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PRODUCT BROCHURE

# Ocal<sup>®</sup> PVC-coated conduit system



# “Better by design”

## Overview

Ocal-Blue® PVC-coated conduit and fittings represent a complete corrosion-protection package for your entire conduit system. This extensive product line includes the largest number of items in stock along with corrosion-resistant supports and patching compounds. With Ocal PVC-coated conduit and fittings, you get corrosion protection that will extend the life of your electrical raceway system for years and years.

### A complete corrosion protection solution

- Industry-leading thread protection through a hot-dipped galvanizing process, and industry-leading UL® Listed type 4X PVC-coated conduit bodies.
- ABB supplies Ocal PVC-coated conduit with hot-dip galvanized threads. Hot-dip galvanizing is the process through which the steel shell is dipped in molten zinc, causing the zinc to penetrate the steel.
- ABB supplies Ocal PVC-coated conduit with a full undisturbed zinc coating under the PVC coating, fulfilling the requirement of NEMA RN-1 regarding the restriction of harmed or eroded zinc coating over the conduit.
- UL Listed including UV resistance testing.
- Ocal supplies “double-coat” coated fittings, enhancing corrosion protection by applying coating to the interior and exterior of the fittings before PVC coating.
- Ocal offers custom colors.
- Ocal offers local installation training and certification.

### Standards met

- ANSI C80.1
- Federal specification WW-C-581
- NEMA RN.1
- UL6



# What is corrosion?

Corrosive elements cause millions of dollars in damage through lost time, materials and labor.

**Examples of corrosion:**



## Corrosion protection of electrical conduit systems

**Corrosion protection options**

Chemical category	Chemical examples	PVC	Urethane	304	316	Polycarbonate	Cast iron	Brass	Aluminum
				stainless steel	stainless steel				
Compatibility rating									
Solvents (excluding alcohols and aliphatic)	Acetone, toluene, ketones, etc.	NR	NR	L	L	NR	L	L	L
Fuels	Jet fuel (alcohol based and aliphatic solvent based)	L	L	L	L	L	L	L	L
Plating solutions	Chrome, nickel, copper, brass, gold, zinc, etc.	L	F	F	F	F	NR	NR	NR
Salts and alkaline materials	Caustic soda, caustic potash, alkaline cleaners, etc.	L	F	L	L	F	NR	NR	NR
Mild acids	Low-concentration hydrochloric, sulfuric, fruit acids, glycolic, citric, etc.	L	S	L	L	S	NR	NR	NR
Strong or high-purity acids	Nitric, hydrofluoric, etc.	S	S	F	F	S	NR	NR	NR
Oxidizing agents	Bleach, chlorine, hydrogen peroxide, etc.	L	S	L	L	S	NR	NR	NR

The chart above provides a general guide for the end user to choose the most suitable material for his corrosion protection needs.

As you can see, PVC-coated conduit and fittings are suitable for almost all applications. When it comes to PVC-coated conduit systems, there is no higher quality than Ocal.

**Chemical compatibility legend**

Suitability description	Compatibility rating
Rated for all fumes, splash and liquid	L
Rated only for fumes and splash	S
Rated for fumes only	F
Not recommended	NR

## Ocal manufacturing process

Our Ocal PVC-coated conduit system fully complies with all standards for proper use and protection in corrosive environments mandated by UL6, NEMA RN-1 and ANSI C80.1. It is manufactured in the United States by ABB in our Jonesboro, TN manufacturing facility.

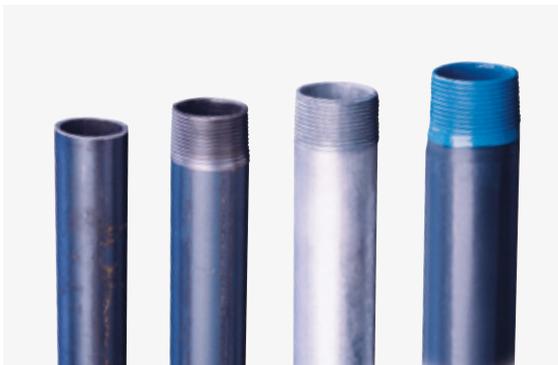
### The process of manufacturing PVC-coated conduit

- The process begins with 20-foot sticks of raw steel shell.
- The steel shell is then cut and threaded — before galvanizing.
- The cut and threaded conduit is then prepared for the hot-dip galvanizing process.
- The threaded shell is immersed in a molten zinc bath. This hot-dip galvanizing process enables the zinc to penetrate the steel, providing the best possible protection. After the conduit is extracted from the zinc bath, super-heated steam is blown through the interior and over the outside of the conduit to remove any slag.
- The ends of the conduit are then heated enough to blow excess zinc out of the thread cavities. ABB manufactures steel conduit that provides hot-dipped galvanized threads in addition to the conduit itself. Other methods such as “hot-galvanizing” provide only a “sprayed-on” zinc coating.
- Prior to the PVC application, the inside diameter of each conduit has 2 mils of blue urethane applied to the inside as well as the threads.
- After priming, the conduit is heated then rolled through liquid plastisol; achieving complete coverage of 40 mils in thickness.

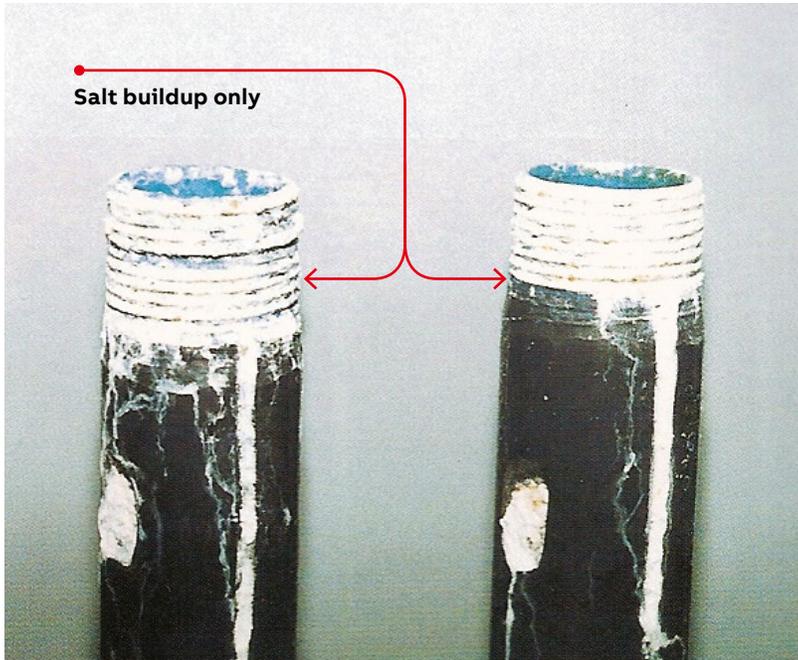
### The process of manufacturing PVC coated fittings

- Fittings are cleaned and then sprayed on the inside and the outside with 2 mils of blue urethane. This gives the fittings corrosion protection on the exterior as well as the interior — the fittings are “double-coated.”
- 40 mils of PVC is then applied to the exterior of the fitting.
- Covers are coated with a molded flange and conduit bodies are molded with a flat surface to ensure a superior seal.

ABB works hard to provide standards-compliant PVC-coated conduit. It is this dedication to superior quality that makes Ocal “better by design.”



## Evaluating corrosion protection of PVC-coated conduit



Example of hot-dip galvanized threads after 42-day salt-fog test.

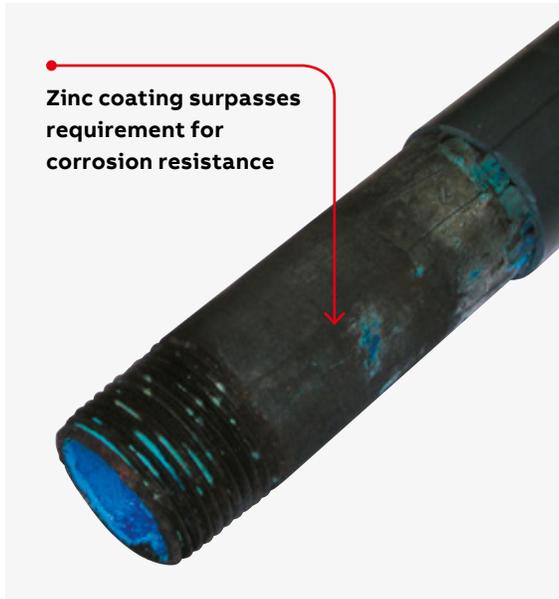
When evaluating any electrical raceway conduit or fittings, applicable standards should be referenced. The three standards that address the design and performance of PVC-coated rigid steel conduit are ANSI C80.1, UL6 and NEMA RN-1. ANSI C80.1, UL and NEMA have determined the appropriate ASTM standards and test methods that apply.

### Hot-dip galvanized threads

Since electrical conduit systems breathe, the threads will be exposed to the corrosive environment for the duration of the installation. NEMA RN-1-2005 is the electrical industry's standard for PVC externally coated galvanized rigid steel conduit. Section 2.1 of this standard states, "Where unusually corrosive environments are encountered, it is recommended that threads be given additional protection suitable for the intended application." Hot-dip galvanizing is the process through which the steel shell is dipped in molten zinc, causing the zinc to penetrate the steel. ABB hot-dip galvanizes the threads of the conduit, in addition to the conduit itself. This gives the threads the protection recommended in corrosive environments.

A compelling demonstration of the protection hot-dip galvanizing provides is shown at left, using a common corrosive agent, salt, on hot-dip galvanized threads. UL6, the standard for rigid metal conduit, references ASTM B117 for evaluating protective coatings. At left are the results of a salt-fog test using the standard test method ASTM B117.

## Evaluating corrosion protection of PVC-coated conduit (cont.)



Zinc coating surpasses requirement for corrosion resistance

### Why is the Preece test relevant to PVC-coated conduit?

In cases where the PVC protection is accidentally breached, resulting from cuts, scrapes, etc., it is critical to have a second line of defense — a zinc, or galvanized, coating. The zinc coating will significantly slow corrosion and allow more time for repairs. Conduit systems without adequate zinc protection underneath the PVC coating are most likely to suffer catastrophic corrosion damage. This is why NEMA RN-1 section 3.1.1 requires the proper and correct treatment of galvanized conduit before it is PVC coated. It states, “The surface shall be cleaned in such a manner that the galvanized surface of the conduit is not harmed or eroded.”

The purpose of the Preece test is to evaluate the zinc coating on galvanized rigid conduit to ensure adequate protection from corrosion per UL6.2.2. The test will also determine if the surface of the conduit has been damaged as a result of preparation for PVC coating.

### Galvanized conduit underneath the PVC coating — Preece test

With so much riding on the integrity of their electrical conduit systems, facilities need the superior protection offered by the ABB Ocal PVC-coated conduit systems. The simple fact is that the Ocal PVC-coated conduit system complies fully with the design and performance standards for PVC-coated conduit set forth by UL6, NEMA RN-1 and ANSI C80.1.

ANSI C80.1, UL6 and NEMA RN-1 have determined the appropriate ASTM standards and test methods that apply, and the Preece test is one test that must be passed to be in full compliance.

In evaluating the test results, the conduit receives a passing grade when the sample does not show a bright, adherent deposit of copper after four 60-second immersions in the copper sulfate solution. The conduit showing the bright, firmly adhering copper has failed to provide adequate zinc protection against corrosion.

The Preece test follows procedures set forth by UL6.2.2 and ASTM A239 and is the test recognized by UL6, NEMA RN-1 and ANSI C80.1 to adequately assess zinc protection for rigid steel conduit. The Ocal line of PVC-coated conduit systems, manufactured by ABB, complies with UL6, NEMA RN-1 and ANSI C80.1 without exception.

## Evaluating adhesion of PVC coating

01 Step 1 consists of two cuts through the plastic to the substrate along the length of the conduit at approximately  $\frac{1}{2}$ " apart, three to four inches in length. A third perpendicular cut crosses the lengthwise cuts.

02 Step 2 calls for the edge of the PVC that was cut on the perpendicular to be carefully lifted to form a plastic tab.

03 In Step 3, the tab is pulled perpendicular to the conduit with a pair of pliers. The plastic tab will tear off rather than having any peeling effect, or coating separating from the substrate.

04 Step 4 is the evaluation of the test, which in this case, results in a passing grade for Ocal. This result is more testimony to the fact that Ocal is "better by design."

The following demonstration shows Ocal PVC-coated conduit being subjected to the adhesion test.



01



02



03



04

The evaluation process for adhesion of PVC coating on conduit is governed by NEMA RN-1, section 3.8; Adhesion, which states that, "The adhesion of the PVC coating to the conduit shall be greater than the strength of the coating itself." This adhesion test is straightforward and simple. There are no specialized conditions necessary to perform this test. Ocal routinely performs quality control testing that includes the adhesion test, on conduit as it rolls off the line. Conduit that passes this test demonstrates that the adhesion will provide years of trouble-free service.

## Results

With Ocal PVC-coated conduit and fittings, you get corrosion protection that will extend the life of your electrical raceway systems for years and years.





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