

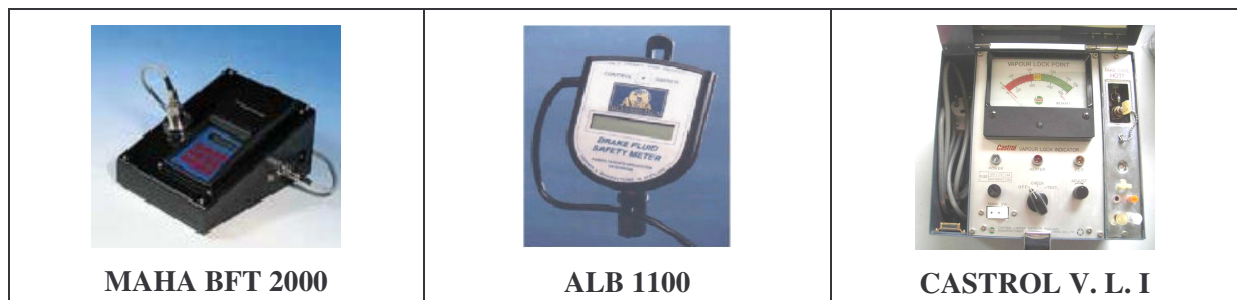
## SELECTED PROBLEMS OF BRAKE FLUID DEVICES EXPERTISE

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*Summary:* In the Journal of the Ministry of Transport, Posts and Telecommunications of the Slovak Republic (ISSN 1335-9789) is published „The list of recommended measurement devices for measuring of the brake fluid boiling point“. These are the devices BFT 2000, ALB 1100 and CASTROL V.L.I. They underwent a partial evaluation of measurement precision that took place at the Department of Combat and Special Vehicles of the University of Defence in Brno, in co-operation with Testek, s.r.o., Bratislava and Velvana, a.s. Velvary companies.

### 1. INTRODUCTION

The vehicle inspection centres (STK) in the Czech Republic are not obliged to check the boiling point of the brake fluid and therefore they are not equipped with appropriate diagnostic devices. The similar situation like in the Czech Republic is also in the neighbouring states, but in the Slovak Republic the situation is different. The measurement of the brake fluid boiling point is set by the legislature as a part of the scope of technical vehicle inspections in Slovakia. The devices are show on picture No. 1.



*Picture No. 1: Devices BFT 2000, ALB 1100 and CASTROL V.L.I.*

With respect to the fact that some other states, e. g. Austria but the Czech Republic too, have considered the possibility of including the inspecting item „determination of the brake fluid boiling point“ into the technical vehicle inspection already for a longer time, the diagnostic devices MAHA BFT 2000, ALB 1100 and CASTROL V. L. I. underwent a partial evaluation of measurement precision.

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## 2. SAMPLE PREPARATION AND DEVICE CALIBRATION FOR MEASURING OF THE BRAKE FLUID BOILING POINT.

Four different samples of brake fluid SYNTOL HD 265, containing 1 000 ml each, were laboratory prepared directly at its producer, the company Velvana, a. s. The samples (standards) differed by the percentile share of water content in the brake fluid. The company Velvana carried out the actual measuring of the brake fluid boiling point of these samples according to the company's own standard. The parameters of each sample are evident from the table No. 1.

*Table No. 1: Degrading effect of water on brake fluid boiling point (Syntol HD 265).*

Parameter	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4
Boiling point [°C]	259	229	175	157
Water content in sample [%]	0,18	1,15	3,13	4,01

From the table No. 1 it is clear that already a small amount of water in brake fluid causes a considerable decrease of the brake fluid boiling point – at the content 1,15 % of water in the brake fluid sample the average decrease of the boiling point temperature is 30°C (compared with the initial state, sample with 0,18 % of water), at 3,13 % of approximately 54 °C more and at 4,01 % of even 18 °C more (compared with the previous sample). As a whole the brake fluid boiling point decreased from the value 259 °C (at content of 0,18 % H<sub>2</sub>O ) to the value 157 °C (at content of 4,01 % H<sub>2</sub>O), that means a difference of 102 °C.

The evaluated devices MAHA BFT 2000, ALB 1100 and CASTROL V.L.I have had a valid calibration at the time of the measurement. In spite of it a control comparison measurement (calibration) of these devices was carried out. Distilled water with the boiling point at 100 °C was used as the standard. The measured values are listed in table No. 2, they complement the chosen parameters of the brake fluid boiling point measurement devices.

*Table No. 2: Comparison of the parameters of brake fluid boiling point measurement devices.*

PARAMETER	BRAKE FLUID MEASURING APPARATUS			LABORATORY METHOD
	MAHA BFT 2000	ALB 1100	CASTROL V.L.I	
Measuring range	0 - 300 [°C]	0 - 500 [°C]	65 - 300 [°C]	0 - 300 [°C]
Accuracy of apparatus	± 7 °C	± 5 °C	± 5 °C	± 5 °C
Calibration on distilled water boiling point	100 °C	101 °C	101 °C	100 °C

The procedure recommended by the manufacturer was used during the measurement of the boiling point of the brake fluid samples by CASTROL V.L.I. When using the devices MAHA BFT 2000 and ALB 1100 each brake fluid sample was at first filled into a centrifugal test tube with a content of 35 ml. The following measurement was carried out according to the scheme given by the manufacturer of the above mentioned diagnostic devices.

### 3. RESULTS OF THE DEVICE COMPARISON

Total measurement results of single brake fluid samples (No. 1 to No. 4) by evaluated diagnostic devices and the results of the laboratory method are summarised in table No. 3.

*Tab.3: Results of the device comparison and the results of the laboratory method.*

		Sample No. (% Water content in sample)							
		1 (0,18 % H <sub>2</sub> O)	2 (1,15 % H <sub>2</sub> O)	3 (3,13 % H <sub>2</sub> O)	4 (4,01 % H <sub>2</sub> O)				
Device	Mesur. No.	Boiling point [°C]							
A	0*	248**		210		170		157	
	1	248 **	Ø 249**	210	Ø 211	170	Ø 169	157	Ø 158
	2	250 **		211		169		159	
	3	250 **		212		167		158	
B	0*	255		214		180		160	
	1	256	Ø 255	222	Ø 222	178	Ø 180	166	Ø 167
	2	254		222		180		166	
	3	255		222		182		168	
C	0*	256		237		201		169	
	1	256	Ø 264	233	Ø 239	186	Ø 191	170	Ø 179
	2	267		246		194		181	
	3	269		238		194		185	
LAB. METHOD (SYNTOL HD 265) ETALON	-	259		229		175		157	

Note: Ø = average from measurement No.1, 2 and 3,

\* measured value wasn't evaluated (measurement was effected just by reason of sensor of devices clearing)

\*\* after achievement cca 250 °C temperature, device automatically unplugs oneself

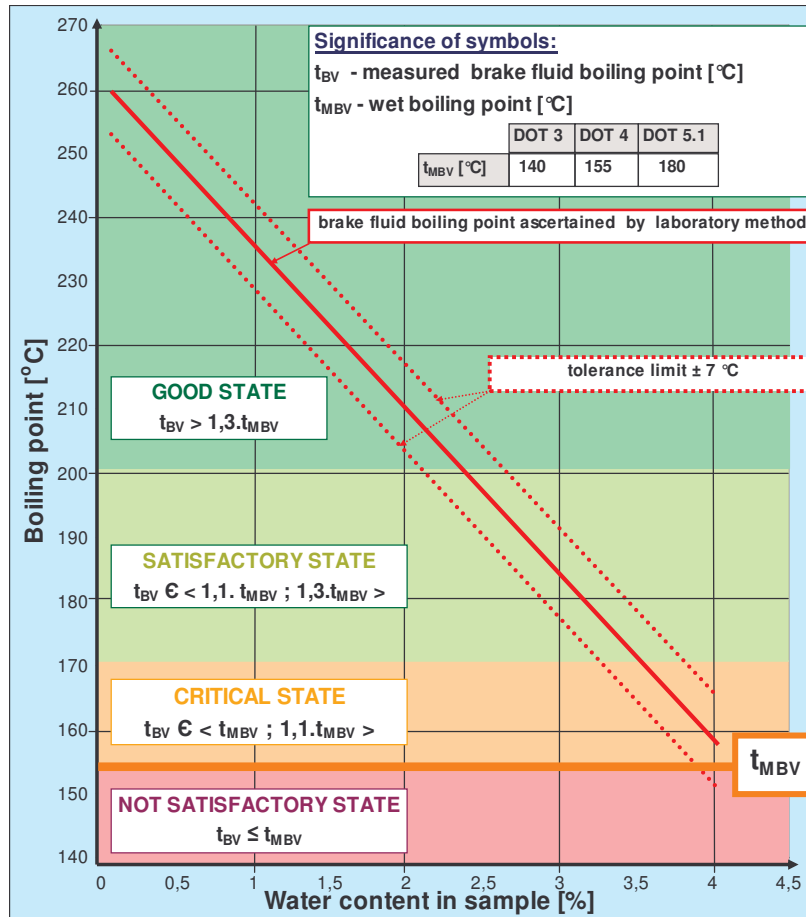
### 4. PRACTICAL RECOMMENDATION FOR BRAKE FLUID BOILING POINT DEVICES EVALUATING

It is necessary to choose a suitable (the most precise) calibration method for the setting of the „theoretic“ brake fluid boiling point temperature values when evaluating the brake fluid boiling point measurement devices. To these „theoretic“ values tolerance zones of measurement and single running state zones of brake fluid boiling point values must be fixed.

The zones for the classification of further operation (the state of the brake fluid with the boiling point  $t_{BV}$ ) with respect to the brake fluid wet boiling point temperature ( $t_{MBV}$ ) and the amount of water contained in it (% H<sub>2</sub>O) can be specified as follows:

- $t_{BV} \leq t_{MBV}$  ... **NOT SATISFACTORY STATE**, an immediate change of brake fluid is necessary,

- $t_{BV} \in (t_{MBV} ; 1,1 \cdot t_{MBV})$  ... **CRITICAL STATE** (carry out the change of brake fluid within 2 months),
- $t_{BV} \in (1,1 \cdot t_{MBV} ; 1,3 \cdot t_{MBV})$  ... **SATISFACTORY STATE** (carry out the change of brake fluid within 9 months),
- $t_{BV} \geq 1,3 \cdot t_{MBV}$  ... **GOOD STATE** (safe running during a period longer than 9 months).



Picture No. 2: Setting of theoretic running state zones of the boiling points of the DOT 4 class brake fluid.

The mentioned zones are depicted on picture No. 2 and are valid for brake fluid of the DOT 4 class.

## 5. CONCLUSION

As it follows from the results of device measurement and evaluation, for cases when the measured values of the brake fluid boiling point temperature are located in the tolerance zone of the laboratory method ( $\pm 10$  °C), the values determined

by the single diagnostic devices can be regarded as relevant. For the brake fluid quality check using the boiling point measurement e. g. in vehicle inspection centres or garages, it is not essential whether it is measured 250 °C or 260 °C for SYNTOL HD 265. Such a result shows that this is a high-quality (new) brake

fluid. On the other hand if the measured brake fluid boiling point is  $165 \text{ °C} \pm 10 \text{ °C}$  the result indicates that the brake fluid is of inferior quality (old) and it must be strongly recommended to the vehicle owner to change it. For more details on this subject see Literature No. 1.

## 6. ACKNOWLEDGEMENT

This contribution arose during research proposal solution at Department of Combat and special vehicles MOOFVT0000401.

## 7. BIBLIOGRAPHY

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