Whitepaper

Envalior
Imagine the Future

SOLVING TIRE PRESSURES WITH *MATERIAL SOLUTIONS*

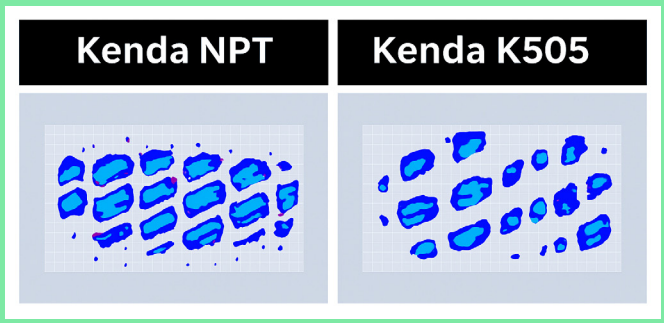
Tire performance is shaped by design—not air—fueling the rise of non–pneumatic solutions.

Off highway and recreational vehicles face constant shifts in terrain, hidden hazards, and operating conditions. These factors expose the limitations of traditional pneumatic tires, such as puncture and blow outs, uneven or accelerated wear, heat sensitivity, and limited durability in harsh environments. These limitations lead to equipment downtime and revenue loss.

A single flat on a pneumatic tire can exceed the cost of a non–pneumatic tire installation. NPTs deliver greater efficiency and reliability, especially in challenging terrain and demanding environments.

NON–PNEUMATIC *TIRE BENEFITS*

- **Airless design** – eliminating downtime and labor for flat tire service calls
- **Extended service life** – 2–3x longer than traditional tires
- **Dynamic absorption of energy** during impact, creating a much more smooth and comfortable ride.
- **Tunable web design** improves contact patch design, minimizing turf damage*
- **Hard tread surface with soft response** of the overall tire – resulting in improved wear performance without jeopardizing ride quality



* **Footprint Study**
The study demonstrates that the flatter tread's bar–shaped footprint provides better traction and reduces turf tearing compared to the pneumatic tire's oval footprint.

AIRLESS TIRES *FIND WIDER USE* IN OFF–ROAD MARKETS

Non–pneumatic tires are increasingly popular in the outdoor power equipment segment, with strong growth in the all–terrain vehicle (ATV), utility vehicle (UTV), and lawn care markets. They all have common pneumatic tire issues, including high rebound and poor damping on rough terrain, durability flaws, routine tire pressure monitoring, and downtime due to a flat.

The popularity of non–pneumatic tires in ATV/UTV markets began as a solution for niche applications such as military forces operating in remote locations. Today, they're becoming increasingly popular for vehicles used in off–highway contract work, construction, farming, mining, emergency service response, recreation, and other debris–laden areas where flat tires cause serious interruptions and potential personal safety risks.

Even in recreational vehicle industries, such as the golf cart market, leading manufacturers are beginning to utilize the superior handling and reduced maintenance needs to improve the customer experience on and off the course.

LANDSCAPERS IMPROVE *UPTIME & CUTTING PERFORMANCE*

In the commercial lawn equipment market, leaders such as Kendra, Toro, and John Deere are increasingly leveraging the benefits of non–pneumatic tires in zero–turn mowers for professional landscaping. Repairing a flat tire is relatively inexpensive, but when landscapers account for machine downtime, the real cost can range from $150 to $350 of lost revenue during repair. And, because there is no need to maintain consistent air pressure to avoid balance issues with non–pneumatic tires, mower decks stay level for a more even cut, increasing customer satisfaction.

Proven TPC (TPE–E) Material for Durable, Sustainable Non–Pneumatic Tires

Envalior engineers have partnered with leading tire manufacturers and OEMs to identify an optimal material solution for non–pneumatic tires. After years of rigorous testing versus thermoplastic polyurethane (TPU) and other materials, Envalior's Arnitel® Performance copolyester elastomer TPC emerged as the material of choice. TPC is also referred to as TPE–E.

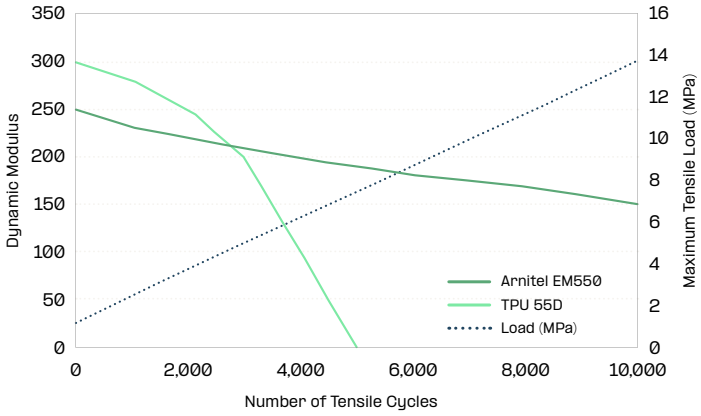
Arnitel® Performance is properly suited for non–pneumatic tire applications due to its outstanding mechanical performance — flex fatigue endurance, high load bearing capability, excellent dynamic creep resistance, superior tear and abrasion resistance, and high–impact strength. Industry leaders also appreciate the enhanced sustainability of a tire manufactured using recyclable plastics instead of rubber.

These mechanical properties are combined with the thermal properties of Arnitel® Performance, making it consistently perform under all foreseeable climate conditions:

- A wide operating temperature (–30 to +100°C)
- Extremely low temperature ductility (< –40°C)
- Stable modulus as a function of temperature

Additional benefits are strong resistance to weathering, chemicals, hydrolysis, and microbial growth.

Dynamic Tensile Creep Comparison
Tensile hysteresis [@1Hz] load increasing per cycle @23°C



Envalior's Arnitel® Performance is a superior solution for high–load and durability requirements compared to thermoplastic polyurethane (TPU) materials.

M. El Fray, V. Altstadt Polymer 44 (2003) 4635–4642

Arnitel® Recommended Grades

Grade	Melt volume flow rate (cm3/10 min)	Tensile modulus (MPa)	Density (kg/m³)	Shore D Hardness (3s)
ARNITEL® PL420–H	23	100	1180	38
ARNITEL® EM460–08	46	85	1150	43
ARNITEL® PL461	39	135	1200	45
ARNITEL® EL550–08	23	170	1200	54

To learn more about our materials for non–pneumatic tires, contact us via Envalior.com.

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