Tire Warmers

An Unfair Advantage?

By Mike Burrell

Engineer turned race driver, Mark Donohue, wrote the book "The Unfair Advantage" in the mid-1970's documenting the never-ending search for the single advantage Donohue, and his car owner, Roger Penske, sought over the competition. As a serious kart racer, your search for the edge over the competition never ends, too.

Madsen checks the cold durometer rating of the set used for baseline setup.

In search of the unfair advantage, NKN got together with Chicken Hawk Racing to evaluate the advantages or myths behind using tire warmers in karting. This article outlines the theories behind the advantages of tire warmers, the different types available for karts, and concludes with the first test of Chicken Hawk's karting tire warmers with NKN.

Since tire manufacturers learned to "work the rubber" for more grip, through heat and friction, racers have searched for ways to get heat into the tires faster. Over the years, many crude and often unsafe methods to preheat karting tires have been observed – handheld open-flame propane torches, salamander heaters blowing on tires and wheels under a blanket, and more. These and other methods are not safe, not heating the tires and wheels evenly, and not predictable for proper tuning

The drawstring seals the heat in and doesn't allow it to escape out the sides of the warmers.

The theory behind using tire warmers goes much deeper than having an advantage over your competition for the first two laps. Racing tires and rubber are complex: the result of years of testing and engineering.

Optimal operating temperatures for kart racing tires (asphalt) are between 170-195 degrees Fahrenheit. At 200 degrees of surface temperature, the inside temperature of the tire (in the "air space") is about 175 degrees on average. Many kart racers never observe or even reach optimal operating temperatures, thereby searching for grip in unnecessary ways.

Erik Madsen, Chicken Hawk Racing's four-wheel manager, states there are four primary rea-

Wrapping the tires in the warmers only took a matter of seconds.

sons for using tire warmers: performance, safety, economy, and tuning. The main performance advantage is obvious; hot tires at the green flag are better than cold tires. Madsen sited examples where he has seen opening lap times up to three seconds faster on heated tires versus non-heated. However, there are other performance advantages in addition to setting the fastest lap time on the opening lap.

Tires have moisture trapped inside of them, even if a dry gas such as nitrogen is used to mount and inflate the tire. Typically, it's this moisture that comes to the sur-

face when the tire is semi-heated, around the third or fourth lap depending on track length. Heating a tire and wheel through to the tire's carcass will bring a significant amount of this moisture to the surface (and out) and be expelled before it affects on-track performance.

It took about 45 minutes for the tires to come up to temperature.

Closely tied into the performance benefits of heated tires are the tuning advantages. Tire warmers allow the tires to be set to the expected hot pressures. For racers who figure stagger into their setups, warm tires and hot pressures allow for a more accurate measurement of stagger before leaving the pits. Finally, when there is a choice between soft and hard tires, tire warmers help make that decision easier.

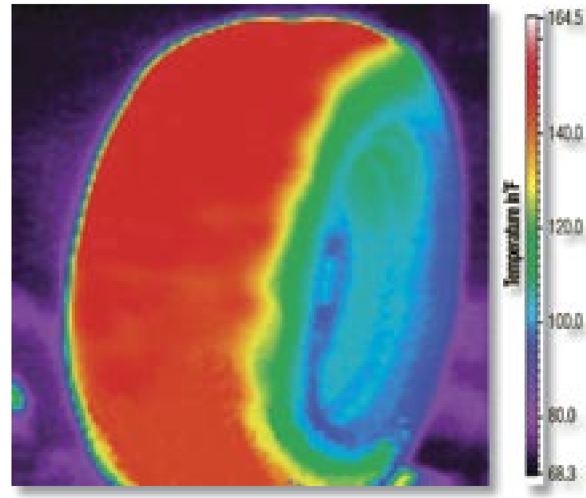
Everyone knows a hard tire will last longer and probably be more consistent over the duration of a race. Everyone also knows a softer tire will "come in" sooner and probably be faster. In some cases, tire warmers eliminate the difficult decision of which compound to use by allowing the driver to have the durability benefits of the harder tires with the heat of the softer tires from the start of the race.

The safety benefits of leaving the pits on hot tires are simple: avoid the accident caused by cold tires. How many times have we, as race fans, seen cold tires result in even the top professional series result in crashes, races lost, and injury? Like a wild animal, race drivers get excited at the sight of a green flag, often losing control when horsepower exceeds tire grip and talent level. Even without personal injury, the repair costs from one cold tire crash could exceed the cost of the tire warmers.

Reducing the number of heat cycles, say between practice and a heat race, by the use of tire warmers is the primary economical benefit. A heat cycle completed, and the tire hardens when it is cooled to ambient temperature after completing a session. Think of it like a cookie: from the oven it's fresh and soft, and sitting on the counter it cools and hardens. You can heat it back up in the oven, but how many times without losing flavor?

Another benefit is the time and engine wear savings from making fewer laps in testing and practice just to heat the tires. This example is extreme but makes the point, Indy Racing League teams calculate it costs over $200 per mile to operate an Indycar. Although even an ICC kart is probably under $1 per mile, savings are savings.

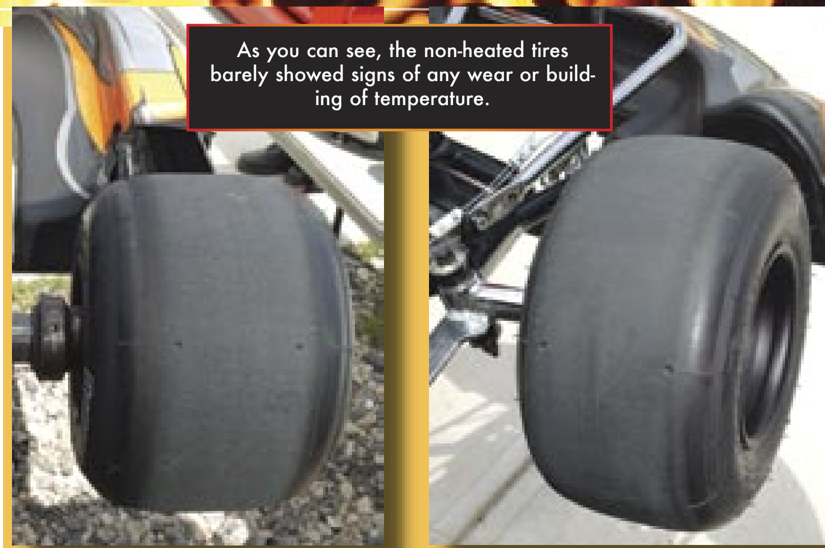
Madsen talked about heating the tire uniformly and heating it to the carcass, heat-soaking a tire. This deep heating allows not only the contact patch of the tire, but also the inner construction of the tire and the gases inside. As seen in the thermal image provided by Chicken Hawk Racing, the contact patch (red) is at 171-177 degrees Fahrenheit and the sidewall (representing the internal gases and tire carcass) is around 140-150



degress Fahrenheit. Even the center part of this image (representing the wheel itself) is above 120 degrees. Uniform heating eliminates another variable from the tuning or testing scenario. At the end of the day tuning boils down to eliminating the variables.

Types of Tire Warmers:

Chicken Hawk Racing has been producing nothing but tire warmers for the past twelve years (and doing it exclusively in the U.S.A.). Teams from around the world, in almost every form of motorsports, two and four wheeled, have experimented with tire warmers at some time. However, many sanctioning bodies have not allowed pre-heated tires in competition citing "economic reasons", a misconception that is beginning to change.



As you can see, the non-heated tires barely showed signs of any wear or building of temperature.

Chicken Hawk Racing produces three different tire warming systems for karters, just like they do for "big cars". Chicken Hawk karting tire warmers come in three sizes, based on tire circumference.

The **"Standard Model"** (which was used in this test) features a unique fabric heating element that provides uniform heating of the tire. It has Arimid insulation, and a neon light that shows when the tire has reached temperature. The Standard Model heats a tire to 155 degrees in about 40-50 minutes. MSRP is $340 per set.

The **"Pole Position"** model, which will soon be available at the time of publication, features a three-way temperature control switch. This switch allows the user three settings to control the temperature at which the tires will be heated: low (135 degrees), medium (155 degrees), and high (175 degrees). One benefit of adjustable temperatures would be adjusting temperatures for different compounds or tire makes (dry vs. rain tires). The Pole Position model will retail for $490 per set.

Chicken Hawk's **"Pro Line"** model features a digital temperature control which allows the tuner to set custom temperatures in increments appropriate to your racing applications. The Pro Line sells for $720 a set.

The model that would be right for your kart racing would most probably be contingent on your needs and budget. If you run in a race at events, like say the Rock Island Grand Prix, where each class has a standing start, any model tire warmer would be of great benefit. Perhaps racing at a Sprint track where one sits on the grid for an excessive time, a model that allows you to set a hotter temperature would be more beneficial. For Dirt racers who may run multiple compounds over the course of a night, a warmer with adjustable temperatures would be essential. The potential benefits are there for any karter.

NKN and Chicken Hawk Racing's Initial Test:

Erik Madsen flew to Indianapolis for the tire warmer test, and had a very professional plan ready to conduct the test around. He brought with him both a "Standard Model" set and a "Pole Position Model". Our plan was to use the Standard Model, which is the most popular model with karters. This set would preheat one set to 155 degrees Fahrenheit.

The warmers even work while on the kart; however, wind is a factor in even heating.

The weather couldn't have been more perfect to exploit the benefits of tire warmers. Even though it was early May when we performed the test, the weather at New Castle Motorsports Park only produced an ambient temperature of a mere 47 degrees, and the track temperature of 48 degrees. The day was a hazy, overcast and the wind was a constant 20 mph from the southwest (which blew nearly head on down the long straightaway). As stated, the track temperature stayed consistent at 48 degrees, an important factor for testing.

For the test, we used NKN's CRG Blue Demon test chassis with a Leopard TaG engine. The chassis was set as neutral and free as possible; rear track just under 55", as much caster as possible removed, and camber set at nearly 0 degrees.

Madsen points to the 3-position switch on the new "Pole Position" model.

The warmer unit plugs into a standard 110 outlet.

We had two sticker sets of Bridgestone YHC tires mounted on spun aluminum Douglas wheels (fronts were direct spindle mounts). The cold pressures were set at 17 psi rear and 15 psi front, which is a bit higher than recommended by Bridgestone, but appropriate for the conditions of the day.

The test began with a baseline to evaluate the track conditions on old tires that were not preheated. After ten laps on this cool day, the chassis had a moderate understeer that was consistent after about the fourth or fifth lap when the tires began to heat up. For the actual testing, we decided to widen the front track two inches overall to help reduce the understeer (and it worked).

Before we started the actual test, Madsen insisted we temperature stabilize both sets of test tires and durometer each set. Each set was set to the 15 front and 17 rear cold pressure, and placed in the trailer for about 45 minutes. At this point, Madsen probed each tire's temperature, and declared them stabilized at 55 degrees.

Each of the new tire's durometer rating was then tested. With the exception of the right rear on Set 2 (the set to be heated) which durometered at 65, all tires rated at 64. Also, stagger had been measured, and was under 1/16th of an inch (an insignificant amount to effect the test on a one mile road course).

With each set stabilized, Madsen began to put Set 2, the set to be heated, on the Chicken Hawk Racing tire warmers. It would take about 50 minutes to heat the set to optimal temperatures. During that time, we would run Set 1, the non-heated set through the test cycle.

The test cycle would consist of ten timed laps and one simulated pace lap. At the end of the simulated pace lap, Madsen had me stop just before the start finish line for a tire temperature reading at what would have been the drop of the green flag.


Rolled out, it's easy to see the heating element that goes throughout the warmer.

As Set 2 sat in the trailer in the Chicken Hawk warmers, Set 1 was mounted and the engine warmed up. Madsen jogged to the starting line as I set off on the simulated pace lap. One would believe a one mile track would give you plenty of time to bring tires up to temperature no matter what the weather conditions, right?

Wrong! Even as I scrubbed these non-heated tires as hard as I could to build heat, when I stopped at the line for Madsen to read the temperatures they were way below optimal racing temperatures. Measuring only the center temperatures, the LF was 94 degrees, RF 96 degrees, LR 98 degrees, and the RR was only 99 degrees.

At this point, I dropped the throttle and began the timed run as quickly as possible. Driving hard, but not over my head, we began the first simulated 10 lap race. On the third lap, the tires began to feel sticky, as if they were at operating temperatures. However, by the end of this lap, I experienced a moderate slide from all four corners of the kart.

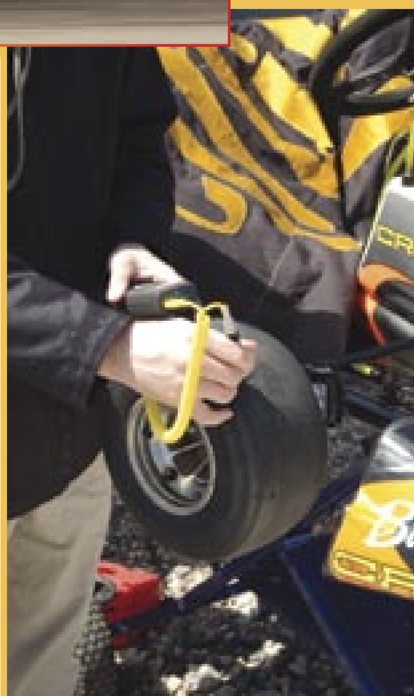
Madsen had mentioned the moisture in any non-preheated tire coming to the surface, usually around the third or fourth lap, giving the driver that greasy feeling for a lap or so until the moisture is totally pulled out. For years, I've felt this and always just assumed I was putting too much confidence in the tires a lap too early.

At the beginning of the seventh timed lap, a bad battery in the dash made itself known, and the unit shutdown. Although the batteries had been replaced two days earlier, an 'old' battery had found its way into the unit. After the run the batteries were replaced, and the MyChron3 Plus functioned flawlessly. Madsen was backing up the lap times on digital stopwatches, and upon comparing results he was less than a tenth difference.

I continued the run (but had forgotten what lap we were on), and concluded it after eight timed laps. The total run time for the eight timed laps on non-preheated tires: 9 minutes and 52 seconds.

Over the course of the run, the handling went from free (on cold tires) to continuing to become slightly tighter throughout the run. This was the way this kart has handled from day one.

Even on the "in lap", I pushed to get an accurate temperature and pressure reading. I stopped on the pit-in lane and met Madsen with the pyrometer and pressure gauge. At the end of the ten lap run, the center temperatures were as follows: LF: 118, RF: 124, LR: 132, and RR:n136. Hot tire pressures were: LF: 17 3/4, RF: 17 3/4, LR: 19 3/4, and RR: 20 (up from 15 front and 17 rear CPSI).



Madsen probes the baseline and sets the temperature with a digital pyrometer.

With these results in hand, we quickly made our way back to the trailer to change tires to the heated Set 2.

As the second set was mounted, Madsen checked the temperatures as they came out of the warmers. They were as follows: LF: 138, RF: 142, RR: 151, and LR: 150. The LF was on top of the stack. Madsen explained the wind (or lack of) is a major factor in the even heating of tires. However, the 142 degree RF was warm enough to allow the steel wheel bearing on one side to slide out of the aluminum wheel!

When the preheated set was mounted, I immediately hit the track. We followed the same procedures, stopping before the starting line to have the "would be" green temperatures checked. The preheated tires were between twelve and twenty-three degrees hotter for the simulated start at: LF: 106, RF: 110, LR: 116, and RR: 122.

I took off on the eighth lap timed run, and instantly felt a degree more of comfort on the preheated tires. However, upon tripping the beacon at the end of the first timed lap, I was somewhat surprised that the lap time was not significantly faster than with the cold tires.

At the end of the third lap, when the moisture was being expelled from the non-preheated tires, I did not experience the greasy sliding feeling on the preheated tires.

In fact, over the course of the run on the preheated tires, the handling stayed much more consistent over the course of the run. It began slightly tight and stayed slightly tight.

At the end of the run, Madsen measured the tire temperatures as: LF: 128, RF: 136, LR: 146, and RR: 151; between ten and fifteen degrees warmer (and still way under the manufacturer's recommended temperatures) than the non-preheated set.

Hot tire pressures were almost identical. The one exception was the RF; it was one half of a pound lower on the heated set versus the non-heated set. Madsen stated this suggests a higher moisture level in the non-heated tire as it registered a higher hot PSI.

The Conclusion:

At the end of the test, the stopwatch was the final measure of success. Although the difference in lap times was not dramatic, it was consistently .3 seconds faster on the preheated versus non-preheated tires.

From a driver's standpoint, the preheated tires were more consistent in their handling characteristics. The third or fourth lap greasy feeling, due to the moisture leaving the tire, was not present in the preheated tires.

A few days later, at a NCMP club race, I used the tire warmers in the first practice session for the TaG class; a real world application. The day was much warmer; near 80 degrees and sunny (about 115 degrees of track temp). After about an hour on the warmers, the tires were all above 150 degrees.

When I rolled to the grid at what should have been about three minutes before the session started, the reality began and we didn't leave the pits for another five minutes. The tires had cooled, but were still better than what the competitors had. I had significantly more grip leaving the pits; however, I learned the kart's setup would have to be adjusted to compensate for this added grip, as it felt tight from out lap.

One other point I would like to make regarding the use of tire warmers is the benefit of using them on hot days. Many racers assume tire warmers are only to be used on cool days; however, the track temperature and ambient temperature will never be near the manufacturer's recommended operating temperatures.

The verdict: Would I like to have hot tires from the minute I leave the pits? You bet! Are tire warmers an advantage to karters? Yes, they can be. But like anything else in motorsports you have to know how to use them to your advantage. There is more to it than plugging the warmers in and setting fast lap. Also evaluate your racing budget and situation, and check to confirm your organization will allow tire warmers.

Tire warmers can save heat cycles. They can lower lap times, and they can eliminate one more variable from the tuning equation.