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Media Contact: +33 1 45 66 22 22



THE DEVELOPMENT OF MICHELIN'S MOUNTAIN BIKE TYRES



*FROM THE LABORATORY STAGE
TO THE TYRE THAT GOES ON SALE,
THE DIFFERENT STEPS
DESIGNED TO DELIVER
OPTIMUM PERFORMANCE*



MICHELIN

A better way forward



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**MICHELIN
SELLS
PERFORMANCE,
NOT RUBBER**

Declaration by Michelin's Managing Partners (2010 Michelin Challenge Bibendum)



**More than merely a philosophy,
this is the pledge of an entire company.**

Michelin develops and manufactures tyres that are capable of delivering maximum performance courtesy of its cutting-edge technologies and innovative approach. Better still, these tyres are designed to extract maximum performance from the motorised or non-motorised vehicles they equip. This is the key to their added value, and the secret behind the world-class reputation of the Michelin brand.

Michelin, therefore, **'sells performance, not rubber'**. This phrase – which neatly summarises the Group's mission – also applies to the tyres the company produces for mountain bikes, for serious competition use and active amateurs alike.

When it comes to high performance, Michelin has always been inclined to defy the established boundaries. From high-level competition to commercially available tyres, the development process follows a rigorous chain of requirements. The breakthroughs so vital to sporting success similarly benefit the brand's mass-produced tyres. In taking advantage of the expertise of the world's very best mountain-bikers, Michelin turns the sport into a life-size laboratory for its work.

In addition, testing its products in the most extreme conditions using athletes with differing profiles and riding styles, allows Michelin to define the technical configuration of its new solutions in a coherent, holistic manner, enabling all users to benefit from optimum performance.

Finally, the Michelin Group's Technology Centre provides its designers with the technological 'building blocks' they require to successfully tackle the challenges specific to their markets and uses. Grip, durability, strength and agility are at the very core of the performance of every mountain bike tyre developed by the Group.

RESEARCH AND INNOVATION, **THE DNA OF THE MICHELIN GROUP**

 **Research and development have always been major driving forces for Michelin.**

At Michelin, the quest for innovation inspires the company's 6,600 research staff, engineers and tyre chemists who work in Europe, North America and Asia on materials, design, development and manufacturing. Throughout the company's history, innovation and research into new technologies for the benefit and satisfaction of customers have been at the heart of Michelin's strategy – and these innovations are designed to meet users' exacting expectations.

The scope of these activities is very wide, from a thorough understanding of fundamental chemical and physical phenomena, to the creation and testing of prototypes, all the way to the feasibility analysis of production on an industrial scale. Meanwhile, spreading the Technology Centre's activities across three different continents is a means of developing knowledge of local tyre requirements and uses. It also facilitates external collaboration with the very best research laboratories and technical partnerships that provide complementary skills and expertise.



AT THE HEART OF **MICHELIN INNOVATION**

MICHELIN'S RESEARCH AND DEVELOPMENT ACTIVITIES IN NUMBERS

€650^{MILLION}

Michelin's annual investment in Research and Development.

1

The Michelin Group's Technology Centre is unique and global, but spread across three locations on three continents (North America, Asia and Europe).

(MORE THAN)

6,600

The number of people who work at the Group's Technology Centre.

350

The number of different professions found within the Technology Centre (researchers, engineers, developers, testers, technicians, etc.).

1,5^{MILLION}

The number of measurements of materials and semi-finished rubber compounds and textile or metallic materials carried out in Michelin laboratories each year.

10,000

The number of active patents protecting Michelin's innovations throughout the world.

12

Every 12 minutes, the distance covered by all Michelin's durability and endurance test programmes equate to once around the world (1.8 billion kilometres per year).

5

The number of different types of tyre test: laboratory tests, rig testing (static and dynamic), vehicle tests (objective and subjective) and customer tests.

THE HEART OF **MICHELIN** **TECHNOLOGY CENTRE**

LADOUX IN NUMBERS

3,300 The number of people who work at the Ladoux centre, near Clermont-Ferrand, France (more than half of all the company's dedicated R&D staff).

450 The surface area of Ladoux in hectares (the test tracks account for 380 hectares).

79 The number of buildings (total floor space: 169,400 square metres).

19 The number of test tracks, totalling 41 kilometres.

1965 The year the Ladoux facility was inaugurated.

The Ladoux facility houses half of all the Michelin Group's Research and Development teams worldwide. This is where major innovations that have since gone down in tyre-making history first saw the light of day.

Over the past 50 years, the Ladoux Technology Centre has continuously evolved and developed – it now seems incredible to think that in 1965, just 150 people worked there...

Today, it enjoys substantial investment in France.

The €270 million spent across the whole project (named URBALAD) represents a significant part of the Group's global innovation strategy and underscores its very strong links to France's Auvergne region.

The URBALAD project aims to modernise the entire Research Centre at Ladoux. The architecture of the new main building called 'Campus RDI' (standing for "Recherche, Développement et Industrialisation") will enable staff in the 'RDI Monde' network to work in a cross-functional, multi-disciplinary manner.

This ambitious project is being undertaken in several phases ahead of its scheduled completion in 2018.

R&D ACTIVITY SPECIFIC **TO MOUNTAIN BIKE TYRES IN NUMBERS**

18 TO 24 The number of months required to develop a mountain bike tyre.

20 The number of prototype mountain bike tyres produced and tested for each new range.

10 For every new range, this is the number of days of track testing that are carried out to determine the best prototype.

200 The number of different components that go into the production of a mountain bike tyre.

1 The minimum number of seasons a tyre must be used competitively before going on general sale.



THE DEVELOPMENT OF **A MICHELIN MOUNTAIN BIKE TYRE**

5

KEY STAGES CHARACTERISE THE DEVELOPMENT PROCESS OF A MICHELIN MOUNTAIN BIKE TYRE:

- ▶ **1 THE BRIEF**
- ▶ **2 THE DESIGN AND MODELLING OF THE TYRES**
- ▶ **3 TESTING**
- ▶ **4 THE MANUFACTURING STAGE**
- ▶ **5 MASS PRODUCTION**

THE BRIEF

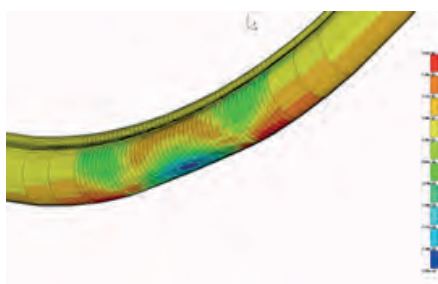
1 The brief for Michelin's commercially-available tyres above all sets out to meet the expectations of our customers, as relayed by the marketing department. Thanks to this in-depth understanding of users' needs, the brand is capable of developing tyres that can be adapted to every possible use, from cross-country to enduro.

THE DESIGN AND MODELLING OF THE TYRES

2 The brief is passed on to an engineer at the Technology Centre, whose mission it is to establish the specification of the new tyre.

Our research specialists, engineers and development experts do not start out from a blank page when it comes to designing a new range of tyres. The experience acquired over the course of many years – both within the Technology Centre, as well as in the world of competition – has led to the creation of an unrivalled database of tyre-related knowledge and expertise.

This comprehensive database enables a tyre's objective performance and level of durability to be defined by means of simulation, even before that tyre physically exists. This is what the engineers term 'finite element calculations', and Michelin has the ability to produce prototype tyres based upon the outcome of this design process.



TESTING

After the virtual world of calculations comes real-life testing. This phase is vital in order to sign off the chosen technologies. Michelin employs five types of test:

- **Laboratory tests on the materials and semi-finished rubber compounds and textile or metallic materials that make up the tyre**
- **Tyre testing on rigs (static and dynamic)**
- **Subjective tests**

A strict and rigorous methodology is implemented to ensure the reliability and consistency of the information collected:

- *The same bike*
- *Identical wheels (to avoid the influence of different wheels)*
- *The same track*
- *Regular evaluation of the benchmark tyre in order to assess changing track conditions*
- *Tyres are tested 'blind' so as not to influence riders' feedback*
- *Tyre pressures are monitored before and after every test run (to guarantee consistency of this parameter which has the greatest effect on the performance of a mountain bike tyre)*

As mountain-biking is not a discipline in which any given route is necessarily representative of tyre use, Michelin repeats the same tests in several different places and even several different regions.



■ **Competition**

In drawing upon the expertise of the world's very best mountain bikers, equipped with prototype tyres, Michelin turns the sport into a life-size laboratory in which it can put the tyres of tomorrow to the test in the most extreme conditions.

■ **Customer tests**

In order to validate new technologies, Michelin occasionally needs to call upon the services of customers. This is a means of verifying whether these technologies allow the tyre to deliver the required level of performance.



THE MANUFACTURING STAGE

While improving the across-the-board qualities of a single tyre is a challenge for those working in the laboratory, Michelin's prowess can be found in its ability to identically reproduce such tyres millions of times over. In order to achieve this, Michelin relies upon a group of engineers who focus solely on the manufacturing stage. The brand's flair for innovation can be seen as much in the final product as in its production processes, which ensure flawless replication of the tyres.

MASS PRODUCTION

This is Michelin's trademark. All Michelin tyres – wherever and whenever they are manufactured – meet the same high quality standards and deliver identical performance. To maintain this consistency, Michelin has invested in manufacturing processes and inspection systems that are amongst the most exacting within the industry.



APPENDIX

THE HISTORY OF MICHELIN BICYCLE TYRE INNOVATIONS

Making its innovations available to as many people as possible – in addition, of course, to all the benefits that those innovations provide in terms of performance, safety and sensations – is at the very heart of the Michelin philosophy. Indeed, many of these Michelin innovations have revolutionised the world of bicycle tyres and become established benchmarks.

1891

First patents for removable and repairable bicycle tyres

1978

Michelin introduced the first foldable bicycle tyre with a flexible bead

1995

Launch of the first dual-compound bicycle tyre incorporating high-performance silica

2000

Launch of Michelin's first tubeless mountain bike tyre

2013

Introduction of a new set of Michelin MAGI-X rubber compounds for enduro use

THE MICHELIN GROUP IN NUMBERS

FOUNDED

1889

FACTORIES

68 in 17 countries

WORLDWIDE STAFF

112,300

RESEARCH & DEVELOPMENT STAFF

More than **6,600** working out of **25** sites on three continents (North America, Europe and Asia)

RESEARCH & DEVELOPMENT BUDGET

€656 million

ANNUAL PRODUCTION

178 million tyres, more than **13 million** maps and guides sold in **170** countries, plus **970 million** itineraries calculated by ViaMichelin

TURNOVER (2014)

€19.55 billion

