

It's fair to say, most race teams would prefer the optimal racecar set-up and the best set of working tyres out on the track to a few per cent of extra horsepower. Set up and grip allow the car to be driven with confidence, remain stable into and through the corners, with a good drive down the next straight. This makes fast laps and happy racers.

Sometimes it can seem that with the myriad options available regarding camber, toe, balance and suspension settings, teams tend to focus on these settings and feel that the tyres are what they are. When it comes to working with tyres, there are usually only a few compound choices available from the supplier suitable for the track and conditions, along with selecting a tyre pressure. Don't despair though, there are still a few things you can do to influence your tyres' performance.

One way to 'manage' tyres and get better use of your available track time is to utilise tyre warmers to their full ability. The following is a review of the ways to work with tyre warmers that could assist your racing efforts.

Going quick from the out lap

The first and most obvious use of tyre warmers is to get the tyres up to operating temperature prior to heading out of the pit. Even on hot days tyres are far below optimum temperature for grip and it will take some time circulating on the track to get the tyres into their operating range. Most race tyres work best at carcass temperatures between 75-100degC (167-212degF), depending on the compound. When the weather and track surfaces are cold the

“BETTER USE OF PRACTICE SESSIONS OR OFF-SEASON TESTING”

amount of time required to get the tyre 'up to temperature' can take additional laps. Being able to drive at full pace right away makes better use of practice sessions or off-season testing, which is often done in cooler weather. It also saves valuable time on the engine.

Sometimes teams think of this function as the only benefit a tyre warmer affords, but there are more subtle and equally important gains to be had.

Hot pressure

All teams are concerned with competing with the proper hot tyre pressure when out on the circuit. As tyres heat up to operating temperature on the track, the pressure of the tyres increases as well. Depending on the →

The most obvious use of tyre warmers is to get tyres to their optimum working temperature prior to going out on track, but there's much more to them than that



Tyre warmers also prevent tyres from cold cycling during practice, prolonging tyre life and maximising a team's time at race speed. They also help avoid rapid heat shock which can be detrimental to the tyres' chemical composition



Forsythe Racing – Paul Tracy's Champ Car



Naykid Racing - Scotty White's Viper



Kraco Race Team's Lola Chassis Car

type of motorsport they are being used for, the increase can be between 15 and 50 per cent of the cold settings, which is significant in the performance and handling of the tyre.

The tyre is the first 'damper', or suspension component, to begin working, as it is in direct contact with the track surface. A tyre at its proper hot pressure will work the suspension properly. The tyre will be stiffer as the cords and belts are under more tension and, when loaded, this results in additional grip. For the tyre to perform as desired under braking, cornering and acceleration, having the hot pressure correct is essential. Hot pressures can be set more accurately by using nitrogen in place of air and by using tyre-drying equipment. These measures ensure the gas in the tyre is as dry as possible and are performed to reduce the amount of pressure increase, making predicting the eventual hot pressure more reliable.

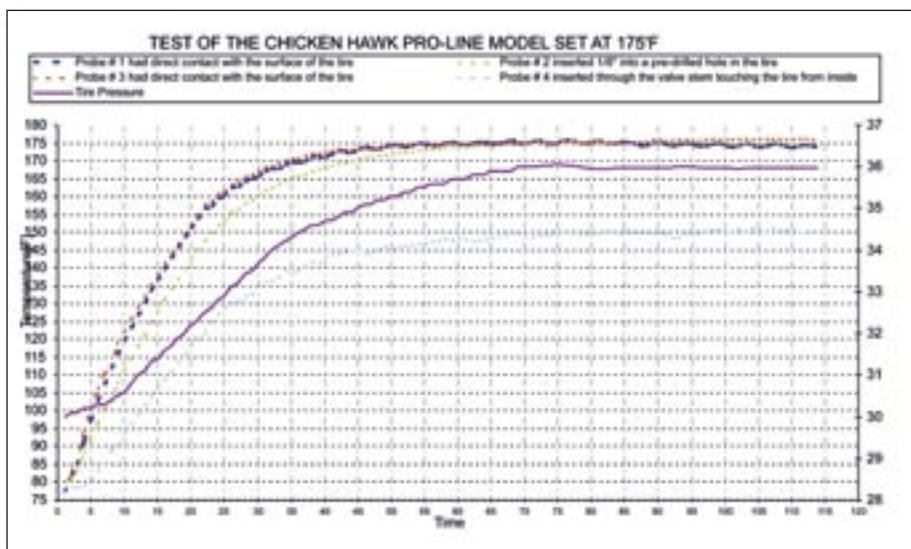
Utilising tyre warmers in the pits is one way to assist in this set-up. A proper tyre warmer not only heats the surface of the rubber, but 'heat soaks' the tyre carcass, resulting in a stable tyre which will not vary once it hits the track. Let's just state that again for clarity – if a tyre warmer is used properly to set the carcass temperature to

“**A TYRE AT ITS PROPER HOT PRESSURE WILL WORK THE SUSPENSION PROPERLY**”

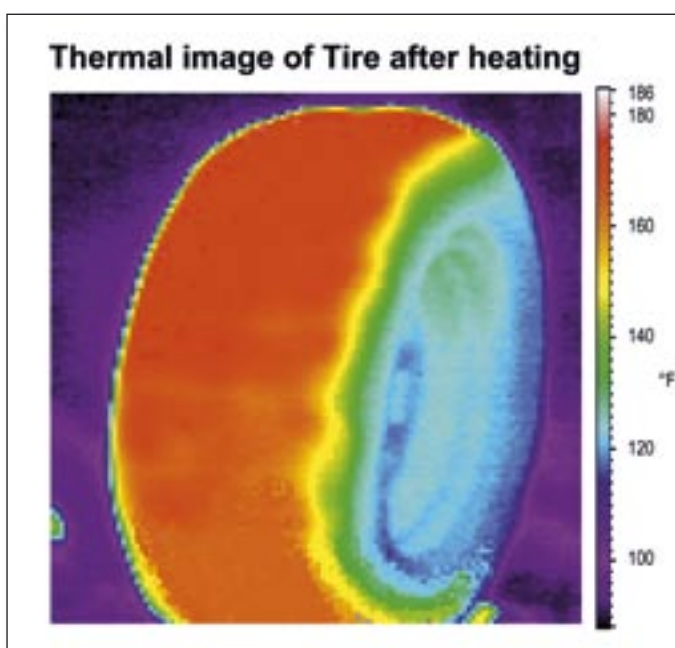
match the temperature which will be achieved on the race track, there will be no pressure rise once the car goes out onto the track.

The correct method is to log tyre temperatures using a probe (infrared devices only check superficial tyre temperatures) after each track session and note the hot pressures as well. Remember, ambient air and track surface temperatures will affect this, so be aware that early morning practice will not create the same increase as in the warmer afternoon session or during a race.

If, for example, the tyre were working well at 80degC (176degF) and a hot pressure of 36psi, you'd want to recreate that condition as close as possible in the pits prior to heading out onto the track. The graph in figure 1 (above right) shows not only that the surface temperature has come up to optimal, but also that the carcass is heat soaked, duplicating the difference in surface and carcass temperatures seen when the tyre comes off the track. In this way the tyre is stable. Be it three laps or 30, the temperature and pressure remain constant, but only if you've correctly predicted the hot temperature the tyre will actually achieve during the event.



The warmer was using a 175 degree set point and was on for 50 minutes. It was then removed and the thermal image taken



Saving heat cycles

From seat-of-the-pants experience, drivers know that after heating a tyre on the track and then allowing it to cool in the pits, it will lose grip. Not unlike cookies removed from the oven to cool, it is during this cooling process that tyres harden. Tyres are amazingly complex, both mechanically and chemically, so I will not try to take the position of the tyre engineer, but will simply describe the effect and the benefits to be had. As tyres cool, a change occurs that can be seen, measured and felt. On some tyres you can actually see a blue haze form over the tyre as some 'oils' migrate to the surface and oxidation occurs, whilst on others one might observe a drier, grayish haze – it all depends on individual tyre composition. Putting the tyre through these hot-to-cold cycles reduces grip, hardens the rubber and reduces its useful life.

A tyre warmer can keep tyres hot, or simply warm, between track sessions and reduce the

amount of heat cycles a tyre goes through. If the tyre is to see more than one track session it makes sense not to allow that tyre to cool all the way to ambient. This can extend how many sessions the tyre can perform at near maximum grip, therefore increasing the tyre's grip life.

Many professional teams utilising tyre warmers change the temperature set point to about 55degC (131degF) if there will be an extended period of time between track sessions. Then, 30 minutes prior to the track session the tyre can be brought back up to operating temperature again. In the USA, the Pro Toyota Atlantic series limits the number of tyres each team is allocated for a season in an effort to reduce the costs incurred. This allocation limit inspired at least one of the top teams to utilise tyre warmers during its private testing sessions. After an enviable season it attributed much of its success to the fact that it made full use of the available track time by starting out with hot tyres that were already



up to race pressure, therefore avoiding wasting time. It also claimed to be able to get much more use out of its tyre allotment by saving heat cycles between sessions. The effect was to get more valuable testing done than competitors with the same amount of tyres. In addition to increasing valuable test data, a reduction of costs was achieved by limiting wear on other components of the racecar.

Extending grip life

When a tyre hardens from going through heat cycles, some changes are happening to the tyre on a molecular level. The same is true of heating a tyre. Depending on the circuit, vehicle, driver, conditions and type of tyre, the tyre surface can be at temperatures upwards of 175degC (347degF). The tyre will be heated due to the abrasion, deformation and hysteresis of the tyre that occurs during driving, and can be at operating temperature in only a few laps, or as little as three to five minutes.

This rapid heating seems to 'heat shock' the tyre and, during this process, molecular changes occur within the chemical composition of the tyre. These chemicals, which are the 'lifblood' of the tyre, are released quickly but are also wasted if spent too quickly when heating up the tyres on the track [The term 'lifblood' is an effort to describe the various chemicals, additives, elastomers, long-link carbon molecules and other components tyre companies use in the process of manufacturing racing rubber].

This 'feeling' can actually be sensed by professional drivers on the track, who may feel the tyre is at operating temperature, only to realise a few corners later that this rapidly heated, high temperature rubber has been scrubbed off. This is why getting the tyre to full, hot pressure and stable carcass

temperature takes longer than just getting the surface hot.

When tyres are heated with tyre warmers, this sensation is not present and testing has found the grip life of the tyre is extended. Examining the graph in figure 1 you can see how slowly the tyre is brought up to operating temperature on a tyre warmer. The result is that the lifblood of the tyre is not spent so quickly and grip life is improved.

Safety

Experienced drivers know to take the first few laps on new rubber with caution to get their tyres to operating temperature on the track safely. However, there are those situations where either a lapse of concentration or excessive emotion can take over and an off-track incident due to cold tyres occurs. This can be dangerous to both the

“A STABLE TYRE WILL NOT VARY ONCE IT HITS THE TRACK”

driver and the racecar. High horsepower vehicles that are also very light can be especially prone to the cold tyre incident but, in almost all cases, it is necessary to 'work' racing tyres first to generate heat.

Racing is also a business though and seeks to have more events each season. This tends to extend the racing season into cooler months of the year where temperatures become more of an issue. Yet in the USA, many professional race series ban the use of tyre warmers, and it can regularly be observed that when cars return to the racetrack with cold tyres after pit stops drivers need to either employ blocking

tactics or risk some daring moments sliding on cold tyres, while they wait for their tyres to come up to temperature and to hot pressure. Not only can this be dangerous – with several serious incidents having been attributed to cold tyres – it makes for a less exciting event when cautious drivers choose to use the blocking tactic.

Tuning with compounds

Should a team have a choice of compounds or race in the rain, tyre warmers can be set for the varying conditions. Rain tyres, even though engineered to work well at low temperatures, still experience an increase in both temperature and pressure during use. I have personally seen MotoGP teams use the standard dry tyre temperature of 80degC (176degF) on rain tyres, although their own tyre engineer and our experience shows that 55degC (131degF) is enough to get the tyre in the area of correct operating temperature and pressure. This provides first lap confidence and grip even in the wet.

As for dry compound choices, the tyre warmers can open up some further options. For example, a driver may be torn between two compounds, tempted to use a softer one for the grip in the early laps, but concerned it may not make the race distance. By using tyre warmers (perhaps even at a slightly higher than standard temperature ie 90degC or 194degF) the harder of the two choices can be used so that less of a disadvantage is present during the opening laps and the tyre will last the entire session.

For those experienced with tyre warmers, these issues probably seem like a review of the obvious but the purpose of this overview is to highlight some possibilities of how to manage your race tyres better. One thing that is important to remember is that tyres, once sold to the team, can still be influenced by your use and mis-use of them. If you are not already paying careful attention to cold and hot pressures, cold and hot temperatures, tyre graining and wear patterns, in addition to the standard information on compound and lap times, then start now.

A brand new tyre, if made without defect, is just ready for your input. It is up to you how to store it, pre-heat it, inflate it, drive on it and decide when to allow it to cool down. Moving forward during testing sessions and races begins in the paddock and the treatment of your tyres is one of the most important areas to focus your attention on.

■ David Podolsky founded Chicken Hawk Racing Tyre Warmers (see www.chickenhawkcracing.com)



Formula 1 teams have long been convinced of the benefits of tyre warmers, like Honda at the Malaysian GP