



DOT DOT DOT - Brake Fluid Tech

by Jim Lunson

I got a surprise the other day when I went to my trusty auto parts store for some brake fluid to flush out my lines. I looked for my stalwart, Castrol DOT 4 with LMA and found it is no longer made. It is now synthetic and new formula. This change led me to some questions where I found out that it is really the same stuff and easily mixed with the old. But this started me on some research on brake fluids to see what is going on here.

Brake fluid is designed to be as close to an inert fluid as possible. The goal is for it to do virtually nothing, not boil, not freeze, not expand, not evaporate, not anything; just sit in the system and move the brake pads and shoes when called for. The problem is that this type fluid is almost impossible to make. The main restriction found in the fluid today is in the boiling point, and this is where the Department of Transportation (DOT) comes into play.

Brake fluid gets very hot as it works the disc brake calipers and drum shoes. The brakes work on friction which generates heat, and the piston or cylinder is right next to the pads and gets very hot as the brakes are applied (just touch the wheels after a long run with lots of downhill braking required). The higher the boiling point, the better the fluid will perform. As the fluid reaches the boiling point under severe use, it vaporizes into a gas which is compressible. This results in the brakes fading, becoming spongy, and not able to stop the car. This is not good.



I ran into this recently on my summer trip to Colorado. Ann and I drove up the road to the summit of Pikes Peak. This road is quite a climb, going up over 5,000 feet in less than 20 miles. On the return trip down, we kept seeing signs to use lowest gear, hot brakes will fail, and about halfway down, we passed a checkpoint where a forest ranger stops each car and points a temperature sensing gun at the front brake caliper. There is a big sign that says any brakes reading over 350 degrees must stop here for 30 minutes before proceeding further. My brakes registered 300 degrees so so I was able to continue. There is, conveniently, a gift shop at this spot. It is a real concern and not just a gimmick because brakes can get that hot and not because they fail mechanically but due to the brake fluid is so hot it boils.

Because of this safety issue in stopping the car, DOT got involved, evaluated brake fluids and rated them according to their boiling temperature (STD #116) with the following table:

DOT 3	311°
DOT 4	356°
DOT 5	376° (the odd numbers are conversions from centigrade temperatures used by DOT)

This is the only criteria for their rating. It has nothing to do with the material of the fluid, only the boiling point. The problem and misconception comes in that DOT 3 & 4 fluids are alcohol/glycol-based and work reasonably well in most applications, although their boiling point is fairly low. Silicone-based fluids have a higher boiling point, and they qualify as DOT 5. But it is only the performance, not the material, that yields the rating. Lockheed now makes a glycol-based fluid which meets the DOT 5 criteria, but has been given the designation DOT 5.1 to avoid confusion because it is glycol based rather than silicone. And you can see from my experience on Pikes Peak, these temperatures mean something in braking the car.



But, back to my original dilemma, it seems my Castrol DOT 4 fluid has always been synthetic, they just decided to add the new buzz word on the label. And although it may be a new formula, it is still only DOT 4 rated, is still alcohol/glycol based and is completely compatible with their old product. So don't panic at the new product, it is the same old stuff and can be added to the DOT 4 fluid already in the system.

There is an issue in mixing fluid types. The problem is moisture. DOT 3, 4, and now 5.1 type fluids are alcohol/glycol-based and this material absorbs water. As moisture from the air touches the system (such as when you check the master cylinder fluid level), it enters into glycol-based systems. Once in the system, it slowly causes corrosion and rusting as it touches the metal parts. The longer this fluid remains in the system, the more moisture it takes on, and the faster the deterioration occurs. That is why it is important to replace the fluid every few years to maintain the system in good condition. I have found the Castrol, with their LMA additive (low moisture additive) helps prolong the life of the fluid (but not indefinitely) a few more years while the DOT 4 boiling rating helps over DOT 3 in braking performance, especially on long downhill runs. DOT 5 is silicone based and does not mix with either water or the glycol fluid.

The silicone fluids do not have this moisture absorption problem as it will not take on water. Silicone fluids, therefore, will last a great deal longer, are easier on the

rubber gaskets and seals, and with the higher boiling point, provide the best braking system available. That is why the US military specifies only silicone fluid for all its vehicles. Here maintenance is usually suspect and to avoid any confusion, it is all they use.

Mixing two types of fluids in the brake system will not work. That would mean two distinct non-mixing fluids flowing in the same lines, causing all sorts of problems. Flow will be restricted, moisture will concentrate in low spots, the expansion due to heat and boiling will vary and braking will be adversely affected. So don't mix the two types under any circumstances. Silicone will not absorb water, but it will not remove any moisture already in the system either. Water will just sit in the low spots causing severe rust. The only way to use silicone is to completely clean all parts of the system of any moisture or glycol. This includes the master cylinder, wheel cylinders and pistons, as well as all lines and hoses. Any moisture remaining in the system will cause the same rust and corrosion wherever it remains. This is why switching to silicone is best done only when a complete brake system replacement is done, and everything is spotless.

One final note: brake fluid is not considered a top off type fluid. The brake system is sealed and the fluid does not evaporate so if the level in the master cylinder drops, it is the sign of leak problems somewhere in the system and should be checked thoroughly. The only reason for fluid level going down is as the pads wear the pistons and cylinders move slightly outward, but this decrease in fluid level is very slight and occurs over the life of the brake pads, not weekly or monthly. So, watch your fluid level, and if it needs topping off frequently, there is a leak somewhere in the system and it should be attended to soon. And if you have to add fluid, make sure you do not mix the two types of fluids.