SUPPORTING LEED V4 AND LIVING BUILDING CHALLENGE SUSTAINABLE DESIGN STANDARDS

SHERWIN-WILLIAMS COIL COATINGS CHROMIUM-FREE PRIMERS
FOR HOT-DIP GALVANIZED STEEL AND GALVALUME®
White Paper

SHERWIN-WILLIAMS
Coil Coatings

OVERVIEW

Interest in building more sustainable buildings is growing around the globe. Living Building Challenge (LBC), a leading international green building standard, is quickly gaining momentum as a comprehensive and advanced approach to sustainability. The U.S. Green Building Council's LEED—already the most widely used green building certification program in the world—has launched LEED v4, in part, to support manufacturers' ingredient disclosure and safer material selection. As a result, market demand has increased for chromium-free primers to meet both LBC and LEED v4 guidelines for hazardous material reduction and material transparency.

Sherwin-Williams Coil Coatings (formerly Valspar) PMY0500FP primer is hexavalent chromium-free and as part of the Fluropon® Pure coating system, is LBC Red List Compliant. When paired with approved pretreatments, topcoats, and backers, this primer can be used to deliver a coated product that is LBC Red List Free. Sherwin-Williams Coil Coatings initially approved the primer for use on Hot-Dip Galvanized (HDG) with a zinc phosphate pretreatment based on real-world performance data to support the decision. Sherwin-Williams Coil Coatings recently has expanded its warranty position based on real-world performance data to include HDG G90 (non-passivated and non-chemically treated) and Galvalume® AZ50 with Sherwin-Williams Coil Coatings approved dried-in-place pretreatments.

This paper provides an overview of the real-world exposure data that supports Sherwin-Williams Coil Coatings warrantied chromium-free primer solution for HDG and Galvalume. Sherwin-Williams Coil Coatings has been a leader in the development of chromium-free coatings since the early 2000s and continues to innovate with active evaluation underway for the warranty of additional pretreatment systems. Sherwin-Williams Coil Coatings is committed to formulating its coatings to perform strongly under real-world conditions—providing long-term durability and beauty.

Figure 1: Fort Myers exposure site with thousands of test panels.

BACKGROUND ON OUTDOOR CORROSION TESTING AND TEST PARAMETERS

Through extensive outdoor corrosion testing and ASTM B117 salt spray testing, Sherwin-Williams Coil Coatings has concluded that real-world conditions are the only true indicator of a chromium-free coating system's strengths and weaknesses. Sherwin-Williams Coil Coatings follows industry best practices from accreditation bodies to ensure precise, accurate test data in its extensive testing of this solution and in all coating tests. Sherwin-Williams Coil Coatings uses several testing sites around the world.

Provided below is background on the outdoor exposure sites used to test chromium-free primer panels:

- **Fort Myers, Florida**
  Sherwin-Williams Coil Coatings flagship facility is a world-class ISO 17025 accredited exposure site with the same certifications as third-party testing sites. Fort Myers has the most accreditations of any test facility owned by a manufacturer in the global coating industry. More than 100,000 panels have been on the exposure test fence for decades—some more than 40 years. This inland subtropical test site in Southwest Florida serves as an exceptional testing location because of a very warm, moist environment with strong UV rays from the sun. This environment is good for weathering and corrosion tests. However, it is approximately 15 miles inland from the Gulf of Mexico, so it is not a high-chloride, highly-corrosive site. Nonetheless, it is typical of many environments across the Southern United States. The facility also has accelerated outdoor corrosion and weathering test capabilities.

- **Daytona Beach, Florida**
  This warm, high-chloride, highly-corrosive test site is located 120 meters from the Atlantic Ocean and operated by the Battelle Memorial Institute. The environment makes the site very good for testing performance in a worst-case scenario for corrosion.

- **Rochester, Pennsylvania**
  This location in the Northeastern part of the United States is in an acid rain/high sulfur dioxide region. The environment has become less corrosive over the last 10 years as sulfur dioxide emissions have fallen, but is still typical of the industrial atmosphere and climate in the Northeastern United States.

COATING TEST PANEL PREPARATION AT TESTING SITES

Some test panels were flat, while others were configured with a tension bend. All panels had sheared (cut) edges, which provides a better indication of corrosiveness on building panels. Most panels were also scribed to simulate scratch damage points.

BACKGROUND ON SHERWIN-WILLIAMS COIL COATINGS LBC COMPLIANT FLUROPON® PURE COATING SYSTEMS

Sherwin-Williams Coil Coatings Fluropon® Pure PVDF coating systems for coil and extrusion applications use chromium-free primers and are LBC Red List Compliant. Declare Labels for Sherwin-Williams Coil Coatings Fluropon Pure PVDF Coating systems support and promote product transparency and informed product selection through voluntary disclosure of ingredients.

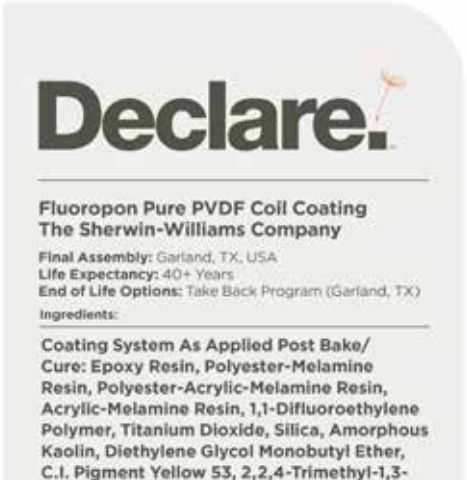


Figure 2: LBC Compliant Sherwin-Williams Coil Coatings Fluropon Pure PVDF Coil Coating system: applied after curing and baking; includes primer PMY0500FP, backer PMA0507FP and all Fluropon Pure topcoats.

Image above shows part of a Declare Label.
For complete information:
https://living-future.org/Fluropon-pure-pvdf-coil-coating

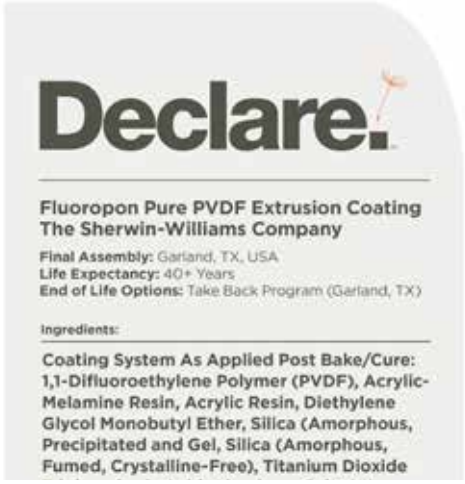


Figure 3: LBC Compliant Sherwin-Williams Coil Coatings Fluropon Pure PVDF Extrusion Coating system: applied after curing and baking; includes extrusion primer 732X1023FP and all Fluropon Pure Extrusion topcoats.

Image above shows part of a Declare Label.
For complete information:
https://living-future.org/Fluropon-pure-pvdf-extrusion-coating

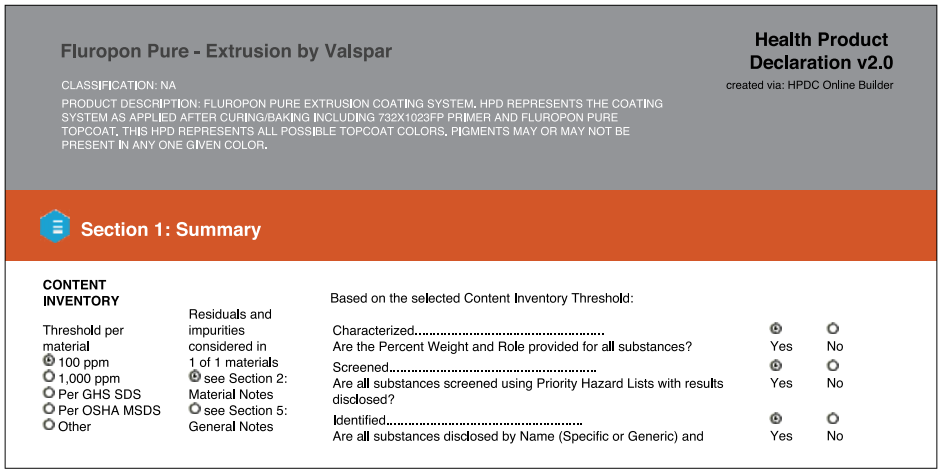


Figure 4: Sherwin-Williams Coil Coatings has completed Health Product Declarations (HPDs) for its Fluropon Pure Coatings and is participating in the newly launched HPDC Public Repository to provide the industry with a single, authoritative source for publicly available HPDs. Publishing HPDs in this repository provides the easiest path for users of products to find associated HPDs. It also signals commitment by participating companies to public disclosure and transparency. For a complete HPD, visit www.hpd-collaborative.org/hpd-public-repository/. Both the HPD and LBC's Declare label are approved programs to meet the transparency requirements in the LEED v4 new Materials and Resources credit "Building Product Disclosure and Optimization-Material Ingredients."

HOT-DIP GALVANIZED (HDG) EXPOSURE RESULTS FOR CHROMIUM-FREE PRIMER

Sherwin-Williams Coil Coatings HDG performance data shows:

- **Proven Pretreatments Work With Chromium-Free Primer:**
  Zinc phosphate with chromium-free sealer, as well as chromium-free dried-in-place pretreatment perform well based on real-world exposure.
- **Strong Real-World Performance:**
  Although there are some statistical differences, chromium-free edge and scribe corrosion is minimal on all systems in a two- to four-year time frame in Fort Myers and Daytona Beach, FL.

Figure 5: 9-year field test at Jaguar Land Rover building in Macomb, Michigan.

Let's take a look at the data and case studies that support Sherwin-Williams Coil Coatings warranty position.

HDG CASE STUDY 1: ZINC PHOSPHATE PRETREATMENT

When Sherwin-Williams Coil Coatings' first customer began looking for a chromium-free coating solution to meet the Living Building Challenge requirements, Sherwin-Williams Coil Coatings started the evaluation process by looking at its most comprehensive data—nine years of real-world performance data.

Sherwin-Williams Coil Coatings chromium-free primer was used on a roof application installed in 2006 at a Jaguar Land Rover dealership in Macomb, Michigan. For this roofing project, G90 HDG steel went through a two-stage pretreatment process using zinc phosphate, followed by a chromium-free seal, and then the Sherwin-Williams Coil Coatings PMY0500FP chromium-free primer and Fluropon® PVDF topcoat. The backside of the steel was coated with the PMY0500FP chromium-free primer and a standard-polyester backer.

When Sherwin-Williams Coil Coatings field technicians surveyed the building in 2015, they found the roof to be in excellent condition, with average drip edge corrosion creep of 4.5 mm after nine years of continuous service. There was no face blistering observed. Based on this field data, paired with other weathering exposure data, Sherwin-Williams Coil Coatings warrantied the use of HDG with a zinc phosphate pretreatment and chromium-free primer to respond quickly to the customer's needs.

HDG CASE STUDY 2: DRIED-IN-PLACE PRETREATMENT

The next step Sherwin-Williams Coil Coatings took was to look at real-world results for HDG with a chromium-free, dried-in-place pretreatment and chromium-free primer.

Sherwin-Williams Coil Coatings had multiple years of corrosion testing for this solution at test sites in Fort Myers and Daytona Beach, Florida. Together, the data showed strong performance for the chromium-free relative to chromium-containing products.

With this data, Sherwin-Williams Coil Coatings made a decision to warranty proven dried-in-place pretreatments with HDG for Living Building Challenge applications.

7-YEAR FIELD TEST AT FORT MYERS, FLORIDA

Longitudinal Edge Creep

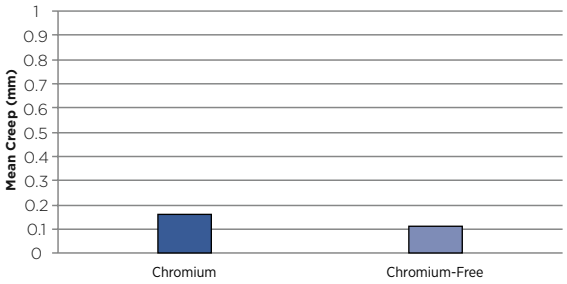
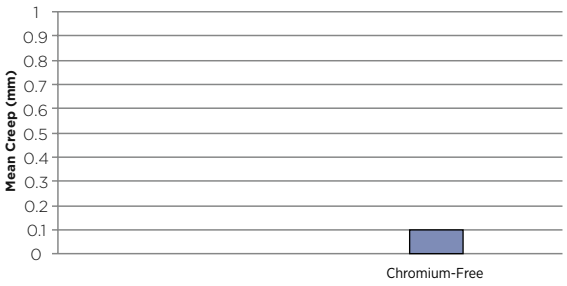


Figure 6: Sherwin-Williams Coil Coatings exposed test panels in Fort Myers, Florida, comparing chromium-free pretreatment and primer to chromium pretreatment and primer. This inland subtropical test site has very moist, warm air and strong UV rays. Corrosion was measured, and creep was minimal—less than 1 mm. Furthermore, the scribe, face and tension bends gave good performance on the corrosion test panels.

2-YEAR FIELD TEST AT DAYTONA BEACH, FLORIDA

Scribe Creep



2-YEAR FIELD TEST AT DAYTONA BEACH, FLORIDA

Longitudinal Edge Creep

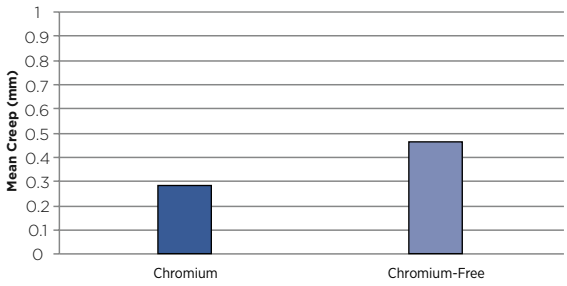


Figure 7: Sherwin-Williams Coil Coatings exposed test panels in Daytona Beach, Florida, comparing chromium-free primer to chromium primer. This coastal marine test site has very moist, warm air, strong UV rays and salt spray—a high corrosivity environment. Corrosion was measured, and creep was minimal— less than 1 mm on average. Furthermore, the scribe, face and tension bends gave good performance on the test panels.

CHROMIUM-FREE FORT MYERS AND DAYTONA BEACH PANELS

Figure 8: These HDG panels with a chromium-free primer show almost no visible corrosion. Photo on left is two-year exposure at 45°E Daytona Beach. Photo on right is seven-year exposure at 45°S Fort Myers.

GALVALUME® EXPOSURE RESULTS FOR CHROMIUM-FREE PRIMER

Sherwin-Williams Coil Coatings Galvalume® performance data shows:

- **Proven Pretreatments Work With Chromium-Free Primer:**
  This solution performs well based on real-world exposure data.
- **Salt Spray Tests Are Not Predictive:**
  ASTM B117 Standard salt spray testing does not predict results from coastal marine or inland subtropical exposures; values are exaggerated compared to outdoor, real-world exposure.
- **Edge Corrosion Rate Slows Over Time:**
  Rates slowed between the 17- and 29-month exposure time in the coastal marine environment, suggesting that coastal cut edge corrosion rate on painted Galvalume is not linear and slowly approaches an upper limit.

Let's take a look at the data and case studies that support Sherwin-Williams Coil Coatings warranty position.

GALVALUME CASE STUDY 1: 7-YEAR FIELD TEST AT FORT MYERS, FLORIDA

Sherwin-Williams Coil Coatings exposed test panels for seven years at a test fence in Fort Myers, Florida, comparing chromium-free primer to chromium primer. This inland subtropical location has very moist, warm air and strong UV rays. Corrosion was measured, and creep was so minimal that Sherwin-Williams Coil Coatings had to magnify it. (There was no intentional scribe line or tension bend on these panels.)

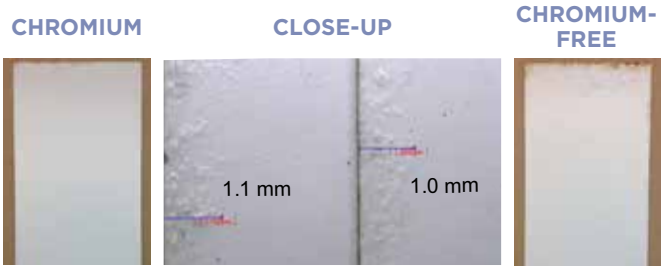


Figure 9: PMY0302 Primer with Silicone Polyester Topcoat

Figure 10: PMY0500FP Primer with Silicone Polyester Topcoat

2-YEAR FIELD TEST AT DAYTONA BEACH, FLORIDA

Sherwin-Williams Coil Coatings exposed test panels for two years at a test fence in Daytona Beach, Florida, to measure the performance of a chromium-free primer with chromium-free pretreatment on Galvalume. This coastal marine environment has very moist, warm air, strong UV rays, and salt spray—a highly corrosive environment. Corrosion was measured, and average creep was less than 3 mm. Furthermore, performance of the scribe, face, and tension bends was good.

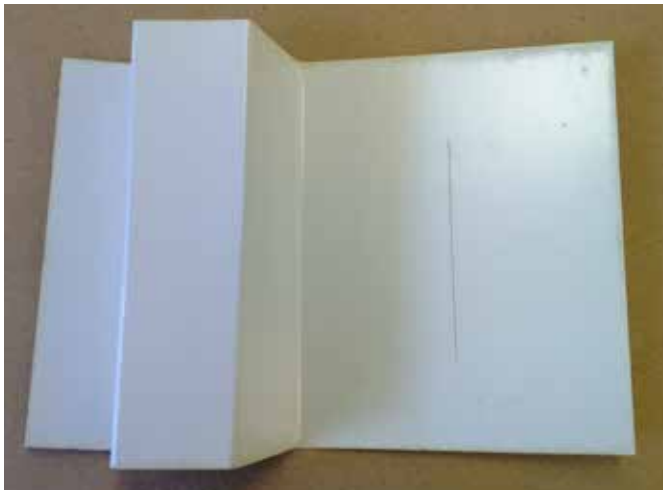


Figure 11: PMY0500FP Primer with Silicone Polyester Topcoat

GALVALUME® CASE STUDY 2: 52-MONTH FIELD TEST AT FORT MEYERS, FLORIDA

These panels compare chromium-containing primer to chromium-free primer. There is a small, almost invisible amount of edge corrosion about 1 mm in size. The face, tension bend, and scribe all look excellent, providing good confidence after more than four years in this moist environment.

CHROMIUM

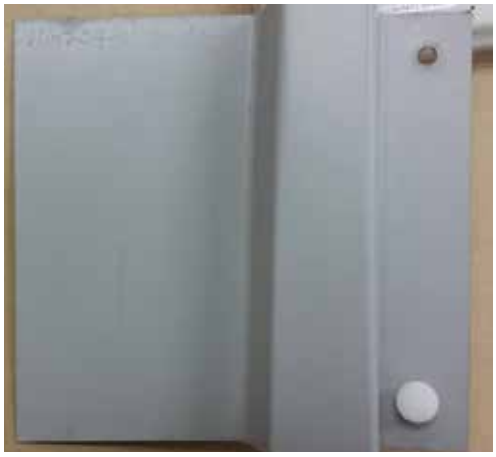


Figure 12: PMY0302 Primer with Fluropon PVDF Topcoat

CHROMIUM-FREE

Figure 13: PMY0500FP Primer with Fluropon PVDF Topcoat

NOTE: Panels represent the same topcoat quality (PVDF), which gives equivalent corrosion performance regardless of color.

39-MONTH FIELD TEST AT ROCHESTER, PENNSYLVANIA

These panels compare chromium-containing primer to chromium-free primer. The panels also performed well in this Northeast industrial environment. There is visible dirt, particularly on the chromium-containing sample, but corrosion was measured and found to be minimal—approximately 1 mm on average. Furthermore, no problems were observed with the scribe, face or tension bends.

CHROMIUM

Figure 14: PMY0302 Primer with Fluropon PVDF Topcoat

CHROMIUM-FREE

Figure 15: PMY0500FP Primer with Fluropon PVDF Topcoat

29-MONTH COASTAL MARINE EXPOSURE AT DAYTONA BEACH, FLORIDA

These panels compare chromium-containing primer to chromium-free primer. There is a small amount of edge corrosion. The face, tension bend, and scribe all look excellent, providing good confidence after 29 months in this corrosive environment.

CHROMIUM

Figure 16: PMY0302 Primer with Fluropon PVDF Topcoat

CHROMIUM-FREE

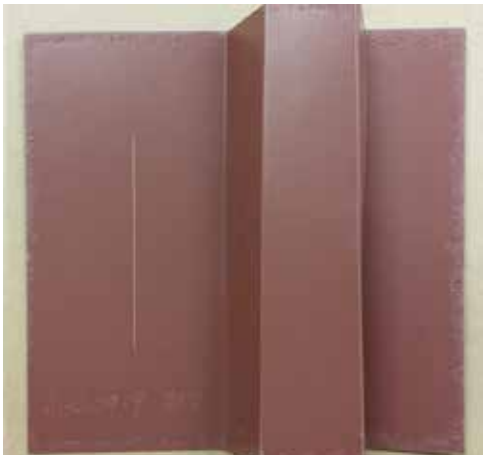


Figure 17: PMY0500FP Primer with Fluropon PVDF Topcoat

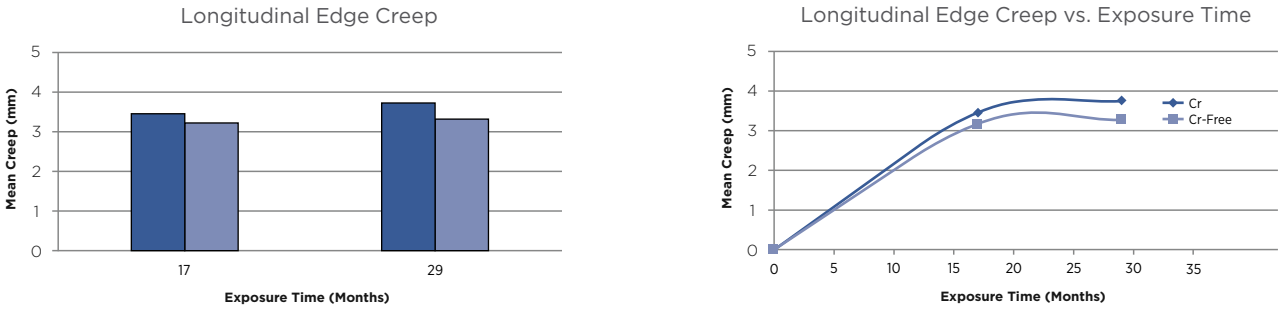


Figure 18: The samples were tracked throughout the 29 months. This graph shows that the edges corroded faster in the first 17 months; then there was little if any edge creep over the next 12 months, and the corrosion creep appeared to be approaching a limit. The 95% confidence interval brackets show that there is no statistical difference between the measured values for edge creep of chromium and chromium-free primers at this time. This data provides confidence that the chromium-free primer will perform well over time.

SHERWIN-WILLIAMS COIL COATINGS CHROMIUM-FREE PRIMERS
FOR HOT-DIP GALVANIZED STEEL AND GALVALUME®

SUMMARY

As a leading global manufacturer of coatings, Sherwin-Williams Coil Coatings is constantly innovating to develop new coating formulations that deliver beauty and long-term performance, along with meeting specific market needs. With a growing selection of green coating formulations, Sherwin-Williams Coil Coatings is on the forefront of science to support the growth of sustainable buildings.

Sherwin-Williams Coil Coatings has delivered warrantied chromium-free primers for HDG and Galvalume®. These primers are part of Sherwin-Williams Coil Coatings Fluropon® Pure LBC Red List Compliant coating system. When paired with an approved pretreatment system, customers can meet LBC Red List Free requirements for the coated product. Sherwin-Williams Coil Coatings Declare labels and HPDs also can be used to help building projects earn LEED v4 new Materials and Resources credits.

Strongly committed to ongoing research and development, Sherwin-Williams Coil Coatings' goals are to expand the use of Sherwin-Williams Coil Coatings chromium-free primer with more approved pretreatments as real-world data proves these solutions, and to formulate a Red List Free coating that delivers the durability and longevity expected by building owners. Sherwin-Williams Coil Coatings has a history of innovation and continues as an industry leader by driving technological advancements in coatings.

SOURCE

By Ted Best, Senior Scientist; and Teresa McGrath, Environmental Regulatory Toxicologist

SOURCES

coil.sherwin.com

LEED: usgbc.org/LEED

Living Building Challenge: living-future.org/lbc

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