

PRESS RELEASE

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Did you know?

Michelin's lunar wheel prototype at the 2024 Le Mans 24 Hours

- The Le Mans 24 Hours will see Michelin reveal an airless lunar wheel prototype conceived to meet NASA's tender brief for its Artemis programme.
- Michelin's lunar wheel prototype provides further evidence of its expertise in the field of composite materials, a cornerstone of the Group's growth.
- On ordinary roads, at the Le Mans 24 Hours and on the Moon alike, Michelin's is continuously breaking new ground thanks to its unique capacity for innovation.

The objective of NASA's Artemis programme is to explore the Moon's south pole, where no human has ever been, in order to acquire scientific data and search for water in the form of ice.

Michelin is in the process of developing an airless wheel for the project's rover which will need to operate on the Moon for a decade, carry two astronauts, explore remote areas and take samples.

Between manned missions, this vehicle will be expected to travel to the different landing points by its own means and function independently, a huge leap in comparison with NASA's Apollo work over the period 1961 to 1972.

"For 135 missions from 1995 until 2007, NASA entrusted Michelin with the design and production of the tyres for its space shuttle," says **Christophe Moriceau**, Michelin's Director of Advanced Research. "We have since carried out research for a variety of lunar vehicles and, in 2021, began a new collaboration with the Intuitive Machines design team and its partners: Northrop Grumman, Boeing, and AVL to develop wheels for the Artemis lunar rover. This is how we became involved in the programme after responding to a call for tenders launched by NASA."

This wheel will clearly have to cope with extreme conditions once on the Moon:

- Adhesion: with gravity one-sixth of that on Earth, the Moon stands out as a unique challenge, irrespective of the vehicle's size or weight. It can be hard enough to climb sandy slopes on Earth, but it is even more complex on the Moon where the rover will face inclines of up to 20 degrees on loose, virgin ground. This will call for specific, durable wheels that provide grip on a wide spectrum surface types, aided by having the biggest contact patch possible in the same way that we wear albeit less flexible snowshoes to spread our weight when walking on snow.
- **No atmosphere:** the Moon's surface is not protected by an atmosphere. UV levels are consequently much higher and materials age significantly faster. The rover's wheels will be in permanent contact with the ground and subject to attacks from the sun and UV light.



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They will also need to resist electromagnetic radiation. These phenomena will clearly impact on the performance of the vehicle and its wheels, so it is vital to address them through in-depth work on materials and their tribologic properties (frictional interaction), as well a thorough understanding of what it takes to function in such a hostile environment.

- Low rolling resistance: The rover will spend much of its time in the shade and will therefore not be able to recharge its batteries frequently by means of its solar panels. As a result, the materials and design conceived by Michelin will have to minimise energy needs in order to preserve the vehicle's autonomy. The less resistance it has to overcome when moving forward – resistance caused directly by its wheels – the less energy it will require to do so.
- **Resistance to abrasion:** sand at the Moon's southern pole has been subject to very little erosion, which means it can be very aggressive and abrasive to surfaces that come into contact with it. To function reliably over 10,000km/10 years, and in addition to its all-terrain capabilities on sand, rocks and craters, the vehicle's wheels will need to be made of particularly resilient materials capable of maintaining their properties irrespective of the conditions.
- **Climate:** scientists hope to find water in the form of ice in temperatures that can fall to almost -250°C, but which climb to +100°C in places. This variation does not exist on Earth and only exceptional materials through their composition and ability to deform will be able to survive.

The volcanoes of France's Massif Central to replace the Moon for development work

Although samples of lunar rock have been brought back from previous missions, scientific publications are the chief source of reference for Michelin's research experts. This is how they realised that France's volcanic Auvergne region – not far from the firm's Clermont-Ferrand's headquarters in the Massif Central – bears certain similarities with lunar soil, making it ideal for testing purposes.

Michelin's capacity for innovation showcased on ordinary roads, at the Le Mans 24 Hours... and on the Moon

There may be precious little in common between the MICHELIN Pilot Sport Endurance tyres raced by the FIA World Endurance Championship's Hypercars and the airless tyres engineered to spend 10 years on the Moon, but both are eloquent of Michelin's unique capacity for innovation in its quest for optimal performance over the longest possible time-frame!

Both are the fruit of Michelin's research facilities in Clermont-Ferrand, France, and owe their exceptional longevity to the advanced materials developed thanks to the knowledge and know-how of the 6,000 experts who work out of the firm's Research and Development Centres.



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In the world of motor racing, Michelin's unique grasp of materials enables it to provide its partners with lasting performance. Indeed, driven by the belief that the chief environmental quality of a tyre is its ability to last, Michelin has long turned to innovation to maximise tyre life.

Over the years, this has produced a long list of longevity-related records at racetracks around the world. Since 2011, for example, Michelin tyres for endurance racing's premier class have successfully covered more than 700 kilometres at the Le Mans 24 Hours while posting near-consistent lap-times. That's equivalent to the distance of more than two Formula 1 grands prix. At the same time, Michelin has halved the number of tyres actually consumed in the race compared with the early 2000s.

More recently, at last April's 6 Hours of Imola in Italy, one of the Ferrari prototypes completed 129 laps/632km on a single set of tyres.

The solutions that make up Michelin's endurance racing range are capable of taking long distances in their stride at very high average speeds, despite the exceptional loads and extremely high longitudinal and lateral forces generated by today's sophisticated Hypercar prototypes.

In addition to enabling the company to explore new forms of mobility and applications for a brighter future, Michelin's unique expertise is consolidating its place at the cutting edge, not only in motorsport and on ordinary roads, but also – why not? - in space!

About Michelin

Michelin is building a world-leading manufacturer of life-changing composites and experiences. Pioneering engineered materials for more than 130 years, Michelin is uniquely positioned to make decisive contributions to human progress and to a more sustainable world.

Drawing on its deep know-how in polymer composites, Michelin is constantly innovating to manufacture high-quality tires and components for critical applications in demanding fields as varied as mobility, construction, aeronautics, low-carbon energies, and healthcare.

The care placed in its products and deep customer knowledge inspire Michelin to offer the finest experiences. This spans from providing data- and AIbased connected solutions for professional fleets to recommending outstanding restaurants and hotels curated by the MICHELIN Guide.



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