



White Paper:

Rear Brake Upgrades...

Is Bigger Really Better?

One of the most common questions received from new owners of our front brake upgrade kits is "Do I now need to upgrade my rear brakes too?" To answer this, we need to look at the role of the rear braking system from a few different perspectives. The answer may surprise you, especially hearing this from a company that sells big brake upgrades!

Rear Brake 101

One of the many design factors that goes into the development of a base braking system is the mysterious "bias" or "balance." Truth be told, it's a pretty simple concept to grasp: for vehicle stability under braking, it is required that the rear brakes do NOT lock before the front brakes. Simple, right? Most of you probably knew that already.

OK, so what governs the "lockup" point of the rear brakes? Drum roll, please:

1. Tire tractive capability (friction)
2. Tire normal force (weight on the tire)

This can be proven from looking at the fundamental relationship for maximum sustainable tire force: $F = \mu N$, where:

- F = the lockup point, or peak force
- μ = tire-road coefficient of friction
- N = normal load sitting on the tire

So, when the OEM is designing a brake system, they "size" the system components (calipers, master cylinder, rotor OD, etc.) to generate the proper amount of torque at both ends of the vehicle so that the front brake force ('F' above) exceeds its peak traction first. At this point, the front brakes lock and the car slides in a nice, stable straight line. (Note that at STOPTECH, we design our front brake upgrade kits in the very same fashion for the very same reasons.)

Potential Impacts of Big Front Brakes

Fortunately (from a safety standpoint anyway), when most big-brake suppliers adapt a mondo rotor and caliper package to a vehicle, they end up actually increasing the FRONT bias. How? By increasing the effective caliper piston area and the rotor effective radius, these two factors work together to increase the "mechanical gain" of the front brakes, building more torque for the same pressure, everything else being equal. So, from a bias perspective we are not pushing the vehicle toward instability, but rather just the opposite - we are underbraking the rear axle! The obvious impact would be an increase in stopping distance - probably the one thing the new owner was actually hoping to reduce. Ironic. So, say you chose to install these big brakes on the front axle but want to maintain the OEM bias. What's the answer? Well, one way would be to invest in big rear brakes too which increase the rear mechanical gain to the point that the system is balanced once again.

So, What's The Harm In Doing That?

Well, let's look at why we upgraded the front brakes in the first place. Contrary to popular belief, the real reason sports- and racing cars use big brakes is to deal with heat. Period. There has been a bunch of stuff published which will disclaim this, but when you look at the braking system from a design standpoint, making them "bigger" doesn't fundamentally do anything for stopping distance. It's all about the heat. So, you upgraded the front brakes because of thermal concerns but as a hidden surprise got a shift in brake bias. As a band-aid to this condition, you now spend thousands more on a rear brake upgrade because the front system was not sized correctly in the first place. Sure, it looks great, but there is another option...

Which Is?

When upgrading your front brakes, it is possible to size the caliper pistons and rotor effective radius to maintain the original brake system's pressure-torque relationship. Yes, it takes more engineering know-how and you can't sell the same part to everyone anymore, but you are not altering the base brake balance from what the OEM intended. This design philosophy stands behind every brake upgrade kit StopTech manufactures. Now, if you sized the front brakes correctly, why would you need to change the rear brakes? Good question. If there are no thermal concerns with the rear brakes (and on a front-engine street car there rarely are) then by installing a rear big-brake kit all you are doing is (a) spending money and (b) adding unsprung weight. This is not usually viewed as favorable, unless you like driving a heavy, expensive car.

Oh Yeah - One More Thing...

Finally, under an OEM bias condition, the rear brakes only contribute about 15-20% of all the braking force the vehicle generates, and when you install sticky tires you actually DECREASE the amount of work they need to



do. Why? Because at the higher deceleration levels afforded by race tires, there is more weight transfer taking place, reducing the normal force on the rear tires and increasing it on the front (remember $F = \mu N$ from above?). If anything, we now want to decrease the rear effectiveness. Ironic once again.

Of course, if you decide to upsize your rear brake system components you can also impact the front-rear torque relationship, and consequently you can "bias" the "balance" more toward the rear. Go too far, and the rear brakes could lock before the fronts. Again, not the end result you were expecting, right?

It has been said that "The folks at StopTech should consider developing a rear kit to match their front setup. Customers will be very happy with the performance improvement if done properly." Well, since our FRONT systems are designed properly, we save you the need to spend your money on the back axle.

Let's reword that quote to reflect the StopTech philosophy: "Our competitors should consider developing a FRONT kit to match the stock bias condition. They'll be very happy with the performance improvement if done properly, *and* will save their customers the cost of a rear brake upgrade in the process."

by James Walker, Jr., exclusively for Centric Parts/StopTech

About Centric Parts®

[Centric Parts®](#), which includes the [StopTech®](#) and [Power Slot®](#) divisions, is a leading manufacturer and supplier of aftermarket brake components and systems for everyday cars, performance duty vehicles and ultra performance vehicles. The Southern California company was founded in 2000 and now employs over 500 workers at its multiple warehouse and production facilities that total more than half a million square feet of floor space. The company's skilled and seasoned engineers and experts, and an award-winning executive team drawn from across the industry, fuel Centric Parts' mastery of the automotive aftermarket and its dedication to research and development. The patent-holding company also has one of the industry's best programs for tracking and cataloging original equipment parts and uses this expertise to devise and deliver quality aftermarket and OE parts for consumers, technicians and auto makers.

About StopTech®

[StopTech®](#), the ultra performance and racing division of [Centric Parts®](#), is a leading innovator of world class brake components and systems for production-based racing cars and high performance vehicles on the street and track. Founded in 1999, StopTech was the first to offer Balanced Brake Upgrades® for production cars and remains the worldwide leader with over 650 platform offerings to dramatically improve overall braking performance. StopTech's industry leading technologies and materials, from rock solid calipers to ingeniously efficient heat handling rotors, result in shorter stopping distances, better brake modulation and less brake fade.

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