RDW

TEST REPORT

Concerning the Trailer anti-lock braking system corresponding Annex XIV corresponding the Directive of the Council 71/320/EEC as last amended by the Commission Directive 2002/78/EC and Annex 19 of ECE Regulation no. 13.10

Test report number	:	**RDW-13R-0228**
0.1. Make	:	WABCO Vehicle control systems
0.2. Type	:	Trailer EBS
0.3. Variety	:	Trailer EBS "E "
0.4. Category of vehicle	:	O3 and O4
0.5. Name and address of the manufacturer	:	WABCO Vehicle Control Systems . Am Lindener Hafen 21 D-30453 Hannover Germany
0.6. Name and address of the principal	:	See 0.5

General : The anti-lock braking system does comply with the requirements laid down in Annex XIV of the above mentioned Directive and Annex 19 of the above mentioned Regulation.
See documentation number(s): Information document ID_EB 123.7 and Approval report EB 124.3E
Information document ID_EB124.4E, and Approval report EB 123.8E

Tests : The tests have been conducted according to Annex ~~II, III, IV, V, VI, VII, VIII, X, XI, XII, XIII,~~ XIV ~~and XV~~ of the above mentioned Directive and~~/or~~ Annex ~~IV, V, VI, VII, VIII, IX, XI, XII, XIII, XIV XV,XVI,XVII,XVIII,~~XIX -of the above mentioned Regulation.
See Annex number(s): 1-11

Conclusion : The response time measurement of both systems showed identical values. The energy consumption of the new "TEBS-E" Version was better than the "TEDS D" version. Although some testresults show a deviation in their ABS performance , this new "TEBS E " version has proven to comply with the stated requirements , and there are no objections against approval according to the above mentioned Directives and Regulation.
This testreport can be used for the purpose of brake approval's , i.e. extension of the new "TEBS-E "system

Test date(s) : 10-11/01/2007

By : W.Hartman

Jeversen, 11-01-2007
The Test-engineer

Invoice number: VR130653

This testreport has been compiled to verify the compliance with the requirements of ECE – Regulation 13/10 by spot checking the system and the results laid down in Approval report EB 123.8E, and EB 124.3E. Furthermore tests have been performed to show the equivalence between EBS D and EBS E in terms of ABS performance to Annex X paragraph and 2.3 and energy consumption according to Annex XIV , paragraph 6.1.
All tests were carried out with a 3 axle semi trailer , equipped with both EBS “D” and EBS “E” systems.
The results of the the comparison can be found in the annex 3 and 4 of this report

FMEA spot check

To verify the contents of testreports EB 123.8E and EB 124.3E , a spot check has been carried out on the WABCO system FMEA.
Due to the fact that the systematic method for verifying the presented system was already performed and was approved in the fore mentioned reports, an a-systematic test was carried out to test the effectiveness.
During the spot check no weakness was found in the sytem , and therefore no doubt was risen to the accuracy of the results in fore mentioned testreports
The spot checks were carried out on a model by introducing failure’s to the system.by observing and monitoring the response .
The response and it’s safety hazards were compared to the information in the system FMEA.

(1) Strike out what is not applicable.

Failure	Vehicle Speed (km/h)	System Config.	Failure Affect	Fault Indication	Pass	Notes
Under voltage	Any	4S/3M	System shut down	Yellow warning	✓	Off at <19Volt, red warning lamp on at 18 Volt
Over Voltage	Any	4S/3M	System shut down	Yellow warning	✓	> 32 Volt , system functions pneumaticly
Wheel Speed Sensor Faults						
Sensor SL open circuit	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Sensor SL open circuit	50	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Sensor SL - excessive air gap	0 to 20	4S/3M	System shut down	Yellow warning	✓	At a sensor gap of more than 0,7 mm the fault condition is recognised and a yellow warning signal transmitted. Yellow warning signal will extinguish , once the air gap has been repaired , and after a speed signal is generated of at least ≥ 7 km/h vehicle speed .
Modulator Faults						
Exhaust Solenoid - open circuit	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Exhaust Solenoid - short circuit	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Exhaust Solenoid - short V Bat	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Hold Solenoid - open circuit	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Hold Solenoid - short circuit	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Hold Solenoid - short V Bat	0	4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available

(1) Strike out what is not applicable.

Failure	Vehicle Speed (km/h)	System Config.	Failure Affect	Fault Indication	Pass	Notes
ISO 7638 Failures (No stop lamp connection)						
Pin 1 Open circuit	Any	4S/3M	System shut down	Yellow + red	✓	No ABS function Pneumatic system available
Pin 2 Open circuit	Any	4S/3M	System shut down	Yellow + red	✓	No ABS function Pneumatic system available
Pin 3 Open circuit	Any	4S/3M	System shut down	Yellow + red	✓	No ABS function Pneumatic system available
Pin 4 Open circuit	Any	4S/3M	System shut down	Yellow + red	✓	No ABS function Pneumatic system available
Pin 5 Open circuit	Any	4S/3M	ABS available	No warning at power up	✓	Fault indicated by the absence of the yellow warning signal at power up.
Warning Lamp Sequences						
No fault present	0	4S/3M	ABS available	Check lamp sequence	✓	Warning lamp illuminates and is extinguished after verification check.
Static fault	0	4S/3M	System shut down	Check lamp sequence	✓	Permanent warning signal at system power up.
Dynamic fault	Any	4S/3M	System shut down	Check lamp sequence	✓	Permanent warning signal after detection of fault.
		4S/3M	System shut down	Yellow warning	✓	No ABS function Pneumatic system available
Verification of Modulator Energisation at System Power Up						
No fault present	0	2S/1M	-	Normal lamp sequence	✓	Sequencial energisation of solenoids at power up. If the brakes are applied prior to power up air will be exhausted during solenoid energisation.

(1) Strike out what is not applicable.

Failure	Vehicle Speed (km/h)	System Config.	Failure Affect	Fault Indication	Pass	Notes
Failures within Auxilary Functions)						
Open circuit Auxilary output	0	4S/3M	None	Continuous warning signal	✓	Auxilary output configured with sensor for axle load.If the failure is recognised, the load sensing is set in the laden position, 1:1.
Open circuit Auxilary output + static ABS falt	0	4S/3M	System shut down	Continuous warning signal	✓	Auxilary output open circuit and exhaust solenoid open circuit the yellow warning signal is illuminated permanently- no flashing as prescribed ABS fault has priority. Normal braking function without ABS
Open circuit Auxilary output	> 20	4S/3M	None	No fault indication	✓	ABS control available . No warning signal transmitted
Open circuit Auxilary output	0 - 20	4S/3M	None	No fault indication	✓	ABS control available . No warning signal transmitted
Verification of Modulator Energisation at System Power Up						
No fault present	0	4S/3M	None	Normal lamp sequence	✓	Sequencial energisation of solenoids at power up. If the brakes are applied prior to power up air will be exhausted during solenoid energisation.

(1) Strike out what is not applicable.

Vehicle specifications:					
Make	RENDERS		Type	Test vehicle	
~~Nat./EC~~/ECE (1)			Category	O4	
VIN	YA5B30ID636S51446				
Test carried out by	W. Hartman				
Place	Jeversen (WABCO)		Date	10-01-2007	
Road-surface	Asphalt		Weather conditions	Dry	
Wind force	-	m/s	Wind direction	-	
Barometric pressure	-	mbar	Temperature	-	°C
Humidity	-	%	Remarks	-	
Static measurements:					
Maximum allowed weights (mass):			Weights ~~laden/unladen~~ (1) including - persons.		
king pin	12.000	kg	Axle 1 tractor	5.536	kg
Axle 1	9.000	kg	Axle 2 tractor	3.838	kg
Axle 2	9.000	kg	Axle 3	1.962	kg
Axle 3	9.000	kg	Axle 4	1.982	kg
Axle 4		kg	Axle 5	2.150	kg
Total	39.000	kg	Total	15.528	kg
Tyre size(s)	385/65 R22,5				
Tyre pressure	9.0	bar	Load Index	160K	
Brake cylinders			Brake levers		
Axle number 1	24	inch	Axle number 1	127	mm
Axle number 2	24	inch	Axle number 2	127	mm
Axle number 3	24	inch	Axle number 3	127	mm
Make and type	Renders		Wheelbase (E_r)	8.100	mm
Axles:					
Make and type	SAF SKRS 9042		Code	TDB 0381	
Brakes:					
Make and type	SAF 4218-11S		Lining make and type	Bremskerl 6386	
Bogie:					
Make and type	SAF air		Security cable	~~Agreed/not agreed~~/N.A. (1)	
Tyres:					
Tyre size	385/65 R22,5				
Suspension:					
Type	~~Mechanical/~~pneumatic (1)				
Make	SAF				
Dimensions	Air suspension				

(1) Strike out what is not applicable.

ABS test of semi trailer:

- $V_{initial}$ = 50 km/h
- ABS in operation
- Condition of the vehicle: unladen

Annex XIV section 6.2. (Appendix 2 ad 2.2.and 2.3)

Kd = dry asphalt

Braking test	EBS "D "			EBS "E "		
	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number
number 1	See diagr	2,365	ReD2_3AU.at2	See diagr	1,995	Re2S_3AU.at2
number 2	See diagr	2,388	ReD2_3AU.at3	See diagr	2,070	Re2S_3AU.at3
number 3	See diagr	2,440	ReD2_3AU.at4	See diagr	2,161	Re2S_3AU.at4
t_{min} =	2,36			1,99		
t_m or t_{min} = (1)	2,39			2,07		
deviation	14,4 %					

Kn = wet asphalt

Braking test	EBS "D "			EBS "E "		
	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number
number 1	See diagr	3,304	ReD2_3AU.an3	See diagr	3,625	Re2S_3AU.an1
number 2	See diagr	3,348	ReD2_3AU.an2	See diagr	3,650	Re2S_3AU.an2
number 3	See diagr	3,328	ReD2_3AU.an6	See diagr	3,692	Re2S_3AU.an3
t_{min} =	3,30			3,62		
t_m or t_{min} = (1)	3,32			3,65		
deviation	- 9 %					

(1) Mean value of three values within t_{min} and 1,05 x t_{min} or t_{min} (see Appendix 2, item 2.1.3.2.)
(2) z_{Cmax} in m/s^2 / 9,81.

P total mass of individual vehicle in kg.
g acceleration due to gravity (9,81 m/s^2).
F static load on axle (kg).
h_K height of kingpin.
h_R height of centre of gravity of the trailer.
E_R wheelbase.
F_M total static load of towing motor vehicle.
F_R total static load of the trailer.

k shall be calculated in three digits accuracy.

Kl = 0,3 blau basalt						
Braking test	EBS "D "			EBS "E "		
	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number
number 1	See diagr	10,473	ReD2_3AU.bb1	See diagr	12,765	Re2S_3AU.bb1
number 2	See diagr	10,754	ReD2_3AU.bb1	See diagr	12,693	Re2S_3AU.bb2
number 3	See diagr	10,759	ReD2_3AU.bb1	See diagr	12,689	Re2S_3AU.bb3
t_{min} =	10,47			12,68		
t_m or t_{min} = (1)	10,66			12,71		
deviation	- 16 %					
Kh/l = Basalt/ wet asphalt						
Braking test	EBS "D "			EBS "E "		
	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number	$V_{initial}$ (km/h)	t_{40-20} (sec.)	Diagram number
number 1	See diagr	4,897	ReD2_3AU.sp1	See diagr	5,430	Re2S_3AU.sp1
number 2	See diagr	4,933	ReD2_3AU.bb2	See diagr	5,554	Re2S_3AU.sp2
number 3	See diagr	5,038	ReD2_3AU.bb4	See diagr	5,575	Re2S_3AU.sp3
t_{min} =	4,89			5,430		
t_m or t_{min} = (1)	4,95			5,51		
deviation	- 10.1%					

(1) Mean value of three values within t_{min} and 1,05 x t_{min} or t_{min} (see Appendix 2, item 2.1.3.2.)
(2) z_{Cmax} in m/s^2 / 9,81.

P total mass of individual vehicle in kg.
g acceleration due to gravity (9,81 m/s^2).
F static load on axle (kg).
h_K height of kingpin.
h_R height of centre of gravity of the trailer.
E_R wheelbase.
F_M total static load of towing motor vehicle.
F_R total static load of the trailer.

k shall be calculated in three digits accuracy.

ABS test, energy consumption k > 0,5. EBS "D "

- V = minimum 30 km/h
- capacity of reservoirs: 80 dm^3
- ABS in operation
- Condition of the vehicle: unladen with LSD set to the laden position.
- Initial energy level in the energy storage device shall be 8,0 bar.

Annex X section 6.1.

V_{max} = km/h

- t = 15 seconds
- Maximum pressure stated by manufacturer : 8,0 Bar
- Pressure of the reservoir before braking : 8,0 Bar

Speed (km/h)	Braking time (s)	Diagram number
See Diagram	15 sec	ReD2_3AU.LV1

- Pressure in the reservoir after 15 seconds = 5,41 bar

- Pressure in the reservoir after 4 times fully actuating the brakes (at standing position):

	Front axle (bar)	Rear axle (bar)	Air reservoir (bar)
number 1	-	-	5,41
number 2	-	-	5,03
number 3	-	-	4,72
number 4	-	-	4,43
number 5	-	-	4,16

- Pressure necessary for secondary braking: 3,0 Bar

Static energy consumption test according to Annex XIV section 6.2

$P1_{(bar)}$	$P_{2(bar)}$	$P_{3(bar)}$	$P_{4(bar)}$	$P_{5(bar)}$	$P_{6(bar)}$	$P_{7(bar)}$	$P_{8(bar)}$	$P_{9(bar)}$	$P_{10(bar)}$
8,0	7,49	7,04	6,61	6,2	5,88	5,58	5,29	5,01	4,74

$P_{11(bar)}$	$P_{12(bar)}$	$P_{13(bar)}$	$P_{14(bar)}$	$P_{15(bar)}$	$P_{16(bar)}$	$P_{17(bar)}$	$P_{18(bar)}$	$P_{19(bar)}$	$P_{20(bar)}$
4,52	4,30	4,10	3,91	3,71	3,53	3,35	3,19	3,05	2,90

Remarks : Energy consumption test after 16 fullstroke applications = 2,95 bar

ABS test, energy consumption k > 0,5. EBS "E "

- V = minimum 30 km/h
- capacity of reservoirs: 80 dm^3
- ABS in operation
- Condition of the vehicle: unladen with LSD set to the laden position.
- Initial energy level in the energy storage device shall be 8,0 bar.

Annex X section 6.1.

V_{max} = km/h

- t = 15 seconds

- Maximum pressure stated by manufacturer	:	8,0	bar
- Pressure of the reservoir before braking	:	8,0	bar

Speed (km/h)	Braking time (s)	Diagram number
See Diagram	15 sec	Re2S_3AU.LV1

- Pressure in the reservoir after 15 seconds = 5,58 bar

- Pressure in the reservoir after 4 times fully actuating the brakes (at standing position):

	Front axle (bar)	Rear axle (bar)	Air reservoir (bar)
number 1	-	-	5,58
number 2	-	-	5,22
number 3	-	-	4,91
number 4	-	-	4,62
number 5	-	-	4,40

- Pressure necessary for secondary braking: 3,0 Bar

Static energy consumption test according to Annex XIV section 6.2

$P1_{(bar)}$	$P_{2(bar)}$	$P_{3(bar)}$	$P_{4(bar)}$	$P_{5(bar)}$	$P_{6(bar)}$	$P_{7(bar)}$	$P_{8(bar)}$	$P_{9(bar)}$	$P_{10(bar)}$
8,0	7,51	7,09	6,71	6,36	6,06	5,78	5,52	5,28	5,05

$P_{11(bar)}$	$P_{12(bar)}$	$P_{13(bar)}$	$P_{14(bar)}$	$P_{15(bar)}$	$P_{16(bar)}$	$P_{17(bar)}$	$P_{18(bar)}$	$P_{19(bar)}$	$P_{20(bar)}$
4,83	4,64	4,45	4,27	4,11	3,94	3,80	3,65	3,51	3,38

Remarks : Energy consumption test after 16 fullstroke applications = 2,95 bar

Conclusion : The Wabco EBS "E "is equal or better in the Energysonsumption performance than the EBS'D'version

(1) Strike out what does not apply.
(2) $k_H \geq 0,5$ and $k_H/k_L \geq 2$ and ABS category A only!
(3) If $\varepsilon_H > 0,95$ use $\varepsilon_H = 0,95$.

4. General requirements.

4.1.	Is any electrical failure (supply, wiring) or sensor anomaly signalled to the driver by a specific optical warning signal?	: Yes/~~no~~
4.1.1.	Does the warning signal light up when the ABS-system is energised?	: Yes/~~no~~
	Does the warning signal only extinguish if none of the in 4.1. mentioned defects are present?	: Yes/~~no~~
4.1.2.	Does the static sensor check verify that a sensor was not functioning the last time that the vehicle was at a greater speed than 10 km/h? The warning signal may light up again while the vehicle is stationary, provided that it is extinguished before the vehicle reaches 10 km/h when no defect is present.	: Yes/~~no/N.A~~.
	Does the electrically controlled pneumatic modulator cycle at least once during the above mentioned verification phase?	: Yes/~~no/N.A~~.
4.4.	Does the electrical connection between the trailer and the towing vehicle conform to ISO Standard 7638-1985 or ISO/DIS Standard 7638-1996? (not for vehicles of category O1 and O2) The wiring specification of point 6.2 of ISO 7638-1985 or point 5.4. of ISO/DIS 7638-1996 for the trailer may only be reduced if the trailer is equipped with its own independent fuse. The rating of the fuse shall be such that the current rating of the conductors is not exceeded. With the exception of vehicles of categories N3 and O4, and until a uniform international standard has been agreed, the electrical connection between towing vehicles and trailers equipped with a 12 volt electrical system shall conform with DIN standard 72570, Part 4.	: Yes/~~no/N.A~~.
4.5.	Is the residual braking performance in the event of a defect in the anti-lock braking system (according to point 4.1. of this Annex) at least 80% of the laden prescribed performance for the service braking system?	: Yes/~~no~~
4.6.	Does the ABS system comply with the requirements laid down in 72/245/EEC (95/54/EC)?	: Yes/~~no~~
4.7.	Is there no manual device to disconnect the ABS or to change the control mode of the ABS? Only allowed on N2 and N3 OFF-ROAD vehicles under special conditions, see item 4.7.1. - 4.7.5. of Annex X.	: ~~Yes~~/no

- see also testreport RWTűV /EB 123.5 E

(1) Strike out what is not applicable.
Note: yes means ok, no means not ok.

USED TEST EQUIPMENT	
Description	**Registration number**
Scale	Wabco scale
Pressure meter	A_1230V/A_1251V/A_1229V/A_1249V/A_1250V A_1231V/A_1248V02/04/05
Speed measurement equipment	
Deceleration meter	GPS system (Quality system wabco)
Pedal-force meter	
Temperature meter	
Tyre-pressure meter	
Force measurement equipment	
Dynometer	
Time measurement test equipment	
Angle meter	
Reaction-time measurement test equipment	Wabco CTU
Engine revolutions meter	
Brake test bench	
Hydraulic parking-brake pull equipment	
Recorder	
Noise measurement test equipment	
Torque measurement test equipment	
Dynamic fatigue test equipment	
Length measurement equipment	
Amplifier	
Filter	
Remarks:	