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BRAKE FLUID INFORMATION SHEET

Introduction

Before we can discuss the relevant properties of brake fluid, it is important that from the outset we understand that these physical properties are dependent on the chemical makeup of the fluid.

There are three main groups of fluids used in braking systems:

- Glycol based fluids
- Silicon based fluids
- Mineral oil based fluids

This information sheet will focus primarily on the glycol based fluids as these are by far the most common. The disadvantage is that glycol based fluids are hygroscopic (they absorb water) and damage paint if spilt.

It is true to say that silicon based fluids have achieved a certain popularity amongst the classic car fraternity. They have the advantage that they are hydrophobic and do not damage paintwork if spilt. Alas their hydraulic performance is not as good as the glycol based fluids.

Mineral oil based fluids are rarely used, being limited to a small number of vintage cars and some specialist vehicles. It is unlikely that you will encounter a system utilising these fluids.
There are 4 properties of brake fluid that are relevant:

- Viscosity – the lower the better
- Boiling point – the higher the better
- How it responds to water – is it hygroscopic or hydrophobic?
- Its ability to lubricate the seals and brake pistons

After all, what we are interested in is that the hydraulic fluid can transfer the pressure you apply through the brake pedal to move the brake pistons and thus apply the brakes, in the most efficient manner possible.

Brake fluid specification

In the UK we use the American Department Of Transport specifications (DOT). The most commonly used is DOT 4 fluid, with DOT 5.1 being used for fast road use.

Some older cars used DOT 3 fluid but in nearly all cases this can be safety replaced with DOT 4 or DOT 5.1

Glycol based fluids
DOT 3
DOT 4
DOT 5.1

Silicon based fluids
DOT 5

The glycol and silicon based fluids are **not** compatible and must never be mixed in a braking system. If you own a classic car and are contemplating changing from glycol based fluids to silicon fluid, it is essential that all traces of the old fluid are flushed from the system and in many cases the contaminated seals and components should also be replaced.

Dry and wet boiling points

Strictly speaking it's the 'Equilibrium Reflux Boiling Point' (ERBP) but we are going to be here forever if I keep typing that so 'boiling point' it is.

The dry boiling point is for new fluid taken from a sealed container, as soon as the seal is broken the fluid in the container will start to absorb water from the air (but not DOT 5 of course). It is therefore best to purchase brake fluid in small containers, as the fluid does not keep very well once the container has been opened.

The wet boiling point is when the fluid is very contaminated and contains 3.7% water by volume. The minimum temperatures set by the DOT standard are shown in the following table. Remember these are **minimum** standards; fluids from many manufacturers will perform significantly better than this.

	Dry (minimum boiling point)	**Wet (minimum boiling point)**
DOT 3	205°C	140°C
DOT 4	230°C	155°C
DOT 5	260°C	180°C
DOT 5.1	270°C	190°C

Whilst DOT 5 silicon fluid has a very respectable boiling point it is not suitable for fast road or competition use as it does not give the right 'feel' due to it being slightly compressible even when new.

Warning: Be extremely careful not to confuse DOT 5.1 and DOT 5 fluids

The trouble with water in the brake fluid

Once water has entered the brake system, either by permeating through the rubber hoses or via the vent in the brake reservoir cap, or from topping up with contaminated fluid, the problems are the same. These potentially are:

- **Brake fade** – a little water vapour has formed and will make the brake pedal feel a little spongy under prolonged braking
- **Vapour lock** – A large amount of vapour has been produced and as it is compressible little or no braking effort is transferred to the brakes; this is a serious situation, make no mistake
- **Corrosion** – This problem is frequently over looked, but the water in the braking system will promote corrosion and lead to early failure of the braking components. We often find that cars with high levels of water in the brake fluid also have seized brake cylinders or pistons.

Once the water has got in the only solution is to empty out the contaminated fluid replacing it with fresh dry fluid and at the same time bleeding out any air that may have become trapped in the system.

Whilst silicon based brake fluid does not absorb water, there is still a problem if water enters the system as it gathers together in small pockets and is a menace just the same.

Seized nipples?

In order to bleed air or contaminated fluid from the braking system it is necessary to open the bleed nipple on each brake calliper and brake cylinder. Unfortunately the bleed nipples can corrode in place and if they snap off during attempts to undo them it can mean that the whole calliper assembly or wheel cylinder has to be replaced.

In order to help preserve the bleed nipples it is important to ensure they are protected by a rubber cap. If these caps are missing they should be replaced. A light application of water resistant anti-corrosion grease to the base of the nipple where it enters the calliper can also help ward off corrosion.

Bleeding the brakes and the risk of damaging the seals in the master cylinder

During normal use the piston in the master brake cylinder only moves over a small fraction of its total travel. This leads to small ridges forming at the ends of this travel and this leads to a problem. If, whilst bleeding the brakes, the brake pedal is moved over a greater distance than in normal use these ridges can damage the rubber seals and cause the master cylinder to leak fluid internally and fail.

The risk of this can be minimised by using one of the following methods:

The 'short pump' method – basically this is the traditional two person method but the person operating the pedal only presses the pedal down by a similar distance to when the vehicle is being driven. This is a good basic low tech approach and if you have the time and someone to assist you is probably the best method.

The vacuum method – The fluid is drawn from the bleed nipple using a slight vacuum.

The pressure method – A special cap is fitted to the brake fluid reservoir and fluid is forced in from an external container. Care must be taken as there is a risk of system damage if the pressure is inadvertently set too high and there is the risk of the special cap becoming displaced and brake fluid being sprayed all over the paint work.

The reverse bleed method – This is a more recent development and entails utilising a small hand pump to pump fluid in to the bleed nipple. The air and contaminated fluid then appears at the brake fluid reservoir and is sucked out. Advocates of this system point out that the air is rising naturally due to gravity, but whether or not this is the case in a small diameter brake pipe remains to be seen.

For cars with ABS the use of a diagnostic tool is required to put the ABS system in to brake bleeding mode.

Keeping the water out

There is no great secret to keeping the water ingress to a minimum, the key points are:

- Make sure the seal on the brake fluid reservoir cap is undamaged
- Make sure the cap on the brake fluid reservoir is tightened securely
- Only use brake fluid from new unopened bottles
- Make sure that the brake hoses and components are maintained in good condition
- Have your brake fluid tested regularly and replaced as necessary

Brake fluid testers

There are three principal methods for testing brake fluid although only two are suitable for use in the garage. In ascending order of accuracy these are:

- **Electrical conductivity tester** – This is a simple test and is most common. The tester has two probes that are dipped in the fluid and by measuring the resistance of the fluid the approximate water content can be calculated.
- **Boiling point tester** – this heats a sample of the brake fluid and measures its boiling point.
- **Fractional distillation** – This is a laboratory only method and uses a flask with a fractional distillation column to separate the various components of a sample by boiling point. The volume of water separated can then be measured and expressed as a percentage of the sample volume.

Safety

Glycol based brake fluids can cause serious damage to paintwork and in some cases can strip it off entirely. It is therefore of great importance to prevent any spillages on the paintwork. In the event of an accidental spillage absorb it immediately with paper towel and then wash the area thoroughly with plenty of water and car shampoo.

When handling brake fluid it is prudent to wear disposable nitrile or vinyl gloves to prevent any contact with the skin.

It must also be pointed out that brake fluids are surprisingly flammable, so take appropriate precautions.

At the risk of stating the obvious where safety critical items like brakes are concerned, unless your 100% certain you know what your doing, have the work done by a qualified mechanic.