10/10ths MOTORSPORTS

The Black Crack Report

The addiction you don't want to fight

Issue 8, September, 2009

2 Great Events in September

10/10ths has 2 great events coming up in September.

- ***9-19-09 at Putnam Park***.
  - A single day event (Saturday) which provides up to 3.0 hours of track time for all 3 groups.
  - We are excited to welcome Sidelines Sports Photography to this event to provide you the opportunity to get professional photographs of you and your car on track.
  - You can visit our website at www.1010thsMotorsports.com for details and registration.

- ***9-28/29-09 at Virginia International Raceway***
  - A two day event (Monday and Tuesday) which provides upt to 3.0 hours of track time each day for all 3 groups. Depending on the turnout, this could increase to about ***5.0*** hours of track time each day.
  - This is our first ever 10 / 10ths event at VIR so tell your buddies and come on out for some great driving.
  - You can visit our website at www.1010thsMotorsports.com for details and registration.

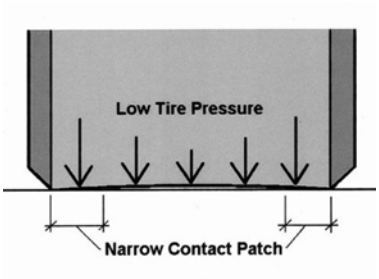
SideLines Sports Photography coming to 10/10ths

Great News !! Mike with SideLines Sports Photography is coming to our September 19th event at Putnam Park. I have ordered my track photos CD from Mike in the past and have been very pleased with the quality of shots and photography. This is a great addition to 10/10ths Motorsports and I am sure you will be interested in what Mike has to offer.

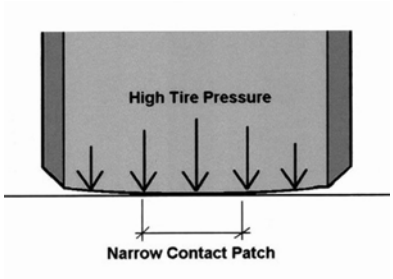
September Safety Note

Is it really September already? I am not sure what happened to the Summer but we must all now be thinking about a "Cold Track" in the morning. It seems like this is stating the obvious, but is it? Too many times I have seen drivers go out for that first session on a cool or cold morning, only to spin off track and a few times, trash their cars. Sadly, there really is no excuse for this. Everyone needs to step that first session back a notch or two to fully warm up their cars and especially their tires. The track itself also needs some warming up. It's a simple matter really, slow down a bit for that first session. You will feel your tire grip increase as they heat up. Drive within your comfort level and be prepared to correct that over or understeer as a result of cold tires on a cold track.

Also remember that cold weather can cause a greater range of cold to hot tire pressures. The difference of just a few pounds can drastically change the way your car handles. Cold weather will cause these changes throughout your on track session. The wear on your tires can also increase due to changing temperatures. It is a good idea to always watch and maintain your tire pressures but especially so in cold weather.



Just some tire pressure affects to think about.



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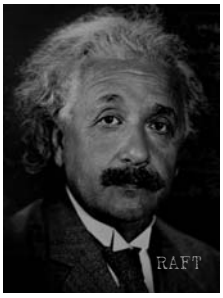
Check Out the New 10/10ths Hat

The new 10/10ths Hat will be in stock before our next event. I am sure there will be a couple of these for door prizes.
This one size fits all hat is made with some great stitching and simply looks fantastic.
You can find it on the 10/10ths website.

The Physics of Racing

Brian Beckman has written many articles about the Physics of Racing and grants the right to use each article in any manner needed to further advance this great sport.
***BALANCE AND WEIGHT TRANSFER** is a fundamental part of going fast and this is a great article on the subject. Some heavy reading but very eye opening.*



Einstein could have been a heck of a race car driver.

Most autocrossers and race drivers learn early in their careers the importance of balancing a car. Learning to do it consistently and automatically is one essential part of becoming a truly good driver. While the skills for balancing a car are commonly taught in drivers' schools, the rationale behind them is not usually adequately explained. That rationale comes from simple physics. Understanding the physics of driving not only helps one be a better driver, but increases one's enjoyment of driving as well. If you know the deep reasons why you ought to do certain things you will remember the things better and move faster toward complete internalization of the skills.

Balancing a car is controlling weight transfer using throttle, brakes, and steering. This article explains the physics of weight transfer. You will often hear instructors and drivers say that applying the brakes shifts weight to the front of a car and can induce oversteer. Likewise, accelerating shifts weight to the rear, inducing understeer, and cornering shifts weight to the opposite side, unloading the inside tyres. But why does weight shift during these manoeuvres? How can weight shift when everything is in the car bolted in and strapped down? Briefly, the reason is that inertia acts through the centre of gravity (CG) of the car, which is above the ground, but adhesive forces act at ground level through the tyre contact patches. The effects of weight transfer are proportional to the height of the CG off the ground. A flatter car, one with a lower CG, handles better and quicker because weight transfer is not so drastic as it is in a high car.

The rest of this article explains how inertia and adhesive forces give rise to weight transfer through Newton's laws. The article begins with the elements and works up to some simple equations that you can use to calculate weight transfer in any car knowing only the wheelbase, the height of the CG, the static weight distribution, and the track, or distance between the tyres across the car. These numbers are reported in shop manuals and most journalistic reviews of cars.

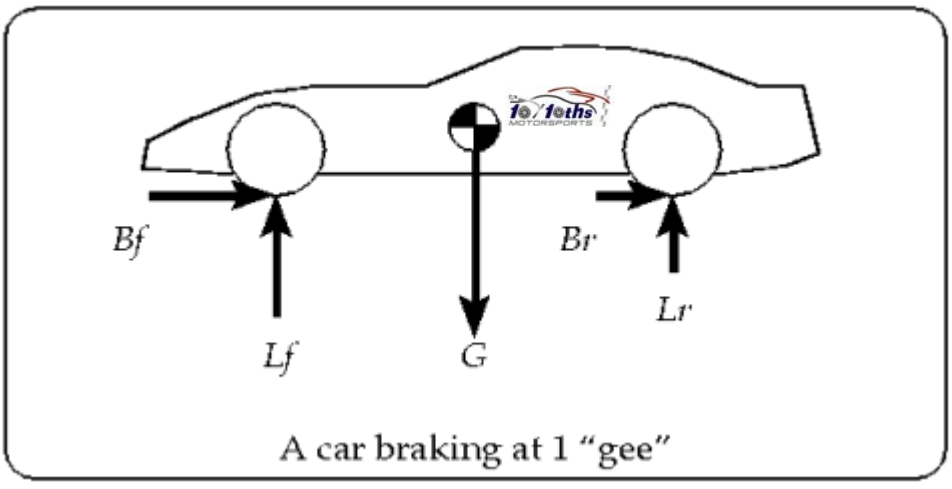
Most people remember Newton's laws from school physics. These are fundamental laws that apply to all large things in the universe, such as cars. In the context of our racing application, they are:

The first law: **a car in straight-line motion at a constant speed will keep such motion until acted on by an external force**. The only reason a car in neutral will not coast forever is that friction, an external force, gradually slows the car down. Friction comes from the tyres on the ground and the air flowing over the car. The tendency of a car to keep moving the way it is moving is the inertia of the car, and this tendency is concentrated at the CG point.

The second law: **When a force is applied to a car, the change in motion is proportional to the force divided by the mass of the car**. This law is expressed by the famous equation ***F = ma***, where ***F*** is a force, ***m*** is the mass of the car, and ***a*** is the acceleration, or change in motion, of the car. A larger force causes quicker changes in motion, and a heavier car reacts more slowly to forces. Newton's second law explains why quick cars are powerful and lightweight. The more ***F*** and the less ***m*** you have, the more ***a*** you can get.

The third law: **Every force on a car by another object, such as the ground, is matched by an equal and opposite force on the object by the car**. When you apply the brakes, you cause the tyres to push forward against the ground, and the ground pushes back. As long as the tyres stay on the car, the ground pushing on them slows the car down.

Let us continue analysing braking. Weight transfer during accelerating and cornering are mere variations on the theme. We won't consider subtleties such as suspension and tyre deflection yet. These effects are very important, but secondary. The figure shows a car and the forces on it during a "one g" braking manoeuvre. One g means that the total braking force equals the weight of the car, say, in pounds.



A car braking at 1 "gee"

In this figure, the black and white "pie plate" in the centre is the CG. ***G*** is the force of gravity that pulls the car toward the centre of the Earth. This is the weight of the car; weight is just another word for the force of gravity. It is a fact of Nature, only fully explained by Albert Einstein, that gravitational forces act through the CG of an object, just like inertia. This fact can be explained at deeper levels, but such an explanation would take us too far off the subject of weight transfer.

L_f is the lift force exerted by the ground on the front tyre, and L_r is the lift force on the rear tyre. These lift forces are as real as the ones that keep an airplane in the air, and they keep the car from falling through the ground to the centre of the Earth.

We don't often notice the forces that the ground exerts on objects because they are so ordinary, but they are at the essence of car dynamics. The reason is that the magnitude of these forces determine the ability of a tyre to stick, and imbalances between the front and rear lift forces account for understeer and oversteer. The figure only shows forces on the car, not forces on the ground and the CG of the Earth. Newton's third law requires that these equal and opposite forces exist, but we are only concerned about how the ground and the Earth's gravity affect the car.

If the car were standing still or coasting, and its weight distribution were 50-50, then L_f would be the same as L_r. It is always the case that L_f plus L_r equals G, the weight of the car. Why? Because of Newton's first law. The car is not changing its motion in the vertical direction, at least as long as it doesn't get airborne, so the total sum of all forces in the vertical direction must be zero. G points down and counteracts the sum of L_f and L_r, which point up.

Braking causes L_f to be greater than L_r. Literally, the "rear end gets light," as one often hears racers say. Consider the front and rear braking forces, B_f and B_r, in the diagram. They push backwards on the tyres, which push on the wheels, which push on the suspension parts, which push on the rest of the car, slowing it down. But these forces are acting at ground level, not at the level of the CG. The braking forces are indirectly slowing down the car by pushing at ground level, while the inertia of the car is 'trying' to keep it moving forward as a unit at the CG level.

The braking forces create a rotating tendency, or torque, about the CG. Imagine pulling a table cloth out from under some glasses and candelabra. These objects would have a tendency to tip or rotate over, and the tendency is greater for taller objects and is greater the harder you pull on the cloth. The rotational tendency of a car under braking is due to identical physics.

The braking torque acts in such a way as to put the car up on its nose. Since the car does not actually go up on its nose (we hope), some other forces must be counteracting that tendency, by Newton's first law. G cannot be doing it since it passes right through the centre of gravity. The only forces that can counteract that tendency are the lift forces, and the only way they can do so is for L_f to become greater than L_r. Literally, the ground pushes up harder on the front tyres during braking to try to keep the car from tipping forward.

By how much does L_f exceed L_r? The braking torque is proportional to the sum of the braking forces and to the height of the CG. Let's say that height is 20 inches. The counterbalancing torque resisting the braking torque is proportional to L_f and half the wheelbase (in a car with 50-50 weight distribution), minus L_r times half the wheelbase since L_r is helping the braking forces upend the car. L_f has a lot of work to do: it must resist the torques of both the braking forces and the lift on the rear tyres. Let's say the wheelbase is 100 inches. Since we are braking at one g, the braking forces equal G, say, 3200 pounds. All this is summarized in the following equations:

3200 lbs times 20 inches = L_f times 50 inches - L_r times 50 inches

$L_f + L_r$ = 3200 lbs (this is always true)

With the help of a little algebra, we can find out that

L_f = 1600 + 3200 / 5 = 2240 lbs, L_r = 1600 - 3200 / 5 = 960 lbs

Thus, by braking at one g in our example car, we add 640 pounds of load to the front tyres and take 640 pounds off the rears! This is very pronounced weight transfer.

By doing a similar analysis for a more general car with CG height of h, wheelbase w, weight G, static weight distribution d expressed as a fraction of weight in the front, and braking with force B, we can show that

$$L_f = dG + Bh / w, \quad L_r = (1 - d)G - Bh / w$$

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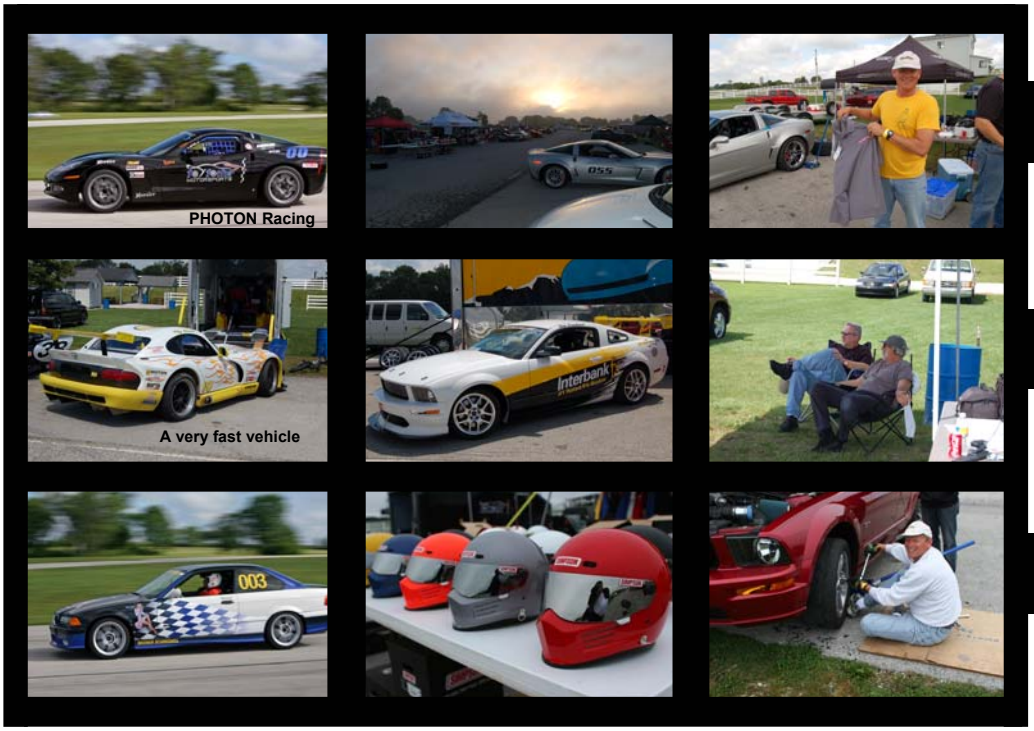
These equations can be used to calculate weight transfer during acceleration by treating acceleration force as negative braking force. If you have acceleration figures in gees, say from a *G-analyst* or other device, just multiply them by the weight of the car to get acceleration forces (Newton's second law!). Weight transfer during cornering can be analysed in a similar way, where the track of the car replaces the wheelbase and ***d*** is always 50% (unless you account for the weight of the driver). Those of you with science or engineering backgrounds may enjoy deriving these equations for yourselves. The equations for a car doing a combination of braking and cornering, as in a trail braking manoeuvre, are much more complicated and require some mathematical tricks to derive.

Some Photos from the August Event

Another great event with many great drivers in attendance, THANK YOU. The weather was perfect and everyone got plenty of track time. We did have about an hour delay on Saturday but I arranged for an extra hour with the track to ensure everyone got their seat time..



Winner of a Forgeline Shirt

A couple of very capable drivers

Ensuring a track ready car

The Official Event Name Badge

The 9-19-09 Event Badge has already been designed and is ready for production.

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10/10ths Tech Corner

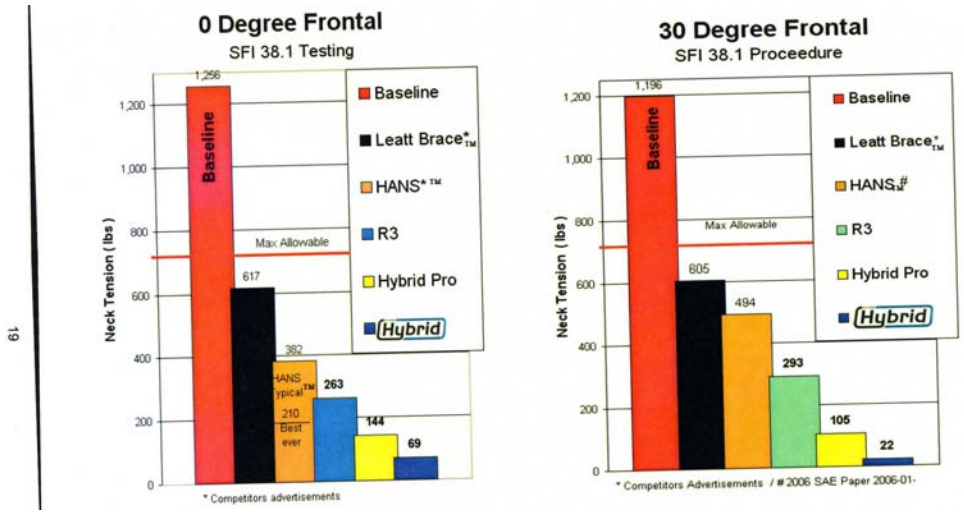
This month, I would like to thank Craig Freisinger of U.S. RaceGear which is located in Cincinnati. Craig was at our last event and has since put together the following article. I am a firm believer in safety at our events and hope this information is of value to you. It is ultimately your decision about the safety gear you purchase and use. This article will give you some insight into what to look for when choosing your safety equipment.

HEAD AND NECK RESTRAINTS

The following article is a combination of facts and my opinions on the subject of head and neck restraints. I am the owner of a company that sells personal safety equipment. The information that I have accumulated on the subject is the result of my training and interaction with experts in this field. I do not present myself as an expert. I feel compelled to write this article because many drivers are out there thinking they have much more protection than they actually do. I was one of them – You don't know what you don't know.

When people talk about head and neck restraints they are usually referring to the Hans Device. This is because it was one of the first devices available and quickly became the most popular. It did a wonderful job of fulfilling a need but it does have many limitations and shortcomings. It was a good first effort. It is my opinion that it is now obsolete as there are devices that addresses the shortcomings of the Hans and provides far greater driver protection. These devices are the Hybrid, Hybrid Pro and R3 from Safety Solutions.

The logical place to start the comparison is with the SFI sled test results. As you can see from the following chart the Safety Solutions devices dramatically lower forces on your neck more than the Hans does. These devices are the best performing at **all angles**. This is an indisputable fact, not an opinion. The Safety Solutions devices use multiple load paths to dissipate the head loads. The Hybrid and Hybrid Pro utilize a dual tether design. The tethers are arranged in a triangular design incorporating a S*ide Stabilizing Gusset* configured to enhance protection in angular and side impacts and produce unbeatable results. Additionally, they have a S*eatbelt Anchoring System* that produces the most effective results in all impacts and sets them apart in angular and side impacts. The Safety Solutions devices are the only ones that actually score better at an angle than frontal. Again, looking at the chart, the performance of the Hans drops off dramatically as the angle increases. This is because the driver is always going to slide into the impact and the far shoulder belt is *always* going to slide partially or completely off the Hans device. Look at the numbers for the 30* sled test and compare the Hans to the Hybrid. Where do you think you are less likely to be injured, with 494lbs pulling on your neck or 22lbs? Just because you don't suffer a basal skull fracture doesn't mean your neck isn't injured. According to Dr. John Melvin* "The most common impact angle in a stock car is right frontal and left rear". In recent years the right frontal has produced the most fatalities.



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To me the most compelling argument for switching to a Hybrid is not the numbers above but the fact that the Hans provides **NO SIDE IMPACT PROTECTION**. It was designed to work only from head on to 45* left or right and its best numbers are at 0*. How many accidents have you seen where the car contacted something perfectly perpendicular? The lack of side impact protection was proven in an article published by Chevrolet and The Society of Automotive Engineers involving side impact tests while developing the C5R race car. This is critical as almost all fatalities in road racing involve side impacts. This is why Grand-Am mandated side nets on both sides for their competitors. They were driving around the tracks in a Hans device with no protection in side impacts. It was just a matter of time before someone suffered death or a serious injury. Safety Solutions does more sled testing than any one else in the field and they have 17 years experience doing it.
I personally wore a Hans device for 7 years and thought I had state of the art protection. I was very wrong. Once I had the facts, I would not get in my race car with a Hans and would not let anyone I cared about do it either. This is the difference between a potentially fatal accident and getting out of the car uninjured.

Another significant difference between the devices is that the Safety Solution products actually work with your body in an accident, unlike the Hans which uses you body as a fulcrum. The multiple load paths of the Safety Solutions devices direct forces away from the body in an impact, reducing the risk of an injury. The Hans device can actually injure your chest while protecting your neck.

A side benefit of the Safety Solutions devices design is comfort. I have placed drivers in many different kinds of race cars, from sprint cars to sedans and dragsters, in these devices and the one comment I hear over and over is " once I was on the track, I didn't even know it was on". Drivers like the feel and security of having the belts lying on their chest. The low back allows easier exit of the vehicle.
One last important difference in the performance of these devices is that the Safety Solution devices are true multiple impact devices. A Hans is dependent upon your shoulder belts holding it tightly in place to function. If you hit hard in an impact and stretch your belts the performance of the Hans will be diminished or non-existent. The Safety Solutions devices will protect you until you get out of the car and take it off. This is critical in cases where there are multiple impacts or when the car rolls.
In summary, it is my contention that the Safety Solutions devices are not a competitor to the Hans but in fact the next evolution in personal safety gear. They replace it.

I am happy to discuss questions or comments you have on the subject. I can be reached at 513-300-4221

Craig Friesinger, President

U.S. Race Gear

www.usracegear.com

There are various types of equipment available on the market. Read up on them and choose what best fits your situation and needs.

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You Can Help 10/10ths Motorsports !

I hope you enjoy the monthly 10/10ths Motorsports Newsletter. Please feel free to forward this to any of your friends and point them to the 10/10ths Motorsports website. I believe word of mouth advertising is the best route to introduce both new drivers and experienced drivers to the 10/10ths Motorsports events. For those that have come out to the events, Thank You Very Much and I look forward to seeing you again.

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Take a look at the great Forgeline Wheels on the 10/10ths Race Car at our next event.

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