WHITE PAPER

Galvanized-Finish Metal Strut and Acid Rain
Civil infrastructure, such as the electrical utility grid, is often located outdoors and subjected to a wide range of weather conditions that affect its service life. Among the weather conditions that threaten the working condition of infrastructure is acid rain. According to the Environmental Protection Agency (EPA), the term, “acid rain,” refers to precipitation that contains deposited material from the atmosphere with higher-than-normal amounts of nitric and sulfuric acids (http://www.epa.gov/acidrain/what/). While natural phenomena, such as volcanoes and decaying vegetation, can contribute to acid rain, man-made sources of sulfur dioxide and nitrogen oxides from fossil fuel combustion also elevate acidic levels in precipitation (http://www.epa.gov/acidrain/what/).

Among the types of components found in civil infrastructure, especially in electrical utilities, is metal strut, or channel. Used to hold wiring and cable, metal strut is typically formed from sheet metal with inward-curving edges and holes along its central panel for mounting of interconnecting components. The holes also enable the metal strut to be fastened to building structures. Metal strut is designed to offer numerous options for assembly, and can be easily modified and added to. It also is known for being quick to assemble, requiring minimal tools and construction. Metal strut systems often include a selection of hardware to fasten channel to copper pipe.

Most metal strut systems are made of carbon steel, which requires plating, or galvanizing, usually with zinc, to protect the components from corrosion (there also are stainless-steel channel systems for highly corrosive environments). Superstrut™ channel systems, manufactured by Thomas & Betts (T&B), offers a selection of zinc galvanizing options, among them being zinc electroplating that has an average of 0.5 mils of zinc and a clear chromium sealant, which does not obscure the zinc plating’s silver color. T&B markets this finish as SilverGalv® plating.

Superstrut™ metal framing with SilverGalv® finish: All surfaces are electroplated with 0.5 mils of zinc after cutting and punching, providing a durable, corrosion-resistant product.

Superstrut™ metal framing with GoldGalv® finish: All surfaces are protected with a trivalent chromium finish applied over zinc, creating a chemically bonded, nonporous barrier.
Zinc electroplating also is available with a trivalent chromium finish, which creates a chemically bonded, nonporous barrier, as well as its characteristic yellow color. T&B markets this finish as GoldGalv® plating.

SilverGalv® and GoldGalv® finishes are applied after cutting and punching to protect all surfaces, providing a durable, corrosion-resistant product.

In addition to zinc, copper is also available for outdoor applications, especially ones subjected to precipitation and other sources of moisture. As copper does not react with water, it is often used to fabricate or plate components that are exposed to moisture. Its moisture tolerance, however, may be compromised by the acidic content of acid rain.

The Kesternich test, which conforms to ASTM G-87-84, recreates the acid rain environment to evaluate how well materials tolerate exposure to acid. The acid used in this test is sulfur dioxide (SO₂), also known as sulfuric acid, which is contained in compressed water to which specimens are exposed.

(Compressed water remains a liquid as its volume is less and its pressure is greater than at the boiling point.)

T&B sent specimens of its Superstrut™ channel, affixed to copper tubing with clevis hangers, to an independent laboratory for Kesternich testing. Some of the channel and clevis hangers were SilverGalv® plated and the rest were plated with GoldGalv® finish.

Sample no. 1, SilverGalv® finish at 45 cycles of exposure
Sample no. 4, GoldGalv® finish at 45 cycles of exposure
Sample no. 1, SilverGalv® finish, both brackets at 64 cycles of exposure
Sample no. 4, GoldGalv® finish, both brackets at 64 cycles of exposure
Once the specimens begin their exposure to moisture with \( \text{SO}_2 \), they are thoroughly inspected for red rust corrosion of the carbon steel during the series of test cycles. The testing conducted on copper tubing mounted to channel with clevis hangers used four 12-inch-by-12-inch-by-3-inch channel specimens, two with SilverGalv\textsuperscript{®} plating and two with GoldGalv\textsuperscript{®} plating. The clevis hangers also were plated with the same finish as the channel they were affixing to the copper tubing. The specimens were subjected to water spray that contained \( \text{SO}_2 \), amounting to two liters of \( \text{SO}_2 \) for each test cycle.

Channel plated with SilverGalv\textsuperscript{®} finish first exhibited red rust on the edges at an average of 49 cycles, or 1,176 hours; the clevis hangers exhibited red rust after an average of 64 cycles, or 1,536 hours. There was moderate red rust at the edges of the channel when the test was completed.

Channel plated with GoldGalv\textsuperscript{®} finish exhibited red rust on the edges at an average of 55 cycles, or 1,320 hours. There was slight red rust at the edges of the channel when the test was completed.

As the test results indicated, the GoldGalv\textsuperscript{®} zinc plating with trivalent chromium finish performed significantly better than the SilverGalv\textsuperscript{®} zinc electroplating.

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