Another method of protection is to simply provide a physical barrier over the base metal. The barrier protects the base metal from corrosion by keeping it free from moisture and oxygen. Paint is the most common barrier protection that is currently used. While barrier protection can be effective, they must be maintained. Once the protection is compromised by weathering, scratches, abrasions, or chemical reactions, the base metal will be vulnerable to corrosion.

Basic Considerations

For the selection process to begin, a few basic questions should be considered. A few of the most common considerations are discussed below.

Will the roof be visible from the ground?

Designers typically refer to roofs as low slope or architectural. Low slope roofs typically cover large one-story commercial buildings and are not visible from the ground. Architectural roofs have steeper slopes (typically 3:12 or more) and are visible from the ground. Many buildings include both types of roofs. A typical example of this is the modern shopping centers (otherwise referred to as a strip mall). These buildings typically consist of a pre-engineered metal building with a low slope roof. The front and side elevations are often clad with brick or stucco with a steep slope roof extending from the front elevation to cover a walkway. Regardless of the application, the answer to this question can often determine the type of finish you should consider.

The visibility factor also relates directly to the ability of the roof to drain. The steeper the roof slope, the less the metal roof panels are exposed to water. For this reason, steeper slope roof panels can be expected to retain their finish for a longer period of time. As the roof slope decreases, careful consideration should be given to proper waterproofing details and the durability of the selected finish.

Will the roof be exposed to any adverse conditions?

Some metal finishes do not react well to certain environments. A few examples are provided below.²

1. Contact with strong acids should be avoided. When using aluminum or aluminum alloy, strong alkalis can be detrimental. For this reason, exposure to wet cementitious mortars should be avoided. If necessary, an acrylic coating can sometimes be used to protect the metallic coating from mortar. Sometimes, highly alkaline cleansers are used for cleaning HVAC equipment. These cleansers should be avoided on rooftops with metallic coatings.
2. Zinc and aluminum are both anodic metals and should be isolated from electrolytic contact with more noble (cathodic) metals such as lead and copper. Flashing should be constructed with the same metal as the roof covering whenever possible.
3. Rooftop equipment that includes copper lines that will drip onto the roof should be avoided. Runoff from the copper will act as an electrolyte and cause rapid galvanic corrosion of the metallic coating.

4. Although coastal applications are common, exposure to salt should be limited due to corrosion potential. For this reason, metallic coatings in coastal environments can be expected to have a somewhat shorter service life.
5. Aluminum and aluminum coatings are sensitive to graphite. In a wet climate, a heavy graphite pencil mark can corrode metallic coatings containing aluminum in as little as two to three years. The process will take slightly longer in dryer climates.

Sacrificial Coatings

Galvanized

Galvanized finishes offer galvanic protection by providing a sacrificial anode. The concept is that two dissimilar metals are present: steel and zinc. Of the two metals, steel is more noble (higher on the galvanic series). Therefore, when corrosion occurs, it is the zinc that is compromised, while the steel remains intact. Galvanized finishes are easily identified by the coarseness of their appearance, referred to as spangle. The disadvantage of galvanized finishes is that their effectiveness is somewhat limited. Depending on the thickness of the galvanizing and the severity of the environmental exposure, galvanized roof panels can begin to rust in as little as 10 to 15 years. In general, the rule of thumb is the thicker the coating, the longer the protection. For all practical purposes, this relationship can be considered as linear.¹ For this reason, unpainted galvanized panels are typically discouraged. However, the application of a newer technology coating can significantly enhance the long-term performance of galvanized roof panels, making them a viable option. Additionally, zinc coatings are not resistant to acids and alkalis, and must always be topcoated in chemically aggressive environments.

The advantages of galvanized coatings include the fact that zinc can actually “heal” a nick in the coating and provide excellent protection at cut edges and drilled holes. Additionally, galvanized panels are typically less expensive when compared to other protective metal finishes.

(insert close-up view of galvanized spangle)

The minimum zinc coating weights for galvanized steel are designated by ASTM in Specification A924 (formerly A525). Coating weights for galvanized sheets vary, but for roofing applications are typically G90 or 0.90 ounces of zinc per square foot, total both sides. The coating is about 0.76 mils thick per side.

Barrier Coatings

Aluminized Steel

The use of aluminized steel was introduced in the 1930's. However, use of aluminized steel in roofing applications did not begin until 1954. The application of commercially

pure aluminum to steel sheet is a process that was developed by Armco Steel Inc.¹ The aluminum coating provides a barrier to the underlying steel base metal. While two types of aluminized steel are available (Type I and Type II), roofing applications are limited to Type II. When exposed to weather, the aluminum coating will form aluminum oxide. Unlike zinc oxide, aluminum oxide is not soluble. For this reason, the durability of aluminized steel is not proportional to the thickness of the aluminum coating.

The minimum aluminum coating weights for aluminized steel are designated by ASTM in Specification A924 (formerly A463). Coating weights for aluminized steel roofing applications are typically 0.65 ounces of aluminum per square foot (designated as T2-65) total both sides. The coating is about 1.1 mils thick per side. This coating carries a limited 20-year warranty against panel perforation due to normal atmospheric corrosion. However, 20-year exposure testing has shown that in most environments it will far outlive and possibly even double the warranted life. Aluminized steel can be used in painted or unpainted conditions.

Combination Sacrificial / Barrier Coatings

Galvalume

Galvalume finishes were introduced nearly 30 years ago and provide both galvanic and barrier protection. The finish includes zinc and aluminum. The zinc (approximately 45% by weight) provides the sacrificial protection, and the aluminum (55% by weight) provides the barrier protection. This hybrid finish has become extremely popular for low slope (less than 3:12) roof applications. In 1995, it was reported that over 5 billion square feet of Galvalume roofing panels had been installed since its introduction.³ Due to the combination of protection mechanisms, this finish has the ability to provide a longer service life than a galvanized finish in the same exposure. Current marketing literature suggests a service life of 30 years or more in most environments, without major maintenance.

(insert close-up photo of Galvalume spangle)

The minimum coating weights for Galvalume are designated by ASTM in Specification A792. Coating weights for Galvalume roofing applications are typically 0.55 ounces per square foot, total both sides. The coating is about 0.9 mils thick per side.

Galvalume™ is a trademark of BIEC International Inc.

Conclusions

Metallic coatings of many varieties have demonstrated years of successful performance on a wide variety of applications. Advances in technology have resulted in a wide selection of metallic coating options for building owners, architects and roofing contractors. Each successful project should include a conscience effort to match the

metal roofing components with the desired appearance and function of the building. However, as with most construction projects, proper material selection and attention to detail remain key to long-term performance.

References

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