

## Brake Fluid Tech by Paul Hamersly

**BRAKE FLUID. What type of brake fluid do you need? What is the difference between types? Why change your brake fluid?**

All brake fluid sold in the USA has a DOT (Department of Transportation) rating. Our Corvettes come from the factory with fluid rated as "DOT-3." Please do not ask me about DOT-1 or DOT-2 – I don't know if they exist and haven't found a reference for what their use may be. DOT-3 fluid is the 'minimum specification' approved for use in our Corvettes. DOT-3 is also what our Corvette manuals recommend and this is the same, regardless of whether you drive a C1 or a C6.

You may also find brake fluid at your favorite parts store or racing supply house rated as "DOT-4" or "DOT-5."

*Do not use "DOT-5" brake fluid in a Corvette or other car equipped with ABS (anti-lock brake system). DOT-5 fluid is silicone based (versus glycol-based) and can damage the ABS system. Adding silicone-based DOT-5 fluid to DOT-3 or DOT-4 fluid is not recommended as they are not compatible. IF you really wanted silicone-based fluid in a "pre-ABS" car, it should only be done if the entire brake system has been drained, flushed, and purged of all DOT-3 or DOT-4 brake fluid residue. Let's agree to avoid DOT-5 fluids, OK?*

Brake fluid certified as "DOT-3" has a minimum "wet boiling point" of 284 degrees Fahrenheit and a minimum "dry boiling point" of 401 degrees. DOT-4 numbers are 311 and 446 degrees, respectively.

So, what is a "wet" or "dry" boiling point? And, why should we care?

Let's start with the basics. Very simply, and without talking about all the components involved, when you push the pedal in a hydraulic brake system, force is transferred from the pedal to the brake actuators at each wheel stopping the car. Hydraulics are used because fluids are not compressible, thus a very efficient medium for transferring force from the pedal to the wheels.

Moving on, DOT-3 and DOT-4 brake fluids are glycol-based, so they are hygroscopic – they absorb moisture. This means that, over time, humidity from the air is absorbed into the brake fluid in our cars. When we mash the brakes, the hydraulic system transfers that force to the wheels, pushing the pistons in the calipers into the pads. This forces the pads into contact with the rotors (or

shoes/drums). The friction between the pads and the rotors causes the car to stop. Simple, right?

OK, what is the by-product of the friction between the pads and the rotors? Heat! The more heat generated, the more heat transferred into surrounding components including the brake caliper. Since there is brake fluid (a liquid) inside the caliper, it absorbs this heat quickly. If the fluid is heavily contaminated with moisture (water), it can ultimately boil. Guess what? Boiling fluid turns into gas and gasses compress. So, if the fluid boils and we step on the brake pedal, the hydraulics of the system compress the gas instead of forcing the pads to work. The pedal goes to the floor and you don't stop!

This is a 'worst case' scenario. First, you need to be using your brakes extremely long and hard to build up enough heat to actually boil the fluid inside. The fluid will always be mostly brake fluid with very small amounts of suspended water. But, water boils at much lower temperatures than brake fluid, so the more water, the lower the temperature at which your brake fluid will boil.

Boiling brake fluid will most likely only happen on track days when you are doing constant high speed braking, thus generating heat in your calipers over an extended time. If you have brand new fluid, you are subject to the "dry" boiling point's higher temperature limits since it has had very little opportunity to absorb moisture. If you haven't changed your brake fluid in a long time, yours will likely boil much sooner because you are working with a lower boiling point from more moisture.

Gee, maybe that's why the factory recommends regular brake system flushing and new fluid! Hint – is your brake fluid the same color as new?

We do have a significant advantage by living in Phoenix. Our humidity levels are typically very low, so there is less opportunity for our brake fluid to absorb moisture.

So, what should you do? First, flush and replace your brake fluid regularly. Annually is a good and safe recommendation. Second, avoid leaving the brake master cylinder cap off for extended periods of time. If you need to add fluid (common as disk brake pads wear – you can ask me why later), remove the cap, add the fluid, and replace the cap promptly. But before replacing, check to make sure the cap and seal are in good shape so they don't allow contact with the air – and more moisture!

BE CAREFUL! Brake fluid will quickly destroy paint, so take necessary and appropriate precautions when adding, flushing, or bleeding your brakes.

OK, I'm going to flush my brake fluid. What type of fluid should I use?

WE need to decide on our fluid type first. If you are a racer, I hope you are already regularly flushing and replacing your brake fluid. If you are racing, you probably have heard about boiling fluid, so you are probably using fluid with higher boiling temperatures. However, I'll bet most of you have never really boiled the fluid!

People very often confuse boiling fluid with "brake fade" that happens when the temperatures of the pads and the rotors are very high, gases from the heated pads are reducing the friction between the pads and the rotors, and no matter how hard you push the pedal, you don't have as much stopping power. Causes are racing without using pads rated for the temperatures encountered, too mush hard braking, or not cooling our brakes properly – all of which subjects for another day.

We already discussed boiling fluid. Since gas readily compresses, your pedal will go right to the floor! No brakes! Bad things happen now! Pucker factor goes up quickly too! This is extreme, but this is what happens with boiling brake fluid. Typically, if you do reach boiling temperatures, you only boil a very small amount of fluid in the caliper and you will still get braking some force, although greatly reduced, because you are compressing a very small amount of gas (water vapor only).

We can hopefully eliminate the potential of boiling our brake fluid by using fluid with higher than "normal" boiling temperatures, especially if we plan to do track days. Refer to the following chart:

In the chart, you will see the high-end DOT-4 brake fluids with very high "dry" and "wet" boiling points. I find it ironic that racers, me included, use the high end, and more expensive, fluid, even though we change our fluid frequently throughout the year. If you never give the fluid a chance to absorb moisture, buying fluid with high "dry" boiling pints is the most important thing, since you are eliminating the "wet" concern by frequent fluid replacement.

If anything I've said makes sense, the person who never changes their brake fluid, or only does so every few years, should be using the fluid with the highest "wet" boiling point. I.e., the high end racing fluid that street drivers never think about!

The chart shows us that, if we flush and replace our fluid frequently, we can have virtually the same boiling point protection of the most expensive Castrol SRF fluid by buying the cheapest ... I say the following word with c Fluid. This is what Ford uses in their big rig trucks – they brake heavily, but their owners typically follow very frequent brake service regimens.

OK, you can now make an educated choice when buying brake fluid. If you want to know, I use the "ATE" fluids. I flush my fluid frequently. Since ATE makes two colors (SuperBlue is blue & Type-200 is yellow), I can readily tell when I have successfully flushed out all the old fluid by alternating colors.

A little bit more for the racers. Bleed your brakes after every track day. This removes burnt, contaminated fluid from the calipers, keeping the vast majority of your fluid at the performance of its "dry" boiling point rating.

Make your brake pad choice based upon your track needs, but remember that those "high temperature" race pads do not work as well as stock pads at low street driving temperatures!

Brake Fluid	DOT Rating	Wet Boiling Point	Dry Boiling Point	Average Price Per Liter
Castrol SRF	4	518	590	\$73.00
Motul 600	4	421	585	\$12.50
ATE Super Blue & Type 200	4	382	536	\$12.00
Castrol LMA	4	311	446	\$5.50
AP-600	3	284	572	\$20.00
Wildwood 570	3	284	570	\$8.00
AP-550	3	284	550	\$12.50
PFC Z-Rated	3	284	550	\$6.60
Ford HD Truck #C6A2-19542-AA	3	284	550	\$4.00
** Boiling Point = Fahrenheit				