Technical Bulletin

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Bendix provides an insight into the importance of Brake Fluid

Most of us probably drive our cars 15,000 to 20,000 kilometres a year and during that time we would have probably changed our engine oil, had our coolant levels checked, wiper blades replaced and maybe even had our brake pads and rotors checked?

Have we ever thought how many times we actually step on the brake pedal over that period when taking our car for a drive? And have we given any thought to our car's brake fluid at all?

Do we know that our car's brake fluid also needs to be checked and replaced regularly? Many OEMs and maintenance experts recommend that we replace our brake fluid at least every two years. Do we know why? Please read on.

What is brake fluid?

Brake fluid is basically a hydraulic fluid that actuates our car's brake system when we step on the brake pedal. As a fluid that transmits force, an important property of the brake fluid is that it should be non-compressible so that it effectively transmits braking force to the wheels at all times. As brake fluids are exposed to very high temperatures during braking, these should have very high boiling points so that they remain incompressible even during extreme braking.

America's Department of Transportation (DOT) has set the pace in putting in place a standard for brake fluids. In the industry, we have adapted two main standards – DOT 3 and DOT 4. There are other types of brake fluid in use but most vehicles use either DOT 3 or DOT 4 brake fluid so we will stick with these two for purposes of this discussion. The table below shows the boiling point standards. Note that the Australian standard has a more stringent boiling point requirement than the internationally accepted American DOT standard. Note that the Bendix line of brake fluids conforms to both the DOT standards and the Australian standards and in fact exceed these standards by a wide margin.

FOR MORE INFORMATION
Freecall the Bendix Brake Advice Centre on
1800 819 666 (8am-5pm Monday to Friday EST)
or **+61 3 5327 0211** from overseas.
Or visit **bendix.com.au or bendix.co.nz**

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	DOT 3	DOT 4	AS 1960.1 G1 (DOT 3)	AS 1960.1 G2 (DOT 4)	Bendix DOT3	Bendix DOT4
ERBP °C min DRY	205	230	230	260	230 Min	260 Min
ERBP °C min WET, 3.7% WATER	140	155	140	155	140	155

Brake fluid is a glycol-based fluid that remains fluid even when freezing and remains effective as a hydraulic fluid even at high temperatures. It is expected to work in freezing winter and in extremely hot summer months. It is a versatile fluid that does its job in all temperature extremes. However, brake fluid by nature absorbs moisture from the atmosphere through the microscopic pores in brake lines and through the small vent in the reservoir. In fact brake fluid begins to take in moisture the moment you pour it into your braking system.

After a year in service, brake fluid would have absorbed about 2% water and will have progressed to 3% water after only 18 months. These figures would be a lot higher in places that are humid and wet. Moisture in brake fluid decreases its boiling point – 2% water will reduce the brake fluid's boiling point by 75°C. The boiling point drop becomes more pronounced as more moisture is absorbed.

Moisture contamination heightens the risk of brake failure especially during extreme braking conditions like driving downhill or in constant stop and go in heavy traffic or when carrying heavy loads. Constant braking transmits a lot of heat to the brake fluid from the pads and rotors. If a considerable degree of moisture were present, these would easily boil off and form vapour which is extremely compressible and this is when the pedal starts feeling spongy and the brakes would not apply at all!!

This is the reason why there have been many cases of brake failures even if the braking systems were found to be mechanically in order. In fact, the brakes worked perfectly again after the system has cooled down and the vapour has condensed.

Presence of vapour in the brake fluid also affects the performance of the Anti-lock brake systems (ABS). The ABS pulsates about 15 times a second and the brake fluid's viscosity is an important factor for the proper operation of the ABS. The presence of moisture and/or vapour in the brake fluid alters its viscosity characteristics and will result in improper operation of the ABS.

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DOT 4 and DOT 3 Brake Fluids

From the table above, we can see that the main difference between DOT 4 and DOT 3 brake fluids is that DOT 4 brake fluids have higher minimum dry and wet boiling points – and this is why majority of car makers recommend DOT 4 brake fluid over DOT 3 as it provides an extra margin of safety. Both are made from glycol ethers but DOT 4 brake fluids are added with borate esters to give them that improved dry and wet boiling points. DOT 4 maximum viscosity specifications are also slightly higher than that of DOT 3.

Often not mentioned is the effect of the different DOT 4 formulation on the brake fluid behaviour. DOT 4 absorbs moisture at a slower rate than DOT 3 but is more susceptible to suffering a drop in its boiling point.

Typically a DOT 4 brake fluid will suffer a boiling point drop of 50% once it takes in 2% moisture while a DOT 3 brake fluid would only lose 25% of its boiling point at 3% moisture contamination although it takes in moisture at a faster rate. This suggests that DOT 4 brake fluids offer more stability and safety for longer but would need to be replaced at the recommended OEM intervals before it suffers a substantial drop in boiling point.

Some cars have had their brake systems designed before DOT 4 brake fluid was introduced. Their hoses, which inner linings are made of SBR rubber, were found not to be compatible with some DOT 4 formulations in a laboratory setting - possibly those with very high borate ester content. In a report, it is claimed that DOT 4 brake fluid permeates the inner lining and then reacts with the outer PVA reinforcement braiding producing a viscous liquid which could build up between layers of rubber and makes the hose considerably weakened. Attempts to reproduce this problem in real life conditions have proven to be difficult though.

Some Australian vehicle manufacturers may still use brake hoses made with SBR hence their recommendation to stick with DOT 3. Most vehicle marques today use a different rubber (EPDM) in their brake hoses which is much less subject to permeation. Most car makers have taken the view that the extra safety offered by DOT 4 more than outweighed the miniscule risk of hose failure caused by the reaction described above.

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