

# Flexibility Performance Attributes

**TriFLEX™**

## About This Paper

This white paper from Advanced Polymer Coatings discusses the flexibility performance attributes of our new product, TriFLEX™. The purpose of this document is to outline the challenges faced by exterior coatings in protecting assets from corrosion due to environmental exposures such as UV radiation and water and to detail how TriFLEX™ overcomes these challenges, particularly in the context of rail cars like hopper cars. The paper highlights the limitations of traditional epoxy-based coatings and explains the innovative resin technologies in TriFLEX™ that provide superior flexibility and durability.

This document serves as a resource for technical professionals, asset managers, and decision-makers in industries relying on exterior coatings, offering insights into TriFLEX™'s measurable flexibility benefits. The paper also provides standardized testing methods, including ASTM D522/522M, used to evaluate and compare coatings' performance. It presents data demonstrating TriFLEX™'s exceptional elongation and resistance to cracking under stress.

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# Executive Summary

Exterior coatings play a crucial role in shielding assets from environmental factors such as UV radiation, water, and other corrosive elements. This task is particularly daunting for assets like rail cars, especially hopper cars, which endure significant mechanical stresses. These stresses stem from the vibrations of moving down the track and the loading and unloading of cargoes. Weld seams inside hopper cars are especially vulnerable points, often necessitating frequent repairs due to continuous stress that causes the coating to crack. If left unrepaired, these cracks can lead to severe corrosion of the car, highlighting the urgent need for a more flexible and durable solution.

## Current Solutions and Limitations

Hopper cars are typically lined with epoxy-based coatings due to their excellent chemical and abrasion resistance. The high crosslink density of epoxy coatings contributes to this resistance. However, this same characteristic also makes them brittle and less flexible. Consequently, epoxy coatings are prone to cracking when subjected to repeated vibrational forces, particularly at weld seams, leading to premature coating failure and subsequent car corrosion.

## Measuring Flexibility

Flexibility in coatings is assessed through several standardized methods, with ASTM D522/522M being a widely recognized approach. In this test, coated panels are bent around mandrels of varying radii to identify any signs of cracking or peeling. The radius at which the coating begins to crack is recorded, and the coating's elongation is calculated using a standardized chart. For most epoxy-based coatings, cracking occurs at a radius of 1-2 inches, which corresponds to an elongation of 6-12%.

## The TriFLEX™ Solution

TriFLEX™ was explicitly engineered with three resin technologies to address the flexibility limitations of epoxy coatings used for exterior applications. Two of the three resins responsible for the coating's flexibility include:

**Polyurethane Resin:** Chosen for its high flexibility and superior adhesion properties.

**Proprietary Polymer Technology:** Similar to polyolefins, known for their inherent flexibility.

When evaluated for flexibility using ASTM D522/522M, TriFLEX™ exhibited no signs of cracking at any radius, indicating an elongation greater than 30%. This performance was further validated through additional tests where coated panels were bent in half in one direction and then in the opposite direction without any visible cracking or damage.

## Real-World Applications

The exceptional flexibility of TriFLEX™ translates to significant practical benefits, particularly in protecting critical areas such as weld seams in hopper cars. Its superior elongation properties result in fewer coating failures and extended asset life, ultimately reducing maintenance costs and downtime.

## Conclusion

TriFLEX™ represents a significant advancement in protective coating technology for rail applications. By overcoming the flexibility limitations of traditional epoxy coatings, TriFLEX™ offers enhanced durability, reduced maintenance needs, and better overall performance, making it an ideal solution for protecting rail assets against environmental and mechanical stresses.

