Brake Fluid Types and Differences

The brake fluid in a vehicle is essentially the life blood of the braking system. Without it, or enough of it, the forces applied at the brake pedal would not be transferred effectively to the brake caliper, pads and ultimately the brake disc.

There is often confusion around the different types of brake fluid and their compatibility to each other. Brake fluids use the American DOT system set out by the Society of Automotive Engineers and the Department of Transportation, hence the name DOT.

All Dot brake fluids are Poly-glycol ether based (glycol for short) with one main exception, DOT 5 which is silicon based. The main difference between the various DOT classifications of brake fluids is the temperature at which they boil.

Brake fluid is used in the braking system because it is relatively incompressible. This means that when you put your foot on the brake pedal, the force you apply is transmitted through the brake fluid with minimal loss of pressure. If brake fluid boils due to the heat produced during prolonged heavy braking it turns into a vapour and vapour is compressible. Now all you get is a spongy pedal and no brakes!
The DOT standard for brake fluids sets out a dry boiling point (essentially new brake fluid) and a wet boiling point when brake fluid has absorbed approximately 3.5% water as follows:

<table>
<thead>
<tr>
<th>Brake Fluid</th>
<th>Wet Boiling Point</th>
<th>Dry Boiling Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOT 3</td>
<td>140°C</td>
<td>205°C</td>
</tr>
<tr>
<td>DOT 4</td>
<td>155°C</td>
<td>230°C</td>
</tr>
<tr>
<td>DOT 5</td>
<td>180°C</td>
<td>260°C</td>
</tr>
<tr>
<td>DOT 5.1</td>
<td>190°C</td>
<td>270°C</td>
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</tbody>
</table>

Please note - these are **minimum** boiling temperatures and many brake fluids on the market today will exceed these figures!!

The most efficient way to test the fluid is a boil test. The Pagid moisture tester connects to the battery and boils the fluid in the reservoir and displays an accurate temperature reading and a reminder of the minimum values.
Where does the water come from?

Glycol based fluids are *hygroscopic*. This means that they will naturally absorb water from the environment at normal atmospheric pressure. This water finds its way into the brake fluid through microscopic pores in the brake hoses, seals and joints.

We know that water boils at 100°C at normal atmospheric pressure so, any water in your brake fluid is bad news. Well yes and no. Although water will cause a lowering of the brake fluid's boiling point, the hygroscopic nature of DOT 3, 4 and 5.1 brake fluids works to our advantage in a major way.

Water is heavier than brake fluid so when it enters the brake fluid, you would expect it to pool and settle in low spots and boil very easily (e.g. the caliper). Not so! Due to its hygroscopic nature, water is absorbed and dispersed throughout the whole of the brake fluid and this helps to keep the boiling point of the brake fluid higher for longer. It also has the added benefit of preventing localised internal corrosion which you would get if the water was allowed to pool.

So what is DOT 5 brake fluid?

DOT 5 brake fluid is fundamentally different to all other brake fluids in the DOT range due to it being silicon based. It is generally purple in colour and was originally produced to provide a higher boiling point than glycol based fluids. It is also described as *hydrophobic*. This means that unlike other DOT fluids, it does not absorb water.
This hydrophobic property gives it a very long life span which means lower maintenance and fewer fluid changes and it is also kinder to paintwork than corrosive glycol based fluids. Its uses are mainly in vehicles that need to be stored for long periods but need to be constantly ready for service such as military vehicles and some classic cars.

The bad news is that water can still enter the braking system regardless of the type of brake fluid used. Due to its hydrophobic properties, any water in the system would pool and settle in low spots and reduce the boiling point of the whole braking system to 100C as well as potentially causing corrosion.

**Conclusion**

Always use the brake fluid intended for the vehicle. Glycol based fluids can be mixed with each other but DOT 5 must never be mixed with glycol based fluids. It is usually marked on the reservoir cap.

Due to the hygroscopic nature of glycol based fluids, it is important to only keep smaller quantities in sealed containers. Large containers will absorb water once the foil liner covering the opening has been removed even with the cap fitted.

Always test glycol based brake fluids by using a brake fluid boiling point tester which is the most accurate method for professionals and recommend brake fluid is changed every two years.