

# LABORATORY EVALUATION OF SERVICE LIQUID

## ЛАБОРАТОРНОЕ ИЗМЕРЕНИЕ ЭКСПЛУАТАЦИОННЫХ ЖИДКОСТЕЙ

Assoc. Prof. eng. Čorňák Štefan, Dr. <sup>1</sup>, Ing. Jan Skolil. <sup>2</sup>

<sup>1</sup> University of Defence in Brno, Czech Republic

<sup>2</sup> Velvana, a.s, Velvary, Czech republic

**Abstract:** *Reliable and safe riding characteristics depend on the quality properties of brake and cooling fluids. The present article deals with representative knowledge relating to practical evaluation of working fluids (brake and cooling fluids).*

**KEYWORDS:** BRAKE FLUID, COOLING FLUID, SAE, DOT, VW 774, VW 776

### 1. Introduction

A wide range of operating substances and materials is used in vehicle driving systems. Attention is mainly concentrated on fuels and lubricants. Only low attention is directed at brake fluids and at cooling fluids. Laboratory evaluation of service liquid (new brake fluids and new cooling fluids) have been discussed in the article presented.

### 2. Cooling fluids evaluation

Cooling fluids quality is defined in the VW 774 Technical Standard. The latest edition from 2005, identified VW 774F, defines four different classes of fluids (C, F, G and H). The determined results of some selected fluids have been compared with the F class requirements. Fluids identified by producers as B class can be compared with the requirements of the VW 774 Standard from 1994. Twenty brands of cooling fluids (1000 ml each packing) have been bought.

The tests aimed at checking the basic utility properties have been selected for the evaluation. Have been evaluated: water content, boiling point, free alkalinity, density at 20°C, pH of hydrous solution (ratio 1:2) and point of congelation of mixture with water (ratio 1:1 and 1:2).

This evaluation was carried out in September 2006 in Ústav paliv a maziv, a. s. Praha (Fuels and Lubricants Institute, Prague) as a paid order from Velvana, a. s., Velvary in order to guarantee objectiveness of the results measured. The results of the lab testing were compared with the requirements of individual VW specifications; low-temperature properties were compared to the data specified on the packing of individual fluids for the dilution ratio with water 1:1 and 1:2.

The VW specification differs from the evaluated values only in the requirement for free alkalinity where the requirement of 11 as minimum for the B and C classes is specified while the min. required value 5 is required for the F to H classes of fluids. Water content requirements, boiling point range, pH of diluted hydrous solution of the cooling fluid do not differ for individual classes. The results of the experimental measurement are shown in Figures 1 to 3 [1].

#### 2.1. Water content in cooling fluids

The detected water content of all B class tested fluids is higher than the limit specified in VW 774 (Fig. 1). The observed value is higher by 8% m/m in one case. The detected water content of four tested C class fluids is up to 5% m/m, up to 7% m/m in two cases and in one case it is higher than 15% m/m. Detected water content, which can be affected by the presence of additives applied, has not generally exceeded 4% m/m for E-F classes. Only in one case it considerably varies from the value required. In one case it even has exceeded 18% m/m.

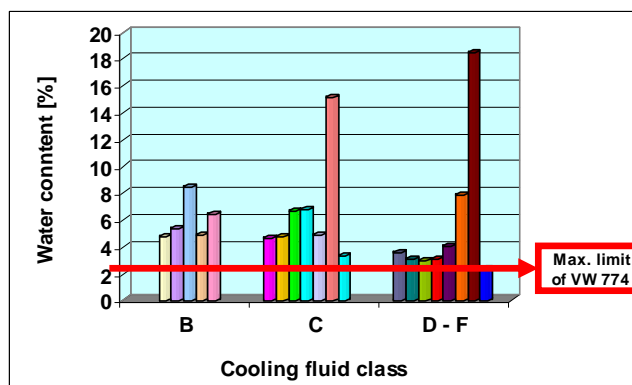


Fig. 1 Water content in cooling fluids

#### 2.2. Free alkalinity of cooling fluids

Free alkalinity value specified in VW 774 for the B class passed the test only for Fridex Stabil cooling fluid (Fig. 2).

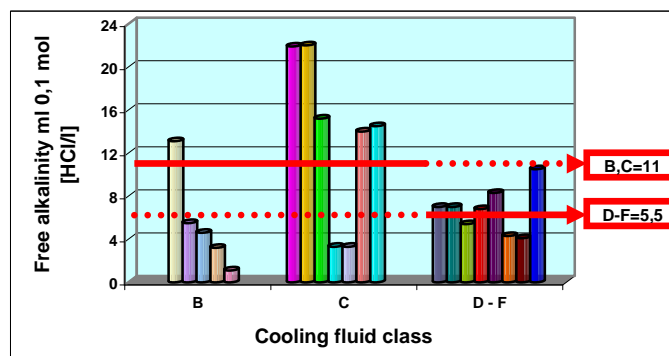


Fig. 2 Free alkalinity of cooling fluids

Note:

- D - F – min. limit of VW 774 specification for D-F class
- B, C – min. limit of VW 774 specification for B&C class

Free alkalinity detected values of other fluids in the given class have attained max. 50% of the value required in the specification. Free alkalinity value specified in VW 774C for the C class has passed the test for the majority of tested fluids. Only in two cases the detected values were considerably lower than required in the specification. Free alkalinity value specified in VW 774F for E-F classes has passed the test for the majority of tested fluids. Only in two cases the detected values were lower by 18% than required in the VW specification.

### 2.3. Boiling point of cooling fluids

The boiling point of all tested B class fluids (Fig. 3) is lower than the VW 774 specification requirements.

In one case the deviation from the requirement is higher than 20 °C. The requirement of the VW 774 specification for the C class is satisfied in one case only, the boiling point of two fluids is lower by more than 10 °C in comparison with the specification requirements. The requirement for the E-F class boiling point specified in the VW 774 specification is satisfied in all cases with the exception of two fluids. The deviation detected is higher than 20 °C in both cases.

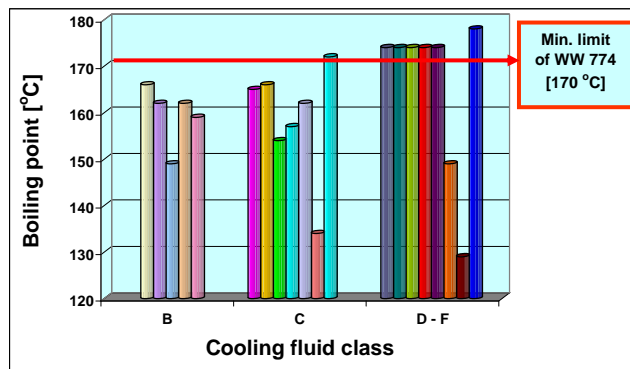


Fig. 3 Boiling point of cooling fluids

### 3. Brake fluid evaluation

SAE J 1703 is a world-wide basis for the evaluation of brake fluids. The basic physico-chemical data of brake fluids are specified in this standard. It is especially the determination of colour, boiling point (dry and wet boiling point), oxidation and chemical stability, kinematic viscosity, evaporableness, compatibility with elastomers, pH factor, mixability, anticorrosive action, etc. The most important physico-chemical value of glycol brake fluid is the boiling point as far as service is concerned.

The dry boiling point is an important value for the new brake fluid quality. This value is guaranteed by the producer. However it only relates to a short time period in service after opening the original container. Let's ask a simple question: "What is the reality?"

The measurement of the boiling point of new, generally available, glycol brake fluids of DOT 3 and DOT 4 classes was carried out for that purpose. 22 types of brake fluids in 500 ml containers (10 pcs of DOT 3 and 12 pcs of DOT 4 class) were purchased on the market. MAHA BTF 2000 apparatus was used to measure the boiling point. This evaluation has been performed in the Department of Combat and Special Vehicles at the University of Defence in Brno. The results of the testing measurement are shown in Figs. 4 and 5.

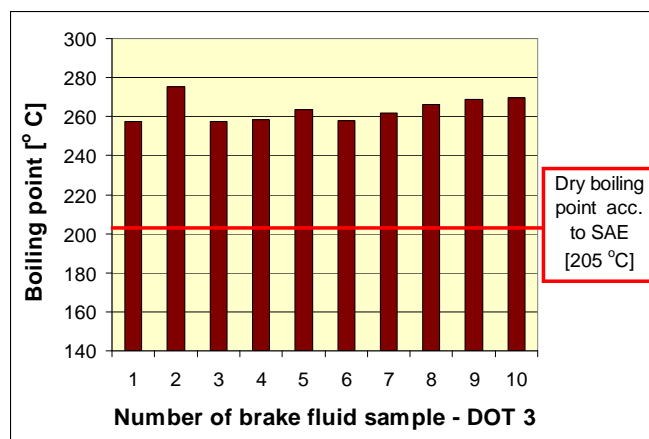


Fig. 4 Boiling point of brake fluids DOT 3

It is obvious from the Fig. 4 that all samples of DOT 3 glycol brake fluids (including considerable margin – more than 40 °C) comply with dry boiling point of 205 °C for DOT 3 class according to SAE and DOT standards.

It is obvious from the Fig. 5 that the purchased DOT 4 class brake fluid samples comply with dry boiling point of 230 °C for DOT 4 class according to SAE and DOT standards. This observation is certainly good news for motorists. No fundamental differences of the boiling point between domestic and foreign brake fluid products have been found out.

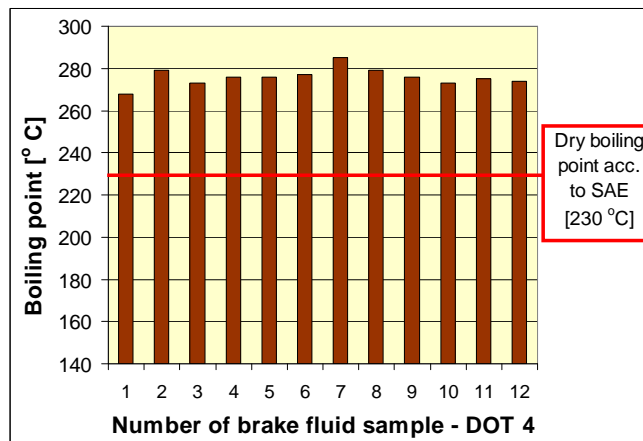


Fig. 5 Boiling point of brake fluids DOT 4

Regarding service conditions the wet boiling points of glycol brake fluids are of essential importance. That is why the brake fluids being based on glycols are hygroscopic, i.e. they absorb water. In actual service, the brake fluid absorbs water mostly through the cap of the brake-fluid tank and from experience it is 2% per year on average. The mentioned problems are discussed in detail in publications [2].

### 4. Conclusion

The basic selected quality features have been tested with 20 brake fluids samples and 20 cooling fluid samples available on the Czech market. The results proved that all tested brake fluids complied with considerable margin with min. dry boiling point specified in the standard. The mentioned low temperature properties of cooling fluids were attained. Some differences were identified between the requirements of the given specification and the measured results especially in water content, boiling point and free alkalinity. As to F class cooling fluids, substantial deviations from VW 774 requirements have been found out only for two products related to water content and boiling point.

### 5. References

- [1] Laboratory evaluation of cooling fluids. Ttechnical report. UPM,a.s., Praha 2006.
- [2] Čorňák, Š. et coll.: Procedure of suitability evaluation of brake fluid boiling point measurement devices. University of Defence in Brno, 2007, ISBN 80-8075-154-4.
- [3] ROSICKÁ, Zdena. Reliable and Safe Management of Hazardous Materials – Asbestos Focused. In *Mezinárodní konference Opatřebení, spolehlivost, diagnostika 2005*. Univerzita obrany, Brno, 2005, s. 155-162. ISBN 80-7231-026-7

**Reviewer:** Assoc. Prof. eng. Pavel BRAUN, CSc., University of Defence in Brno, Czech Republic, tel:+420 973 443 424, e-mail: pavel.braun@unob.cz