



- › Wissen schafft Fortschritt®
- » **Airbag-Emissions: On-line Gas- and Dust-Analysis of two DAB-Modules according to AK-ZV01**
- › GWP white paper AirbEm 002
  
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## 1. Abstract:

The gas and dust emissions of two driver airbag modules were analysed by an accredited testing procedure. The emissions were found to be within the thresholds of AK-ZV01 for the total car, no significant differences between the modules could be observed.

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**Customer:**  
Test Systems GmbH

88888 Teststadt

**Distribution list:**  
Mr. Hans Meier, Test Systems GmbH  
Teststadt  
Dossier-Archive GWP

**Date:** 24.12.2018

**Reported by:** Dr. Gundolf Weseloh  
**Internal Verification:** Dr. Stefan Loibl

**Pages:** 8

**Appendix:** see document

**Status:** confidential

**Order:** XYZ1234

**Ordered by:** Mr. Hans Meier

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### 1. Task

Gas and dust emissions of the provided airbag modules had to be analysed according to AK-ZV01 in a test volume of 2.7 m<sup>3</sup> by a complex multicomponent gas analysis system for potentially hazardous pollutants. To obtain concordance with the standard, results were recalculated to a test can volume of 2.5 m<sup>3</sup>.

### 2. Submitted samples

The following samples were provided to GWP:

Table 1: Submitted Samples

Date of Receipt	GWP #	Customer-#	Description	Remark
24.12.2017	1	Trabi 601/DAB	DAB Sachsenring	XYZ 01; 601AF; QWERTZ
24.12.2017	2	Trabi 601/DAB	DAB Sachsenring	XYZ 02; 601AF; YXCVBN

GWP had no influence on selection of samples. Handling of pyrotechnics was performed according to the German Explosives Act (Sprengstoffgesetz).

### 3. Standard operating procedures

The tests were carried out according to the following guideline

- AK - ZV 01 “Pyrotechnische Rückhaltesysteme im Gesamtfahrzeug” and in account to the following directive:
- RL 08 GasL REV03 Airbag-Gasanalyse (GWP internal directive, accredited acc. to DIN ISO EN 17025), including current standard operating procedures.

### 4. Gas emission analysis<sup>1</sup>

Tests were performed on 2018-MM-DD and 2018-MM-DD. DAB modules were mounted on a customer-provided steering wheel in a 2.7 m<sup>3</sup> gas tight test can. The angle between the main axis of the steering wheel and the horizontal was adjusted to 60°. Ignition of the single stage modules with adaptivity was initialized by an airbag control unit (GWP inventory #703, airbag control unit 2-stage “Zenz”), delay of adaptivity ignition was adjusted to 200 ms.

<sup>1</sup> Accredited test procedure of GWP mbH according to DIN EN ISO 17025

## 4.1 Gas Analysis

The gas to be analysed was pumped out of the tank with a flow rate of 5 L/min and analysed using

- Mass Spectrometry (MS, Balzers, Mod. GAM 500 Ultratrace, Inv.# 152)
- Chemoluminescence Detection (CLD, ECO Physics, Mod. CLD 700 EL, Inv.# 181)
- dedicated non-dispersive IR CO-Analyser (NDIR, Maihak, UNOR610, Inv.# 246)
- Fourier Transform Infrared Spectrometer (FTIR, ThermoFisher Scientific Mod. Antaris equipped with 10m gas cell, Inv.# 734)

Additionally, the gas was tested for chlorine (Cl<sub>2</sub>) and hydrogen sulphide (H<sub>2</sub>S) by Dräger tubes and an ACCURO sampling pump.

Total dust was sampled in the course of the gas concentration measurements by deposition on a 150 mm glass fibre filter (Whatman GF/A) in line with the gas handling unit (GHU).

The results of concentration measurements and total dust concentration are compiled in Table 3. The shown values are re-calculated to 2.5 m<sup>3</sup> tank volume and standard conditions (T=295 K; p=1013 mbar). Concentration differences in the tank atmosphere after and before ignition of the airbag system are reported in average values. Averages values were computed according to AK-ZV01. Negative concentration differences, e.g. oxygen (O<sub>2</sub>), result, because smaller O<sub>2</sub> concentrations were detected after ignition of the airbag compared to the concentration in the tank atmosphere before ignition. Concentrations below detection limits are indicated as “<DL”.

Table 2: compiled results of the gas emission analysis

Report 18XXX AKR												
Gas Analysis: 2 Trabant 601 DAB at 2.5 m <sup>3</sup> tank												
order	XYZ1234											
customer	Test Systems GmbH / Mr. Meier											
sample	Trabant 601 DAB											
test & part number	n.a.											
date of evaluation	11.10.2018 / Dr. Gundolf Weseloh											
experimental set up	2.7 m <sup>3</sup> tank, no vent; according to AKZV, mean values of 30 min in vppm; GHU, MS, FTIR, CLD, NDIR, test tube											
remark	mean values re-calculated to 2.5 m <sup>3</sup> Tank and standard conditions (T=295 K; p=1013 mbar)											
<b>component [results in vppm]</b>	-	-	<b>CO</b>	<b>CO<sub>2</sub></b>	<b>NO</b>	<b>NO<sub>2</sub></b>	<b>Cl<sub>2</sub></b>	<b>H<sub>2</sub></b>	<b>COCl<sub>2</sub></b>	<b>SO<sub>2</sub></b>	<b>HCl</b>	<b>C<sub>6</sub>H<sub>6</sub></b>
detection limit; AKZV-thresh. car [vppm]	-	-	2 ; 500	10 ; 20000	0,15 ; 50	0.2 ; 10.0	0.5 ; 5.0	- ; -	0.1 ; 1.0	4.0 ; 50	1.0 ; 25	1.0 ; -
CAS identification number	-	-	630-08-0	124-38-9	10102-43-9	10544-72-6	7782-50-5	1333-74-0	75-44-5	7446-09-5	7647-01-0	71-43-2
<b>sample</b>	<b>file</b>	<b>test date</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>
DABXXX, aged	18XXX-1	01.01.2018	136	1558	17.7	0.3	<DL	15.5	<DL	<DL	<DL	- <DL
DABXXX, aged	18XXX-2	02.01.2018	142	1567	18.2	1.1	<DL	17.5	<DL	- <DL	<DL	- <DL
<b>component [results in vppm]</b>	-	-	<b>O<sub>2</sub></b>	<b>Argon</b>	<b>Helium</b>	<b>H<sub>2</sub>O</b>	<b>HCN</b>	<b>HCHO</b>	<b>NH<sub>3</sub></b>	<b>H<sub>2</sub>S</b>	<b>GHU Dust</b>	
detection limit; AKZV-thresh. car [vppm]	-	-	- ; -	- ; -	- ; -	- ; -	0.4 ; 25	0.7 ; 10	0.7 ; 150	2.0 ; 50	125 mg/m <sup>3</sup>	
CAS identification number	-	-	7782-44-7	7440-37-1	7440-59-7	7732-18-5	74-90-8	50-00-0	7664-41-7	7783-06-4		
<b>sample</b>	<b>file</b>	<b>test date</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>total / mg/m<sup>3</sup></b>
DABXXX, aged	18XXX-1	01.01.2018	-1307	- <DL	<DL	396	<DL	<DL	18.8	<DL	19.8	
DABXXX, aged	18XXX-2	02.01.2018	-1117	- <DL	- <DL	446	<DL	<DL	21.0	<DL	19.5	
<DL: low er as detection limit												

## 4.2 Dust Analysis – Andersen Impaction<sup>2</sup>

Dust sampling and dust particle size fractioning were performed by an 8 stage Andersen cascade impactor (inventory # 184 GasL) which had been placed directly inside the test can. Dust sampling was started one minute after ignition for 20 min using a gas flow of 28.3 l/min. Directly after completion, particle size distribution was determined by weighing the 8 fractions plus backup filter. From the resulting histograms (figures 1 and 2), the values for total dust concentration and for total respirable dust concentration were calculated and corrected to standard conditions. For results also refer to table 3.

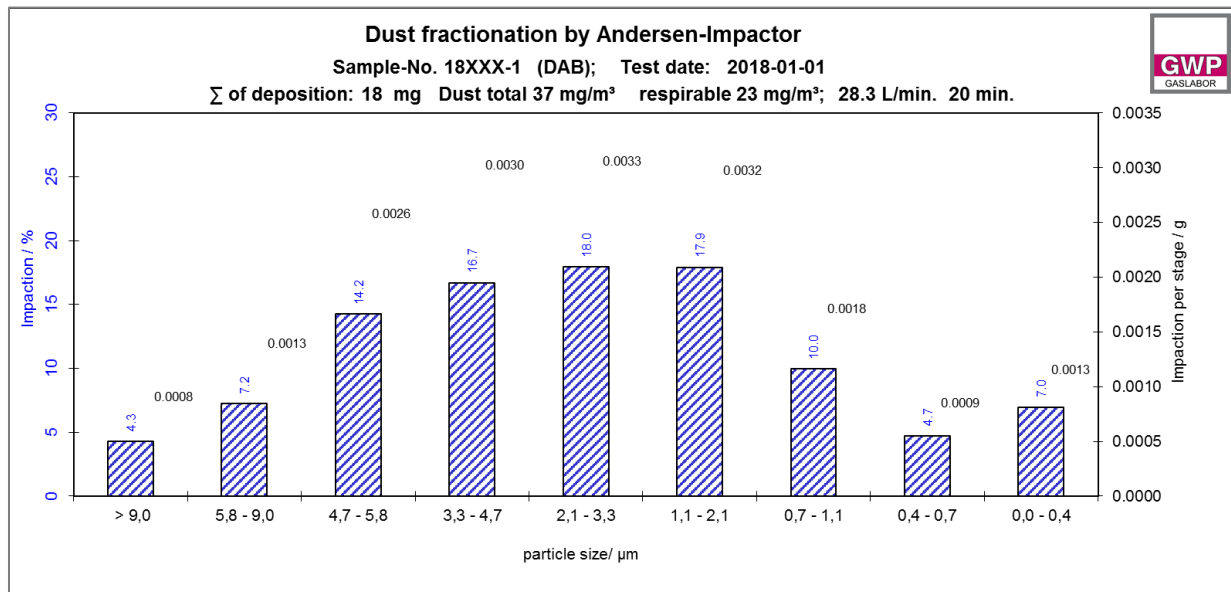


Figure 1: size distribution of fractioned dust samples of module XYZ 001

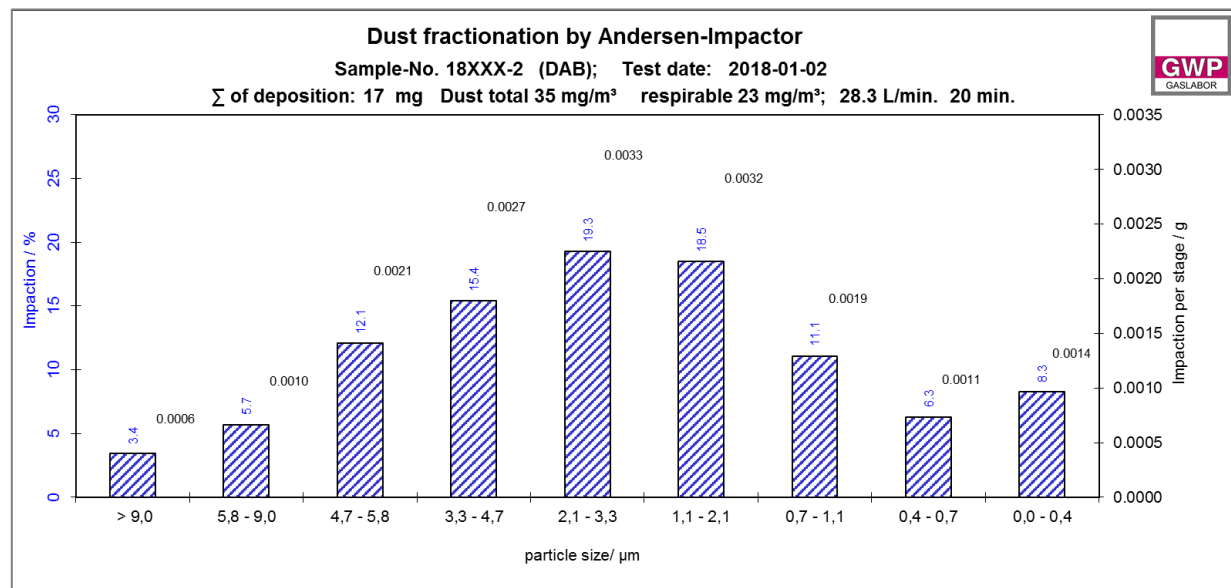


Figure 2: size distribution of fractioned dust samples of module XYZ 002

<sup>2</sup> Accredited test procedure of GWP mbH acc. to DIN ISO EN 17025

Table 3: compiled results of dust analysis

Test date	GWP #	Customer-#	total impaction mg	total dust mg / m <sup>3</sup>	total dust respirable mg / m <sup>3</sup>
01.01.2018	1	XYZ 001	18.1	36.8	23.1
02.01.2018	2	XYZ 002	17.2	35.0	23.3

The values for total dust sampled by the GHU, deposited on the 150 mm glass fibre filter, and the Andersen-impactor were only in poor correlation. The reason might be found in the different locations of the two sampling points (GHU and Andersen impactor) inside the unvented test can (as specified in the standard).

Nevertheless, the total amount of impacted dust was far less than 50 mg and thus insufficient for further chemical analysis.

## 5. Summary and Conclusion

Two driver airbag modules were analysed with respect to their gas and dust emissions. All measured emissions were found within the given thresholds of AK-ZV01 for total car cabin concentrations. Exact evaluation of the limits depends on engineering specifications of the car manufacturer.

## 6. References

- AK-ZV01 „Pyrotechnische Rückhaltesysteme im Fahrzeug“ (Ausgabe Oktober 2001)
- AK-LV01 „Airbag-Module (Einbauort: Lenkrad, Instrumententafel), Anforderungen und Prüfbedingungen (Ausgabe 2010-11)“

Zorneding, 31.12.2018

i.A. Dr. Gundolf Weseloh  
Reporting

Dr. Stefan Loibl  
Internal verification

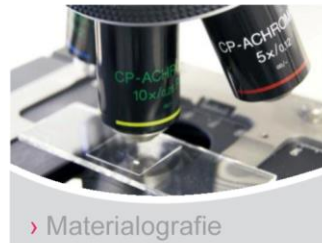
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All results refer exclusively to the tested samples.





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