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XeoBib - a new tractor tyre concept from Michelin

With the XeoBib Michelin has developed a radial tyre for tractors which can be used in-field and on-road at maximum 1.0 bar pressure with speeds permitted for the latter use of up to 50 km/h. The construction aspects and characteristic properties of this tyre are detailed in the following report.

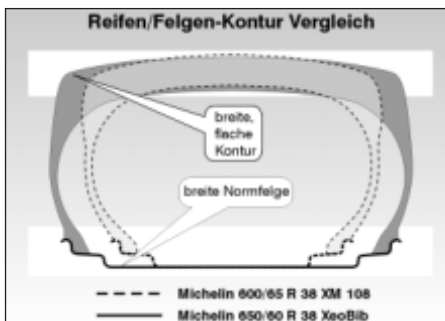


Fig. 1: Comparison of tyre/wheel-rim contour

The radial tyre is nowadays state of the art for tractors. In practice the series 70 and 65 tyres have established themselves as offering the best compromise between draught power transmission, area of ground contact and wear resistance.

Up until now, the tyre's basic functions have been:

- to bear loads, and
- to transmit torque

while protecting the soil structure as much as possible in the process.

This latter role is also established in §17 of the Federal Soil Protection Statute.

When we speak of soil protection the tyre is always immediately involved because it represents the contact point between machine and field surface. Reducing the inner air pressure of the tyre is mentioned in § 17 of the Soil Protection Statute as a measure for protecting the resource "soil".

What, therefore, could be more appropriate in this context than the creation of a tyre which can be used at low pressure, i.e. under 1.0 bar? Nowadays tyres such as the Michelin XM 108 which, depending on load, can be used with pressures as low as 0.4 bar, are already available.

The disadvantage of all these modern radial ply tyres is that when being used on the road inner pressure has to be increased substantially, by up to 1.6 bar or even more, to ensure safe handling of the vehicle and an acceptable working lifetime for the tyre.

As a rule, farmers or agricultural contractors change between tractor on-road and in-field work often. This means continual adjustment of tyre pressures, either manually or via more elegant, but also more expensive, integrated tyre pressure regulating systems.

Often a compromise is reached at the expense of optimum ground pressure, draught power and driving safety. It is also accepted practice to retain the same tyre pressure throughout an operation and accept the disadvantages involved such as soil structure damage and increased wheel slip on the one side or reduced driving safety and increased tyre wear on the other.

Making the situation still more complicated are the different tyre pressures required

for the permitted road speeds of 30 km/h, 40 km/h or 50 km/h.

Requirements of customers

The tyre manufacturer Michelin used the agency Ernst & Young to determine the requirements of its European tractor tyre customers and from the results developed a specification list for the New Michelin Tyre Concept (NMTC) with the product name XeoBib.

The catalogue of characteristics thus brought together comprised opposing requirements such as "low ground pressure" and "improved driving safety at all permitted speeds" at a uniform low tyre pressure of ≤ 1.0 bar.

In the following order, the main requirements of customers for a new tyre concept were:

1. Lowest possible ground pressure
2. Uniform tyre pressure requirements with a maximum of 1.0 bar
3. Improvements in driving safety
4. No worsening of other characteristics associated with modern radial tyres.

The creation of the Michelin XeoBib

The new Michelin XeoBib is a radial tractor tyre with a low cross-sectional area designed so that it has to be mounted on standard wide wheel-rims. Its concept is aimed at permitting work under very high tyre suspension effects in-field and on-road with uniform air pressure for both situations up to a maximum 1.0 bar.

A number of technical hurdles regarding, for example, structural stability, tyre wear and heat creation had to be overcome to achieve the specification targets at the required working tyre pressure of ≤ 1.0 bar.

For instance, using conventional tyres at low pressure increases the shearing stress in the carcass to such an extent that, in continuous operation, this can lead to structural damage (e.g. component separation). Wear on the running surface is increased when tyre pressure is reduced. Additionally, tyre creep increases with low pressure and the

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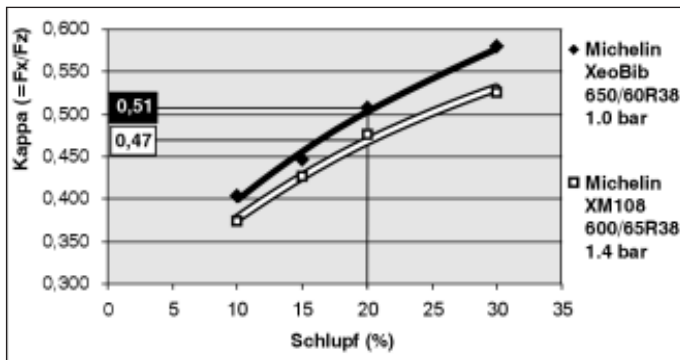


Fig. 2: Driving power coefficients

tyre temperature can rise so steeply that rubber compounds can dissolve.

Xeobib constructional characteristics

The XeoBib performance capacities have been achieved through combining construction, material and design elements, some of them now patented:

- The tyre suspension capability has been extended upwards into the shoulder area; at full load and with appropriate pressure, tyre flexing involves up to 30 % of the XeoBib flank height. In comparison, this suspension movement with a standard tyre lies at ~ 20 %.
- The tyre cross-sectional area and running surface have both been broadened and the latter also flattened. The beads are supported on a substantially broader wheel-rim (a standard wheel and not a special one) (Fig. 1). These steps have increased tyre ground contact area and reduced ground pressure. The usual pressure peaks in the tyre ground contact area are thus avoided.
- The form and design of the tyre lugs have been matched to the requirements of the permitted maximum speed for the tyre (D= 65 km/h). The special angling of the lugs allows good self-cleaning characteristics.

The performance comparisons with the equivalent series 65 tyres which already stand at a technically high performance level demonstrated the significant advantages of

the XeoBib. (Dimensions: XeoBib in VF 650/60R38 - XM 108 in 600/65R38; comparable regarding external circumference and load bearing capacity)

Depending on amount of wheelslip, driving power coefficient achieved improvements of 3 to 8 % (Fig. 2)

Through the 24 % increased ground contact area tyre track depths in loose soil conditions under equivalent loads were reduced by 55 %.

Vehicle stability and steering performance were clearly improved despite the lower tyre pressure, driving comfort was just as good as with the Michelin XM 108 reference tyres which already have the reputation of being especially comfortable.

In loose soil conditions there was a clear reduction in the rolling resistance with the XeoBib tyre with the rolling resistance coefficient at 80 % of the XM 108 reference tyre. This demonstrated clear potential savings in time and fuel consumption.

Despite the reduced tyre pressure the rolling resistance on solid road surfaces is not greater than that for the comparison tyres at higher pressures.

Table 1 shows the performance comparisons between the XeoBib and the already high performance tyre from the 65 series, the Michelin XM 108.

The new XeoBib tyre concept has already been registered with ETRTO as a standard. The letters VF in the tyre size description stand for "Very high flexion" and serve to

	XM108 600/65 R 38	XeoBib 650/60 R 38
Dimension	600/65 R 38	650/60 R 38
Load-Index	153	155
Speed-Symbol	B (50km/h)	D (65km/h)
Luftdruck Straße (50 km/h 3650 kg)	1.8 bar	1 bar
Luftdruck Feld (Arbeiten unter Drehmoment, Last 3650 kg)	1.2 bar	1 bar
Bodenkontakfläche (lockerer Boden, Last 3650 kg)	3570 cm ² (1.4bar)	4440 cm ² (+24%) (1bar)
Spurtiefe, Last 3650 kg	46mm	21 mm (-55%)
Verschleiß	100	116
Rollwiderstand Indikator (lockerer Boden)	100	80
Rollwiderstand (Straße)	100	100
Zugkraft Indikator	100	103 - 105

Table 1: Performance capacity of the Michelin XeoBib compared with the Michelin XM 108 series 65 tyre

avoid confusion with conventional low cross-sectional area tyres.

Because of, among other things, the required wider wheels, deliveries by Michelin of the tyre sets VF 520/60R28 138A8/138D for tractor front axle and VF 650/60R38 155A8/155D for the rear axle will be to factory customers during the first half of the year. The spare parts trade will then be supplied too.

Up to the beginning of 2005, the range will be expanded with a further six sizes, two



Fig. 3: The new Michelin XeoBib

smaller and four larger, for tractors in the power range between 60 and 150 kW.

With its new XeoBib concept, Michelin has developed a tyre for the classic tractor that can be used flexibly in all areas of agriculture.

Conception and design is such that the tyre can be driven in-field and on-road, in the latter case at all speed classes up to 50 km/h, depending on axle loading, with a uniform tyre pressure up to a maximum 1.0 bar. Its main advantages for the user are:

- Reduced soil compaction (+24 % ground contact area, wheel track depth halved)
- Simple, user-friendly, pressure selection and adjustment (uniform, axle-load dependent, pressure for all operations, tyre pressure regulator unnecessary)
- In general a higher performance capacity for tractor and improved driving safety (greater load bearing capacity, increased driving power coefficient, reduced rolling resistance in the field, increased lateral stability, improved tyre wear resistance).