

BFGoodrich's range of WRC tyres

The World Rally Championship is the only form of motor sport that calls for such a broad spectrum of tyre types to meet all the types of conditions encountered and to enable the drivers to stay in control in all circumstances. There are three basic families of surface: gravel, asphalt and snow/ice. The twisty tracks of Cyprus bear little resemblance, however, to those of the Australian bush or the rollercoaster ride of central Finland, so each of these families is divided into sub-families: low-wearing, medium-wearing or hard-wearing gravel, wet or dry asphalt, etc.

ASPHALT

Dry asphalt

BFGoodrich g-Force Profiler

Rallye Automobile Monte-Carlo, Rallye de Catalunya - Costa Daurada, Rallye de France-Tour de Corse, OMV ADAC Rallye Deutschland

Dimension*: 225/40 R 18

(*): width (mm) / height to section width ratio H/S (%) - Radial - interior diameter (inches)

Sea-to-land ratio: 17% - additional grooves can be added in case of wet or cold conditions.

Compounds: 3

g-Force Profiler 0 = soft compound (cold and/or damp conditions)

g-Force Profiler 2 = medium compound (temperatures between 10 and 25 °C)

g-Force Profiler 4 = hard compound (temperatures of more than 25 °C, long stages)

Description: The g-Force Profiler's wide dimension favours the transmission of power to the ground, while the low sidewalls ensure excellent cornering stability.

The punishing constraints to which tyres are exposed on asphalt include heavy braking (up to 1.8g), high cornering speeds and high lateral forces (up to 1.5g), repeated over and over for tens of kilometres at a time. In the case of asphalt tyres, priority is given to outright performance, but drivers also call for tyres that provide consistent grip over the full length of the longer stages.

The maximum dimensions imposed by the FIA regulations since 1995 means that asphalt tyres are somewhat undersized compared with the forces at play: cars of more than 300hp, more than 1 tonne in movement, high speeds, hostile terrain (jumps, broken up asphalt, corner cutting, etc.). The combination of these constraints, the fact that tyres heat up on stages and the presence of a mousse run-flat insert inside the cover, air pressure inside the tyre increases with distance and this in turn leads to a reduction in the size of the contact patch. The amount of rubber in contact with the ground can effectively fall by 20%. One of the missions of BFGoodrich's engineers and chemists is to delay this phenomenon and the consequent reduction in the amount of bonding between the compound's molecules and the asphalt surface.

Wet asphalt



BFGoodrich g-Force Profiler Humid

Rallye Automobile Monte-Carlo, Rallye de Catalunya - Costa Daurada, Rallye de France-Tour de Corse, OMV ADAC Rallye Deutschland

Dimensions*: 225/40 R 18

(*) width (mm) / height to section width ratio H/S (%) - Radial - interior diameter (inches)

Sea-to-land ratio: Between 17 and 30% (according to 'cut') - additional grooves can be added in case of wet or cold weather.

Compounds: 2

g-Force Profiler Humid « froid » = soft compound (cold and/or damp conditions)

g-Force Profiler Humid « normal » = medium compound (temperatures between 15 and 25 °C)

Description: The g-Force Profiler Humid's wide dimension favours the transmission of power to the ground, while the low sidewalls ensure excellent cornering stability.

The challenge associated with wet asphalt is very different. The speeds reached are lower and the tyres are consequently exposed to fewer constraints. Indeed, the skill of the drivers in the wet is possible more decisive than the outright performance of his tyres.

Given that the number of tread patterns teams may choose for asphalt rallies is limited to two, WRC tyres have to be increasingly versatile and there is no longer a specific rain tyre. In case of heavy rain, BFGoodrich's technical staff technicians 're-cut' extra grooves in the pattern of so-called intermediate tyres. These extra grooves can be either longitudinal (to combat aquaplaning) or lateral (for extra grip). A tyre with a full rain 'cut' is capable of clearing up to 20 litres of water per second.

Wintry asphalt

BFGoodrich g-Force Winter

Rallye Automobile Monte-Carlo

Dimension*: 215/45 R 18

(*) width (mm) / height to section width ratio H/S (%) - Radial - interior diameter (inches)

Compounds: 1

Description: The BFGoodrich g-Force Winter can be equipped with two rows of studs (250 studs in total), a single row or no studs at all. On clear asphalt, the tyre's broad width ensures a relatively large contact patch for efficient transmission of the car's power to the ground. The combination of the studs and siped tread pattern provide first class grip on snow and ice. The outer row of studs enhances cornering grip while the inner row favours traction.

This tyre is used exclusively on the Monte Carlo Rally where grip is often at a premium over the mountain passes or in shade. The mixture of dry portions, sheet ice and/or snow can make tyre choice extremely difficult.

The BFGoodrich g-Force Winter enables drivers to cover stages that are practically entirely dry but which include some icy portions which would be impossible to pass with the g-Force Profiler.

Until 2004, the Monte Carlo range included a further choice: the maxi-snow tyre. However, the lack of truly snowy conditions in recent years and the concentration of the event in the Monaco region have led the teams – with the approval of the FIA – to drop this product.

GRAVEL

Low-wearing gravel

BFGoodrich g-Force Gravel

Rally Argentina, Neste Rally Finland, Rally Japan

Dimension*: 195/70 R 15 and 215/65 R 15

(*) width (mm) / height to section width ratio H/S (%) - Radial - interior diameter (inches)

Sea-to-land ratio: approximately 40% - additional grooves can be cut in case of mud or a top-layer of loose gravel

Compounds: 2

g-Force Gravel 8 = soft compound (cold weather or mud)

g-Force Gravel 9 = medium compound (temperatures between 15 and 25 °C)

Description: A relatively compact tread pattern to ensure that a maximum amount of rubber is in contact with the ground for optimised grip and traction. The grooves can be opened up in order to enhance the pattern's ability to clear the loose top coating of gravel and/or mud.

Of the championship's three 'low-wearing' gravel rounds, Rally Finland is without doubt the most specific as far as tyres are concerned. For the extremely fast tracks of Finland, tyres effectively need to be adapted to the extremely high average speeds (more than 120kph, with top speeds in excess of 200kph) and must also provide exacting directional precision. At these high speeds, drivers are forever making tiny corrections to their line via the steering wheel and their tyres must be capable of responding instantly. Rally Finland tyres also have to be capable of soaking up the heavy loads to which they are submitted as the cars land after the countless jumps that are a hallmark of this event. Although slower, the stages encountered in Argentina and Japan feature frequent stony portions.

Medium-wearing gravel

BFGoodrich g-Force Gravel

Corona Rally Mexico, Rally Italia-Sardinia, Rally Australia, Rally of New Zealand, Wales Rally GB

Dimensions*: 215/65 R 15 (*) width (mm)/height to section width ratio H/S (%) - Radial - interior diameter (inches)

Land-to-sea ratio: approximately 40% - additional grooves can be cut in case of mud or a top-layer of loose gravel

Compounds: 2

g-Force Gravel 9 = medium compound (temperatures between 15 and 25°C)

g-Force Gravel 9+ = hard compound (hard ground and/or high temperatures)

Description: A relatively compact tread pattern to ensure that a maximum amount of rubber is in contact with the ground for optimised grip and traction. The grooves can be opened up in order to enhance the pattern's ability to clear the loose top coating of gravel and/or mud.

Although WRC tyres have become increasingly versatile, they still have to be adapted to the demands of each family of surface. For events considered as medium-wearing for tyres, BFGoodrich drivers know they can count on the medium- and hard-compound g-Force Gravel (the harder compound is sometimes employed for the second run through certain stages). The BFGoodrich g-Force Gravel stands out as the worthy successor to the Z BTO which was launched in 2005 and which took Sébastien Loeb to six consecutive gravel rally wins on his way to winning last year's title. The construction and compound of this new tyre ensure enhanced braking potential (longitudinal performance) and lateral grip.

Hard-wearing gravel

BFGoodrich g-Force Gravel

Acropolis Rally of Greece, Cyprus Rally, Rally of Turkey

Dimensions*: 215/65 R 15 and 225/60 R 15

(*): width (mm) / height to section width ratio H/S (%) - Radial - interior diameter (inches)

Sea-to land ratio: approximately 40% - additional grooves can be cut in case of mud or a top-layer of loose gravel

Compounds: 2

g-Force Gravel 9 = medium compound (temperatures between 15 and 25°C)

g-Force Gravel 9+ = hard compound (hard ground and/or high temperatures)

Description: A relatively compact tread pattern to ensure that a maximum amount of rubber is in contact with the ground for optimised grip and traction. The grooves can be opened up in order to enhance the pattern's ability to clear the loose top coating of gravel and/or mud.

For the championship's three hard-wearing gravel rallies, BFGoodrich has developed two compound variants of the g-Force Gravel (medium and hard) which come in a choice of two dimensions. The 215/65 R 15 is generally selected for the first run through the stages, while the wider version (225mm) tends to be more suited to the second runs – by which time the surface has been swept clean of its loose top-coating – for maximum traction and grip. A key parameter on rough rallies is the ability of the drivers to manage their tyres which are exposed to considerable constraints (wheelspin, impact with rocks, cuts produced by sharp stones). This involves refraining from pushing too hard over the rougher portions, allowing the tyres to 'catch their breath' if they get too hot and avoiding wheelspin, etc. Following a change to the regulations which has seen the banning of so-called 'active' differentials for top-seeded drivers, car set-up and intelligent tyre management are vital on this type of rally.

SNOW/ICE

BFGoodrich g-Force Ice

Uddeholm Swedish Rally

Dimension*: 145/80 R 16

(*) width (mm) / height to section width ratio H/S (%) - Radial - interior diameter (inches)

Types of studding: 2

g-Force Ice normal stud: 100% ice

g-Force Ice short stud: ice and frozen gravel (ratio 60 - 40%)

Description: The narrow dimension of this product ensures high pressure on the contact patch which favours the action of the studs in snow and on ice. The asymmetric design of the tread blocks optimises the way the studs strike the ground both in a straight line (traction/braking, perpendicular blocks) and laterally (cornering grip, oblique blocks). The open pattern helps to clear snow.

It's difficult to say whether it's the tyres or the studs that take front stage in Sweden. The answer in fact is both, since the trick lies in ensuring a perfect bond between the rubber of the tread and these metallic tips. Tyres bristle with some 380 studs at the start of each loop of stages and the objective is to have just as many in place at the finish! That, however, is no easy matter. At 120kph, each stud strikes the ice 17 times per second! Yet at any one time, the car sits on just fifty or so metal tips, the total surface area of which is no larger than a postage stamp!

The FIA stipulates a maximum length of 2cm for the studs used in Sweden. The important thing is to decide how much of the stud is glued inside the tread block and how much stands free of the block to bite into the ice. This choice depends essentially on the weather. Since last year, however, tyres for this event have to be nominated prior to the start and conditions can change in between time, with either fresh snow falling or the ice thawing, as was the case in 2005. Since 2005, teams have also been limited to just one type of tread pattern for the Swedish Rally.

RE-CUTTING RALLY TYRES

WRC tyres are increasingly versatile. As a result, in order to adapt them as closely as possible to the conditions of the moment, the drivers do not hesitate to have their patterns 're-cut'.

This work is carried out in the service park before the cars leave for the stages by BFGoodrich's technicians and fitters who use a heated blade to widen existing grooves or gouge out extra grooves in the rubber. The precise nature of these 'cuts' depends on the weather conditions and individual driving styles.

In what situations do drivers 're-cut' their tyres?

- In cold weather, on asphalt or gravel, when the competitive distance to be covered with the same tyres is quite long. In this case, it is not possible to choose an excessively soft compound which might not last the distance. The technique of 're-cutting' involves removing rubber, so the tread is more mobile which in turn causes the tyre's temperature to rise more quickly.

- On damp asphalt, when the amount of moisture doesn't warrant fitting intermediate or rain tyres. There are two techniques in this case: small cuts in the tread to enable the tyre to climb in temperature more quickly, or the gouging out of extra grooves to improve the tyre's water clearance capacity.
- To optimise the clearance of mud in search of better grip underneath (gravel rallies).
- When it is necessary to slice through a loose top coating of sand or stones, etc. in search of better grip underneath (gravel rallies).
- When the first drivers into the stages of certain gravel rallies are faced with the prospect of having to sweep aside the deep loose top surface.

MOUSSE INSERTS

The flexible doughnut-shaped insert fitted inside the tyres allows drivers to continue on a stage with zero air pressure. Only the tyres used in the WRC and in Enduro motorcycling (Bibmousse system) employ this system in motor sport.

This mousse insert is used on all types of surface (asphalt, gravel and snow). However, it is reserved for WRC cars competing in World Rally Championship rounds only. The regulations do not permit its use for Group N and Super 1600 cars.

How the system works

Phase A

The unassuming 'doughnut' of flexible foam that makes up the system (coloured here, but in reality black) is in fact a highly sophisticated piece of technology, notably the make-up of the gas that fills its micro-cavities. BFGoodrich's fitters slide the mousse inside the tyre before fitting the cover to the rim. So long as the tyre hasn't been inflated, the insert takes up all the space inside.

Phase B

When the tyre is inflated to its working pressure of approximately 2 bars, the mousse is compressed; its volume is roughly halved. For the moment, the insert is cold and therefore inactive.

Phase C

Once the stage has started, the heat generated by driving at speed transforms the physical properties of the mousse. The system is now primed and capable of withstanding the sort of dynamic loads all rally tyres must soak up. So long as everything goes according to plan 'on the outside', the system remains inactive, but ready to be deployed at the slightest alert.

Phase D

In case of air loss (because of a cut, a hole or, very often, a damaged or broken rim!), the system is instantly deployed. With air pressure no longer compressing it, the insert automatically expands to fill the inside of the tyre. Thanks to its special properties, notably its flexibility, the mousse perfectly takes over the role of the air that has escaped.

Phase E

The system has been deployed and the driver is able to continue the stage without having to stop to change the wheel. And in the majority of cases, he can carry on pushing as hard as before. It is frequent that he doesn't even realise he has punctured, especially on gravel. Fastest times set after the system has been

activated are not rare. Nor are examples of drivers going on to win the rally thanks to the system!