

# Test Report 'CAN Router'

## Assessment outside the scope of ECE-Regulation No. 13

Approval Report No: **EB124\_CanRou\_0E**

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## 0. General

This report is only for technical information. The purpose of the assessment and tests described in this report is to give guidance for national type approvals which allow road trains with multiple trailers to be approved in their country.

In many countries where Regulation No. 13 is applied, vehicles are operated which include more than one towed vehicle. These may be in the form of a dolly plus a semi-trailer or two or three trailers. The current definition of an electric control line as specified in paragraph 2.24 of Regulation No. 13 limits the application of the electric control line between "power driven vehicle and trailer". This effectively prohibits the electric control line being used to connect one trailer and another which is an unnecessary design restriction. Therefore, it is currently proposed (see document ECE/TRANS/WP.29/GRRF/2009/6) to amend paragraph 2.24 to permit connection between any type of vehicle.

At the moment an international group of braking experts has started to discuss which requirements of ECE-Regulation No. 13 should be amended and which requirements should be added to ECE-R13 to cover also road trains with multiple trailers. Taking also into account the discussion of this group, this report gives an assessment which additional requirements a trailer which tows another trailer (in the following defined as '**towing trailer**') should fulfil. The guiding principle of the assessment in this report is to find adequate requirements for the towing trailer analogue to the towing motor vehicle.

In this assessment it is assumed that the brake control signal to the various individual trailers (in accordance with ISO 11992 up to 5) is transmitted via CAN Routers.

## 1. Identification

- 1.1 Manufacturer:** WABCO Vehicle Control Systems  
Am Lindener Hafen 21  
D - 30453 Hannover
- 1.2 System name:** **Trailer EBS E**

### 1.3 Scope of assessment

#### **CAN Router fitted to a towing trailer**

An ‘Electronic Function & Safety Assessment Test Report’ which covers the special provisions relating to electronic braking systems (EBS) for trailers with an electric control line and an electric control transmission is available under the TÜV NORD test report No. EB124.5E. This report assesses the ‘Trailer EBS E’ in conjunction with the fitment of **one or more CAN Routers** for a road train with more than one trailer.

## 2. General

### 2.1 CAN Router:

The CAN Router is a CAN-communication gateway and power distribution device installed on towing trailers (see also paragraphs 1 and 1.3 above and Appendix 1 to this report) to transmit the brake control signal to different ECUs. Thus, the CAN Router has two output ports for the CAN brake control signal:

- Pow. OUT port 1: Vehicle CAN bus
- Pow. OUT port 2: ISO 11992 CAN bus

The CAN Router communicates with

- The motor vehicle (via ISO 11992 data communication)
- The EBS system of the towing trailer (via vehicle CAN data bus)
- The EBS system of the towed trailer (via ISO 11992 data communication)

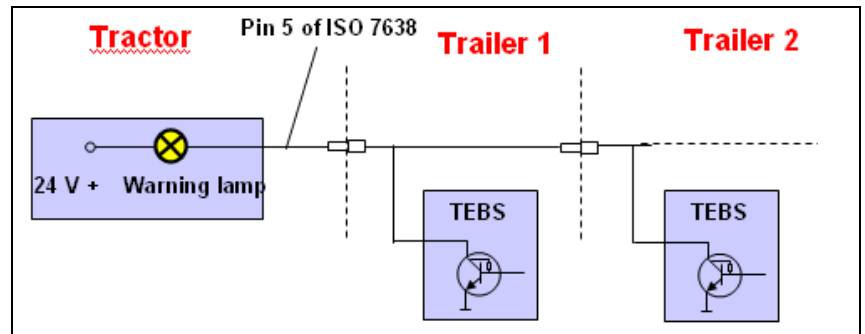
In contrast to the CAN Repeater, the CAN Router may change addresses and/or add new messages. The address routing of the messages is specified in ISO 11992-1. The CAN Router analyses the received data-packages regarding their destination address and blocks or transfers this data-packages.

### 2.2 ISO 7638 connection:

The electrical power supply (Pin 1, 2, 3, 4), warning signal (Pin 5) and CAN communication (Pin 6 and 7) via ISO 7638 connector are distributed to all trailers via the CAN Router(s).

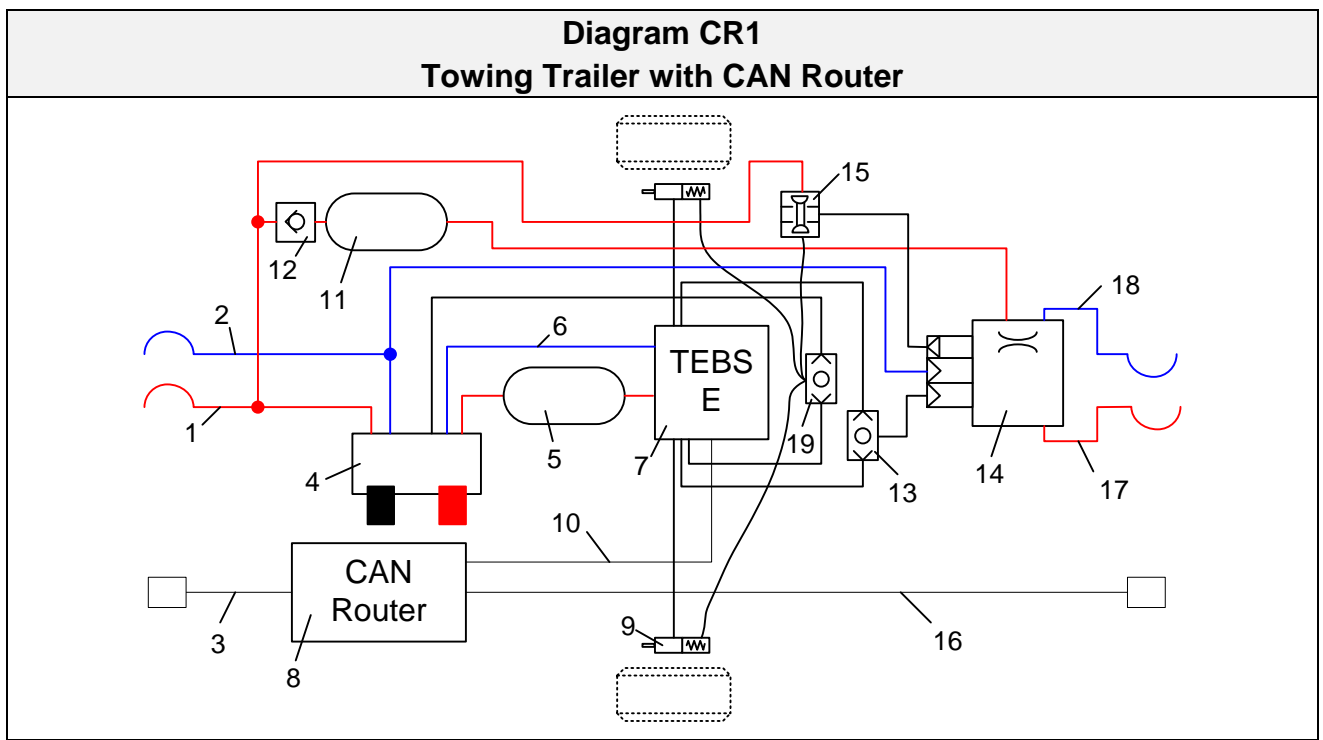
**2.2.1 Pin 5 signalling:**

Each individual trailer may switch on the warning signal (Pin 5) to the motor vehicle in case of a detected failure (independent whether this failure exists also on another trailer or not).



**2.3 System layouts:**

The following diagrams show the braking equipment and wiring of the trailers which is assessed in this report.



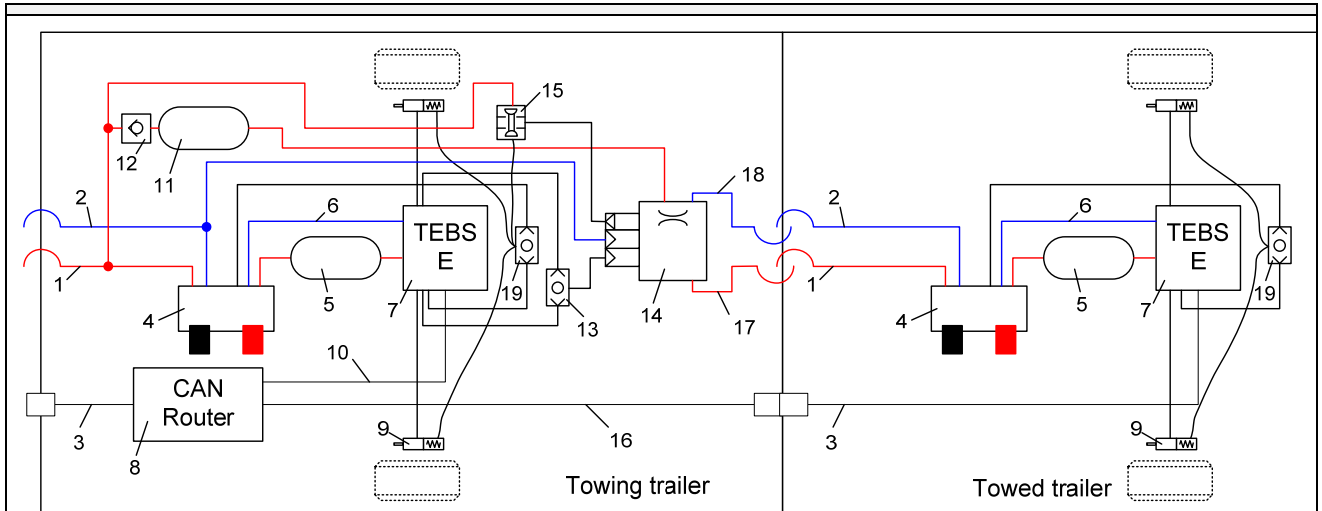
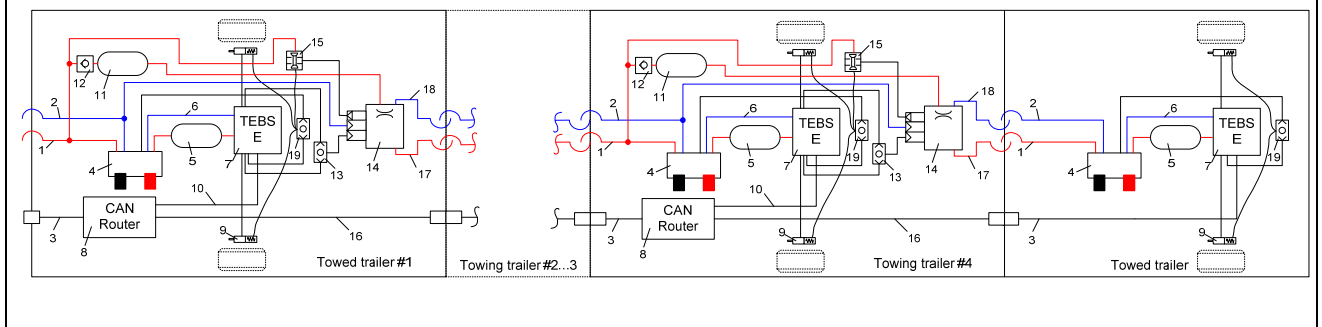


Diagram CR3

Road train with 5 trailers



Position	Name
1	Supply line (incoming)
2	Pneumatic supply line (incoming to PREV)
3	Electric control line (incoming)
4	Park release emergency valve
5	Air reservoir
6	Pneumatic control line (from PREV to TEBS E modulator)
7	Trailer EBS E (TEBS E) modulator
8	CAN Router
9	Spring brake cylinder
10	CAN control line
11	Air reservoir (for towing vehicle)
12	Check valve
13	Select high valve (to select higher brake pressure)
14	Trailer control valve
15	Select low valve

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Position	Name
16	Electric control line (outgoing)
17	Supply line (outgoing)
18	Pneumatic control line (outgoing)
19	Select high (anti-compound) valve

### 3 Synopsis of motor vehicle requirements which are also relevant for a trailer which tows another trailer

In the column "Proposed equivalent towing trailer requirement /notes" of the following table recommendations are given which are seen as adequate to mirror the corresponding motor vehicle requirements when the trailer is also a towing vehicle for a following trailer.

**The following table does not reflect requirements for single trailers which are not related to the special situation of a road train with multiple trailers.**

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Electric control line</b>			
R13/2.24	<p>"<u>Electric control line</u>" means the electrical connection between <b>two vehicles</b> which provides the braking control function to a <b>towed vehicle within a combination</b>. It comprises the electrical wiring and connector and includes the parts for data communication and the electrical energy supply for the trailer control transmission."</p>	<p>According to GRRF proposal ECE/TRANS/WP.29/GRRF/2009/6:  "<u>Electric control line</u>" means the electrical connection between <b>two vehicles</b> which provides the braking control function to a <b>towed vehicle within a combination</b>. It comprises the electrical ... for the trailer control transmission."</p>	<p>The current definition of the "<u>Electric control line</u>" effectively prohibits the electric control line being used to connect one trailer and another which is an <b><u>unnecessary design restriction</u></b>.</p> <p>The CAN-Router supports the full functionality of the electric control line as described in ISO 11992.</p> <p>In paragraph 4 of this report a detailed failure assessment is shown.</p>

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.1.3.6	The electric control line shall conform to ISO 11992-1 and 11992-2:2003 and be a point-to-point type.....	ISO 11992 covers already the concept of a control line between a towing vehicle which tows a succeeding vehicle (see ISO 11992-1, paragraph 3.3.	Under the assumption that the definition for the " <u>Electric control line</u> " (see paragraph 2.2.4) is extended to cover also the control line between trailers no amendment to R13/5.1.3.6 seems to be necessary.
R13/5.1.3.6.1	The functional compatibility ... by checking that the relevant provisions of ISO 11992:2003 parts 1 and 2 are fulfilled. Annex 17 of this Regulation provides an example of tests that may be used to perform this assessment.	n / a	Each individual trailer has to fulfil the relevant requirements of ECE R13, Annex 17.
R13/5.1.3.6.3	When a power-driven vehicle is equipped with an electric control line .... a continuous failure (> 40 ms) within the electric control line shall be detected in the power-driven vehicle and shall be signalled to the driver by the yellow warning signal ...	Analogue, the towing trailer shall also detect a continuous failure (> 40 ms) within the electric control line (received and transmitted signals) and indicate this failure by the yellow warning signal.	The yellow warning signal (Pin 5) of <b>each</b> trailer is transmitted to the motor-driven vehicle (see also paragraph 2.2.1 above).

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.1.3.2	The electric control line of the power-driven vehicle shall provide information as to whether the requirements of paragraph 5.2.1.18.2. can be satisfied by the electric control line, without assistance from the pneumatic control line. It shall also provide information as to whether it is equipped according to paragraph 5.1.3.1.2. with two control lines or according to paragraph 5.1.3.1.3. with only an electric control line.	n / a	Paragraph 5.2.1.18.2 requires that in the case of a circuit failure, it must still be possible to be capable of <b>partially or fully</b> actuating the brakes of the trailer by the non-failed circuit.  Each CAN Router transmits all messages which are communicated according to ISO 11992-2. Thus, each trailer receives this message.
R13/5.2.1.27.10	In the case of a failure in the electric control transmission of a trailer, electrically connected via an electric control line only, according to paragraph 5.1.3.1.3., braking of the trailer shall be ensured according to paragraph 5.2.1.18.4.1. This shall ... connected via an electric control line only, as described in paragraph 5.1.3.5.	n / a	In this test report the situation that the trailer is equipped with an <u>electric control line only</u> according to paragraph 5.1.3.1.3 (one pneumatic supply line and one electric control line) is <u>not considered</u> .  In the foreseeable future such trailers will not be built (e.g. necessity of a two-electrical circuit system).



ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Parking braking system</b>			
R13/5.1.2.3	The parking .... The driver shall be able to achieve this braking action from his driving seat, subject, in the case of a trailer, to the provisions of paragraph 5.2.2.10. of this Regulation. The trailer air brake and the parking braking system of the towing vehicle may be operated .....	Supported by pneumatic layout with trailer control valve. The brakes of all towed trailers will be released when the driver switches the parking valve in the test position	To check the performance the driver applies the parking brake in the towing vehicle and releases for testing the pneumatic control line.
R13/5.1.3.7	If the operation of the parking braking system on the power-driven vehicle also operates a braking system on the trailer, as permitted by paragraph 5.1.2.3., then the following additional requirements shall be met:	The operation of the parking braking system on the towing trailer shall also operate the braking system on the towed trailer.	See the various cases in the following paragraphs R13/5.1.3.7.1 to R13/5.1.3.7.3
R13/5.1.3.7.1	When the power-driven vehicle is equipped according to paragraph 5.1.3.1.1., the actuation of the parking brake system of the power-driven vehicle shall actuate a braking system on the trailer via the pneumatic control line.	The towing trailer shall act analogue to the power-driven vehicle.	The towing trailer has to be equipped with a trailer control valve (see e.g. in Appendix 2 the WABCO brake diagram 841 601 287 0, Pos. 23)  The pneumatic control line signal is transmitted from the towing trailer to the towed trailer via the trailer control valve.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.1.3.7.2	<p>When the power-driven vehicle is equipped according to paragraph 5.1.3.1.2., the actuation of the parking brake system on the power-driven vehicle shall actuate a braking system on the trailer as prescribed in paragraph 5.1.3.7.1. In addition, the actuation of the parking brake system may also actuate a braking system on the trailer via the electric control line.</p>	<p>The towing trailer shall act analogue to the power-driven vehicle.</p>	<p>The pneumatic control line signal is transmitted from the towing trailer to the towed trailer via the trailer control valve (see comment to paragraph R13/5.1.3.7.1 above). The option of actuation the parking brake system on the towed trailer via the electric control line is not supported by the Trailer EBS E.</p>



ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.1.3.7.3	<p>When the power-driven vehicle is equipped according to paragraph 5.1.3.1.3. .... shall actuate a braking system on the trailer via the electric control line. When the electrical energy for the braking equipment of the power-driven vehicle is switched off, the braking of the trailer shall be effected by evacuation of the supply line (in addition, the pneumatic control line may remain pressurized.....</p>	<p>In this test report the situation that the trailer is equipped according to paragraph 5.1.3.1.3 (one pneumatic supply line and one electric control line) is not considered.</p> <p>In the foreseeable future such trailers will not be built (e.g. necessity of a two-electrical circuit system).</p>	<p>Every towing trailer is equipped with a CAN Router (see Diagram CR3 in paragraph 2.3 above). Any actuation of the braking system on the towing trailer via the electric control line will also actuate the braking system on the towed trailer.</p> <p>Automatic braking of the first towing trailer by evacuation of the supply line of the tractor will also actuate the braking system on the towed trailer. This is ensured by controlling the inverse port of the trailer control valve by the supply line pressure from tractor.</p> <p>In Diagram CR1 in paragraph 2.3 above, Pos. 15), a select low valve is installed to give priority to the lowest pressure coming from the supply line and the feed line of the spring brake chamber Pos. 9).</p>

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
A4/2.3.2	<p>On vehicles to which the coupling of a trailer is authorized, the parking braking system of the towing vehicle shall be capable of holding the combination of vehicles stationary on a 12 per cent up or down-gradient.</p>	<p>Multiple trailers may only be coupled to a motor vehicle if the operation of the parking braking system on the power-driven vehicle also operates a braking system on the trailer (see also paragraph R13/5.1.3.7).</p> <p>The parking braking system of the towing vehicle shall also pressurize the pneumatic control line to ensure that the vehicle combination can be held on a 12 per cent up or down-gradient.</p>	<p>According to paragraph A4/2.3.2 two cases have to be considered to hold the combination of vehicles stationary on a 12 per cent up or down-gradient:</p> <ol style="list-style-type: none"> <li>1.) The motor vehicle is capable of holding the vehicle combination without the assistance of the braking system of the trailer</li> <li>2.) The motor vehicle is only capable of holding the vehicle combination with the assistance of the braking system of the trailer</li> </ol> <p>In the case of road trains with multiple trailers regarding first option 1.) it is assumed that this option cannot fulfil the requirement of paragraph A4/2.3.2.</p> <p>In order to comply with option 2.) the trailer air brake system has to operate simultaneously when the parking braking system of the towing vehicle is applied.</p> <p>The brake diagram 841 601 287 0 in Appendix 2 shows that a trailer control valve (see No. 23) is fitted which ensures that also the brakes of the towed trailers are applied.</p>



ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Types of interfaces - connections, for compressed-air braking systems</b>			
R13/5.1.3.	Connections, for compressed-air braking systems, between power-driven vehicles and trailers vehicles within a combination.		
R13/5.1.3.1.1	One pneumatic supply line and one pneumatic control line;	Not permissible on towing trailers	It is proposed to require towing trailers to be equipped at the forward and rear coupling heads and ISO 7638 connection according to 5.1.3.1.2 only.  Towing trailers with CAN-Router have always an electric control line.
R13/5.1.3.1.2	One pneumatic supply line, one pneumatic control line and one electric control line;	Ditto.	This type of interface is seen as the only acceptable solution.
R13/5.1.3.1.3	One pneumatic supply line and one electric control line; this option is subject to footnote 4/.	See also note to paragraph R13/5.1.3.7.3	It is currently prohibited for motor vehicle or trailer to be equipped with such a connection.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Recognition of incompatibility with an interface according to R13/5.1.3.1.1</b>			
R13/5.1.3.3	A power-driven vehicle equipped according to paragraph 5.1.3.1.3. shall recognize that the coupling of a trailer equipped according to paragraph 5.1.3.1.1. is not compatible. ....	n / a	<p>In the foreseeable future a trailer with an interface according to R13/5.1.3.1.3 will not be built (e.g. necessity of a two-electrical circuit system); see also note to paragraph R13/5.1.3.7.3.</p> <p>The recognition analogue the motor vehicle requirement R13/5.1.3.3 is not supported by the Trailer EBS E.</p>
<b>Requirements for vehicles equipped with two control lines as defined in paragraph 5.1.3.1.2. above</b>			
R13/5.1.3.4.	In the case of a power-driven vehicle when electrically connected to a trailer which is also equipped with two control lines the following provisions shall be fulfilled:		
R13/5.1.3.4.1.	both signals shall be present at the coupling head and the trailer shall use the electric control signal unless this signal is deemed to have failed. In this case the trailer shall automatically switch to the pneumatic control line;	Ditto.	The CAN-Router which is installed in any towing vehicle (see Diagram CR3 in paragraph 2.3 above) supports the full functionality of the electric control line as described in ISO 11992.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.1.3.4.3	when the electric control signal has exceeded the equivalent of 100 kPa for more than 1 second, the trailer shall verify that a pneumatic signal is present; should no pneumatic signal be present, the driver shall be warned from the trailer by the separate yellow warning signal specified in paragraph 5.2.1.29.2. below.	Ditto.	Irrespective of the kind of trailer (towing or towed) and the position of the trailer within a road train (first or last) the Trailer EBS E will give the required yellow warning signal. In critical cases it might be necessary to improve the response time of the pneumatic control line signal by using additional relay valves (booster valves) or other appropriate measures.



ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Failures within the connecting lines or the towed trailer braking system affecting the towing vehicle</b>			
R13/5.2.1.15	<p>In the case of a power-driven vehicle to which the coupling of a trailer equipped with a brake controlled by the driver of the towing vehicle is authorized, the service braking system of the towing vehicle shall be equipped with a device so designed that in the event of failure of the trailer's braking system, or in the event of an interruption in the air supply pipe (or of such other type of connection as may be adopted) between the towing vehicle and its trailer, it shall still be possible to brake the towing vehicle with the effectiveness prescribed for secondary braking; it is accordingly prescribed, in particular, that this device shall be situated on the towing vehicle.</p>	<p>Since there are no requirements for secondary braking performance for trailers it is <b>proposed</b> that in the case of trailers under the above described failure conditions the prescribed braking performance for the trailer has to be ensured.</p>	<p>In paragraph R13/5.2.1.15, the phrase “effectiveness prescribed for <b>secondary</b> braking” refers to the performance of the solo <b>motor</b> vehicle. Basically this requirement demands that any fault in the connecting lines or any failure of the trailer’s braking system cannot cause the performance of the service braking system to fall below the performance prescribed for secondary braking. In particular, a leak or break of the air supply pipe may not cause that the pressure of the service brake air reservoirs falls under a level where the prescribed secondary braking performance is not ensured.</p> <p>The brake diagram 841 601 287 0 in Appendix 2 shows that a failure as defined above does not affect the energy level of the trailer air reservoir Nr. 4. Thus, the prescribed service braking performance of the trailer is ensured.</p>





ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Failures within the connecting lines of towing vehicles and towed trailer</b>			
R13/5.2.1.18.	In the case of a vehicle authorized to tow a trailer of category O <sub>3</sub> or O <sub>4</sub> , its braking systems shall satisfy the following conditions:		
R13/5.2.1.18.1	when the towing vehicle's secondary braking system comes into action, there shall also be a graduated braking action in the trailer;	<u>In the case that a towing trailer can be braked</u> irrespective whether there is a fault or is not a fault in the trailer braking system it shall be possible to produce also a graduated braking action in the towed trailer.	<p>For the trailer a graduated braking action is also prescribed when the trailer is only braked by the secondary braking system of the motor vehicle. The secondary braking system may be the parking braking system or the non-failed circuit of a two-circuit brake system.</p> <p>A graduated braking action of the trailer is only possible by the electric or pneumatic control line.</p> <p>The brake diagram 841 601 287 0 in Appendix 2 shows that even under one of the following failure conditions:</p>

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
cont.			<ul style="list-style-type: none"> <li>- either air reservoir No. 4 or No. 24 is depleted</li> <li>- one control line fails (electric or pneumatic)</li> <li>- ISO 7638 power supply fails</li> <li>- any failure within the pneumatic energy transmission</li> </ul> the towed trailer can be braked.
R13/5.2.1.18.2	in the event of failure of the towing vehicle's service braking system, where that system consists of at least two independent parts, the part or parts not affected by the failure shall be capable of partially or fully actuating the brakes of the trailer. It shall be possible to graduate this braking action. If this operation is achieved by a valve which is normally at rest, then such a valve may only be incorporated if its correct functioning can easily be checked by the driver, either from within the cab or from outside of the vehicle, without the use of tools;		<b>n / a</b> The trailer has only a 1-circuit brake system.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.2.1.18.3	in the event of a failure (e.g. breakage or leak) in one of the pneumatic connecting lines, interruption or defect in the electric control line, it shall nevertheless be possible for the driver, fully or partially, to actuate the brakes of the trailer by means either of the service braking control or of the secondary braking control or of the parking braking control, unless the failure automatically causes the trailer to be braked with the performance prescribed in paragraph 3.3. of Annex 4 to this Regulation.	Ditto.	Since the interface (electric and pneumatic connecting lines) between motor vehicle and towing trailer are the same as between towing trailer and towed trailer the requirements of paragraph R13/5.2.1.18.3 are also fulfilled for any trailer within the road train.
R13/5.2.1.18.4	the automatic braking in paragraph 5.2.1.18.3. above shall be considered to be met when the following conditions are fulfilled:		
R13/5.2.1.18.4.1	when the designated brake control of those controls mentioned in paragraph 5.2.1.18.3. above, is fully actuated, the pressure in the supply line shall fall to 150 kPa within the following two seconds; in addition, when the brake control is released, the supply line shall be re-pressurized.	The towing trailer shall be equipped with a trailer control valve as it is commonly used in motor vehicles.	See also commentary to paragraph R13/5.2.1.18.3 The brake diagram 841 601 287 0 in Appendix 2 shows that a trailer control valve (see No. 23) is fitted.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
R13/5.2.1.18.4.2	when the supply line is evacuated at the rate of at least 100 kPa per second the automatic braking of the trailer shall start to operate before the pressure in the supply line falls to 200 kPa.	Ditto.	This requirement applies to any trailer (irrespective if it is a towing or towed trailer)
R13/5.2.1.18.5	in the event of a failure in one of the control lines connecting two vehicles equipped according to paragraph 5.1.3.1.2., the control line not affected by the failure shall automatically ensure the braking performance prescribed for the trailer in paragraph 3.1. of Annex 4.	Ditto.	This requirement applies to any trailer (irrespective if it is a towing or towed trailer)

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Prohibition of independent trailer brake</b>			
R13/5.2.1.21	<p>In the case of a power-driven vehicle authorized to tow a trailer of categories O<sub>3</sub> or O<sub>4</sub>, the service braking system of the trailer may only be operated in conjunction with the service, secondary or parking braking system of the towing vehicle. However, automatic application of the trailer brakes alone is permitted where the operation of the trailer brakes is initiated automatically by the towing vehicle for the sole purpose of vehicle stabilization.</p>	Ditto.	<p>Paragraph R13/5.2.1.21 forbids that the trailer brakes may be actuated alone (independent of the service, secondary or parking braking system of the towing vehicle) <b>except</b> when the trailer brakes are applied automatically by the towing vehicle for the sole purpose of vehicle stabilization.</p> <p>For a towing trailer paragraph R13/5.2.1.21 is always fulfilled.</p> <p>The trailer can not generate a brake control to the towed trailer independently of the service or parking braking system of the towing trailer.</p> <p>An automatic application of the brakes of the towing trailer causes also into a brake intervention of the towed trailers which is permissible.</p>

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Coupling Force Control</b>			
R13/5.2.1.28.1	Coupling force control shall only be permitted in the towing vehicle.	n / a	The Trailer EBS E with Router has no coupling force control capability. Thus, this legal option is not supported.
<b>Response time behaviour</b>			
A06/2.5	In the case of power-driven vehicles having a pneumatic control line for trailers, in addition to the requirements of paragraph 1.1. of this annex, the response time shall be measured at the extremity of a pipe 2.5 m long with an internal diameter of 13 mm which shall be joined to the coupling head of the control line of the service braking system.	<b>Towing trailers</b> having a pneumatic control line for <b>towed</b> trailers, in addition to the requirements of paragraph 1.1. of this annex, the response time shall be measured at the extremity of a pipe 2.5 m long with an internal diameter of 13 mm which shall be joined to the <b>rearmost</b> coupling head of the control line of the service braking system. During this test, a volume of $385 \pm 5 \text{ cm}^3$ (which is deemed to be equivalent to the volume of a pipe 2.5 m long with an internal diameter of 13 mm and under a pressure of 650 kPa) shall be connected to the coupling head of the supply line.	The proposal for towing trailers is made by analogy with the requirements for motor vehicles.



ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification						
cont.		<p><b>Towing trailers</b> for semi-trailers shall be equipped with flexible pipes for making the connection to semi-trailers. The coupling heads will, therefore, be at the extremity of those flexible pipes.</p>							
A06/2.6	<p>The time elapsing from the initiation of brake-pedal actuation to the moment when</p> <p>(a) the pressure measured at the coupling head of the pneumatic control line,</p> <p>(b) the digital demand value in the electric control line measured according to ISO 11992:2003</p> <p>reaches x per cent of its asymptotic, respectively final, value shall not exceed the times shown in the table below:</p> <table border="1"> <thead> <tr> <th>x [per cent]</th> <th>t [s]</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>0.2</td> </tr> <tr> <td>75</td> <td>0.4</td> </tr> </tbody> </table>	x [per cent]	t [s]	10	0.2	75	0.4	<p>For towing trailers with a pneumatic control line the time elapsing between the moment when the pressure produced in the front control line by the simulator reaches 65 kPa and the moment when the pressure at the rear coupling head of the towing trailer reaches 75 per cent of its asymptotic value shall not exceed 0.4 seconds.</p>	<p>It is proposed to measure the response time also at the rear coupling heads of towing trailers. The proposal for towing trailers is made by analogy with the requirements for motor vehicles.</p>
x [per cent]	t [s]								
10	0.2								
75	0.4								



ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
<b>Annex 7 – Capacity of Energy Storage Devices</b>			
A7_A/1.2.2.3	<p>In the case of power-driven vehicle to which the coupling of a trailer is authorized and with a pneumatic control line, the supply line shall be stopped and a compressed-air reservoir of 0.5 litre capacity shall be connected directly to the coupling head of the pneumatic control line. Before each braking operation, the pressure in this compressed-air reservoir shall be completely eliminated. After the test referred to in paragraph 1.2.1. above, the energy level supplied to the pneumatic control line shall not fall below a level equivalent to one-half the figure obtained at the first brake application.</p>	<p>In the case of towing trailers the test defined in paragraph 1.3.2 shall be carried out with rear supply line stopped and a compressed air reservoir of 0.5 litre capacity shall be connected directly to the rear coupling head of the pneumatic control line. Before each braking operation, the pressure in this compressed-air reservoir shall be completely eliminated. After the test referred to in paragraph 1.3.1, the energy level supplied to the rear pneumatic control line shall not fall below a level equivalent to one-half the figure obtained at the first brake application.</p>	<p>The proposal for towing trailers is made by analogy with the requirements for motor vehicles.</p>





ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification		
<b>Annex 16 – COMPATIBILITY BETWEEN TOWING VEHICLES AND TRAILERS WITH RESPECT TO ISO11992 DATA COMMUNICATIONS:</b>					
A16/2.1.1	Messages transmitted from the towing vehicle to the trailer:	Messages transmitted from the towing trailer to the towed trailer:	These messages shall be available at the rear ISO 7638 connector of the towing trailer to the succeeding trailer with the correct addresses according to ISO 11992.		
	<table border="1"> <tr> <td>Function / Parameter</td> <td>ISO 11992-2:2003 Reference</td> </tr> </table>	Function / Parameter		ISO 11992-2:2003 Reference	Ditto.
	Function / Parameter	ISO 11992-2:2003 Reference			
	<table border="1"> <tr> <td>Service/secondary brake demand value</td> <td>EBS11 Byte 3-4</td> </tr> </table>	Service/secondary brake demand value		EBS11 Byte 3-4	
	Service/secondary brake demand value	EBS11 Byte 3-4			
<table border="1"> <tr> <td>Two electrical circuits brake demand value</td> <td>EBS12 Byte 3 Bit 1-2</td> </tr> </table>	Two electrical circuits brake demand value	EBS12 Byte 3 Bit 1-2			
Two electrical circuits brake demand value	EBS12 Byte 3 Bit 1-2				
<table border="1"> <tr> <td>Pneumatic control line</td> <td>EBS12 Byte 3 Bit 5-6</td> </tr> </table>	Pneumatic control line	EBS12 Byte 3 Bit 5-6			
Pneumatic control line	EBS12 Byte 3 Bit 5-6				

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification														
A16/2.1.2	<p>Messages transmitted from the trailer to the towing vehicle:</p>	<p>Messages transmitted from the towed trailer to the towing trailer:</p>	<p>These messages shall be available at the front ISO 7638 connector of the towed trailer to the towing trailer with the correct addresses according to ISO 11992.</p>														
	<table border="1"> <thead> <tr> <th>Function / Parameter</th> <th>ISO 11992-2:2003 Reference</th> </tr> </thead> <tbody> <tr> <td>VDC Active / passive</td> <td>EBS21 Byte 2 Bit 1-2</td> </tr> <tr> <td>Vehicle electrical supply sufficient / insufficient</td> <td>EBS22 Byte 2 Bit 1-2</td> </tr> <tr> <td>Red warning signal request</td> <td>EBS22 Byte 2 Bit 3-4</td> </tr> <tr> <td>Supply line braking request</td> <td>EBS22 Byte 4 Bit 3-4</td> </tr> <tr> <td>Stop lamps request</td> <td>EBS22 Byte 4 Bit 5-6</td> </tr> <tr> <td>Vehicle pneumatic supply sufficient / insufficient</td> <td>EBS23 Byte 1 Bit 7-8</td> </tr> </tbody> </table>	Function / Parameter		ISO 11992-2:2003 Reference	VDC Active / passive	EBS21 Byte 2 Bit 1-2	Vehicle electrical supply sufficient / insufficient	EBS22 Byte 2 Bit 1-2	Red warning signal request	EBS22 Byte 2 Bit 3-4	Supply line braking request	EBS22 Byte 4 Bit 3-4	Stop lamps request	EBS22 Byte 4 Bit 5-6	Vehicle pneumatic supply sufficient / insufficient	EBS23 Byte 1 Bit 7-8	<p>Ditto.</p>
	Function / Parameter	ISO 11992-2:2003 Reference															
	VDC Active / passive	EBS21 Byte 2 Bit 1-2															
	Vehicle electrical supply sufficient / insufficient	EBS22 Byte 2 Bit 1-2															
	Red warning signal request	EBS22 Byte 2 Bit 3-4															
	Supply line braking request	EBS22 Byte 4 Bit 3-4															
	Stop lamps request	EBS22 Byte 4 Bit 5-6															
Vehicle pneumatic supply sufficient / insufficient	EBS23 Byte 1 Bit 7-8																

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification																	
<b>Annex 17 – Functional Compatibility of the Electric Control Line:</b>																				
A17/3.2.2.1.1	<p>The parameters defined in EBS 12 byte 3 of ISO 11992-2:2003 shall be checked against the specification of the vehicle as follows:</p> <table border="1"> <thead> <tr> <th rowspan="2">Control Line Signalling</th> <th colspan="2">EBS 12 Byte 3</th> </tr> <tr> <th>Bits 1-2</th> <th>Bits 5- 6</th> </tr> </thead> <tbody> <tr> <td>Service braking demand generated from one electrical circuit</td> <td style="text-align: center;">00<sub>b</sub></td> <td></td> </tr> <tr> <td>Service braking demand generated from two electrical circuits</td> <td style="text-align: center;">01<sub>b</sub></td> <td></td> </tr> <tr> <td>Vehicle is not equipped with a pneumatic control line <sup>1/</sup></td> <td></td> <td style="text-align: center;">00<sub>b</sub></td> </tr> <tr> <td>Vehicle is equipped with a pneumatic control line</td> <td></td> <td style="text-align: center;">01<sub>b</sub></td> </tr> </tbody> </table>	Control Line Signalling	EBS 12 Byte 3		Bits 1-2	Bits 5- 6	Service braking demand generated from one electrical circuit	00 <sub>b</sub>		Service braking demand generated from two electrical circuits	01 <sub>b</sub>		Vehicle is not equipped with a pneumatic control line <sup>1/</sup>		00 <sub>b</sub>	Vehicle is equipped with a pneumatic control line		01 <sub>b</sub>	Ditto.	<p>TEBS-E for towing trailers supports only connections according to 5.1.3.1.2 (e.g., see also paragraphs R13/5.1.3.7.3 and R13/5.2.1.27.10).</p> <p>These messages shall be checked at the rear ISO 7638 connector of the towing trailer.</p>
Control Line Signalling	EBS 12 Byte 3																			
	Bits 1-2	Bits 5- 6																		
Service braking demand generated from one electrical circuit	00 <sub>b</sub>																			
Service braking demand generated from two electrical circuits	01 <sub>b</sub>																			
Vehicle is not equipped with a pneumatic control line <sup>1/</sup>		00 <sub>b</sub>																		
Vehicle is equipped with a pneumatic control line		01 <sub>b</sub>																		

<sup>1/</sup> This specification of vehicle is prohibited by footnote <sup>4/</sup> to paragraph 5.1.3.1.3. of this Regulation.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification												
A17/3.2.2.2.1	<p>The parameters defined in EBS 11 of ISO 11992-2:2003 shall be checked as follows:</p> <table border="1"> <thead> <tr> <th>Test condition</th> <th>Byte reference</th> <th>Electrical control line signal value</th> </tr> </thead> <tbody> <tr> <td>Service brake pedal and secondary brake control released</td> <td>3 - 4</td> <td>0</td> </tr> <tr> <td>Service brake pedal fully applied</td> <td>3 - 4</td> <td>33280<sub>d</sub> to 43520<sub>d</sub> (650 to 850 kPa)</td> </tr> <tr> <td>Secondary brake fully applied <sup>2/</sup></td> <td>3 - 4</td> <td>33280<sub>d</sub> to 43520<sub>d</sub> (650 to 850 kPa)</td> </tr> </tbody> </table>	Test condition	Byte reference	Electrical control line signal value	Service brake pedal and secondary brake control released	3 - 4	0	Service brake pedal fully applied	3 - 4	33280 <sub>d</sub> to 43520 <sub>d</sub> (650 to 850 kPa)	Secondary brake fully applied <sup>2/</sup>	3 - 4	33280 <sub>d</sub> to 43520 <sub>d</sub> (650 to 850 kPa)	Ditto.	These messages shall be checked at the rear ISO 7638 connector of the towing trailer.
Test condition	Byte reference	Electrical control line signal value													
Service brake pedal and secondary brake control released	3 - 4	0													
Service brake pedal fully applied	3 - 4	33280 <sub>d</sub> to 43520 <sub>d</sub> (650 to 850 kPa)													
Secondary brake fully applied <sup>2/</sup>	3 - 4	33280 <sub>d</sub> to 43520 <sub>d</sub> (650 to 850 kPa)													

<sup>2/</sup> Optional on towing vehicles with electric and pneumatic control lines when the pneumatic control line fulfils the relevant requirements for secondary braking.

ECE-13	Current R13 requirement	Proposed equivalent towing trailer requirement / notes	Comment / Justification
A17/3.2.2.3	<b>Failure warning:</b>		
A17/3.2.2.3.1	Simulate a permanent failure in the communication line to pin 6 of the ISO 7638 connector and check that the yellow warning signal specified in paragraph 5.2.1.29.1.2. of this Regulation is displayed.	Simulate in the towing trailer a permanent failure in the communication line to pin 6 of the rear ISO 7638 connector and check that the yellow warning signal (pin 5) is transmitted to the preceding vehicle.	See also section 4 of this document (failure No. 6 in 'Table 4.2 Failure Matrix'.
A17/3.2.2.3.2	Simulate a permanent failure in the communication line to pin 7 of the ISO 7638 connector and check that the yellow warning signal specified in paragraph 5.2.1.29.1.2. of this Regulation is displayed.	Simulate in the towing trailer a permanent failure in the communication line to pin 7 of the rear ISO 7638 connector and check that the yellow warning signal (pin 5) is transmitted to the preceding vehicle.	See also section 4 of this document (failure No. 7 in 'Table 4.2 Failure Matrix'.
A17/3.2.2.3.3	Simulate message EBS 22, byte 2 with bits 3-4 set to 01 <sub>b</sub> and check that the red warning signal specified in paragraph 5.2.1.29.1.1. of this Regulation is displayed.	Simulate message EBS 22 Byte 2, Bits 3-4 set to 01 <sub>b</sub> (red warning signal request) at the rear ISO 7638 connector and check at the front ISO 7638 connector that this message is transmitted to the preceding vehicle..	See also section 4 of this document (failure No. 8 in 'Table 4.2 Failure Matrix'.

#### 4 Failure simulation

In the following failures have been simulated for a road train with five individual trailers which are addressed in ECE-Regulation No. 13 for single trailers.

The “Failure Matrix” of Table 4.2 shows various failure conditions which have been simulated in the five individual trailers of a road train. In particular, the failure assessment is concentrated on Pin 1 to Pin 7 failure conditions at the ISO 7638 interface.

By way of example, Table 4.3 ‘Warning behaviour – Comments to Table 4.2’ shows the warning messages and signals given in reaction to the simulated failures.

The used abbreviations in Table 4.2 and 4.3 are defined in Table 4.1.

<b>Table 4.1 Abbreviations used in Table 4.2 ‘Failure Matrix and Table 4.3 ‘Test Comments’</b>	
<b>Amb WR or AW</b>	“Amber warning signal request” sent by message EBS22 in byte 2, bits 5 – 6.
<b>Pin5 Warning</b>	X indicates that a Pin 5 (ISO 7638) warning signal was transmitted to the motor vehicle simulator. This signal can be generated by each trailer (Pin 5 of trailers A to E are hardwired connected between each other.)
<b>o/c failure</b>	open circuit failure
<b>Red WR or RW</b>	“Red warning signal request” sent by message EBS22 in byte 2, bits 3 – 4.
<b>RW1 / AW1</b>	refers to a “Red warning signal request” or an “Amber warning signal request” in EBS22 message (identifier 18 FE C4 C8 <sub>h</sub> ) sent by trailer A.
<b>RW2 / AW2</b>	refers to a “Red warning signal request” or an “Amber warning signal request” in EBS22 message (identifier 18 FE C4 C0 <sub>h</sub> ) sent by trailer B.
<b>RW3 / AW3</b>	refers to a “Red warning signal request” or an “Amber warning signal request” in EBS22 message (identifier 18 FE C4 B8 <sub>h</sub> ) sent by trailer C.
<b>RW4 / AW4</b>	refers to a “Red warning signal request” or an “Amber warning signal request” in EBS22 message (identifier 18 FE C4 B0 <sub>h</sub> ) sent by trailer D.
<b>RW5 / AW5</b>	refers to a “Red warning signal request” or an “Amber warning signal request” in EBS22 message (identifier 18 FE C4 A8 <sub>h</sub> ) sent by trailer E.
<b>X</b>	Directly simulated failure
<b>(X)</b>	Indirectly simulated failure (as a result of failure X)

Table 4.2 Failure Matrix

“X” indicates the location of the simulated failure described in the second column

“(X)” indicates that the simulated failure “X” causes the same effect on the following trailer

	Trailer ⇒ ↓ Failure	A	B	C	D	E
No.	<u>Front</u> connector	EBS #1	EBS #2	EBS #3	EBS #4	EBS #5
1	ISO 7638 o/c Pin 1	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
						X
2	ISO 7638 o/c Pin 2	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
						X
3	ISO 7638 o/c Pin 3	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
						X
4	ISO 7638 o/c Pin 4	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
						X

Table 4.2 Failure Matrix

“X” indicates the location of the simulated failure described in the second column

“(X)” indicates that the simulated failure “X” causes the same effect on the following trailer

	Trailer ⇒ ↓ Failure	A	B	C	D	E
No.	<u>Front</u> connector	EBS #1	EBS #2	EBS #3	EBS #4	EBS #5
5	ISO 7638 o/c Pin 5	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
						X
6	ISO 7638 o/c Pin 6	X				
			X			
				X		
					X	
						X
7	ISO 7638 o/c Pin 7	X				
			X			
				X		
					X	
						X
8	Permanent fail- ures according to Annex 17/4.2.2.2 see notes 8.1 and 8.2 in Table 4.3	X				
			X			
				X		
					X	
						X



Table 4.2 Failure Matrix

“X” indicates the location of the simulated failure described in the second column

“(X)” indicates that the simulated failure “X” causes the same effect on the following trailer

	Trailer ⇒ ↓ Failure	A	B	C	D	E
No.	<u>Front</u> connector	EBS #1	EBS #2	EBS #3	EBS #4	EBS #5
9	Low voltage Pin 1 & 2 (19 V to 18 V)	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
10	Low voltage Pin 1 & 2 (below 18 V)	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
11	Low voltage Pin 1 & 2 (below 16 V)	X	(X)	(X)	(X)	(X)
			X	(X)	(X)	(X)
				X	(X)	(X)
					X	(X)
12	Low system supply pres- sure warning 5.2.2.16	X				
			X			
				X		
					X	
					X	

Table 4.2 Failure Matrix

“X” indicates the location of the simulated failure described in the second column

“(X)” indicates that the simulated failure “X” causes the same effect on the following trailer

	Trailer ⇒ ↓ Failure	A	B	C	D	E
No.	<u>Front</u> connector	EBS #1	EBS #2	EBS #3	EBS #4	EBS #5
13	o/c wheel speed sensor	X				
			X			
				X		
					X	
						X
14	driver de- mand - pres- sure trans- ducer o/c	X				
			X			
				X		
					X	
						X
15	Axle load sensor (external) o/c	X				
			X			
				X		
					X	
						X

Table 4.3 'Warning behaviour – Comments to Table 4.2'

Case	Failure	Red WR [RW]	Amb WR [AW]	Pin5 Warning	Test observations / remarks
1A	ISO 7638 o/c Pin 1	RW1 RW2 RW3 RW4 RW5	AW1 AW2 AW3 AW4 AW5	yes	<u>Example for failure 1 of vehicle A</u> (X) means $\Rightarrow$ that the o/c failure X results also in failures (X), that means there is also no power supply via Pin 1 (clamp 30) to the succeeding trailers. Red WR and Amb WR are sent by all ECUs 1 to 5
1C	ISO 7638 o/c Pin 1	RW3 RW4 RW5	AW3 AW4 AW5	yes	<u>Example for failure 1 of vehicle C</u> (X) means $\Rightarrow$ that the o/c failure X results also in failures (X), that means there is also no power supply via Pin 1 (clamp 30) to the succeeding trailers. Red WR and Amb WR are sent by all ECUs 3 to 5.
2A	ISO 7638 o/c Pin 2	-	AW1 AW2 AW3 AW4 AW5	yes	<u>Example for failure 2 of vehicle A</u> (X) means $\Rightarrow$ that the o/c failure X results also in failures (X), that means there is also no power supply via Pin 2 (clamp 15) to the succeeding trailers. Amb WR are sent by all ECUs 1 to 5.
2E	ISO 7638 o/c Pin 2	-	AW5	yes	<u>Example for failure 2 of vehicle E</u> No power supply via Pin 2 (clamp 15) to trailer E. Amb WR are sent by ECU 5.
3A	ISO 7638 o/c Pin 3	-	AW1 AW2 AW3 AW4 AW5	yes	<u>Example for failure 3 of vehicle A</u> (X) means $\Rightarrow$ that the o/c failure X results also in failures (X), that means there is also no ground connection via Pin 3 (clamp 31) to the succeeding trailers. However, the yellow warning lamp signal via Pin 5 is transmitted because the failed ground connection via Pin 3 is replaced by the ground connection via Pin 4. Amb WR are sent by all ECUs 1 to 5.

Table 4.3 'Warning behaviour – Comments to Table 4.2'

Case	Failure	Red WR [RW]	Amb WR [AW]	Pin5 Warning	Test observations / remarks
3C	ISO 7638 o/c Pin 3	-	AW3 AW4 AW5	yes	<p><u>Example for failure 3 of vehicle C</u></p> <p>(X) means <math>\Rightarrow</math> that the o/c failure X results also in failures (X), that means there is also no ground connection via Pin 3 (clamp 31) to the succeeding trailers. However, the yellow warning lamp signal via Pin 5 is transmitted because the failed ground connection via Pin 3 is replaced by the ground connection via Pin 4.</p> <p>Amb WR are sent by all ECUs 3 to 5.</p>
4	ISO 7638 o/c Pin 4	-	-	yes	<p>(X) means <math>\Rightarrow</math> that the o/c failure X results also in failures (X), that means there is also no ground connection via Pin 4 (clamp 31) to the succeeding trailers. Since the ECU of these trailers are not electrically powered anymore no CAN messages can be sent by these trailers.</p>
5	ISO 7638 o/c Pin 5	-	-	no	<p>An o/c failure of Pin 5 'X' cannot be indicated to the motor vehicle.</p> <p>(X) means <math>\Rightarrow</math> that the o/c failure 'X' results also in failures (X) to the succeeding trailers since no "Pin 5" signal of these succeeding trailers can be transmitted to the preceding trailers and thus to the motor vehicle.</p>
6	ISO 7638 o/c Pin 6 Failed CAN High signal	-	AW*	yes	<p>In the case of this failure the CAN-communication between the towing (rear end connector) and the towed vehicle (front end connector) switches to 1-wire operation mode according to ISO11992 Part 1, paragraph 6.4.3.2. For the succeeding trailer the ECU generates again the CAN High signal. All other CAN-communications operate in the non failed 2-wire operation mode.</p> <p>* The "Amber warning signal request" message is only given from the two vehicles which are affected by the o/c failure.</p>

Table 4.3 'Warning behaviour – Comments to Table 4.2'

Case	Failure	Red WR [RW]	Amb WR [AW]	Pin5 Warning	Test observations / remarks
7	ISO 7638 o/c Pin 7 Failed CAN Low signal	-	AW*	yes	<p>In the case of this failure the CAN-communication between the towing (rear end connector) and the towed vehicle (front end connector) switches to 1-wire operation mode according to ISO11992 Part 1, paragraph 6.4.3.2. For the succeeding trailer the ECU generates again the CAN Low signal. All other CAN-communications operate in the non failed 2-wire operation mode.</p> <p>* The "Amber warning signal request" message is only given from the two vehicles which are affected by the o/c failure.</p>
8.1	<p>Pneum. &amp; electr. contr. line A17/4.2.2.2 Permanent failure within the electric control transmission which precludes the service braking performance being met</p>	RW*	AW*	yes	<p>Annex 17/4.2.2.2: A permanent failure within the electric control transmission, an electrical failure (o/c) was simulated by disconnecting the high side wire (+UB) of an inlet/outlet solenoid of the modulator. This failure caused a complete shut down of the pressure control circuit on the individual trailer where this failure was introduced with the consequence that the prescribed service braking performance could not be met. This failure is without consequence to the other trailers. Thus, the "Amber warning signal request" and the "red warning signal request" messages is only given from the trailer where the o/c failure had occurred.</p> <p>After recognizing this fault the ECU electrically isolates all solenoids and the system reverts to entirely pneumatic control (without sending the "supply line braking request" (byte 4, bits 3-4) of message EBS22, set to 01<sub>b</sub>).</p>

Table 4.3 'Warning behaviour – Comments to Table 4.2'

Case	Failure	Red WR [RW]	Amb WR [AW]	Pin5 Warning	Test observations / remarks
8.2	Electr. contr. line <u>only</u> A17/4.2.2.1.3 Permanent failure within the electric control transmission which precludes the service braking performance being met	RW*	AW*	yes	Annex 17/4.2.2.2: A permanent failure within the electric control transmission, an electrical failure (o/c) was simulated by disconnecting the high side wire (+UB) of an inlet/outlet solenoid of the modulator. This failure caused a complete shut down of the pressure control circuit on the individual trailer where this failure was introduced with the consequence that the prescribed service braking performance could not be met. This failure is without consequence to the other trailers. Thus, the “Amber warning signal request” and the “red warning signal request” messages is only given from the trailer where the o/c failure had occurred. In addition, the signal “ <u>Supply line braking request</u> ” (byte 4, bits 3-4) of message EBS22 was set to 01 <sub>b</sub> .
9	Low voltage Pin 1 & 2 (19 V to 18 V)	-	AW*	yes	* Since the low voltage condition is present on all trailers which succeed the trailer where this under voltage condition was simulated the Amb WR is sent by all ECUs which are effected by this failure condition. In addition, the CAN message EBS22 (Byte 2, bits 1-2) set to 01 <sub>b</sub> “Vehicle electrical supply <b>sufficient</b> ” is sent by these trailers
10	Low voltage Pin 1 & 2 (below 18 V)	RW*	AW*	yes	* Since the low voltage condition is present on all trailers which succeed the trailer where this under voltage condition was simulated the RW and Amb WR is sent by all ECUs which are effected by this failure condition. In addition, the CAN message EBS22 (Byte 2, bits 1-2) set to 00 <sub>b</sub> “Vehicle electrical supply <b>insufficient</b> ” is sent by these trailers
11	Low voltage Pin 1 & 2 (below 16 V)	RW*	AW*	yes	Warnings as in failure case 11 above In addition: - A software reset was carried out when the supply voltage reached a value of 21 V

Table 4.3 'Warning behaviour – Comments to Table 4.2'

Case	Failure	Red WR [RW]	Amb WR [AW]	Pin5 Warning	Test observations / remarks
12	Low system supply pressure warning	RW*	AW*	yes	* When the pressure in the air reservoir of an individual trailer was reduced below the nominated value of 450 kPa, only this individual trailer transmitted the red and yellow warning signals and the CAN message EBS23 (Byte 1, bits 7-8) set to 00 <sub>b</sub> "Vehicle pneumatic supply <b>insufficient</b> ".
13	Wheel speed sensor o/c	-	AW*	yes	* A wheel speed sensor on an individual trailer was disconnected from its TEBS E modulator. The failure was only indicated by the individual trailer, where the failure was introduced.
14A	Driver demand - pressure transducer o/c	RW*	AW*	yes	* The electrical power supply of an external demand pressure sensor on an individual trailer was disconnected to its TEBS E modulator. The failure was only indicated by the individual trailer, where the failure was introduced.
15	Axle load sensor (external) o/c	-	AW*	yes	* The electrical power supply of an external axle load sensor on an individual trailer was disconnected to its TEBS E modulator. The failure was only indicated by the individual trailer, where the failure was introduced.

## 5 Attached Documentation

- Appendix 1 "General Technical Information"

## 6 Further documents

The following documents relate to the basic Trailer EBS E system:

- TÜV NORD test report No. EB124.5E (including Electronic Safety Assessment Test Report which is the Appendix 1 of this report)
- Manufacturer's Information Document (Trailer Electronic Braking System Information Document ID\_EB124\_5E) of 29.04.2009

## 7 Conclusions

This test report is only for technical information.

For the assessed braking systems (see Diagrams CR1 to CR3 in paragraph 2.3 above) with the installation of a CAN Router into the braking system of “towing trailer(s)” in road trains with multiple trailers neither ECE-Regulation No. 13 contains the necessary relevant provisions nor is the current definition for the electric control line (see ECE-R13, paragraph 2.24) applicable to the control line between trailers since this definition limits the application of the electric control line only between the power driven vehicle and the trailer.

This report gives a technical assessment and shows/proposes additional towing trailer requirements to ECE-Regulation No. 13 which are seen as adequate to mirror the corresponding motor vehicle requirements when the trailer is also a towing vehicle for a following trailer.

Essen, 07<sup>th</sup> August 2009

TDB/Gaupp

Order-No. 08.1027

**TÜV NORD Mobilität GmbH & Co. KG**  
Institute for Vehicle Technology and  
Mobility (IFM)

Accredited by the accreditation authority of the Kraftfahrt-  
Bundesamt Bundesrepublik Deutschland - Federal Re-  
public of Germany - DAR-registration-number KBA-P  
00004-96

Technical Service for Braking Systems



Dipl.-Ing. Winfried Gaupp





## General Technical Information

### CAN Router

The CAN Router is a CAN- communication gateway and power distribution device for towing trailers. It communicates via the ISO 11992 data communication with the preceding vehicle (connector Power-In) and with the EBS system of the succeeding trailer (connector Power-OUT 2). It communicates via a proprietary data communication with the EBS system in the towing trailer (connector Power-OUT 1).

It supplies also the power for the EBS systems of the towing trailer and the succeeding trailer(s).

### Identification

CAN Router: 446 122 050 0  
446 122 052 0  
446 122 054 0

Software N

RR00.....-.....

Version-number for  
changing's which do  
not concern ECE R13

Version-number for changing's  
concerning ECE R13

### Identification:

- Name of software program: **RR000110**
- Software identification number: **246 122 071 2**

## WABCO CAN-Router 446 122 059 0

NAME / DENOMINAZIONE / BEZNAČENÍ	PRODUCT NUMBER / NUMERO DI PRODOTTO / ČÍSLO PRODUKTU	DATE OF MANUFACTURE / DATA DI FABBRICAZIONE / DATUM VÝROBY	DATE OF INSPECTION / DATA DI ISPEZIONE / DATUM KONTROLY	WABCO / STEUER / STÖDER CONNECTOR / SPINA POWER IN	WABCO / STEUER / STÖDER CONNECTOR / SPINA POWER OUT	WABCO / STEUER / STÖDER CONNECTOR / SPINA POWER OUT2	PLUG PRESSURE SENSOR CONNECTOR / SPINA SENSORE DI PRESSIONE
ROUTER CLASSIC	446 122 050 0	325.0		FEMALE	MALE	MALE	--
ROUTER	446 122 002 0	325.2		MALE	MALE	MALE	--
REFEATER CLASSIC	446 122 051 0	325.1		FEMALE	MALE	--	FEMALE
REFEATER	446 122 053 0	325.3		MALE	MALE	--	FEMALE

VIEW / ANSICHT / VISTA	DESIGNATION / BEZNAČENÍ / DESIGNAZIONE	CONNECTOR / STEUER / STÖDER CONNECTOR / CONNETTORE	PIN / KONTAKT / SPINA / PATA	NAME / NOME / NOM / CANAL
Z	POWER IN	A6 A1 A2 A3	2 3 4 5 6	WALA GND GND GND
X1	POWER OUT1	B1 B2 B3 B4 B5 B6 B7	1 2 3 4 5 6 7	WALA GND GND GND GND GND
X2	POWER OUT2	B1 B2 B3 B4 B5 B6 B7	1 2 3 4 5 6 7	WALA GND GND GND GND GND
Y	PRESSURE SENSOR	A1 A2	1 2	SENSOR IN SENSOR OUT

OPERATING TEMPERATURE / TEMPERATURA DI ESPOSIZIONE / TEMPERATURA DI SERRAGGIO	RESISTANCE TO AIR, WATER, MINERAL OIL, PETROL, DIESEL OIL, SALTS/SEAWATER / RESISTANZA A: AIR, WATER, MINERAL OIL, PETROL, DIESEL OIL, SALTS/SEAWATER / RESISTANZA A: LUFT, WASSER, MINERALÖL, BENZIN, DIESEL ÖL, SALZSEWASSER	STORAGE TEMPERATURE / TEMPERATURA DI STOCCAGGIO / TEMPERATURA DI AMMAGLIAMENTO	MAX. PERMISSIBLE OVERALL LENGTH / MAX. LUNGHEZZA CESSANTE / LUNGHEZZA TOTALE AMMISSIBILE MASS.
-40°C...+85°C	AIR, WATER, MINERAL OIL, PETROL, DIESEL OIL, SALTS/SEAWATER / AIR, LUFT, WASSER, MINERALÖL, BENZIN, DIESEL ÖL, SALZSEWASSER	-25°C...+85°C	< 18 m
		-25°C...+85°C	< 80 m
			< 15 m

WABCO / STEUER / STÖDER CONNECTOR / SPINA	REFEATER	ROUTER	ROUTER	ROUTER
446 122 059 0	446 122 002 0	446 122 050 0	446 122 002 0	446 122 053 0
449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0
449 235 000 0	449 235 000 0	449 235 000 0	449 235 000 0	449 235 000 0
449 347 000 0	449 347 000 0	449 347 000 0	449 347 000 0	449 347 000 0
449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0

WABCO / STEUER / STÖDER CONNECTOR / SPINA	REFEATER	ROUTER	ROUTER	ROUTER
446 122 059 0	446 122 002 0	446 122 050 0	446 122 002 0	446 122 053 0
449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0
449 235 000 0	449 235 000 0	449 235 000 0	449 235 000 0	449 235 000 0
449 347 000 0	449 347 000 0	449 347 000 0	449 347 000 0	449 347 000 0
449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0

WABCO / STEUER / STÖDER CONNECTOR / SPINA	REFEATER	ROUTER	ROUTER	ROUTER
446 122 059 0	446 122 002 0	446 122 050 0	446 122 002 0	446 122 053 0
449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0
449 235 000 0	449 235 000 0	449 235 000 0	449 235 000 0	449 235 000 0
449 347 000 0	449 347 000 0	449 347 000 0	449 347 000 0	449 347 000 0
449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0	449 135 000 0

## WABCO Brake Diagram 841 601 287 0

