

COOLING TECHNOLOGY INSTITUTE

Treatment of Galvanized Cooling Tower to Prevent White Rust



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FOREWORD

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This guideline document summarizes the best current state of knowledge regarding the specific subject. This document represents a consensus of those individual members who have reviewed this document, its scope and provisions. It is intended to aid all users or potential users of cooling towers.

Approved by the CTI Executive Board.



This document has been reviewed and approved as part of CTI's Five Year Review Cycle. This document is again subject to review in 2015.

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Overview

Cooling towers are subjected to varying water chemistry and environmental conditions, and require protection from these elements. The major source of cooling tower corrosion is the warm circulating cooling water, which contains dissolved and suspended solids. The most common material used today for this purpose is galvanized steel, providing protection to both the interior and exterior of the cooling tower. Although galvanized steel has been successfully used for many years to protect cooling towers, a competent water treatment program must be employed to protect and maintain the galvanized steel. The following document reviews the galvanizing process, the means of corrosion, and the recommended measures to protect cooling towers from corrosion.

Galvanized Steel Cooling Towers

Galvanizing is simply the process of protecting steel with zinc for corrosion protection. The galvanizing process provides a tenacious zinc coating that is alloyed directly with the steel substrate. The zinc protects the underlying steel by providing a mechanical barrier to the environment as well as electrochemical resistance to corrosion. In the event that the zinc is damaged, e.g. scratched, so that the steel beneath it is exposed, the zinc acts as a sacrificial anode (by galvanic corrosion), effectively protecting the steel. Galvanized steel also provides excellent corrosion protection in the external areas of the cooling tower.

There are three different galvanizing processes used in the industry, and it is important to understand the different uses, along with the strengths and limitations, of each of the processes.

Galvanizing Processes

Hot Dip Galvanization - Steel mills and independent contractors have performed galvanizing for the last 50 years. The earliest galvanized steel process used in cooling towers was "Hot Dip Galvanizing" (HDG). HDG is a batch process consisting of submerging clean and dried fabricated steel components directly into a molten zinc bath until the zinc is fused onto the steel surface. Hot-dip galvanizing provides a durable coating. The thickness of the zinc coating will vary with the time spent in the bath and the thickness of the part. Specifications are written to require thicker zinc coatings for thicker steel parts. The following chart details the minimum average zinc-coating thickness by steel thickness for strip, structural shapes, and tubing using the information in ASTM 123/A.

	Wall Thickness <1/16"	Wall Thickness 1/16 to <1/8"	Wall Thickness 1/8 to 3/16"
Structural Shapes, Plate and Strip	1.77 mils (45 micron)	2.56 mils (65 micron)	2.95 mils (75 micron)
Pipe and Tubing	1.77 mils (45 micron)	1.77 mils (45 micron)	2.95 mils (75 micron)

Table 1: Galvanized Layer Thickness

Small cooling tower components of heavy gauge or welded together sections are sometime HDG coated for corrosion protection on modern cooling towers. The steel-tube coil assemblies used in evaporative refrigeration condensers and fluid coolers are typically HDG after fabrication (HDGAF).

Heavy Mill Galvanization - Most of the galvanized sheet steel coating provided in cooling towers today is "Heavy Mill Galvanized" (HMG). HMG steel is produced at the steel mill by continuously running steel sheet through a bath of molten zinc. HMG zinc also includes small amounts of aluminum or nickel (typically less than 0.3% by weight). These additives enhance the ductility of the coated steel allowing post galvanizing bending of the sheet steel. Without the additives in the bath, the zinc layer may be brittle and may break during forming applications.

HMG classifications are based on the total weight of zinc on both sides of the sheet in contrast to the thickness of zinc for HDG surfaces, which is based on one surface only. The composition of HMG zinc coating is similar to HDG zinc with the primary exception that the zinc thickness can be more easily controlled. The zinc layer can range from G-90 up to G-235. HMG coated steel used in modern cooling towers conforms to the industry standard coating class G-210 or G-235, which means the weight of zinc averages 2.1 oz./ft² (640.5 g/m²) of steel sheet for G-210, or 2.35 oz./ft² (716.8 g/m²) for G-235. A sheet of G-210 will have approximately 1.78 mils of zinc coating per surface; a sheet of G-235 will have approximately 2.0 mils per surface.

Major steel suppliers have manufactured the HMG product since 1960. During the last 20 years, major steel manufacturers have reported only minor changes in the chemistry of steel, preparation, or zinc bath., the most significant being the elimination of lead from the zinc baths for environmental reasons.

Most HMG coated steel produced today is post treated with a corrosion inhibitor rinse. This treatment is designed to protect the galvanized steel sheet during storage and is reasonably effective in preventing "water storage staining" of the sheet or