GTS Rule Proposal
Removal of TQ greater than HP Calculation

Proposal:

Remove the alternate power calculation for cars that have torque (TQ) greater than horsepower (HP)

Justification:

The current method creates a less parity instead of more.

Additionally, higher TQ is becoming common in many modern turbo powered German vehicles. With the current methodology GTS risks alienating these vehicles because they can't be competitive under the current rules.

Detailed Explanation:

Torque is an instantaneous (or moment) of force.

Horsepower is a measure of the rate of work. Specifically it is the measure of the rate that engine torque is applied.

So Torque is a force and horsepower defines how often (aka the rate) at which that force is applied. This is why the formula exists:

HP = Torque X RPM / 5252

You take the force (torque) and multiply it by the rate (revolutions per minute). You divide by 5252 to convert from angular (circular rotation) to linear force.

Horsepower is an excellent indicator of performance, because it gives you a measure of how much work (acceleration) can be done. Torque can only tell you that when considered with RPM, which of course is exactly what Horsepower is.

Horsepower, not torque is measured on a dyno such as a DynoJet. Specifically, the DynoJet measure the time to accelerate a drum of a known mass, said another way, it measures the rate of work done. It expresses this as horsepower and then calculates torque from the measured horsepower.

In the GTS power calculation for cars with TQ exceeding HP the use of the HP + TQ / 2 method counts the TQ twice. Once in the TQ number and the other in the HP number. This was originally done to make a 2.5L motor with a peak power of 240 HP competitive with a 5L motor with a peak power of 240 HP. People surmised that the 5L had an advantage because it has more torque, but another way to look at it is that the 5L has an advantage because it has a higher average HP.

How can I know this? Because HP is a function of torque. Thus more TQ = more HP. The real question is having a higher average HP because of torque an advantage that needs to be reduced?

Misconceptions about TQ and HP

The main problem with TQ and HP as people want to treat them as two separate things. In reality they are two related things. The thing to remember is that if you want to measure performance, than HP is always the best indicator.

Misconception #1

TQ gets you out of the corner – false.

Moving the car is continuous work—that's HP. The car that gets out of the corner better is the one that is making the most average HP accelerating out of that corner. The bigger factor here is gearing.

Misconception #2

TQ gets you moving—false.

Again we are talking about work, which means HP is what we want to look at. People will point to a diesel truck as an example of why this isn't a misconception. Diesel trucks make gobs of torque. And there is no denying that a diesel truck will tow a heavy load better. But why?

A modern turbo diesel may make 800 lbs ft of TQ at 1200 RRM and only have a peak hp of 400 HP at 3500 RPM. A sports car might make 400 lbs ft or TQ and 600 HP, but can't tow as well. The reason isn't specifically the TQ, but rather where the HP is made.

Let's looks at the diesel's HP at 1200 RPM

HP = (800 * 1200)/5252 = 182 HP.

At 1200 RPM is sports car is probably only making 100 lbs ft or TQ.

HP = (100 * 1200)/5252 = 22 HP.

Thus we can see why the truck can move from a dead stop and tow better. It takes off making over 150 more HP than the sports car. If the sports car could start from a stop at 5000 RPM, then it would be just as capable of moving the load.

Torque, a Competitive Advantage?

When GTS first started, making more average HP through low end torque may have been a competitive advantage. The landscape is dramatically different in 2015. There are many ways of improving average horsepower today. Examples include Variable Cam Timing, Variable Lift, Adjustable Boost Controllers, and detuning. Even modern transmission have changed things. Although they don't change the average HP or breadth of the powerband, they do increase the average HP per lap. This is done by letting the driver keep the car near peak power more per lap. All of these things give a vehicle a competitive advantage, but are completely legal.

One legal method, the "detune", has a dramatic impact on average power. Detuning is an awesome competitive advantage in GTS. It allows a competitor to increase their average HP without increasing peak power. Here is an example of an actual GTS 3 legal detune:

This competitor has an average HP 277 HP across his entire power band--and it is legal! Although the dyno only shows MPH, I know this is an BMW S54, so we are talking a 277 HP from 5200 RPM - 8200 RPM.

Now, consider this dyno:

Using his best run, this BMW 335i has an adjusted power of 282.7, ((277.77 + 287.62)/2) virtually the same as the car above. But his average HP from 4000-7000 is only 255 HP. *(Please ignore the fact that this isn't a GTS legal dyno because it is not using SAE correction, smoothing 5. It is just for demonstrative purposes.)*

Assuming both cars weighed the same, which would you rather have, the Torque monster that has an average power of 255 HP or the detuned 277 average HP car?

More Analysis

To illustrate this point further I utilized the tool at:
http://vlsicad.ucsd.edu/~sharma/Potpourri/perf_est.html

This tool has been around for years. It uses a simple but accurate physics model to determine performance characteristics of vehicles. If you would like to play with it yourself, I found it works best in Internet Explorer with the site added to your list of Compatibility View sites.

For my analysis, I configured the 4 identical E46 M3s. The all had a weight of 2920, a 200 lbs driver, 250 ms shift time, the same gearing, the same coefficient of drag, etc. The only difference between the 4 cars is the power output of the motor.

Car 1
This is the modified and detuned S54 from above.

Car 2
This car utilized the 335i motor from above.

Car 3
This is a typical S54 with only slight tuning.

Car 4
My fictional 335i torque monster motor. This has lots and lots of low end torque for illustrative purposes.

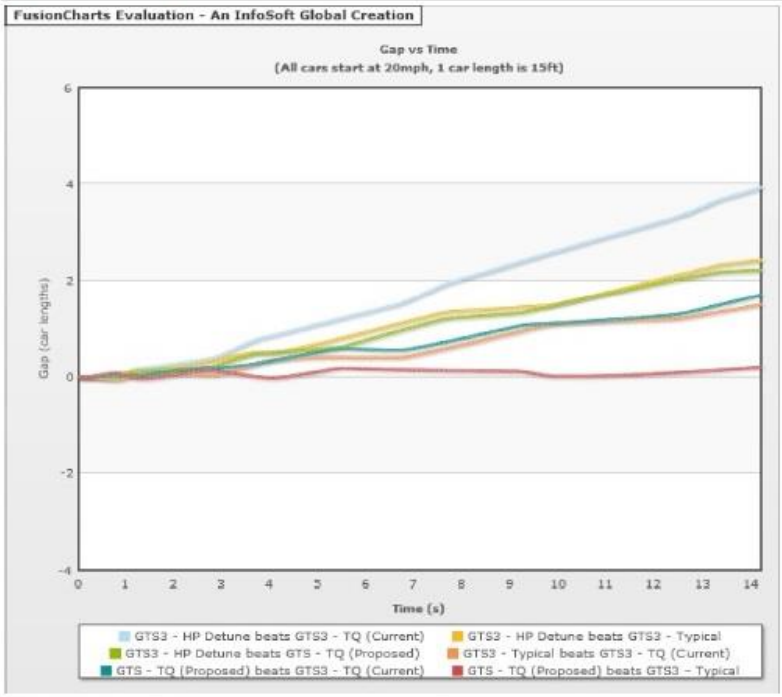
Cars 1-3 all would be GTS3 car under the current GTS rules for Power calculation.
Car 4 would be legal for GTS3 if the (HP+TQ)/2 rule is removed and we used peak HP for all cars.

Results:

Car Performance Calculator

<< Edit Inputs

Performance Charts



Select Chart

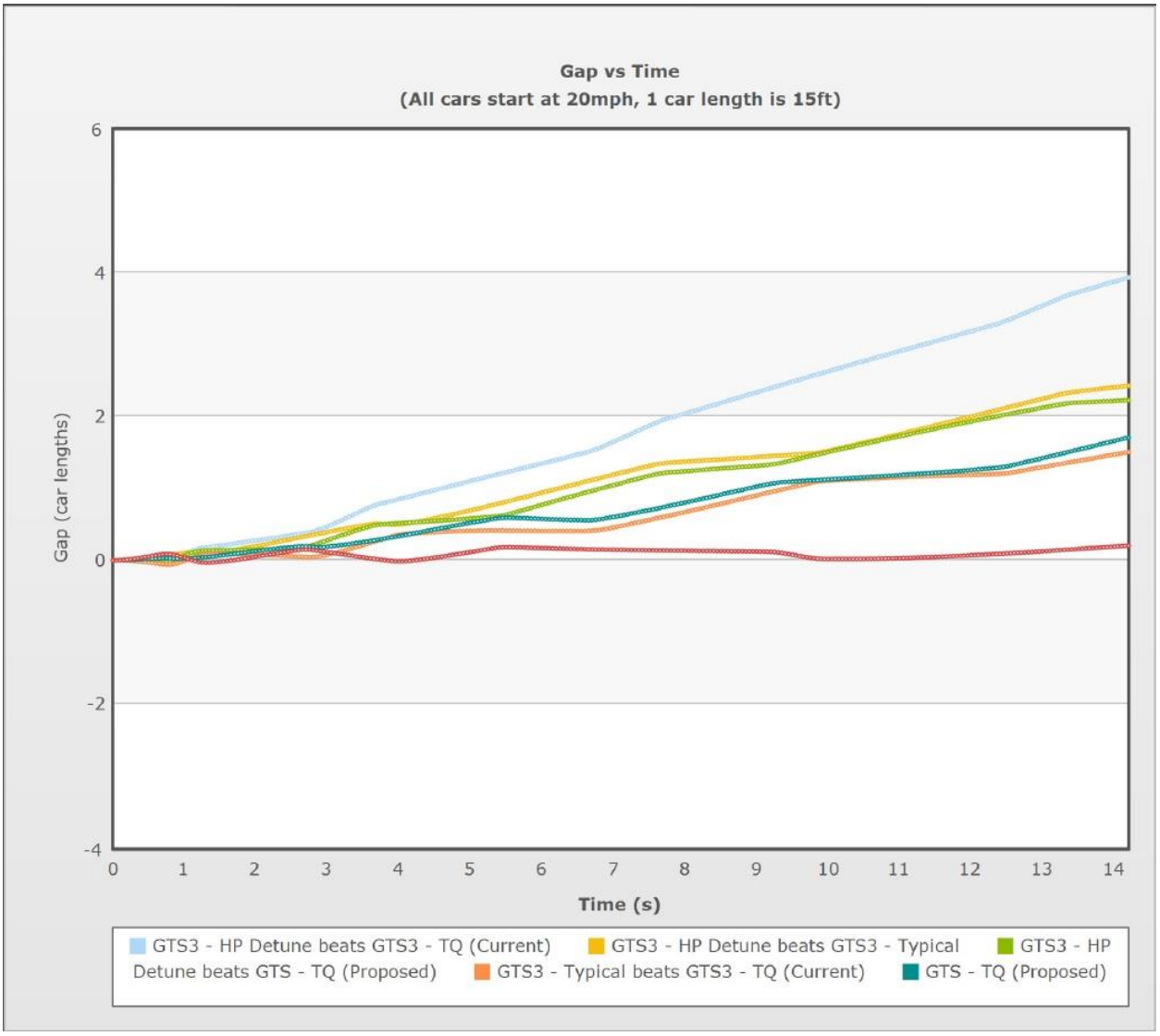
Gap vs Time

Performance Metrics

	GTS3 - HP Detune	GTS3 - TQ (Current)	GTS3 - Typical	GTS - TQ (Proposed)
Peak Power (HP)	282 @ 7200 RPM	276 @ 6000 RPM	282 @ 7600 RPM	282 @ 5400 RPM
Peak Torque (ft-lbf)	279 @ 4200 RPM	287 @ 3400 RPM	240 @ 5000 RPM	301 @ 2600 RPM
Top Speed (mph)	167	164	166	163
30-60 time (s)	2.35 *Start in gear 2*	2.7 *Start in gear 2* *Shift gear 2 to 3 @ 6932 RPM*	2.55 *Start in gear 1* *Shift gear 1 to 2 @ 8200 RPM*	2.55 *Start in gear 2* *Shift gear 2 to 3 @ 6855 RPM*
30-90 time (s)	6.45 *Start in gear 2* *Shift gear 2 to 3 @ 8080 RPM*	7.1 *Start in gear 2* *Shift gear 2 to 3 @ 6932 RPM* *Shift gear 3 to 4 @ 6823 RPM*	6.9 *Start in gear 1* *Shift gear 1 to 2 @ 8200 RPM* *Shift gear 2 to 3 @ 8200 RPM*	6.75 *Start in gear 2* *Shift gear 2 to 3 @ 6855 RPM* *Shift gear 3 to 4 @ 6259 RPM*
30-120 time (s)	13.7 *Start in gear 2* *Shift gear 2 to 3 @ 8080 RPM* *Shift gear 3 to 4 @ 7469 RPM* *Shift gear 4 to 5 @ 6942 RPM*	14.45 *Start in gear 2* *Shift gear 2 to 3 @ 6932 RPM* *Shift gear 3 to 4 @ 6823 RPM* *Shift gear 4 to 5 @ 6576 RPM*	14.05 *Start in gear 1* *Shift gear 1 to 2 @ 8200 RPM* *Shift gear 2 to 3 @ 8200 RPM* *Shift gear 3 to 4 @ 8200 RPM*	13.75 *Start in gear 2* *Shift gear 2 to 3 @ 6855 RPM* *Shift gear 3 to 4 @ 6259 RPM* *Shift gear 4 to 5 @ 5865 RPM*
60-90 time (s)	3.9 *Start in gear 3*	4.45 *Start in gear 3* *Shift gear 3 to 4 @ 6808 RPM*	4.25 *Start in gear 3*	4.25 *Start in gear 3* *Shift gear 3 to 4 @ 6255 RPM*
60-120 time (s)	11.15 *Start in gear 3* *Shift gear 3 to 4 @ 7474 RPM* *Shift gear 4 to 5 @ 6944 RPM*	11.8 *Start in gear 3* *Shift gear 3 to 4 @ 6808 RPM* *Shift gear 4 to 5 @ 6579 RPM*	11.45 *Start in gear 3* *Shift gear 3 to 4 @ 8200 RPM*	11.2 *Start in gear 3* *Shift gear 3 to 4 @ 6255 RPM* *Shift gear 4 to 5 @ 5863 RPM*
Cruising RPM at 80mph	3176	3176	3176	3176

I would ask that you not get too caught up in acceleration times. They are interesting, but aren't very important to racing. Distance over time is more important. This is why you can win a 1/4 mile drag race with a lower time and a lower top speed.

This chart illustrated the gaps between the cars. This shows how far each competitor is a part after x seconds of acceleration.



This tool equates a car length to 15 ft. Using that here is the approximate results after 14 seconds:

Car	Gap to Leader (ft)	Gap to Leader (sec)	Gap to Next (ft)	Gap to Next (Sec)
1 - Detune	0	0.00	0	0.00
4 - TQ Monster	34	0.23	34	0.23
3 - S54 Typical	37	0.25	3	0.02
2 – TQ Current	60	0.40	23	0.15

Assumed an average speed of 80 mph to convert gap into seconds.

After just 14 seconds of acceleration, Car 1 (S54 Detune) has a commanding lead. The car with gobs of torque fared no better than a typical S54. The car held to the current HP and TQ calculation is left in everyone's dust.

Now remember, this is after 14 seconds of acceleration. Think of the gaps after a 20 minute race!

This is why I say TQ shouldn't be penalized—GTS allows cars that have huge performance advantages to compete without penalty.

Other Thoughts

If GTS truly wants to create power parity, then we need to move to Average HP instead of peak. I am **NOT** suggesting this for 2015, because I feel like more data would need to be collected.

At this point here as my current thoughts:

Average HP should be calculated using the 3000 RPM range that produces the highest average. This can be found using the actual run files from a Dynojet. I have tested it and I am able to calculate the average power from real world dynos. This could easily be done with an Excel workbook that could be made available to all competitors.

I also performed the average HP calculations on Cars 1-4 in my above example. Here are the results:

	GTS3 - HP Detune	GTS3 - TQ (Current)	GTS3 – S54 Typical	GTS - TQ (Proposed)
Peak Power (HP)	282	276	282	282
Peak Torque (ft-lbf)	279	287	240	301
Average Power	278	256	263	263

If you scale these power numbers to the gaps above, they scale nearly perfectly. Thus the more average power you have, the better average performance you have.

Again, this is a limited set. Before I would ask GTS to consider this methodology I think more data would need to be gathered.