

MICHELIN VIEWPOINT ON WIDE BASE SINGLES AND OTHER FUTURE TRUCK TYRE TYPES.

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ABSTRACT

The White Paper on a common transport policy was published by the European Transport Commissioner in September 2001. For goods transportation, the target in the European Union is to reduce the growth rate of goods road haulage to 38% by 2010 in comparison with its 1998 level. The main concerns leading to this decision are road traffic congestion, road safety and road haulage environmental effects.

As a responsible tyre manufacturer committed to sustainable development, Michelin strives to contribute to an acceleration of road transportation progress regarding these concerns.

The wide base single is part of this commitment. With lower rolling resistance, leading to reduced fuel consumption and subsequent environmental impacts, it has a comparatively lower weight, resulting in a greater payload and a reduced amount of material during manufacture and dismantling after use. The X One tyre range was developed with these criteria in mind. It is already on the European market for urban buses and available in North America for long haul and regional transportation. Other projects are in progress in order to extend this range to other uses.

Other notable and envisaged trends for future truck tyre types are :

- *A continuation of traditional tyre performance improvements, such as reliability, wear life, rolling resistance, grip, noise, dynamic active safety....*
- *The introduction of new tyre sizes in order to increase the payload volume, through the design of smaller diameter tyres.*
- *The introduction of electronically instrumented tyre-wheel assemblies offering new services.*
- *In general, a more integrated tyre design covering the entire life cycle of the tyre, targetting the reduction of societal impacts, including their effects on the road surface.*

GENERAL CONTEXT AND INTRODUCTION

The White Paper on a common transport policy was published by the European Commission on September 12th, 2001. Unless major new measures are taken by 2010 in the European Union, heavy goods vehicle traffic on the road will increase by almost 50% in comparison with 1998 levels. The approach endorsed by the White Paper consists of a number of measures to reduce the growth rate of road haulage to 38%, through more effective use of other means of transport. This level is the equivalent of a return to the 1998 market share for road transportation. Even in these conditions, important and urgent efforts must be taken by the road transport industry, including truck and tyre manufacturers, road authorities etc, to progress towards sustainability and obtain acceptable or improved levels of road congestion, pollution emissions, noise, road safety and transport efficiency by 2010.

Wide base single tyres are part of the answer to this challenge.

WIDE BASE SINGLE TYRES

Tyre manufacturers introduced wide base single tyres about thirty years ago as a replacement for dual tyre fitments on towed vehicles.

Their presence became more widespread in Europe about twenty years ago, with the adoption of five axle, 40 tonne articulated vehicles.

The advantages of these tyres for operators are significant; their lower assembly weight allows payload increases, and their decreased rolling resistance reduces fuel consumption.

They also allow an increase of the semi-trailer track, leading to improved safety achieved through better rollover stability.

Recent advances in tyre technology now offer a further step forward : the introduction of a new wide base single tyre range for the drive axle of motor vehicles in Europe as well as for the drive and towed axles in North America. This new range is called X One for Michelin products.

The advances required in tyre technology deal primarily with casing endurance, both in the crown and in the bead regions. Michelin developed new and patented solutions for the X One range, for instance "Infinicoil™" for the crown region.

The industrial production and commercialisation of the X One range started with two different configurations, North American long haulage 6x4 tractors and semi-trailer articulated vehicles in November 2000 and European Urban Buses in May 2001.

The most important customer benefits obtained with the Michelin 445/50R22.5 X One XDA and XTA on 80000 lbs 6x4 tractors and tandem axle semi-trailers are increased payload and reduced fuel consumption. For these vehicles, the two tractor drive axles and the two semi-trailer axles may be fitted with X One tyres replacing the 275/80R22.5 dual assemblies. See figure 1 for an example.



Figure 1 - Michelin 445/50R22.5 X One tyres on North American tractor and semi-trailer.

When fitted on the tandem axles of both the tractor and the semi-trailer and compared to Michelin's best twinned solutions, the payload increase is around 850 lbs (385 kg) and the fuel consumption reduction is about -4%. Fuel costs account for about 20% of the haulier's operating costs and these results lead to a very significant improvement in this respect.

Six X One tyre sizes are commercially available on the North American market:

445/50R22.5 X One XDA and XDA-HT for 6x4 tractor drive axles. Replacement of 275/80R22.5 tyres.

445/50R22.5 X One XTA and XTE for tandem axles of semi-trailers. Replacement of 275/80R22.5.

455/55R22.5 XDA-HT and XTE respectively for 6x4 tractor drive axles and for tandem axles of semi-trailers.

Replacement of 11R22.5 and 275/80R24.5 tyres.

Additional information about the interest of X One tyres for the North American transportation industry can be found in ref [4]. This paper details the improvements offered in weight, fuel economy, handling, pass by noise and comfort, while offering at the least equivalent tread wear and acceptable rapid air loss control in comparison with an equivalent dual tyre set.

The 495/45R22.5 tyre size was designed by Michelin for the drive axle of motor vehicles in Europe and is now also proposed by other tyre manufacturers.

Its societal impact, when compared to twinned 315/70R22.5, is described in detail in the COST 334 report, chapter 7, "Examination and consequences of using tyre types". A cost-benefit analysis was carried out, taking into account road surface maintenance costs, vehicle operating costs and environmental costs (mainly pollution emissions and manufacturing of material and recycling). It shows that the use of this tyre on the drive axle of European heavy goods vehicles and wide base single tyres of the same diameter on the trailer or semi-trailer would not significantly modify the road surface maintenance costs but would reduce the vehicle operating costs and environmental costs. Globally, the annual cost reduction would be about 600 million Euros at EU level.

This new tyre size is not yet commercially available for 4x2 trucks and tractors.

Indeed, a concern is what effect would the single tyre concept have on vehicle stability in the occurrence of a rapid air loss during road use. For a current dual tyre set if one of the tyres suddenly fails, usually one good tyre remains on the wheel-end to help support the vertical and traction load of that wheel-end. For similar reasons, there is no safety issue for vehicle stability for 6x4 tractors and semi-trailer North American configurations (ref 4).

Obviously this is different for the 4x2 trucks and tractor combinations.

Common studies are in progress with truck manufacturers to find practical solutions and reach the safety level of dual tyres. They will be developed within a relatively short period of time.

This safety issue does not exist in urban use, which is operated at very low speeds and transverse accelerations. It is the reason why this dimension is currently on the market for European urban buses, under the name 495/45R22.5 X One XDU.

The most significant customer benefit obtained from the use of this tyre in urban buses is an increased aisle width at the rear end of the bus. See figure 2 for an example.

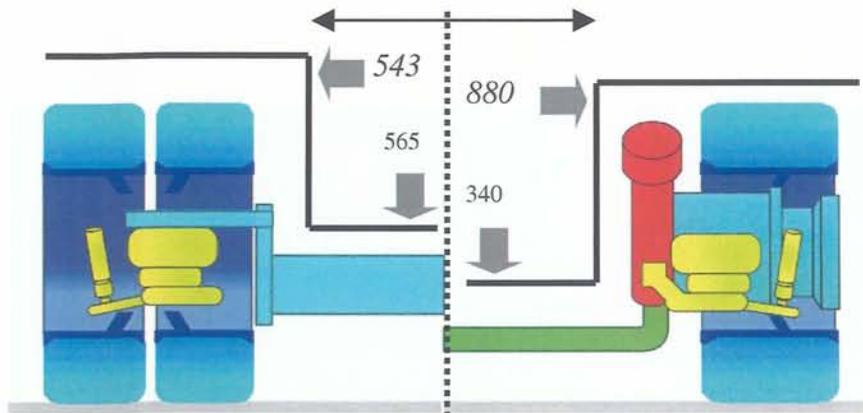


Figure 2 - Comparison of Irisbus Agora and Civis aisle width.

The 495/45R22.5 X One XDU tyre size has a maximum load capacity of over 13000 kg per axle for urban use. This load capacity is necessary for France, which authorises such a load on its road network. A new tyre size, the 455/45R22.5 X One XDU will be available on the market very shortly, with a maximum load capacity of 12190 kg per axle for urban use. This load capacity corresponds to the requirements of all the other EU countries. This new size will still allow bus manufacturers to increase aisle width by several centimetres.

Additional information about the X One relation to the road surface in terms of response and wear can be found in refs [1], [2] and [3]. They show that this new generation of wide base single tyres is much less aggressive to the road surface than its predecessors.

Michelin's viewpoint regarding the new wide base single tyres is that they represent a major breakthrough for urban buses and heavy goods transportation (in the near future, for 4x2 trucks and tractor combinations).

In addition, COST 334 results make it clear that, considering vehicle operating costs and environmental costs as well as road surface maintenance costs, they reduce the overall societal costs related to heavy commercial transportation.

Thus there is no obvious reason to restrict their use in the European Union, as was the case with the former generations of wide base single tyres.

In particular, the load restriction applied to the tandem drive axles fitted with single tyres (18 tonnes maximum load instead of 19 tonnes with dual tyres) in directive 92/53 should be deleted.

OTHER FUTURE TRUCK TYRE TYPES

Naturally, the future truck tyre types will continue traditional improvements in tyre performance, such as reliability, wear life, rolling resistance, grip, noise, dynamic active safety... in order to provide lower operating costs and impacts on the environment as well as safety improvements.

As an illustration, during the last twenty years, the tread life and casing endurance of long haul Michelin tyres has approximately doubled, while their rolling resistance has been reduced by about 30 percent.

Additionally, new tyre sizes will be introduced in order to increase payload volume through the design of a lower outer diameter.

For an example, see figure 3. From this diagram, based on existing commercial tyre sizes, it can be seen that switching from an outer tyre diameter of approximately 1100 mm (315/80R22.5) to about 940 mm (295/60R22.5), the payload volume is increased by 10 m³, without any change in vehicle dimensions.

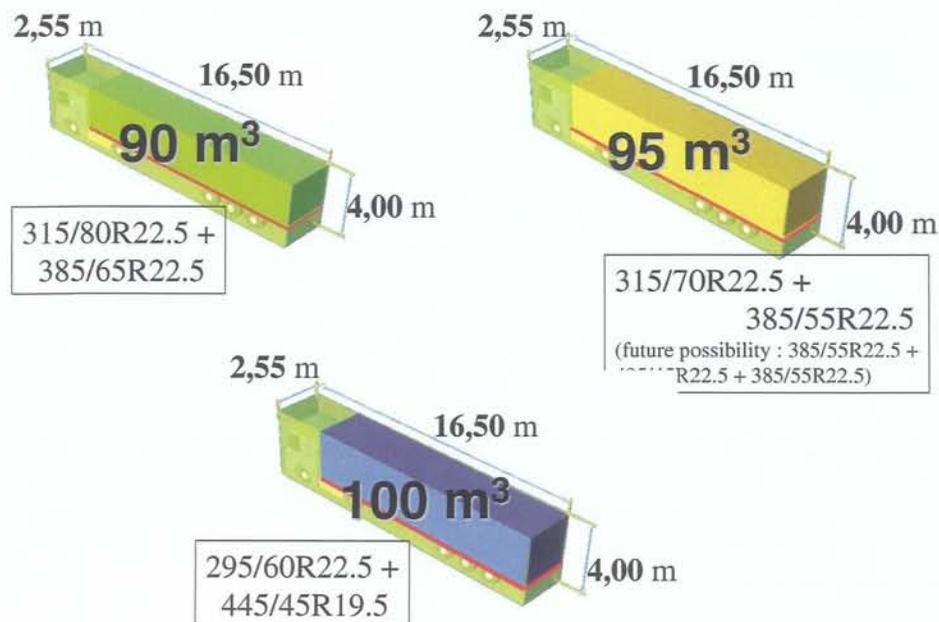


Figure 3 – Evolution of payload volume according to tyre size.

The trend for European transportation is to move progressively from bulky transportation (coal, steel, wood ...) to more sophisticated goods transportation with lower density. This evolution requires vehicles with greater volumes and this trend is set to continue. Smaller diameter tyres will be offered, in close co-operation with vehicle designers in order to maintain or simultaneously improve braking efficiency.

Another important trend for future tyre types is the introduction of "electronic" or "smart" tyre-assemblies.

These new products will include electronic devices and provide new services.

The first product of this kind to be available in the heavy vehicle business is IVTM (Integrated Vehicle Tyre Monitoring), jointly developed by WABCO and Michelin. This device provides an on-board tyre identification and pressure measurement. It includes an original algorithm, developed by Michelin, able to detect slow punctures and help to prevent major tyre failures. This advance will improve road safety, as well as hauliers operating costs especially in just-in-time transportation. See figure 4 for a schematic description of the system.

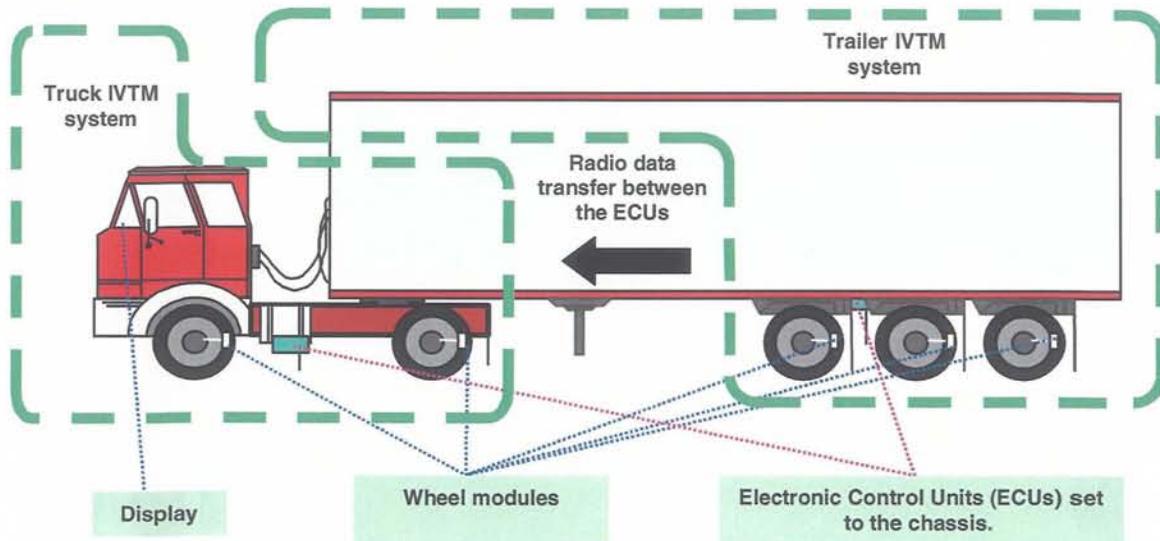


Figure 4 – IVTM general description.

Many new functions are being studied by the tyre and electronics industry. They will lead to new services designed to improve safety and vehicle operating costs, and to reduce traffic congestion and negative impacts on the environment.

In general, the future tyre types will offer a more integrated design covering the entire life cycle of the tyre and targeting the reduction of societal impacts, including their effects on the road surface. For example, with this aim in mind, new tyres with wider treads are progressively launched on the market. Rolling resistance reduction will also remain a very important goal.

REFERENCES

- 1 Al-Qadi, Loulizi, Janajreh & Freeman. Pavement response to dual and new wide-base tires at the same tire pressure. Transport Research Board. 81st annual meeting, January 17-22, 2002, Washington DC.
- 2 Gramsammer JC & JP Kerzreho (1998) Etude comparative des ornièrages obtenus sous de nouvelles montes simples et sous des jumelages classiques (comparative study of pavement rutting from new single tyres and classical dual tyres); Research report 'essai Michelin 1997'; Laboratoire Central des Ponts et Chaussées LCPC; 20 pp.; Nantes, FR
- 3 Halliday AR & DI Blackman (1997) Tests to establish pavement wear from selected tyre sizes; confidential report PR/CE/22/97; TRL; Crowthorne, Berkshire, UK
- 4 Markstaller, Pearson, Janajreh. On Vehicle Testing of Michelin New Wide Base Tire. SAE technical paper 2000-01-3432. International Truck & Bus Meeting & Exposition, Dec 2000, Portland, OR, USA.
