

Finding the market's most

Durable and sustainable steel protection

It's time to **AVANTGUARD**

Introduction

When designing and specifying steel structures, the ambition is always the same: to deliver constructions that withstand time, weather, and use, while preserving their architectural beauty and functionality for generations to come.

37%

– of global CO₂ emissions come from construction

Today, that goal is more urgent. With resource scarcity and climate change, the construction industry must move beyond throwaway culture and focus on preservation. The stakes are high: **construction drives 37% of global CO₂ emissions¹**, while **corrosion costs \$2.5 trillion annually² – 3.4% of the world's GDP**. These figures underline the environmental and economic impact of neglecting durability.

These facts place a clear responsibility on the industry: reduce resource use, lower lifecycle costs, and build for longevity. Selecting the right steel protection is no longer just technical – it is a sustainability imperative. The risks of poor choices, from premature degradation to costly maintenance and replacement, are too great to ignore.

This paper guides you on how to choose the most durable steel protection and how the activated zinc-rich epoxy primer, Avantguard®, introduces a new standard in corrosion protection

methods. Enhanced with a proprietary activator, it outperforms zinc-free and conventional zinc-rich systems, achieving stronger long-term corrosion protection.

1. United Nations Environment Programme. (2023, September 12). Building materials and the climate: Constructing a new future. <https://www.unep.org/resources/report/building-materials-and-climate-constructing-new-future>

2. Engineering360 News Desk. (2016, March 21). Annual global cost of corrosion: \$2.5 trillion. GlobalSpec. <https://insights.globalspec.com/article/2340/annual-global-cost-of-corrosion-2-5-trillion>

ISO 12944 VS the real world

When lab tests **fall short**

Today, corrosion protection of steel structures is commonly guided by the international standard ISO 12944.

This standard is based on a series of accelerated laboratory tests designed to simulate the multi-decade exposure that steel structures typically endure (Part 6³ and 9⁴ in ISO 12944).

By accelerating intense environmental conditions into shorter timeframes, these tests aim to predict long-term performance. However, the accelerated laboratory tests cannot fully replicate the complexity of real-world environments in which steel structures must stand the test of time.

In natural settings, weather fluctuations are far more unpredictable than the controlled, cyclic conditions used in lab simulations. Real-life exposure includes sudden shifts

in temperature, irregular humidity conditions, and random environmental stressors that are difficult to reproduce under standardised test protocols.

Relying solely on ISO 12944 as a benchmark can therefore pose risks: increased maintenance requirements, unplanned operational disruptions, and the potential for premature degradation – all of which can impact project costs and reputation.

That's why it's essential to look beyond lab standards when specifying protective coatings – and to consider the solution proven to perform best under actual service conditions.

[Read more in this paper >](#)

3. ISO 12944-6:2018 – Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test methods

4. ISO 12944-9:2018 – Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures

Finding superior coating solutions in strong environmental conditions

Let's return to our core focus in steel construction - selecting the right corrosion protection for valuable assets. Independent industry testing and Hempel's field and lab tests reveal that zinc-rich primers consistently outperform zinc-free alternatives under real-world conditions.

For instance, in a marine test⁴ site in Norway – a high-corrosivity C5 environment – zinc-rich systems showed corrosion creep between 0.1-0.4 mm, while epoxy primers without zinc exhibited 1-4 mm creep. That's up to **10 times more corrosion for the zinc-free systems.**

An additional study⁵ conducted by researchers in Denmark and China further confirmed this: **zinc-rich primers delivered 9.5 times better corrosion resistance, outperforming zinc free epoxies in durability.**

Consistent with the independent research, Hempel's testing – across both accelerated cyclic ageing and real-world offshore exposures – demonstrates that zinc-rich primers deliver significantly lower rust creep than zinc-free systems. This performance holds true across both atmospheric and splash zone service conditions, indicating durable long-term protection.

Notably, while lab results showed up to 2.6 times less rust creep for zinc-rich primers, field trials revealed even greater reductions in corrosion progression – **up to 8.4 times less rust creep – when a zinc-rich primer was used.**

These findings underscore the importance of validating corrosion protection solutions under actual service conditions, rather than relying solely on laboratory tests.

**Zinc-rich
primers
compared
to zinc-free
alternatives:**

8.4×

**less corrosion in
offshore field study**

2.6×

**less corrosion in
cyclic ageing tests**

4. "Correlations between standard accelerated tests for protective organic coatings and field performance" (Knudsen et al., 2022)

5. "A quantitative real-time evaluation of rust creep propagation in coating systems exposed to field testing and cyclic ageing test." (Li, Shu, et al., 2023)

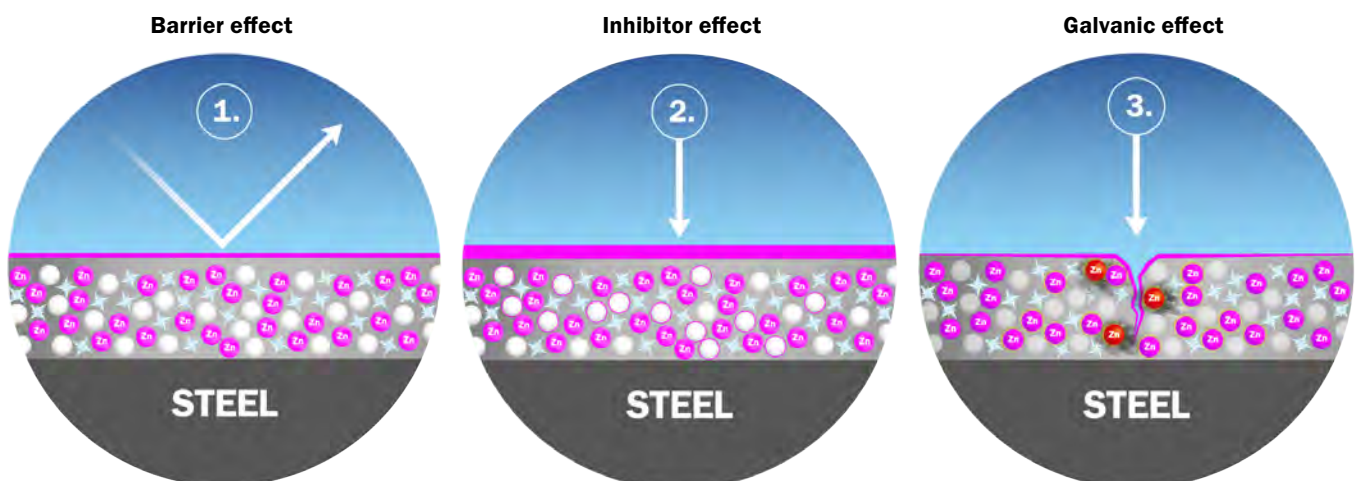
Latest development in coating technology

With zinc-rich primers already proven to perform far better than zinc-free systems in real-world conditions, the next step in coating technology is an even more advanced solution: activated zinc-rich primers.

Avantguard is the first of its kind, combining zinc, hollow glass spheres, and a proprietary activator to deliver **three layers of anti-corrosive protection: barrier, inhibitor, and galvanic effects.**

The result is stronger, longer-lasting protection than standard zinc-rich primers. Even in the harshest environments, Avantguard extends asset lifetime, reduces maintenance needs, and ensures more reliable performance over time.

In short, Avantguard consistently outperforms not only zinc-free primers but also conventional zinc-rich coatings – setting a new benchmark for steel protection and long-term sustainability, with less wasted steel and fewer resources consumed.



The different coating types

Zinc-free primers

Zinc-free epoxy primers protect by forming a dense, impermeable barrier that blocks moisture, oxygen, and contaminants – but unlike zinc-rich primers, they offer no sacrificial protection if the coating is damaged.

Zinc-rich primers

In contrast, zinc-rich epoxy primers offer a distinctive advantage: they provide sacrificial protection, meaning the zinc corrodes preferentially, shielding the underlying steel from damage.

Activated zinc-rich primers

Activated zinc-rich primers are advanced protective coatings that combine zinc, special activators, and barrier materials to deliver three layers of corrosion defense.

Conclusion

In the pursuit of the most durable and sustainable way to protect steel, we cannot rely solely on ISO 12944 and lab tests. Field results consistently demonstrate that zinc-rich primers outperform zinc-free alternatives under real-world conditions.

Now, the latest advancement — activated zinc-rich primers — raises the bar even further. That's why Avantguard, the first of its kind, is becoming the preferred choice for long-term corrosion protection.

With its triple-protection technology, Avantguard offers not only superior long-term performance but also a more sustainable solution – reducing waste, lowering environmental impact, and extending the lifetime of valuable steel assets.

Choosing Avantguard means up to :

50%

extended durability

35%

lower carbon footprint

30%

lower maintenance costs

It's time to Avantguard

For more information on how advanced steel durability solutions can benefit your projects, enhance sustainability, and improve cost-efficiency, we invite you to get in touch with our experts.

[Find your local expert here](#) >

About Hempel

As a world-leading supplier of trusted coating solutions, Hempel is a global company with strong values, working with customers in the decorative, marine, infrastructure and energy industries. Hempel factories, R&D centres and stock points are established in every region.

Across the globe, Hempel's paints and coatings can be found in almost every country of the world. They protect and beautify buildings, infrastructure and other assets, and play an essential role in our customers' businesses. They help minimise maintenance costs, improve aesthetics and increase energy efficiency.

At Hempel, our purpose is to shape a brighter future with sustainable coating solutions. We firmly believe that we will succeed as a business only if we place sustainability at our heart. Not only is it the right thing to do, it will strengthen our competitive position, make ourselves more resilient and reduce our risk.

Hempel was founded in Copenhagen, Denmark in 1915. It is majority owned by the Hempel Foundation, which ensures a solid economic base for the Hempel Group and supports cultural, social, humanitarian and scientific purposes around the world.

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