

Introduction

The proper selection of coating thickness to meet a user's needs for galvanized steel sheet requires some knowledge about the relative corrosiveness of the environment in which the product will be used. The thickness of the zinc coating largely determines its ultimate life, but it is not used directly to specify the amount of coating. In GalvInfoNote #1 it was explained why galvanized sheet coatings are specified, not as thickness, but as coating weight (Inch-Pound system) or coating mass (SI system). The terms "coating weight" and "coating mass" will therefore be used throughout the rest of this GalvInfoNote.

Effect of Atmospheric Conditions

The corrosion rate of the zinc coating varies widely depending upon many factors in the environment. For example, the time of wetness is an important issue that affects the corrosion rate. An outdoor application in the dry Southwest United States is very different than an application in a location that experiences a high annual rainfall. Also, the presence of impurities such as chlorides, nitrates, and sulphates can dramatically affect the rate of corrosion. Other issues such as the presence or absence of oxygen and the temperature of the environment are important determinants for predicting the "life of the product".

For those who are technically trained and who know information about the local environment (weather conditions and air-pollution parameters), there is a computer program available to help determine the rate of corrosion. This program was developed to predict the life (corrosion rate) of zinc coatings on galvanized steel in various atmospheric environments. It can be found by accessing the website www.galvanizeit.org. This program is applicable for all zinc-coated steel, that is, coatings composed of zinc exclusively. It does not pertain to the family of zinc/aluminum coatings in use today.

Product Life Considerations

The performance requirements, i.e., the desired product life, will be a factor in determining the required coating weight (mass) needed for a given application. For example, consider an application such as a metal building roof where the desire is for no red rust being visible for many years. In this case, the time to failure might be defined as the time for the onset of red rust (the time for the zinc coating to be consumed in a large enough area for rusting of the steel to be observed). This application requires a thick zinc coating. Another example is an application in which the time to failure is defined as the time when perforation of the steel sheet is observed. In this case, the time to failure is impacted by the thickness of the steel sheet (and the corrosion rate of the steel) as well as the thickness of the zinc coating.

Once the desired product life is determined, it is important to match the desired life with corrosion rate information for any specific application. By combining the rate of corrosion (zinc coating thickness loss/year) for a specific application with the desired life in years, one can then readily determine the zinc coating weight (mass) to specify.

Designation System for Ordering a Specific Coating Weight (Mass)

For galvanized steel sheet products, the coating weight (mass), and hence the thickness, is defined by the designator system in ASTM Specification A 653/A 653M. The inch-pound coating weight designators (as A 653) range from a **G30** (0.30 oz/ft² of sheet) to **G235** (2.35 oz/ft² of sheet), with many intermediate coating weights between these two. The equivalent SI coating mass designators (as A 653M) are **Z120** (120 g/m² of sheet) to **Z700** (700 g/m² of sheet). This is almost an eight-fold difference in weight (mass) of zinc. These coating

designations are two-sided, meaning that the coating weight (mass) on one side of the sheet is one-half of the indicated value.

For many outdoor applications of bare (unpainted) galvanized sheet, the most common coating weight (mass) in use today is **G90 (Z275)**. This product is also specified for indoor applications where there is the potential for considerable amount of dampness due to condensation, etc. For other indoor applications where the environment is relatively dry, one might be able to apply a **G30 (Z120)** or **G60 (Z180)** coating weight (mass). Outdoor applications such as culverts require very heavy coatings. For example, the most common coating weight (mass) for culverts is **G200 (Z610)**.

Effect of Coating Weight (Mass) on Product Life

Although the corrosion rate can vary considerably depending on the environmental factors, it is well known that, in most instances, **the life of the zinc coating is a linear function of coating weight (mass)** for any specific environment. That means, to achieve twice the life for any specific application, the user should use twice the coating weight (mass).

Examples –

- A G60 coating weight will exhibit approximately twice the life of a G30 coating weight
- A G90 coating weight will exhibit about 50% longer life than a G60 coating weight

Corrosion Rate Data

In addition to the Coating Life Predictor that is available on the previously mentioned website, the following two reference books are excellent sources for additional and more detailed information on the corrosion behaviour of zinc-coated steel sheet products. These publications go beyond the information available with the Coating Life Predictor in that they contain information on corrosion rates in various water-base solutions as well as in organic solutions.

1. Corrosion and Electrochemistry of Zinc, X. Gregory Zhang, Published by Plenum Press, 1996.
2. Corrosion resistance of Zinc and Zinc Alloys, Frank C. Porter, Published by Marcel Dekker, Inc., 1994

In these publications, you will find that the rate of corrosion can range from very low rates, on the order of less than 0.01 mil/year* (0.254 μm) to much higher rates. If the rate of corrosion is 0.05 mil/year (1.25 μm /year) for example, the life of a G90 coating would be approximately 16 to 17 years, since a G90 coating is approximately 0.85 mil (21 μm) thick on each side of the coated steel sheet. In some cases, the rate of corrosion is so high that galvanized steel is not the preferred product. Generally, such applications are those that have either very acidic or very basic conditions.

*One mil = 0.001 inch

Contact the GalvInfo Center

The correct selection of coating thickness is but one of the many factors that need to be considered when using galvanized sheet products. Others include the steel thickness, the steel strength, the steel formability, the surface treatment applied to the galvanized coating, etc. To assist you with these many considerations, please contact the GalvInfo Center by either phone or e-mail.

Toll-free phone: 1.888.880.8802

E-mail: info@galvinfo.com

Note: Additional information on ASTM coating designations, specifications, and corrosion of galvanized steel can be found in GalvInfoNotes #16, #11, and #6, respectively.

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