Voulis®

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brake fluid

HANDBOOK

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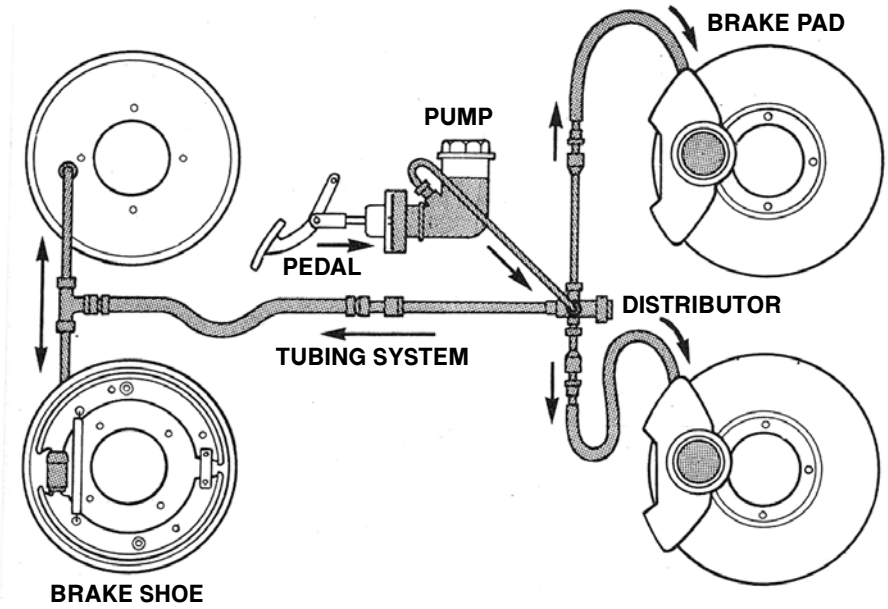
Use of Brake Fluid

Brake fluid is a type of hydraulic fluid used in the hydraulic brake system and the hydraulic clutch which is applied to all kind of vehicles.

Brake Fluids possess a particularly important role in car insurance. Their function is to transmit power by pressing the pedal up to the last piston, to activate the braking system smoothly, quickly and safely. During this braking process much of the kinetic energy is transferred by heat, forming temperatures between 400° C and 600° C on the brake discs. The amount of heat transferred to the brake fluid depends on several factors, e.g. handling, construction characteristics of the brakes, the condition of the brakes (pads) or heat dissipation. Those extreme temperatures can create bubbles in the brake fluid which will lead to collapse of the braking system. Therefore, one of the main characteristics that indentify the quality of brake fluid is the boiling point (ERBP, wet ERBP), viscosity and PH.



Hydraulic brake system

Features and Specifications

For a full understanding of the important properties of brake fluid, we should take into consideration the following:

There exists two Boiling points: the **ERBP** and the **wet ERBP**

• **Boiling point (ERBP)**. Because the glycol, glycol ether and borate esters based brake fluids are hygroscopic, which means that they absorb moisture, we use **ERBP** test without moisture. For all the brake fluid, this value describes the temperature at which the liquid begins to boil when tested brand new and freshly opened bottle before contaminated by humidity or other fluid. The correct term is **Equilibrium Reflux Boiling Point (ERPB)**.

• **Wet boiling point (Wet ERBP)**. Because the glycol, glycol ether and borate esters based brake fluids are hygroscopic, which means that they absorb moisture, we use **wet ERBP** test. This ıs a test similar to the dry boiling point, but this time it takes place in the liquid after it had time to absorb moisture from the environment. The correct term is **Wet Equilibrium Reflux Boiling Point (wet) ERPB**.

Only DOT 5 is non-hygroscopic (does not absorb moisture) because it is silicone based

Viscosity. Another important point is the viscosity grade, ie the density of the liquid at mainly low temperatures. This means that when activated the brake system at -40° C the viscosity should not be too high (thick liquid), thus reacts immediately and with security the given command. Reflection (as with the engine oil) is that the higher the viscosity number, the slower the flow (thicker) oil. The same principle applies to brake fluid, although the measuring technique is different.

PH. The PH of the brake fluid should be from 7 to 11, as not to corrode various metallic and elastomers of the circuit operating the brake fluid.

The specifications for DOT 3, DOT 4, DOT 5 in accordance with **FMVSS 116** are:

SPECIFICATIONS	DOT 3	DOT 4	DOT 5.1
Boiling point (ERBP)	>205°C	>230°C	>260°C
Wet Boiling Point (Wet ERBP)	>140°C	>155°C	>180°C
Viscosity at -40°C (mm^2/s)	<1500	<1800	<900
FMVSS 116 : Federal Motor Vehicle Safety Standards			

International Standards

In the US Ministry of Transport, the National Highway Traffic Safety Administration appointed the Federal Motor Vehicle Safety Standards (**FMVSS**). At Model, number **116**, is dealing with the requirements of the vehicle brake fluid, where later and other International Standards Organizations (SAE, ISO, Australian Standards) harmonized their requirements according to **FMVSS** standards. (Display in the table below)

Those standards define the values of all parameters in the Brake Fluids to be safe and compatible with each other and with metals or plastics that come into contact.

But the modern requirements of car manufacturers, often require the brake fluid to go well beyond international standards, such as for example the electronic **ESP** / **DSC** systems. **Voulis Chemicals** brake fluids have been created in collaboration with major firms of the international automotive industry to have been able to overcome to a large extent the requirements of international standards FMVSS 116, SAE J 1703, SAE J 1704 and ISO 4925.

Below the international FMVSS specifications shown (DOT), SAE, ISO and AUSTRALIAN STANDARDS.

Australian Standards

SPECIFICATIONS	DOT 3	DOT 4	DOT 5.1	SAE J1703	SAE J1704	ISO 4925	GRADE 1	GRADE 2	GRADE 3
Boiling point (ERBP)	205°C	230°C	260°C	205°C	230°C	205°C	230°C	260°C	260°C
Wet boiling point (Wet ERBP)	140°C	155°C	180°C	140°C	155°C	140°C	140°C	155°C	170°C
Viscosity at -40°C (mm^2/s)	1500	1800	900	1800	1800	1800	1500	1800	1800
BRAKE FLUID OF VOULIS CHEMICALS COVERS THE STANDARD FMVSS (DOT), SAE, ISO AND AUSTRALIAN STANDARDS									

The glycol, glycol ether borate esters based brake fluids represent more than 95% of the world market, while the silicone-based brake fluids represent less than 5% of the global market.

Technical notes

• Given the particular strain and the material for the safety function of the brake fluid a total change after a reasonable period of time is recommended (about 3 years)..

• The hygroscopic system glycol, glycol ether and borate esters based (**dot 3 - dot 4 - dot 4 class 6 - dot 5.1**) are not compatible with the non-hygroscopic silicone-based system (**dot 5**). Therefore if admixed brake fluid of these two bases, it generates a reaction that in turn produces a gel. This will result in sticking and incomplete punches functionality of the whole system.

To avoid as much as possible to the entrance of moisture in the brake fluid system attention should be payed to the following:

• Do not use old and open packs that are likely to have collected moisture.

• Diffusion is a place where moisture enters the system through the brake lines or various elastomers. Suitable materials for brake hoses drastically reduces the diffusion is EPDM (ethylene propylene diene monomer).

• If the brake fluid is changed in the system it would be always replaced the caps of master cylinder so as to prevent the entry of moisture on the main cylinder.

• Many times the air in the brake system is a result of moisture is converted to steam (converted to steam when the moisture exceeds the 100° C). Because there is heat in the system, it needs to empty that would result to an unsafe braking or even the collapse of the braking system.

Voulis brake fluids

dot 3

250 ml | 500 ml | 1 Lit | 5 Lit | 10 Lit

This product is glycol, glycol ether and borate esters based. The boiling point (**ERBP**) is at least, 205° C, and the wet boiling point (**Wet ERBP**) is 140° C minimum. The product is hygroscopic and absorbs water 1-2% per year, depending on climate and operating conditions. It is suitable for use in most vehicles under normal driving conditions. When replacing or filling brake fluid, is not required to clean the brake system since it can be mixed with any liquid-like base brake fluid.

dot 5.1

250 ml | 500 ml | 1 Lit | 5 Lit | 10 Lit

This product is glycol, glycol ether and borate esters based. It has boiling point (**ERBP**) at least 260° C, and, the wet boiling point (**Wet ERBP**) is 180° C minimum. It is used in commercial vehicles such as delivery trucks and fleets. When replacing or topping up it does not require cleaning the system and can be mixed with all types of brake fluids similar base without system failure. It has a higher boiling point than DOT 3 or DOT 4. It is excellent for heavy applications especially for racing cars. Also absorbs moisture from the air and thus reduces the boiling point.

dot 5

This brake fluid is silicone based. The boiling point (**ERBP**) is 260° C and the minimum wet boiling point (**Wet ERBP**) is 180° C. It is used in antique collector cars sitting for long periods, and in some military vehicles. It is also proposed by some car manufacturers. Since the silicone is not hygroscopic this brake fluid **is not mixed with the other brake fluids**. It does not absorb water and does not hurt the paint of a vehicle. It is also compatible with most rubber compositions. Absorbs more air giving a poor pedal feel. It is unsuitable for racing. If a drop of water enters the liquid, there is a serious likelihood of corrosion. This can occur because water is heavier and not miscible with silicone therefore **unsuitable for the ABS system**.

dot 4

250 ml 500 ml 1 Lit 5 Lit 10 Lit

This product is glycol, glycol ether and borate esters based. The boiling point (**ERBP**) is at least 230° C and the wet boiling point (**Wet ERBP**) is 155° C minimum. As we see, has ERBP and wet ERBP well above DOT 3, which means that it can absorb more humidity is suitable for all vehicles without any qualitative effect. When replacing or filling brake fluid, is not required to clean the brake system since it can be mixed with any liquid-like base brake fluid.

dot 4 class 6

250 ml 500 ml 1 Lit 5 Lit 10 Lit

This product is an improved version of the DOT 4. It is glycol, glycol ether and borate esters based. It has a higher boiling point **ERBP** (min 265) and a higher wet boiling point - fluid **wet ERBP** (min 175) than DOT 4. It means that far exceeds the standards of DOT4. It offers less response time due to the lower viscosity at -40 (max 700). As a result it enables faster response and optimum performance as brake fluid for brake systems, such as electronic ESP, ABS, TCS, even under the most extreme conditions. Most modern car manufacturers already use DOT 4 class 6, as brake fluid in production cars (OEM and OES). When replacing or filling brake fluid, is not required to clean the brake system since it can be mixed with any liquid-like base brake fluid.

SPECIFICATIONS	DOT 4 class 6
Boiling point (ERBP)	>265°C
Wet boiling point(Wet ERBP)	>175°C
Viscosity at -40°C (mm^2/s)	<700

Voulis' brake fluid quality

Voulis' brake fluids cover all standards DOT 3, DOT 4, DOT 4 class 6, DOT 5 and DOT 5.1 of FMVSS 116 (Federal Motor Vehicle Safety Standards). All brake fluid types meet or even exceed the requirements of international standards and ensure optimum safety for all passengers.

The brake fluids Voulis Chemicals ensure:

- High rate ERBP
- High rate WET ERBP
- Low viscosity at cold temperatures.
- Protection from oxidation and corrosion. Due to the high thermal contamination and aging of metals (aluminum, iron and copper) in the braking system, the metals begin to corrode. Thus the products contain a highly effective suspension package, which protects the metal from oxidation and corrosion.
- Excellent lubrication. The products consist of highly effective ingredients that prevent the abrasion of the brake system by friction.
- Compatibility with elastomers. To avoid loss of liquid rubber components used to achieve sealing. For this purpose, the products offer effective protection in all elastomers, gaskets etc.

As a result

The brake fluids Voulis Chemicals achieve:

- To avoid the collapse of the brake system through extremely high boiling points
- Excellent brake response (via viscosity) at low temperature
- Absence of corrosion of the brake system through a well-designed package inhibitor
- Absence of friction components of the braking system through optimal lubrication
- Absence of damage to elastomers through optimal compatibility of elastomers and liquid