Corrosion College

The Proper Selection of PVC-Coated Conduit System Protects Profitability

One of the best ways to protect your company's profitability is to make sure the product you choose for your project performs as intended. The second way, to ensure your project does not chip away at your bottom line is to evaluate your vendor and the history of performance of their brand in the field. To emphasize these points we will focus on PVC-coated galvanized rigid conduit as an example.

Conduit Materials

Improperly specified conduit and fittings provide inadequate protection in a facility, causing electrical equipment to become subject to damage, which jeopardizes control systems or possibly interrupts the production equipment's power supply.

When outages occur to facility equipment such as pumps, motors, lighting, or other components, maintenance and production costs go up, production losses go up — and in manufacturing environments — profits go down. Therefore, it is important to make informed decisions when designing electrical systems in all facilities.

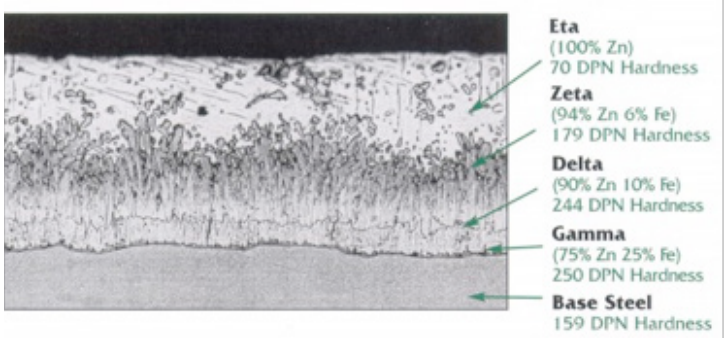
Conduit systems are usually manufactured with aluminum, rigid galvanized steel, stainless steel, PVC or PVC-coated rigid galvanized steel pipe, each of which performs differently under various conditions. Some applications require a combination of these options to achieve proper protection. Therefore, an assessment and diagnosis of the environment must be made before choosing the appropriate conduit.

Protecting Against Environmental Elements - The Basics

Even in mildly corrosive conditions, coatings are necessary to help conduit resist corrosion. Hot-dip galvanized steel conduit is a widely used for corrosive environments where wire and cable systems must be physically protected.

Hot-dip galvanized coatings are produced on conduit by immersing the cleaned conduit in a molten zinc bath. The steel and zinc react to form a metallurgic ally bonded coating consisting of a series of iron-zinc alloys, with increasing zinc content toward the external surface.

Figure 2 shows a cross section of the galvanized coating and the various iron-zinc alloy layers. Zinc is naturally corrosion resistant in many environments, making it useful as a protective coating for a variety of applications.



Microstructure of hot-dip galvanized coating on steel.

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However, this protection only lasts as long as the zinc itself, which erodes away over time as a result of exposure to various elements. Therefore, there is a standard for how thick a zinc coating must be in order to offer protection in conduit systems. Rigid metal conduit standards, such as UL 6 and ANSI C80.1, require that zinc coatings have a minimum thickness of 0.0008 inches (0.02).

However, under the excessive corrosive conditions of many industrial facilities such as water, wastewater, food, airports, oil, gas, and others, additional options must be used to extend the performance life of the electrical infrastructure.

Long-term Corrosion Protection Options

The best solution is the addition of a primary coating such as PVC or polyurethane in addition to the zinc as they will protect the underlying surface from the harsher environment. However, it is important to make sure the coatings are properly applied or their protective ability will fail and corrosive elements will reach the zinc. Therefore, proper manufacturing and adhesion of the coating is crucial for reliable corrosion protection.

Critical Surface Preparation Before Adhesion

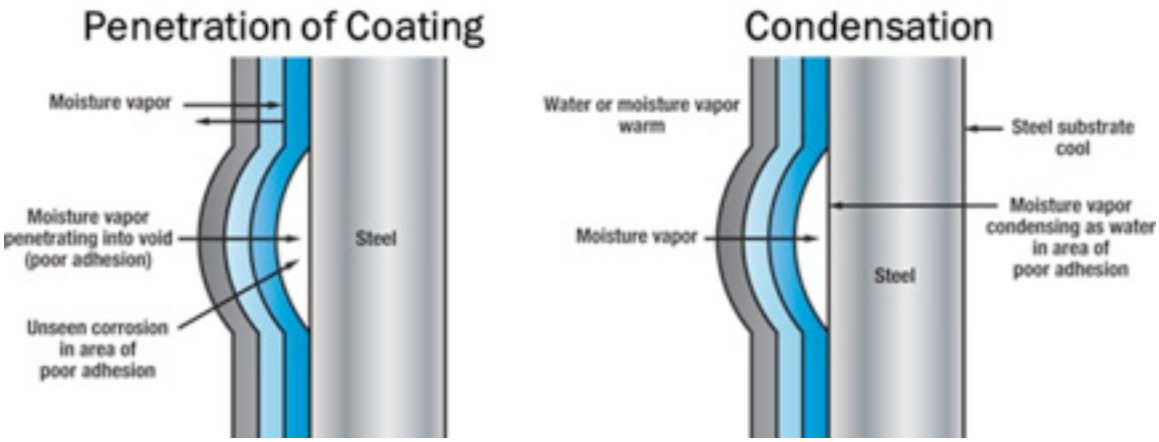
For PVC and polyurethane coatings to adhere to a galvanized zinc surface, proper preparation of the surface is a must. Sherwin Williams states that improper or inadequate surface cleaning and preparation causes most premature coating failures. Failures caused by contaminants left on the surface when the coating is applied causes approximately 80% to 90% of premature coating failures.

Proper surface preparation of galvanized conduit for PVC and polyurethane adhesion is not a straightforward process so it is important to make sure the manufacturing process is suitable. The Robroy Industries Conduit Division uses a two-step proprietary process—a mechanical surface treatment process to remove white rust and prepare the surface in order to promote coating adhesion followed by a chemical cleaning process to remove any surface contaminants. All phases of both the mechanical and chemical processes are stringently controlled to provide surfaces that meet the highest standards for coating adhesion and product conformance.

Physical testing shown above confirms successful adhesion of the PVC coating to the substrate.

The Repercussions of Coating Failure

If the thickness of a polyurethane coating is inconsistent, or the adhesion of PVC fails, the zinc can also become compromised. As seen in Figure 5, when you do not have proper coating adhesion, quite often, corrosive elements become trapped underneath the coating and are held against the substrate, which accelerates the rate of corrosion.



Physical testing confirms major adhesion failure of external PVC coating.

The above photograph reveals a major adhesion failure of the external PVC coating. Due to improper surface preparation, the bond has broken and moisture has penetrated the PVC--causing the PVC to separate from the galvanized surface.

In such instances, non-visible contaminants, usually water-soluble salts, were not completely removed from the zinc surface during the cleaning operation. When the coating is applied over salts remaining on the surface, the salts are hygroscopic and draw moisture through the coating. The moisture, in combination with the salt, creates a corrosion cell beneath the coating and begins to corrode the zinc. Then, the coating usually blisters, as shown in Figure 7, below. Conduit products consisting of galvanized rigid steel, with interior and exterior coatings properly adhered, prevent exposure of the conduit.

The PVC coating has blistered due to poor surface preparation of the galvanized zinc.

Choosing the Right Vendor to Protect Your Conduit System and Protect Your Bottom Line

Corrosion engineers have recognized the significance of coating adhesion for years but it was not documented in conduit performance standards until 2006. In 2006, an independent third party, Intertek ETL SEMKO, was engaged to develop a specification for a Regulated and Quantitative Test protocol to confirm Adhesion Performance. Intertek ETL SEMKO then independently performed the coated conduit evaluation based on the specification and certified that PLASTI-BOND, met the requirements of the specification.

Proper adhesion of the coating to metal relates to success in the harsh environment in many facilities.

Manufacturers of all current brands of PVC-coated galvanized rigid conduit meet precisely the same UL standards for safety compliance. It is the right and obligation of any end-user or specifier to contact UL if they feel a manufacturer is not compliant. The fact remains, however, that all manufacturers privileged to be authorized to apply the UL label have met the same standards of compliance.

ETL PVC-001 validates the coating performance of PVC-coated galvanized rigid conduit based on ASTM D870 and ASTM D2247, the two accepted ASTM tests for predicting product service life. These tests are not intended to replicate a specific environment. Rather, they are designed to predict the service life of a coating under the two most common conditions affecting adhesive bonds: heat and humidity.

Plasti-Bond products have undergone proper manufacturing processes that make them a reliable choice for corrosion protection and long-term performance in the highly corrosive environment of many industrial facilities. ♦

To learn more about The Significance of Predicting Service Life in The Specification of PVC-Coated Galvanized Rigid Conduit, visit: http://plastibond.com/technical-info/support-documentation/significance-of-etl