

## MICHELIN® X® TWEEL® SSL airless radial tire — Innovation Description

### What is the innovation and why is it innovative?

The MICHELIN® X® TWEEL® SSL is the world's first commercially-available airless radial mobility solution for skid steer loaders. Landscapers, general contractors, and other owners of skid steer loaders normally experience several flat tires per month on their existing pneumatic tires. The MICHELIN X Tweel SSL solves this problem by delivering no maintenance, no downtime and no compromise. It provides the advantages of no maintenance of air pressure, easy mounting, damage resistance, increased operator comfort, reduced operator fatigue, improved productivity, longer wear life and excellent traction. The MICHELIN 12N16.5 X-Tweel SSL hub design is universal and can be placed on most skid steer loaders.

### What did it change or replace?

The pneumatic tire has proven to be the dominant design for rolling transport since shortly after its invention by John Boyd Dunlop in 1888. The pneumatic tire brought durability and reliability, as well as maintenance problems. To reduce expensive downtime from flats, many skid steer users fill their pneumatic tires with foam or replace them with solid tires, resulting in machines with inadequate traction, handling and ride comfort. This solution replaces all of the other current offerings. The value of this product has been realized by many skid steer loader operators across North America allowing them valuable up-time for their bottom-line.

### Where and when did it originate, how long has it been used, and how is it expected to be used in the future?

In 1997, Dr. Tim Rhyne and Steve M. Cron, engineers at the Michelin Americas Research and Development Center in Greenville, S.C., began to think about the critical characteristics of the pneumatic tire that made all other wheels obsolete and study the critical characteristics obtained with a non-pneumatic structure. They envisioned a future where vehicles would be able to be driven without experiencing a flat due to loss of air.

When the co-inventors started working on this premise, they were still designing a structure that looked like a regular pneumatic tire. What they discovered was that because they didn't need to seal in the air pressure, they could change the configuration of the tire and in doing so the concept of the Tweel airless radial tire (a tire and wheel assembly) was born. The Tweel tire replaces the 23 components of a typical radial tire. The Tweel tire is comprised of a rigid hub, connected to a circular shear band by means of flexible, deformable polyurethane spokes and a tread band, all functioning as a single unit.

Over the following decade, the engineers worked diligently on various prototypes of the Tweel tire and in 2005, the Tweel prototype was finally showcased at the North American International Auto Show in Detroit, Mich. on the iBOT wheelchair and Segway Concept Centaur Human Transporter. The innovation resulted in recognition by [TIME Magazine](#) as "One of the Most Amazing Inventions of 2005," by *Popular Science* magazine as one of the "100 Most Innovative Products of the Year," and by the InnoVision Hall of Fame.

Through the next several years, the concept of the single-piece tire and wheel assembly was tested on many various types of vehicles from construction to military to passenger vehicles. NASA contracted Michelin to develop a wheel for the next generation Lunar Rover which resulted in the Lunar Rover Initiative AB Scarab wheels.

The first commercially available Tweel tire was offered for sale in July 2012 to the market through local tire dealers in the United States and Canada. While there have been several airless radial concepts and prototypes introduced, Michelin remains the only company worldwide to have an airless radial product currently on the market.

Michelin continues to work on other Tweel applications and options where safety, security and downtime present challenges for operators. Michelin® Tweel® Technologies will continue to work on identifying markets where straightforward and rapid adaptation to the vehicle is possible and will value the Tweel tire's unique performance characteristics. The next applications will be engineered for light weight and low speed. Car and light truck applications remain at the concept phase and are years away from market production. Just as the radial tire, which was invented by Michelin in 1946 but not widely accepted in the U.S. until the 1970s, the new Tweel technology will be guided by acceptance, regulations and market conditions.

### If the nomination is for an innovative project, specifically identify each of its innovations.

- Introduction of the first commercially available airless radial mobility solution for skid steer loaders
- Delivers a no maintenance, no downtime and no compromise solution for the flat tire challenges experienced in this segment
- Provides excellent traction, comfort and stability while eliminating concerns about downtime and maintenance
- Has an increased footprint with strong wear life that is two to three times that of the pneumatic tire at equal tread depth
- Is retreadable, providing a more eco-friendly and sustainable alternative to the other skid steer loader tire options

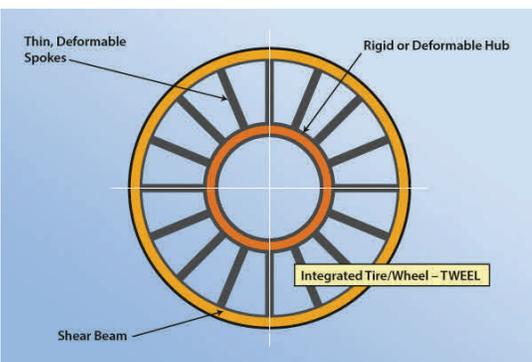


The development of this innovation has allowed Michelin’s research engineers to explore innovation at its fundamental elements. This is the backbone of Michelin.

By challenging the Michelin Engineers to discover why a pneumatic tire was the dominant technology for mobility, despite the inherent vulnerability associated with air loss, a new concept was born that has changed the landscape of mobility solutions.

The Tweel offers a number of inherent advantages due to its revolutionary design. The spokes transfer the load around the circumference of the tread band, the Tweel delivers pneumatic-like performance with excellent shock absorption and lessens the impact to the operator, loader and work surface. The user will experience:

- **minimal downtime** (flat tires and air pressure checks eliminated, over/under pressure situations eliminated, fewer idle man hours, equipment changes/charges and missed deadlines),
- **improved productivity** (greater stability and shock absorption means greater operator ride comfort and reduced driver fatigue to improve operator effectiveness)
- **longer life** (increased footprint size and equal tread depth, 2-3 times longer wear life than radials, replacing only a tread will contribute to a more environmentally sustainable solution)
- **simplified logistics and maintenance** (minimal maintenance with single unit replacement which bolts on and eliminates tire/wheel/valve assembly and mounting/dismounting)
- **damage resistance** (puncture resistance from surface hazards and difficult off-road conditions for continuous mobility)
- **superior performance** (greater rolling resistance, optimized footprint and a best in class solution)



The company has realized several benefits from the project. As a leader in the tire industry, Michelin focuses on innovation. Innovation has always been the cornerstone of Michelin, and it will continue to differentiate our company, products and services and be an engine for growth. Innovation is the backbone of Michelin; it is an integral part of the Michelin DNA.

