Why Independent Product Performance Verification is Essential For Properly Specifying Products For Highly Corrosive Environments

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By law and tradition, a key role of architectural/engineering professionals is to help ensure effective specification of products. This responsibility is especially critical when applications are in highly corrosive environments where product failure is extremely costly but also raises the risk of catastrophe and human harm.

The foundation for preventing corrosion damage through proper product specification is to enforce a high priority on continuous education in the understanding of what causes and what prevents corrosion. There is reason to believe that many professionals, although aware of general facts specific to corrosion, do not maintain adequate knowledge of how and why diverse methodologies for corrosion prevention work well in some applications but are ineffective in others.

Those who study corrosion and the dramatic implications of the damage it causes realize the following:

a.) The literal dollar cost of corrosion is staggering and underscores the inherent economic dangers caused by improper product specification and resulting product failure. Conversely, insistence on the specification of optimum anti-corrosive products provides opportunities for tremendous cost savings.

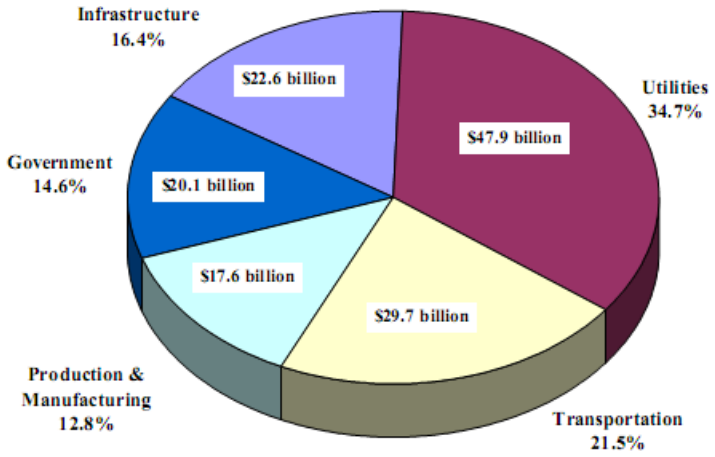
b.) There exists a misconception that nothing can be done about corrosion. There exists a corresponding professional duty to correct that falsehood.

c.) Sound corrosion management, built upon proper product specification, depends on a comprehensive understanding of regulations and standards.

d.) Product life predictions and performance assessment methods are essential for knowing what products truly are successful over time in fighting the high cost of corrosion.

Be aware of the high cost of corrosion:

The annual direct cost of corrosion is estimated in excess of $121 billion. The breakdown of these costs among major sector categories is highlighted in figure 1. Not all industries were examined in this study and, therefore, the total economic impact on the U.S. economy is far greater than this estimate indicates.



http://www.corrosioncost.com/summary.htm

Change the misconception that nothing can be done about corrosion: Properly specifying products for corrosion protection.

Becoming aware that corrosion is much more prevalent in our business than we realized awakens us to new ways of improving what we do for our customers by selecting the best anti-corrosion products and applying them in the most effective ways. Your client can help you decide how important a reliable system is to the production and profitability of their company. Once the mechanisms of corrosion in the environment are defined, the engineer must do their homework to select the correct material for the application.

To begin, the material of choice must be given equal consideration as the design itself. Choosing the wrong material can result in frustrating or even dangerous situations. Defining the corroding agents and determining the concentration can be a complex process. Usually several corrosive elements are present and interactions are not always well documented. Water is the most common corrosive element and is usually present to some extent in every enclosure application. Adjacent processing operations or other intermittent activities such as industrial cleaning and the general plant environment may expose the enclosure to a variety of corrosive agents and temperatures. Each environment is unique and all possible corrosive agents should be identified for the intended application.

Metal corrosion is influenced by surface finish, surface treatment, such as painting or galvanizing and use of materials such as stainless steel or composite fiberglass materials, which are naturally corrosion resistant. Aluminum, for example, should not be used in high-mineral acid environments. Stainless steels should not be used in applications where a high exposure to salts is present. Should the decision be made to use one material over another without in-depth investigation into potential corrosive media, the user may be looking at a very short life span for their most vital devices systems. Next, you must start to take into account some of the compliance issues, standards for the project.

Understand policies, regulations, standards, and management practices to increase corrosion savings through sound corrosion management.

Listed below are some of the most relevant for the electrical industry and a link for you to find more information, if you need more details for your particular project.

About UL :
With more than 110 years as one of the world's leading product safety testing and certification organizations, Underwriters Laboratories (UL) continues to be a valuable resource for safety information. Its' UL Mark is one of the most recognized symbols of safety in the world.

UL is an architect of U.S. and Canada safety systems, having developed more than 1,200 safety standards, and actively participating in national and international standards development. UL tests more than 19,000 types of products, and 21 billion UL Marks appear in the marketplace each year.

Consumers and regulatory authorities value UL as a leader on safety issues. With public safety at the heart of UL's mission, UL acts as a safety resource and advocate. UL works closely with customers, regulators, insurers, retailers and consumers on research, technology and safety initiatives. UL also promotes public safety through education and outreach, including through and to the media. In 2007, UL reached more than 447 million consumers in North America, Europe and Asia with its public safety message.

http://www.ul.com

ASTM International:
ASTM International is one of the largest voluntary standards development organizations in the world-a trusted source for technical standards for materials, products, systems, and services. Known for their high technical quality and market relevancy, ASTM International standards have an important role in the information infrastructure that guides design, manufacturing and trade in the global economy.

Standards developed at ASTM are the work of over 30,000 ASTM members. These technical experts represent producers, users, consumers, government and academia from over 120 countries. Participation in ASTM International is open to all with a material interest, anywhere in the world.
http://www.astm.org

NACE: National Association of Corrosion Engineers
NACE International was originally known as "The National Association of Corrosion Engineers" when it was established in 1943 by eleven corrosion engineers in the pipeline industry. These founding members were involved in a regional cathodic protection group formed in the 1930s, when the study of cathodic protection was introduced. With more than 60 years of experience in developing corrosion prevention and control standards, NACE International has become the largest organization in the world committed to the study of corrosion. Their standards are written and approved by industry professionals, instructors, professors, government officials, and experts from regulatory and governing bodies. Trusted by hundreds of corporations and even the International Maritime Organization (IMO), NACE International standards are the most specified for corrosion control in the world. NACE is a member of the American National Standards Institute (ANSI) as an accredited standards developer.

http://www.nace.org

NEMA: National Electrical Manufacturers Association
It is NEMA’s belief that standards play a vital part in the design, production, and distribution of products destined for both national and international commerce. Sound technical standards benefit the user, as well as the manufacturer, by improving safety, bringing about economies in product, eliminating misunderstandings between manufacturer and purchaser, and assisting the purchaser in

selecting and obtaining the proper product for his particular need.

An overview of NEMA standards publications, including:

- Standardization Policies and Procedures
- How to read a NEMA standard
- How NEMA standards are developed
- How to purchase a NEMA standard
- Technical Frequently Asked Questions (FAQs)
- Electrical Standards & Product Guide

http://www.nema.org

NECA: National Electrical Contractors Association
The NECA Codes and Standards Committee is involved with development, administration, and enforcement of installation codes, safety standards, product standards, and other related industry regulations. This includes, but is not limited to, the National Electrical Code (NEC®), National Electrical Installation Standards (NEIS™), National Electrical Safety Code (NESC), Various NFPA Standards, UL Safety Standards, and OSHA Regulations. Members of the NECA Codes and Standards Committee serve on National Electrical Code-Making Panels, NEIS Technical Subcommittees, and other standards development committees and subcommittees.

http://www.necanet.org/

Advance life prediction and performance assessment methods: Independent Testing

Products meeting identical certification standards are not necessarily "created equal." Many products meet some or all of these standards however these do not guarantee that the product will perform as promised. There is a new need for the importance of independent product performance verification as distinguished from verification of product safety compliance.

So how do you to differentiate between similarly certified products?

You need to start by using empirical data to compare product longevity and accurately assess factors related to the risk of product failure from companies like Intertek that provide Independent Testing results.

Intertek: Independent Testing
Intertek is the world's largest independent testing, inspection and certification partner. When a manufacturer enters a product into a verification program, they must provide an initial qualification sample to Intertek. The sample is then independently tested to the specifications of the appropriate standard. If sample is found to meet the requirements, an Intertek field representative is sent to the manufacturer's location to independently select a final qualification sample for further independent testing. Once the second cable is found to meet performance requirements, the product may be marked by the manufacturer as “ ETL Verified”. The manufacturing facility is then subject to quarterly audits to ensure ongoing compliance.

A Case Study for Need for Independent Testing Results: Coated Conduit

For years all available brands of PVC-coated galvanized conduit met exactly the same UL 6 standards and carried an identical UL label relating to safety conformance. Yet, it was apparent in the marketplace that not all brands performed the same. The lack of performance requirements for coated conduit has been recognized by many companies and is gaining recognition by users. This fact is confirmed by recent discussions with consulting, specifying and maintenance engineers at paper plants, waste water treatment facilities, etc. Committees that develop conduit standards are also considering performance testing.

In 2005 ETL SEMKO evaluated all PVC-coated galvanized conduit brands not for safety issues, but for product performance and product longevity as tested under conditions consistent with highly corrosive environments. The results established that some products of this type, previously viewed as equal by way of UL certification, were in fact far from equal in terms of meeting ETL-Verification standards for meeting performance criteria.

The Basics: Testing for PVC coated conduit adhesion and corrosion protection
The PVC adhesion and corrosion protection afforded by the current coating process has significantly upgraded the performance as confirmed by the hot water and heat/humidity test results. Heat and humidity are recognized corrosion accelerators in corrosion engineering textbooks and published technical documents from organizations such as the National Association of Corrosion Engineers (NACE).

> Immersion in Boiling Water according to the intent of ASTM D 870, Testing the Water Resistance of Coatings Using Water Immersion.
>
> Exposure to heat and humidity according to the intent of ASTM D 1151, Test Method for Effect of Moisture and Temperature on Adhesive Bonds and ASTM D 4585, Testing Water Resistance of Coatings Using Controlled Condensation.

The adhesion was evaluated in accordance with the procedures outlined in Section 3.8, ADHESION, of NEMA Standards Publication No. RN 1, Polyvinyl-Chloride (PVC) Externally Galvanized Rigid Steel Conduit and Intermediate Metal Conduit. The testing began in December 2004 and ended in July 2005; specimens from four sources were tested.

The ASTM Standards do not specify quantitative performance or pass-fail criteria. Section 3.8 of NEMA RN 1 describes how to make the adhesion test; but has no associated performance requirement other than that the PVC tear before separation from the metal substrate. Performance requirements are not defined in existing standards, even though the added cost of coated conduit for application in corrosive environments has been justified by widespread acceptance and application.

Heat and humidity testing were selected for several reasons:

- Universally accepted in the coating industry as standard parameters to evaluate corrosion protection provided by a coating. Standard test procedures are documented and recognized.
- Widely acknowledged as corrosion accelerating agents.
- Typical conditions in coated conduit application environments.

- Heat and humidity chambers are available as standard equipment for testing.
- Provide a method, which combined with real time exposure, can be used to correlate laboratory and product life cycle in corrosive environments.

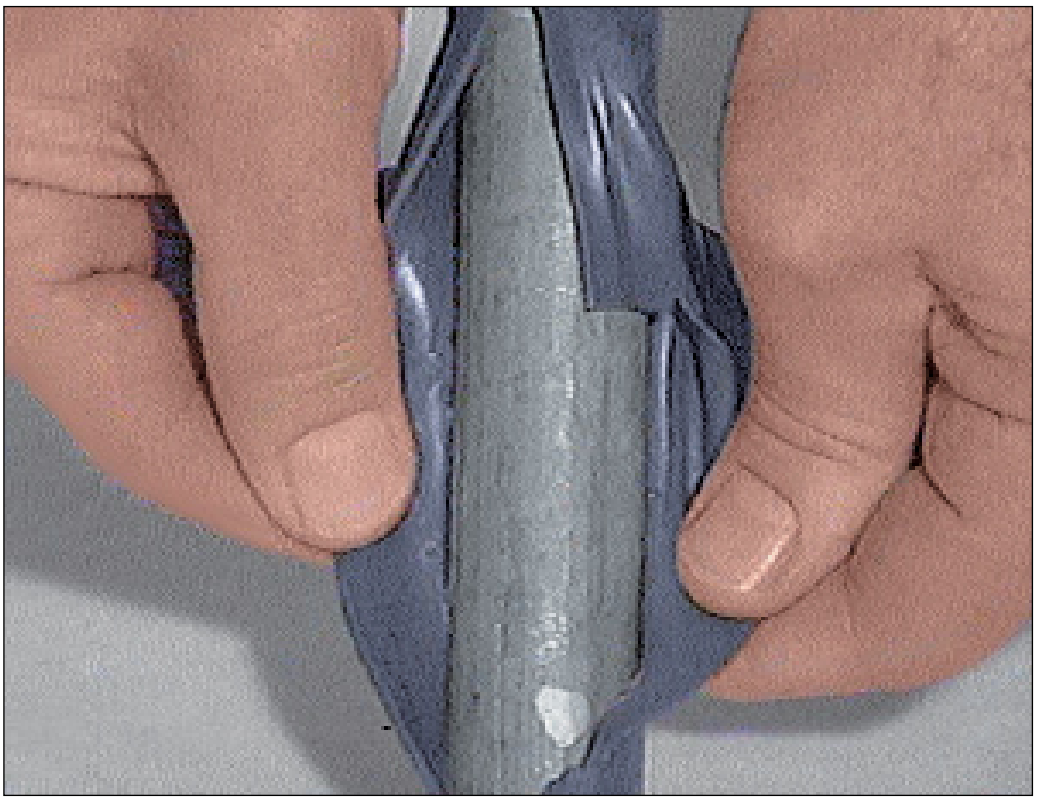


Figure Above: shows a PVC coated conduit specimen where the coating adhesion has failed. This conduit sample was exposed for approximately two days in the Hot Water Immersion Test. Once the cuts are made, the PVC coating is easily removed by pulling the coating by hand. The PVC coating is torn to expose the galvanized steel conduit in the photograph.

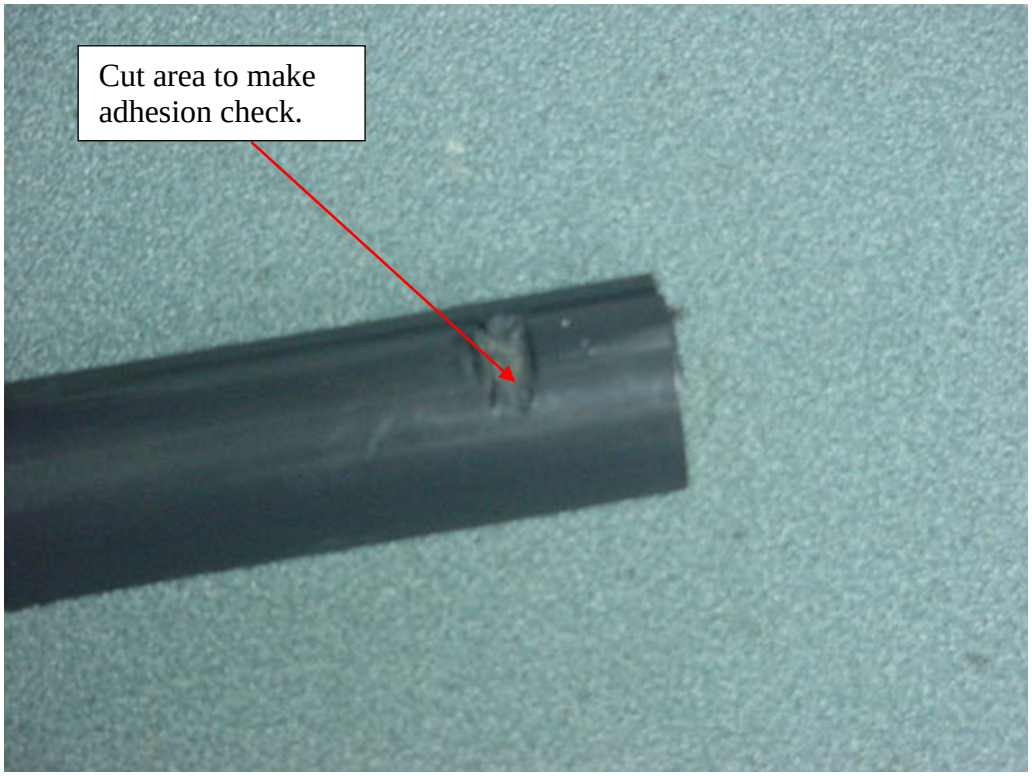


Figure Above: PVC Coated Conduit Specimen with Acceptable Adhesion.

Positive Results: Conduit Specimen after 200+ Hours in the Hot Water Immersion Test.

The test results provided a quantitative method to compare the relative performance of coated conduit systems in conditions typical of the corrosive application environments. The results of both tests confirm significant differentiation in adhesion performance of the four brands of PVC coated conduit available in the market and why certain brands carry the ETL label.

Summary: The Test results

When an engineer is faced with specifying products for highly corrosive environments, I recommend that they specify a product that carries an independent product testing label like ETL. The reason is built upon solid empirical facts: First: All available brands of PVC-coated galvanized conduit meet exactly the same UL 6 standard and carry the same UL label relating to safety conformance. Second, however: only certain brands are authorized to carry the ETL-Verification label.

The significance of this is that ETL testing, and consequently ETL-Verification, is based on actual product performance, as a predictor of reliable service life. Some brands therefore, have a documented, proven ability to perform in a corrosive environment over an extended time --- a fact which has been evaluated and confirmed by a world-recognized, third-party source. To most CSEs, this is a vital reality because it addresses the extremely important need to specify products that will enable users to avoid the high cost, and sometimes disastrous, effects of product failure.

As evident from this article, I have presented why there is a pressing need to look for, appreciate, and accept specification-related third-party verification standards that reach beyond traditional or historic ways of qualifying products intended to help fight the high cost of corrosion damage. Solid empirical product data; that is to say, documentation of product performance that is independently validated by recognized, objective, third-party sources should be considered and used.

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