

THE SPECIFICS ASPECTS OF BRAKE FLUIDS EVALUATION IN OPERATION

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Abstract: *In the presented article the authors follow selected problems of brake fluids evaluation. The introductory section briefly specifies their application. Next section refers to the degradation effects of practical operation and to the methods and instruments for the evaluation of the selected quality properties of brake fluids.*

Key Words: *boiling point, brake fluid, DOT, SAE*

1. INTRODUCTION

A wide range of operating substances and materials is used in vehicle driving systems. Attention is mainly concentrated on fuels and lubricants or on cooling fluids. Only low attention is directed at brake fluids both in civilian and military sectors. It was for instance evidenced by a random test in the USA, which proved that 25% vehicles of eight years average age had water content in brake fluid higher than 4 % [4]. Dekra, the prestigious company, published other unfavourable reports after the investigation in Germany [2]. Partial results of this investigation have demonstrated that the value close to wet boiling point of the brake fluid (appxm. 149 °C) was identified with each fifth vehicle and noticeable 79 % of vehicles older than 7 years did not pass. Specifics aspects relating to practical evaluation of brake fluids in the Czech Republic have been discussed in the article presented.

2. SPECIFICATION AND STANDARDISATION OF BRAKE FLUIDS

There are various specifications based on the American Standard SAE J 1703 (Society of Automotive Engineers) used to describe physico-chemical properties of brake fluids.

The FMVSS CFR571.116 standard, which includes the DOT regulation (Department of Transport, USA), is a standard of world-wide importance. The standard classifies brake fluids as shown in the Table 1.

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Table 1: Boiling point of brake fluids according to DOT and SAE

	Standard				SAE J 1703 (06/1991)
	FMVSS CFR 571.116				
Boiling point	DOT 3	DOT 4	DOT 5	DOT 5.1	
Dry boiling point [°C]	205	230	260	260	205
Wet boiling point [°C]	140	155	180	180	140

3. DEGRADATION EFFECTS OF OPERATION ON BRAKE FLUID QUALITY

Dry boiling point (see Table 1) is an important aspect of new brake fluid quality. The producer guarantees the parameter. But in practice it is only a short period after opening the original package. A simple question can be propounded: “**What is the actual reality?**”

Therefore we have measured the boiling point of new available glycol brake fluids, DOT 3 class. This class has been selected due to the fact that it is a fluid with the lowest boiling point. Packing of ten pieces by 500 ml has been purchased (fig. 1).



Fig. 1: Brake fluids of DOT 3

Brake fluid DOT 3 samples were bought in trade network in the period between Dec. 2005 and Feb. 2006. MAHA BTF 2000 instrument was used to measure the boiling point. Experimental measurement results are shown in the Diagram No. 1.

The Diagram 1 shows the fact that all samples of glycol fluids with rather high thermal allowance more than 40 °C comply with the dry boiling point required by standards (according to SAE and DOT) because for DOT 3 class is fixed value 205 °C. It is definitely positive news for the motorised public.

The wet boiling point is of principal importance considering glycol brake fluids in operation because glycol-based brake fluids are hygroscopic, i.e. they absorb water. In practice water is absorbed into brake fluid especially through the closure of the brake fluid buffer tank and according to practice experience it is an average amount of 2% by weight annually.

For this reason we let ten samples of DOT 3 brake fluid absorb distilled water of 0%, 2%, 4% and 6% ratio by weight. MAHA BTF 2000 instrument was used to measure the boiling point. Experimental measurement results are shown in the Diagram No. 2.

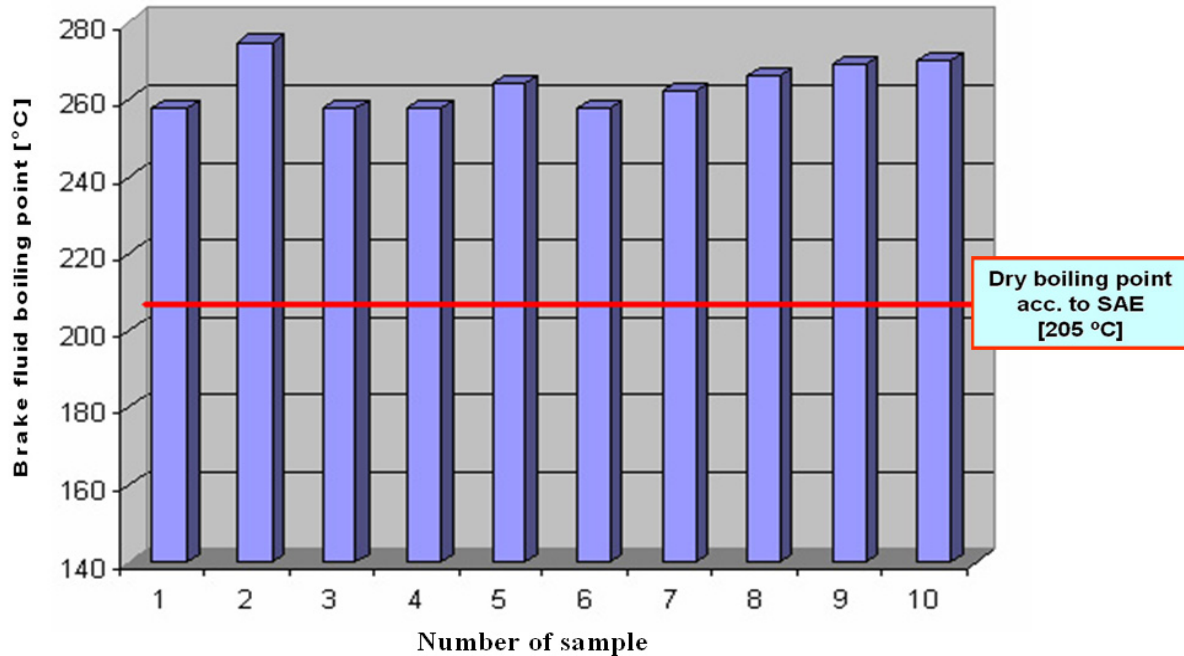


Diagram 1: Dry boiling point of DOT 3 brake fluids

The Diagram 2 shows that:

- even a low water content in the brake fluid causes significant decrease of brake fluid boiling point; with 2% water ratio in brake fluid the boiling point temperature decreases by 60 °C in average (in comparison to the initial condition – 0% water), with 4% by further 40 °C and with 6% by further 20 °C. It means that the temperature drops from the initial average value 260 °C to 140 °C (or less), i.e. to the value of wet boiling point of the brake fluid;
- the most significant drop of the brake fluid boiling point (considering 2% absorption of water a year) relates to the 2-year operation of a vehicle (with new brake fluid filling), therefore 2-year term is recommended for brake fluid replacement by the producers of brake fluids and cars;
- in further period of vehicle operation (after two years = over 4% of water ratio) probably due to “water saturation of the brake fluid”, the drop of the brake fluid boiling point will be more gradual and oncoming to the wet boiling point limit value of the brake fluid, i.e. critical value for securing the function of the hydraulic liquid in the brake system.

Considering the original hypothesis, that average annual increase of water in brake fluids is 2% appxm., then the result of our measurement can recommend the replacement of brake fluid once per 2,5 years at the latest. Our recommendation has been based on the presumption that the brake system is filled with brake fluid without water content.

In practice it can occur that the new (replaced) brake liquid in the brake system can contain water. It could happen when the brake fluid is stored in an opened vessel or when a part of the new brake fluid is mixed with the old fluid when replacing them. In these cases

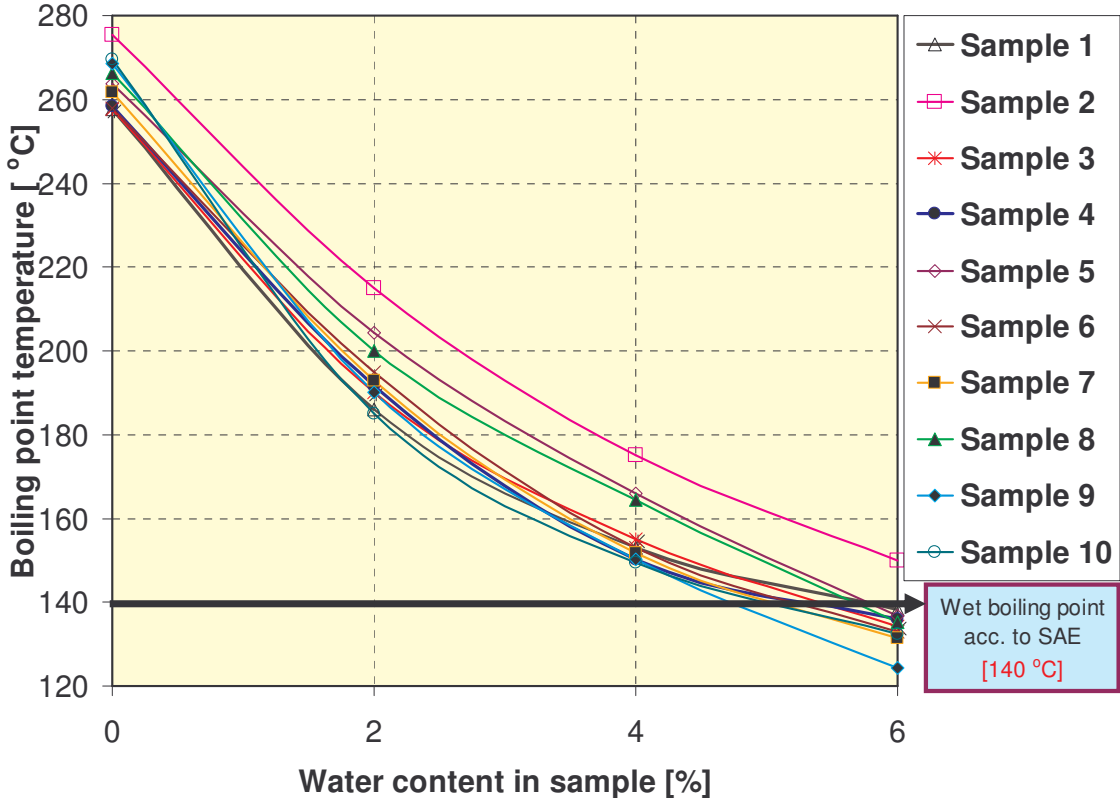


Diagram 2: Boiling point of DOT 3 brake fluids

general time interval cannot be recommended and brake fluid shall be replaced on the basis of its actual condition, i.e. using diagnostic instruments.

4. DIAGNOSTIC INSTRUMENTS SPECIFYING BRAKE FLUID BOILING POINT

We suppose that vehicles will be provided with top-quality brake fluid only when:

- motorists will be perfectly informed about unfavourable consequences of using low-quality brake fluids (with expired recommended term of replacement),









- diagnostic instruments identifying the quality of brake fluids will be available for motorists (at filling stations, service stations, Technical Inspection Stations, etc.), or when the vehicles will be equipped with the dash-board diagnostic system.

„What is the reality and what is the practice?”

The brake fluid boiling point can be measured by external diagnostic instruments only. A brief survey of the best known international and available diagnostic instruments for the measurement of the brake fluid boiling point is in the Table No. 1.

The diagnostic instruments for the boiling point measurement are not produced in the Czech Republic and the price of foreign products ranges between 2,500 to 50,000 CZK. It probably causes that the diagnostic instruments is not widely spread among motorists; most of them do not even know about them.

Table 2: Summary of selected instruments for the measurement of brake fluid boiling point

							
Brake-Check	BFT 2000	ALB 1100	AQUA 10	EBT 03	BFT 6512	BFD 59078	EBT 06

Legislation does not solve this problem and the main guarantors of technical conditions of vehicles, i.e. Technical Inspection Stations (STK), are not obliged to check the boiling point and brake fluid quality in spite of the fact that it is important for operation.

A research intended to identify the level how service shops are equipped with diagnostic instruments for the measurement of brake fluid boiling point was performed. Altogether 33 service stations have been addressed, 8 of them are factory-authorized service stations and 25 are not. The results of the partial investigation are specified in the Table 3.

Table3: Equipment of service stations for the measurement of brake fluid boiling point

Number of services investigated	Classification of service stations	Q-ty	Equipped with diagnostic instruments
33	authorised	8	100 %
	unauthorised	25	30 %

The Table 3 shows that all the addressed factory authorised service stations dispose of diagnostic instruments for the measurement of brake fluid boiling point but these instruments are available in 30% of unauthorised service stations only. The information is not very satisfactory nevertheless it is not the most significant result. A detailed analysis

of the diagnostic instruments for the measurement of brake fluid boiling point at service stations showed the equipment produced only approximate results showing: good – satisfactory – not satisfactory.

The above mentioned facts proved that the procedure of checking and identifying the quality of brake fluids had been neglected. Therefore the authors advise to deal with these problems.

5. THE FUTURE IN THE PROCESS OF BRAKE FLUID QUALITY EVALUATION

The public becomes aware of the document called “National Strategy of Road Traffic Safety” approved by the government of the Czech Republic. It has been aimed to decrease the number of people killed on roads in 2002 by 50% till 2010. The solution of the problems of brake fluid quality evaluation could contribute and partially fulfil the prominent task. Where to aim the attention? These could be suitable fields: advertisement and propagation of the importance of regular checking of brake fluids quality, stressing its dangerous nature, when recommended rules of use are not adhered to; equipment of Technical Inspection Stations and service stations with diagnostic instruments and the possibility to equip dashboards of cars with diagnostic instruments for the measurement of brake fluid qualities.

The above mentioned facts have not been discussed in detail with respect to limited possibilities and the article extent.

6. REFERENCES

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