

Impact Resistance Attributes



About This Paper

This white paper from Advanced Polymer Coatings discusses the impact resistance performance attributes of our product, TriFLEX™. The purpose of this document is to outline the challenges faced by exterior coatings in protecting assets from mechanical damage due to vibrational forces, impacts during loading and unloading, and other operational stresses. It also details how TriFLEX™ overcomes these challenges, particularly in the context of rail cars like hopper cars. The paper highlights the limitations of traditional epoxy and polyurethane-based coatings and explains the innovative resin technologies in TriFLEX™ that provide superior impact resistance and overall 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 impact resistance benefits. The paper also provides standardized testing methods, including ASTM D-2794, used to evaluate and compare coatings' performance. It presents data demonstrating TriFLEX™'s exceptional direct and reverse impact resistance.

To provide feedback and stay informed about subsequent versions of this paper, please get in touch with us at Advanced Polymer Coatings.



Executive Summary

Successful exterior coatings must provide several protective services. Rail cars, including hopper cars, are at particular risk for mechanical damage due to how they are used and the conditions they experience. They can encounter a significant amount of vibrational force while in motion. The loading and unloading process also opens the possibility for impact and damage. Whether the force originates from the interior or exterior of the car, there is the potential for both aesthetic and performance-based damage. When a coating is cracked, it suffers visually and exposes the substrate to corrosion and other environmental challenges. This damage can be patched and repaired, but that involves time, resources, and taking the car out of service.

Challenges with Traditional Coatings

The typical technologies used in rail coatings today include epoxy or polyurethane chemistries. Epoxies provide excellent chemical and abrasion resistance because of their high crosslink density. However, this also makes epoxies brittle and decreases their flexibility and impact resistance. Polyurethanes can avoid this issue with good flexibility, but they fail regarding chemical resistance. Other technologies can involve complex application requirements, multiple coats, and long dry times.

Epoxies

- **Strengths:** High crosslink density, excellent chemical resistance, abrasion resistance.
- **Weaknesses:** Brittleness, decreased flexibility, poor impact resistance

Polyurethanes

- **Strengths:** Good flexibility and UV stability.
- **Weaknesses:** Lower chemical resistance compared to epoxies.

Innovation with TriFLEX

The innovative formulation behind TriFLEX™ combines all the best properties of these chemistries while eliminating the downsides. The triple resin system blends polyurethanes, polyaspartics, and a proprietary polymer technology. Each component works together to provide excellent flexibility and UV, chemical, and impact resistance. The polyurethane and proprietary polymer technology in TriFLEX™ gives the coating impact resistance with a one-coat application at a dry film thickness (DFT) of only 6-8 mils.

TriFLEX™'s Triple Resin System

- **Polyurethane Component:** Provides flexibility and UV resistance.
- **Polyaspartic Component:** Contributes to chemical resistance and rapid curing.
- **Proprietary Polymer Technology:** Enhances impact resistance and overall durability.

Impact Resistance Testing

Traditional methods for measuring the impact resistance of coatings are falling weight tests (ASTM D-2794). An impact tester, or drop tower, for falling weight tests is used by placing a coated metal sample under an indenter and raising the weight to a certain height before dropping it. The weight hits the indenter, which in turn impacts the coated sample, with the units of measurement being inch pounds. If the indenter strikes the coating directly, the damage observed is reported as having a direct impact, while the backside of the sample would show a reverse impact.

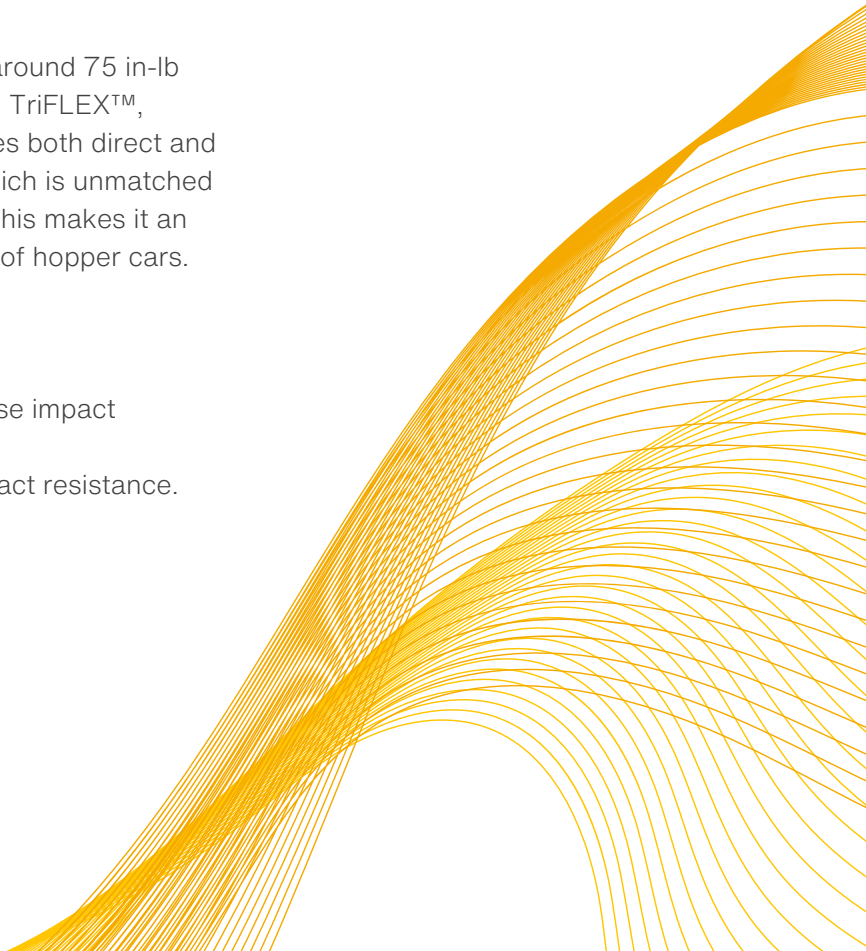
Falling Weight Tests (ASTM D-2794)

- **Direct Impact:** Measured by the damage observed when the indenter strikes the coating directly.
- **Reverse Impact:** Measured by the damage observed on the backside of the sample.

Performance Results

Typical epoxies may have impact resistance of around 75 in-lb and fail at much lower values for reverse impact. TriFLEX™, because of its unique combination of resins, gives both direct and reverse impact results greater than 160 in-lb, which is unmatched by an exterior coating available on the market. This makes it an ideal choice for applications such as the interior of hopper cars.

Comparative Impact Resistance

- **Epoxies:** ~75 in-lb direct impact, lower reverse impact resistance.
 - **TriFLEX™:** >160 in-lb direct and reverse impact resistance.
- 

Real-World Applications and Benefits

Rail Car Applications

Rail cars are subject to significant mechanical stresses and impacts during transportation and loading/unloading. TriFLEX™'s superior impact resistance ensures that the coating remains intact, protecting the substrate from corrosion and other environmental damage. This extends the lifespan of the railcars and reduces maintenance costs and downtime.

Benefits of TriFLEX for Rail Cars

- **Enhanced Durability:** Provides exceptional protection against mechanical damage and environmental factors.
- **Reduced Maintenance:** Minimizes the need for repairs and maintenance, reducing downtime and costs.
- **Extended Lifespan:** Protects the substrate from corrosion, extending the service life of railcars.
- **Cost-Effective:** One-coat application reduces labor and material costs.

Conclusion

TriFLEX™ represents a significant advancement in exterior coating technology, combining the best attributes of epoxies and polyurethanes while addressing their shortcomings. Its superior impact resistance, chemical resistance, UV stability, and durability make it a versatile and reliable choice for protecting railcars and other industrial assets. By choosing TriFLEX™, industries can ensure long-lasting protection and reduce the risk of mechanical and chemical-related damage, ultimately enhancing the performance and longevity of their assets.