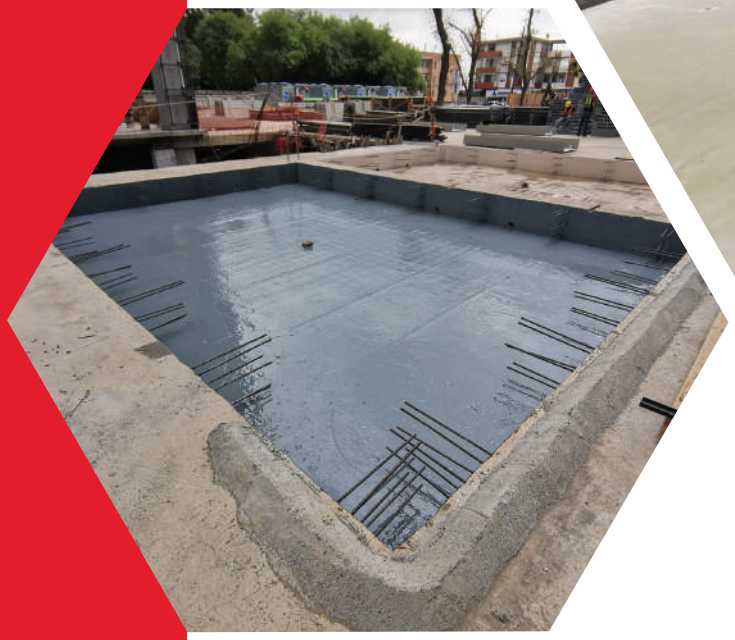
ULTIMATE LININGS



WHITEPAPER

Epoxy vs. Polyurea: Strength, Speed, and Durability

And The Winner Is?

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Introduction

When selecting a protective coating, the debate between epoxy and polyurea often arises. While high-quality epoxy coatings have long been a trusted option, advancements in polyurea technology are setting new benchmarks for durability and performance. Backed by real-world lab tests conducted in Ultimate Linings' ISO 17025-accredited laboratory, this article provides a data-driven comparison of the two materials, revealing which coating stands out as the superior choice for demanding environments.

The results and data presented in this report are based on Ultimate Linings XP-461 pure polyurea and a well-renowned two-pack high-build epoxy coating, commonly used in industrial, marine, and offshore applications. These coatings were evaluated under controlled conditions to reflect real-world performance. In the test data provided, both the epoxy and XP-461 polyurea were applied at a mean thickness of 75 mil to ensure a fair and realistic comparison of each material's capabilities at industry-standard build levels.

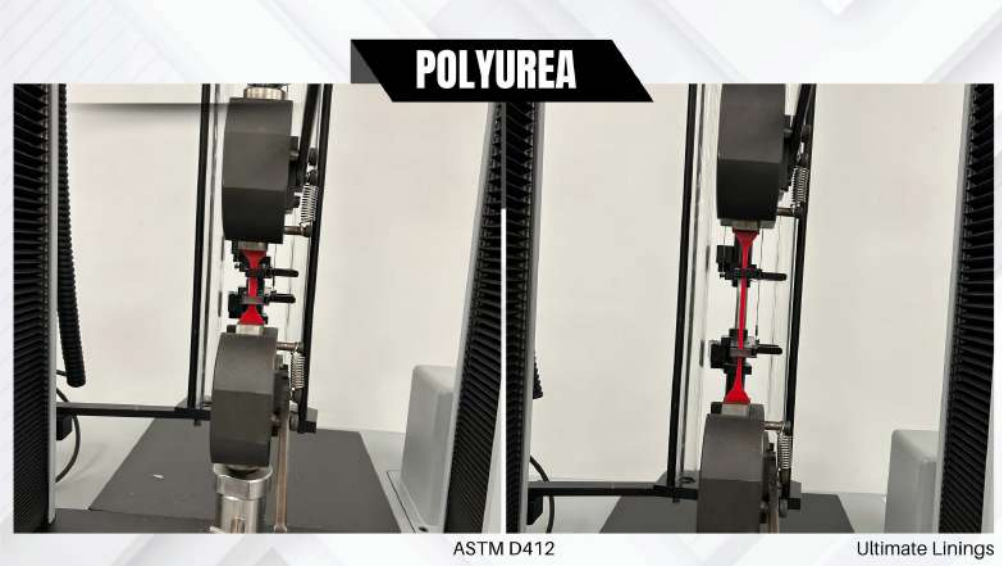
Performance Comparison: Epoxy vs. Polyurea

DURABILITY AND STRENGTH

- Epoxy Coating: While epoxy coatings are recognized for their robust mechanical strength, they are inherently rigid and lack flexibility. In ASTM D412 tensile strength and elongation testing, the epoxy coating demonstrated a tensile strength of approximately 925 psi and an elongation at break of only 13.45%, making it more susceptible to cracking under stress or impact, particularly in situations involving expansion and contraction of the substrate or where dissimilar materials are joined.

- **Pure Polyurea:** Ultimate Linings XP-461 delivered exceptional performance in **ASTM D412** testing, achieving a tensile strength of over 3254.43 psi and an elongation rate of 206.82%. This superior combination of strength and flexibility ensures XP-461 can withstand heavy impacts, dynamic stress, and substrate movement without failure—making it the more reliable choice for demanding applications.

ASTM D412	Epoxy	XP-461 Polyurea
Tensile Strength	925.15 psi	3254.43 psi
Elongation at Break	13.45%	206.82%
Verdict	Limited flexibility, susceptible to cracking under stress	Superior flexibility, resists cracking even under dynamic conditions.



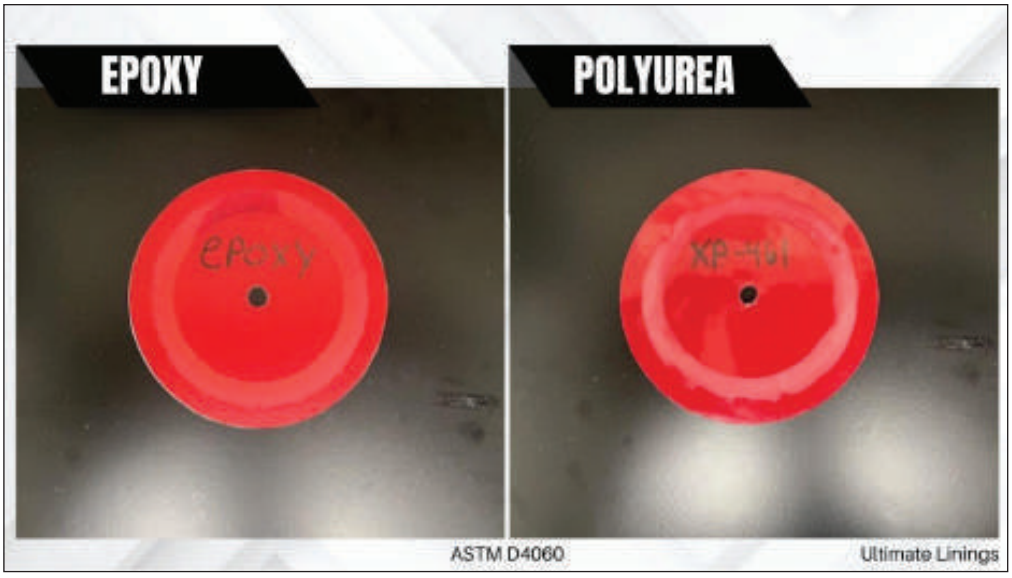
ABRASION RESISTANCE

ASTM D4060 – Taber Abrasion Resistance:
The Taber abrasion test assesses a material's resistance to surface wear caused by friction. It quantifies the rate of material loss under controlled abrasion, offering a reliable indicator of long-term durability in high-traffic or abrasive environments.

- **Epoxy:** While epoxy coatings provide moderate abrasion resistance, they are prone to gradual wear in high-traffic or industrial environments. In **ASTM D4060** abrasion resistance testing, the epoxy coating recorded a wear index of 36.97 mg/1000 cycles, indicating a steady rate of surface degradation under continuous friction and mechanical stress.

- **Pure Polyurea:** Ultimate Linings XP-461 significantly outperformed the epoxy in **ASTM D4060** testing, achieving a wear index of just 21.47 mg/1000 cycles. This result highlights XP-461's exceptional resistance to abrasion, making it the more durable option for environments exposed to heavy machinery, high foot traffic, and aggressive mechanical wear.

ASTM D4060	Epoxy	XP-461 Polyurea
Abrasion Resistance	36.97 mg/1000 cycles	2136.97 mg/1000 cycles
Verdict	Moderately durable but can experience gradual surface degradation when exposed to continuous friction or high-traffic environments	Offers superior abrasion resistance, meaning it will maintain its integrity longer . under mechanical stress, reducing maintenance frequency and extending the service life of the coating.



TEAR STRENGTH

ASTM D624 – Tear Strength:
Tear strength, or tear resistance, indicates how well a material can resist the propagation of a tear once a cut or notch is present. This test reveals the force required to extend a tear, providing insight into the material's toughness and resistance to physical damage.

- **Epoxy:** In **ASTM D624** tear strength testing, the epoxy coating demonstrated an average tear strength of 194 lb/in. While sufficient for general applications, this relatively low tear resistance limits its effectiveness in high-stress or dynamic environments, where materials are subjected to stretching, shearing, or impact forces.

- **Pure Polyurea: Ultimate Linings XP-461** delivered **exceptional performance in ASTM D624 testing,** achieving an **impressive tear strength of 608 lb/in**—more than three times that of the epoxy. This superior resistance makes XP-461 the **preferred choice for applications exposed to sharp objects, heavy loads, and extreme mechanical stress**, ensuring long-term durability and performance in demanding conditions.

ASTM D624	Epoxy	XP-461 Polyurea
Tear Strength	194.31 lb/in	608.55 lb/in
Verdict	The tear strength of 194 lb/in indicates that epoxy may be more susceptible to tearing, especially in applications where the substrate experiences dynamic loads or sharp impacts.	With a tear strength of 608 lb/in XP-461 provides exceptional resistance to cuts, punctures and tearing forces. This makes it highly reliable in demanding environments where structural flexibility and resilience are critical.

HARDNESS (ASTM D2240 - SHORE D)

ASTM D2240 – Shore D Hardness:
The Shore D Hardness Scale evaluates the surface hardness of rigid materials like hard rubber and plastics. Measured on a scale from 0 to 100, higher values indicate greater resistance to indentation, and therefore a harder material.

- **Epoxy:** In **ASTM D2240 hardness testing,** the epoxy coating recorded a **mean Shore D hardness of 61.60.** This level of hardness provides a solid, rigid surface, which is beneficial for applications requiring a firm, impact-resistant barrier. However, **its slightly higher rigidity can contribute to brittleness**, increasing the likelihood of surface cracking under sudden stress or substrate movement.

- **Pure Polyurea: Ultimate Linings XP-461** achieved a **mean Shore D hardness of 62.9 in ASTM D2240 testing**, offering a balance between hardness and flexibility. While comparable to epoxy in surface rigidity, XP-461's **higher elongation and tear strength** ensure it can absorb impact and substrate movement without compromising structural integrity – making it a more **resilient choice in dynamic environments.**

ASTM D2240 - Shore D	Epoxy	XP-461 Polyurea
Hardness	61.60 Shore D	62.9 Shore D
Verdict	Offers a firm, rigid barrier but may lead to brittleness and cracking under sudden stress, sharp impact or if the substrate experiences a dynamic load.	Strikes a balance between rigidity and flexibility, enhancing resilience under impact and movement. It is highly reliable in demanding environments where structural flexibility and resilience are critical.

IMPACT RESISTANCE (ASTM D2794)

ASTM D2794 – Impact Resistance:
*This test evaluates a coating's **ability to withstand mechanical impact without cracking**. It is commonly used to predict how well an organic coating system will perform under sudden or forceful contact in real-world applications.*

- **Epoxy Coating:** In **ASTM D2794 impact resistance testing**, the epoxy coating demonstrated **limited ability to absorb sudden force**, failing at **drop heights of 40 and 30 inches**. Additionally, its **mean failure energy was measured at 240 in·lb**, confirming its **brittle nature** when subjected to significant impact. These results highlight epoxy's vulnerability to cracking or chipping under mechanical stress, making it **less suitable for applications exposed to repeated impact or dynamic loading**.

- **Pure Polyurea: Ultimate Linings XP-461** ahowcased **exceptional impact resistance**, with **no failure observed at the maximum drop height or energy capacity of the testing machine**. This result proves XP-461's ability **to absorb and dissipate impact forces** without structural compromise. Its superior flexibility and durability make it **the ideal choice for environments where coatings must endure continuous mechanical stress, heavy impacts, or substrate movement without cracking or failing.**

ASTM D2794	Epoxy	XP-461 Polyurea
Impact Resistance - Failure Height	Failures at 40 and 30 inches	No failure observed
Impact Resistance - Failure Energy	240 in·lbs	No failure observed
Verdict	Fails at lower drop heights (40/30 inches) with a mean failure energy of 240 in·lb, indicating vulnerability to cracking under repeated impact.	Withstands maximum drop heights and energy capacities, demonstrating superior ability to absorb and dissipate impact forces without damage.

TEST DATA RECAP:

Test Type	Epoxy 646	XP-461 Polyurea
Tensile Strength (ASTM D412)	925.15 psi	3254.43 psi
Elongation at Break (ASTM D412)	13.45%	206.82%
Tear Strength (ASTM D624)	194.31 lb/in	608.55 lb/in
Hardness (ASTM D2240 - Shore D)	61.60 Shore D	62.9 Shore D
Abrasion Resistance (ASTM D4060)	36.97 mg/1000 cycles	21.47 mg/1000 cycles
Impact Resistance - Failure Height (ASTM D2794)	Failures at 40 and 30 inches	No failure observed
Impact Resistance - Failure Energy (ASTM D2794)	240 in·lb	No failure observed

Application Comparison: Epoxy vs. Polyurea

DRY TIMES AND INSTALLATION EFFICIENCY

- **Epoxy Coating:** High-quality epoxies, while offering strong adhesion and durability, require significantly longer **gel times and cure periods**, which can slow down project timelines. The Epoxy coating we tested has a **dry time to touch ranging from 1.5 to 5 hours,** depending on temperature and humidity conditions. However, full cure can take anywhere from **4 to 14 days**, making it **less practical for fast-paced industrial or commercial applications** where downtime must be minimized. This extended curing process can also delay the application of additional coatings or the return to service, further impacting efficiency.

- **Pure Polyurea: Ultimate Linings XP-461**, as a **pure polyurea**, is engineered for **rapid curing and immediate usability**. With a **tack-free time of just 5–10 seconds**, XP-461 allows for **instant return to service**, drastically reducing downtime. It is **usable within hours** and reaches full cure within **24 hours**, with additional post-curing strength developing over **7 days**. This fast-setting nature is particularly beneficial in industries where c**oating efficiency, quick project turnaround, and operational continuity** are essential.

APPLICATION EQUIPMENT

- **Epoxy Coating:** High-quality epoxies offer **greater application versatility**, as they can be applied using **airless spray, conventional spray, brush, or plural component spray equipment**. This flexibility makes epoxy a viable option for projects where specialized equipment is not available or where smaller, detailed applications are required. However, **the manual application methods can result in longer installation times**, especially for large-scale projects.

- **Pure Polyurea: Ultimate Linings XP-461**, as a **pure polyurea**, requires **high-pressure, plural component spray equipment**, such as the **Graco Reactor 3 E-XP2**, for proper application. While this equipment represents a higher initial investment, it is specifically designed for **high-volume applications and large surface areas**, ensuring rapid, uniform coverage with superior adhesion. This makes XP-461 **the preferred choice for industrial and commercial projects** where speed, efficiency, and performance consistency are critical.

Category	Epoxy Coating	Pure Polyurea (XP-461)
Dry Time to Touch	1.5 – 5 hours	5 – 10 seconds
Usable Within	Varies, often requires multiple days	Within hours
Full Cure Time	4 – 14 days (temperature-dependent)	24 hours (full strength develops over 7 days)
Project Downtime	Extended downtime due to long cure periods	Minimal downtime, immediate return to service
Suitability for Fast-Paced Projects	Less ideal due to prolonged cure times	Highly suited due to rapid setting and usability

Why Choose Pure Polyurea?

1. **Enhanced Longevity**
   With its superior strength, abrasion resistance, and impact flexibility, pure polyurea coatings such as XP-461 significantly outlasts traditional epoxy coatings, reducing maintenance costs over time.

2. **Fast Application**
   The rapid gel and cure times of XP-461 translate to minimal disruption for businesses, unlike epoxies, which often require extended curing periods.

3. **Versatility**
   XP-461 adapts to a variety of environments, from warehouses to outdoor structures, providing consistent performance across temperature extremes and high-stress applications.

Final Thoughts

While **high-quality epoxy coatings** offer decent performance for general use, **Ultimate Linings XP-461** pure polyurea delivers exceptional durability, flexibility, and efficiency. Its superior mechanical properties, faster installation, and long-term reliability make it the clear choice for demanding industrial and commercial applications. If you're seeking the ultimate protection solution, XP-461 pure polyurea stands unrivaled.

Ready to protect your assets and minimize downtime? Contact Ultimate Linings today for a free consultation and discover how Ultimate Linings Pure Polyurea can transform your operations.

Contact us today at (800) 989-9869 or visit www.UltimateLinings.com to get started.