

Bulk or what?

When the tires are a way to gain car performance, such as in the motorsport field, there are two parameters which are considered the most important: pressure and temperature.

But why are we looking for these two parameters? The reason is because pressure and temperature are universally recognised as affecting the grip level. The two parameters are not independent, as changing the pressure will affect the temperature as well, but if we look just at the first order effects we can say the pressure has mainly an effect on the contact patch dimension (which is carcass related) while the temperature has a deeper impact on the compound through its effect on elastic and shear modulus as well as the effects on the chemicals inside the tread.

If we restrict the analysis to the relationship between temperature and grip the first thing we need to ask ourselves is: which is the temperature we have to look at? It is generally considered that the so called "bulk" temperature is the one which is more correlated with the grip level. Because of that we now have clear in our mind that the bulk temperature is what we have to control.

But there is a problem: the bulk cannot be measured on the car. Because of that limitation we usually use the surface and inner liner temperature as a reference, accepting the fact that they are not exactly what we need but they must be in some way correlated.

This assumption is obviously correct, the problem is that the correlation is not so straightforward: let's imagine a tire which is running at certain inner liner and surface temperature but on two different tarmacs which have a considerably different roughness. That means the indentation of the tarmac asperities into the tire is quite different, generating more or less stress into the tyre itself, exactly where the so called bulk lies. This means the different stress levels are causing different heat generation inside the tyre. As a result, we have two tyres, apparently running in similar conditions as they have the same surface and inner liner temperature but in reality they have a different bulk temperature, which is the main factor acting on the grip.

If the above statement is clear, it is quite evident that whatever relationship between surface and inner liner has been defined a priori, it cannot be true for all the cases. To have a better reading of the bulk temperature a proper thermal model is required.

There are several thermal models on the market which are developed based on different assumptions; being models, they all are affected by the usual limitation, such as they can be more suited for one application rather than another one; the selection process requires then a severe evaluation of the models looking for their strength and weaknesses.

Based on my experience I would add another parameter to take into account when evaluating a thermal model, which is the background of the developers; since there are different ways to develop a thermal model and since the research is always ongoing, it would be good to select a supplier which is used to work with other companies in the same field, prone to improve the model with strong interaction and, more important, it has behind a proved scientific background such as based on university research, because there are no other way to guarantee the model has the most up to date technologies and that fresher ideas are implemented.

Good bulk temperature estimation to everyone!

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