# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 General Information</td>
<td>3</td>
</tr>
<tr>
<td>2 Introduction</td>
<td>6</td>
</tr>
<tr>
<td>2.1 Service Scope</td>
<td>8</td>
</tr>
<tr>
<td>2.2 General operating instructions</td>
<td>8</td>
</tr>
<tr>
<td>3 CTU concept</td>
<td>9</td>
</tr>
<tr>
<td>3.1 Basic package 446 310 010 0</td>
<td>10</td>
</tr>
<tr>
<td>3.2 “Towing vehicle” expansion package 446 310 013 0</td>
<td>11</td>
</tr>
<tr>
<td>3.3 “Trailer” expansion package 446 310 011 0</td>
<td>12</td>
</tr>
<tr>
<td>3.4 Description of components</td>
<td>13</td>
</tr>
<tr>
<td>4 Start-up</td>
<td>19</td>
</tr>
<tr>
<td>4.1 Connection to the computer</td>
<td>19</td>
</tr>
<tr>
<td>4.2 Connecting the basic package</td>
<td>20</td>
</tr>
<tr>
<td>4.3 Connecting the “Towing vehicle” expansion package</td>
<td>21</td>
</tr>
<tr>
<td>4.3.1 Performing the disconnection test (not required for solo vehicles)</td>
<td>22</td>
</tr>
<tr>
<td>4.3.2 Connecting the “Trailer” expansion package</td>
<td>23</td>
</tr>
<tr>
<td>4.4 Pressure sensor adjustment</td>
<td>25</td>
</tr>
<tr>
<td>4.5 Power supply</td>
<td>26</td>
</tr>
<tr>
<td>4.5.1 Power supply by means of a 24 V mains unit with a constant power supply</td>
<td>26</td>
</tr>
<tr>
<td>4.5.2 Power supply from the towing vehicle by means of an ISO 7638 port</td>
<td>27</td>
</tr>
<tr>
<td>4.5.3 Power supply from an adjustable mains unit by means of an ISO 7638 port</td>
<td>27</td>
</tr>
<tr>
<td>5 The measurement program</td>
<td>29</td>
</tr>
<tr>
<td>5.1 Start screen – Program module</td>
<td>29</td>
</tr>
<tr>
<td>5.1.1 Module 1: Time measurement for trailers with pneumatic brake line</td>
<td>29</td>
</tr>
<tr>
<td>5.1.2 Module 2: Time measurement for trailers with pneumatic and electrical brake line</td>
<td>29</td>
</tr>
<tr>
<td>5.1.3 Module 3: Testing the compatibility of a trailer with electrical brake line</td>
<td>29</td>
</tr>
<tr>
<td>5.1.4 Module 4: Time measurement for towing vehicles without trailer control</td>
<td>30</td>
</tr>
<tr>
<td>5.1.5 Module 5: Time measurement for towing vehicles with pneumatic trailer control</td>
<td>30</td>
</tr>
<tr>
<td>5.1.6 Module 6: Time measurement for towing vehicle with pneumatic electrical brake line</td>
<td>30</td>
</tr>
<tr>
<td>5.1.7 Module 7: Testing response to hose disconnection</td>
<td>31</td>
</tr>
<tr>
<td>5.1.8 Module 8: Compatibility of a towing vehicle with electrical trailer control</td>
<td>31</td>
</tr>
<tr>
<td>5.2 Further program modules</td>
<td>31</td>
</tr>
<tr>
<td>5.2.1 Menu item: ISO 11992</td>
<td>31</td>
</tr>
<tr>
<td>5.2.1.1 Display text blocks</td>
<td>31</td>
</tr>
<tr>
<td>5.2.1.2 Display data contents</td>
<td>32</td>
</tr>
<tr>
<td>5.2.1.3 Text block time behaviour</td>
<td>32</td>
</tr>
<tr>
<td>5.2.1.4 Bus loading</td>
<td>32</td>
</tr>
<tr>
<td>5.2.2 Menu item: Tools</td>
<td>32</td>
</tr>
<tr>
<td>5.2.2.1 Testing the CTU hardware</td>
<td>33</td>
</tr>
<tr>
<td>5.2.2.2 Adjust the simulator pressure sensors</td>
<td>33</td>
</tr>
<tr>
<td>5.2.2.3 Pneumatic testing of the simulator</td>
<td>33</td>
</tr>
<tr>
<td>5.2.2.4 Settings</td>
<td>34</td>
</tr>
<tr>
<td>5.2.3 Menu item: Trailer</td>
<td>34</td>
</tr>
<tr>
<td>5.2.3.1 Capacity test of the supply reservoirs</td>
<td>34</td>
</tr>
<tr>
<td>5.2.3.2 Additional capacity test of the supply reservoirs for vehicles equipped with ABS.</td>
<td>34</td>
</tr>
<tr>
<td>5.2.3.3 Testing in accordance with ISO 11992</td>
<td>35</td>
</tr>
<tr>
<td>5.2.3.4 Towing vehicle simulation</td>
<td>35</td>
</tr>
<tr>
<td>5.2.4 Menu item: Towing vehicle</td>
<td>35</td>
</tr>
<tr>
<td>5.2.4.1 Capacity test of the supply reservoirs</td>
<td>35</td>
</tr>
</tbody>
</table>
### Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.4.2 Testing in accordance with ISO 11992</td>
<td>35</td>
</tr>
<tr>
<td>5.2.4.3 Trailer simulation</td>
<td>36</td>
</tr>
<tr>
<td>5.2.5 Menu item: Help</td>
<td>36</td>
</tr>
<tr>
<td>6 Appendix</td>
<td>37</td>
</tr>
<tr>
<td>6.1 CAN messages</td>
<td>37</td>
</tr>
<tr>
<td>6.2 EC declaration of conformity</td>
<td>38</td>
</tr>
</tbody>
</table>

This publication is not subject to any update service.
You will find the current version on the internet at
http://www.wabco.info/i/142
1 General Information

List of abbreviations

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAN</td>
<td>(Controller Area Network); network for vehicle control systems</td>
</tr>
<tr>
<td>CTU</td>
<td>(Conformity Test Unit); measuring device for conformity tests</td>
</tr>
<tr>
<td>ECU</td>
<td>Electronic Control Unit</td>
</tr>
<tr>
<td>RGE</td>
<td>(Running Gear Equipment); wheel suspension system</td>
</tr>
</tbody>
</table>

Purpose of the document

This document addresses users of the CTU.

Copyright and trademark notice

The content, particularly technical information, descriptions and figures, corresponds to the state current at the time of printing and is subject to change without notice.

This document, including all its parts, in particular texts and figures, is protected by copyright. Use outside the statutory or contractual limits require authorisation by the copyright owner. All rights reserved.

Any brand names, even if not indicated as such, are subject to the rules of the trademark and labelling rights.

Symbols used

WARNING

Specifies a possible hazardous situation
Not observing the safety instruction can result in serious injuries or be lethal.

Follow the instructions in this warning to avoid any injuries.

CAUTION

Specifies possible material damage
Not observing the safety instruction can lead to material damage.

Follow the instructions in this warning to avoid any material damage.

Important instructions, information, or tips that you should always observe.

Reference to information on the Internet

– Action step
General Information

Consequence of an action

- List

Technical documents

- Open the WABCO INFORM online product catalogue:
  [http://inform.wabco-auto.com](http://inform.wabco-auto.com)
- Search for documents by entering the document number.

The WABCO online product catalogue INFORM provides you with convenient access to the complete technical documentation.

All documents are available in PDF format. Please contact your WABCO partner for printed versions.

Please note that the publications are not always available in all language versions.

<table>
<thead>
<tr>
<th>DOCUMENT TITLE</th>
<th>DOCUMENT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTU – Conformity Test Unit – System Description</td>
<td>815 XX0 109 3</td>
</tr>
</tbody>
</table>

*Language code XX: 01 = English, 02 = German, 03 = French, 04 = Spanish, 05 = Italian, 06 = Dutch, 07 = Swedish, 08 = Russian, 09 = Polish, 10 = Croatian, 11 = Romanian, 12 = Hungarian, 13 = Portuguese (Portugal), 14 = Turkish, 15 = Czech, 16 = Chinese, 17 = Korean, 18 = Japanese, 19 = Hebrew, 20 = Greek, 21 = Arabic, 24 = Danish, 25 = Lithuanian, 26 = Norwegian, 27 = Slovenian, 28 = Finnish, 29 = Estonian, 30 = Latvian, 31 = Bulgarian, 32 = Slovakian, 34 = Portuguese (Brazil), 35 = Macedonian, 36 = Albanian, 97 = German/English, 98 = multilingual, 99 = non-verbal.

Structure of the WABCO product number

WABCO product numbers consist of 10 digits.

- Production date
- Type of device
- Variant
- Status digit

0 = New device (complete device); 1 = New device (subassembly); 2 = Repair kit or subassembly; 4 = Component part; 7 = Replacement device; R = Reman

Choose genuine WABCO parts

Genuine WABCO parts are made of high quality materials and are rigorously tested before they leave our factories. You also have the assurance that the quality of every WABCO product is reinforced by a powerful customer service network.

Because WABCO, as a tier one supplier, works with the world’s leading Original Equipment Manufacturers, WABCO has the experience and scale to meet the most accurate production standards. The quality of every genuine WABCO part is supported by:
General Information

- Tooling made for serial production
- Regular sub-supplier audits
- Exhaustive end-of-line tests
- Quality standards below 50 PPM (parts per million defects)

**Installing copy parts can cost lives – genuine WABCO parts protect your business.**

WABCO additional services

The package you will get with a genuine WABCO part:

- 24 month product warranty
- Overnight delivery
- Technical support from WABCO
- Professional training solutions from the WABCO Academy
- Access to diagnostics tools and support from the WABCO Service Partner network
- Straightforward claims handling
- Plus, of course, the confidence that the Original Equipment Manufacturers’ rigorous quality standards are met.

WABCO service partner

WABCO Service Partners – the network you can rely on. You can access 2000 high quality workshops with more than 6000 specialist mechanics, all trained to WABCO’s exacting standards and equipped with our most up-to-the-minute systems diagnostic and support technology.

Your direct contact to WABCO

In addition to our online services, trained members of staff are there to help you at our WABCO Service Partners to directly answer any technical or business-related questions you may have.

Contact us if you need assistance:

- Find the right product
- Diagnosis support
- Training
- System support
- Order management

You can find your WABCO partner here:

2 Introduction

The CTU (Conformity Test Unit) is used for testing the requirements as described on the UNECE Regulation 13. Requirements up to and including the amendment 8 for the 11th amendment series of ECE R 13 are have been recorded.

The CTU replaces the time measurement unit and can be used for the following measurements:

- Test for sufficient capacity of the supply reservoirs on towing vehicles as well as on trailers
- Measurement of the threshold times on conventional and electronically controlled pneumatic braking systems on towing vehicles as well as trailers
- Compatibility of towing vehicle and trailer ports, pneumatic as well as electronic
- Test of the CAN data line and CAN data transmission
- Test of the CAN data

The last update of the CTU concerns an improved test of the towing vehicle reservoir capacity and a new capacity test for trailers.

---

2.1 Service Scope

This CTU can be used to carry out the following tests:

Tests on the towing vehicle

- Testing pressure increase behaviour on the least favourably positioned wheel brake cylinder on a vehicle with no trailer control system (ECE R 13 Annex 6 Item 2)
- Testing of pressure increase behaviour on the least favourably positioned wheel brake cylinder, and testing of pressure increase behaviour at the yellow coupling head for vehicles with pneumatic trailer control system (ECE R 13 Annex 6 Item 2)
- Testing of pressure increase behaviour on the least favourably positioned wheel brake cylinder, and testing of pressure increase behaviour at the yellow coupling head, as well as testing of signal behaviour at the ISO 7638 7-pole socket for vehicles with pneumatic and electronic trailer control system (ECE R 13 Annex 6 Item 2)
- Testing of pressure drop behaviour at the red coupling head in the event of a failure of the pneumatic control signal (disconnection behaviour) for vehicles with pneumatic trailer control system (ECE R 13 Annex 6 Item 2.7)
- Testing of the data transfer at the ISO 7638 electronic trailer port (ECE R 13 Annex 16)
- Electrical simulation of the trailer - Testing of reactions induced by means of CAN text blocks at the ISO 7638 electronic trailer port (ECE R 13 Annex 17 Item 3)
- Testing of supply pressure reservoir volume (ECE R 13 Annex 7 Item A.1.2)
Tests on the trailer

- Test of the response and pressure rise characteristics at the least favourably positioned wheel brake cylinder when a pneumatic control signal is input (ECE R 13 Annex 6 Item 3)
- Test of the response and pressure rise characteristics at the least favourably positioned wheel brake cylinder when a pneumatic and electronic control signal is input (ECE R 13 Annex 6 Item 3)
- Testing of the data transfer at the ISO 7638 electronic towing vehicle port (ECE R 13 Annex 16)
- Electrical simulation of the towing vehicle - Testing of reactions induced by means of CAN text blocks at the ISO 7638 electronic towing vehicle port (ECE R 13 Annex 17 Item 4)
- Testing of supply pressure reservoir volume (ECE R 13 Annex 7 Item A.1.3)
- Testing of supply pressure reservoir volume according to ECE R 13 Annex 20 Item 7.3

Tests on the "towing vehicle - trailer" data port

The exchange of digital information at the electrical connection between the towing and towed vehicle is covered in ISO 11992. The provisions therein have been partially transferred to ECE R 13 and must be verified. It must in particular be possible to perform the following tests:

- Search and display the text blocks arriving at the 7-pole socket
- Display the data content and repetition times of the arriving EBS text blocks
- Display of data bus utilisation

Testing of other special functions

Other special functions are primarily used for CTU self-verification. Calibration and control functions are combined. Specifically, they are:

- Calibration of the CTU hardware (ECE R 13 Annex 6 Item 3)
- Calibration of the simulator internal pressure sensors (ECE R 13 Annex 6 Item 3)
- Pneumatic verification of the simulator (ECE R 13 Annex 6 Item 3)
2.2 General operating instructions

Compliance with the following operational guidelines is required so as to ensure the trouble-free operation of the CTU.

CTU operation by qualified personnel

Although the actual measurement is performed with the support of the CTU software, the CTU must be operated by qualified personnel. Qualified personnel can for example include test engineers, automotive experts and senior personnel, as well as persons who have been trained on the measurement equipment by the aforementioned personnel, or by authorised WABCO service personnel.

Safety provisions

When working with the CTU, the relevant applicable safety provisions (e.g. securing the vehicle, occupational safety guidelines, etc.) must be complied with.

Maintenance

The CTU is maintenance free.

Calibration

Certain basic principles must be observed with regard to the calibration of the measurement recorders (e.g. pressure sensors). The measurement recorders are subject to the relevant applicable national calibration requirements.

The pressure sensors must be verified in a calibration laboratory. In the event that the pressure sensors do not comply with the set calibration limits, they must be replaced.

Testing the time measurement equipment

A note on the "Directive governing the use, characteristics and testing of time measurement devices for the determination of communication and reaction times for certain operating brakes of motor vehicles and trailers" to §41 of the Road Traffic Licensing Regulation: In Para 1 Sub-section 1.3, this directive refers to the need for routine testing and describes this further in Para 7 "Routine testing". The following meaningful excerpts are listed here:

- Routine tests shall be performed at intervals of 2 years at most.
- The test body shall issue a routine test certificate.
- The routine test shall compare a device to be tested with a normal device, who limit errors shall be defined in terms of Para 5.6 of the Directive.
3 CTU concept

In order to be properly equipped for the various possible uses of the CTU, the CTU is offered in three modules:

- Basic package 446 310 010 0
- “Towing vehicle” expansion package 446 310 013 0
- “Trailer” expansion package 446 310 011 0

This categorisation was decided upon in order to be able to meet the different requirements of technical services, towing vehicle manufacturers, trailer vehicle manufacturers and workshops.

Using the USB-RS232 adapter

The connection between the CTU-ECU and the computer is normally established by means of a serial data connection. The computer's 9-pole COM port is used for this.

Besides the COM port, the computer's USB port can also alternatively be used. A USB-RS232 adapter is used for this purpose. This adapter is also connected between the computer and the CTU-ECU.
3.1 Basic package 446 310 010 0

The basic package can be used to carry out tests on the ISO 7638 port.

The basic package enables the electronic verification of the towing vehicle / trailer ISO 7638 port (EBS socket) as well as a towing vehicle / trailer simulation. The basic package is accommodated in an accessories case and includes the basic electronic equipment for the performance and evaluation of investigations. The basic package also includes components which are required in both the towing vehicle and the trailer (pressure sensor for the least favourably positioned wheel brake cylinder including a pressure sensor cable as well as connector element for the wheel brake cylinder and hose to the red coupling head).

The mains unit and the power supply cable for the CTU and PC power supply do not form part of the scope of supply of the CTU.

The system requirements for the necessary PC are as follow:

- Standard PC with Windows operating system and COM port, or alternatively a USB adapter.

The measurement value recording equipment is – with the exception of components for wheel brake cylinder pressure measurement and the connector hose for the trailer supply pressure (red coupling head) – accommodated in the relevant expansion packages for towing vehicles and/or trailers.

The basic package consists of the following components:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;Test connection to pressure sensor adapter&quot; hose</td>
</tr>
<tr>
<td>2</td>
<td>Pressure sensor adapter</td>
</tr>
<tr>
<td>3</td>
<td>&quot;CTU to pressure sensor adapter&quot; cable</td>
</tr>
<tr>
<td>4</td>
<td>CTU</td>
</tr>
<tr>
<td>5</td>
<td>&quot;Red coupling head&quot; hose</td>
</tr>
<tr>
<td>6</td>
<td>&quot;ISO 7638 adapter to ECU&quot; cable</td>
</tr>
<tr>
<td>7</td>
<td>Insertion adapter</td>
</tr>
<tr>
<td>8a / 8b</td>
<td>Alternative: 8a USB-RS232 Adapter (+ USB stick) / 8b data transmission cable CTU to PC</td>
</tr>
</tbody>
</table>
Together with the basic package, this expansion package is particularly suitable for towing vehicle manufacturers, because with these, the CTU can for example be used for system verifications and optimisation.

The “Towing vehicle” expansion package comprises components for performing pressure flow time records and measurements on the towing vehicle.

The components of the “Towing vehicle” expansion package are installed in the accessories case if ordered.

The “Towing vehicle” expansion package consists of the following components:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pressure sensor adapter + “Red coupling head” pressure sensor (2x)</td>
</tr>
<tr>
<td>2</td>
<td>&quot;Yellow coupling head&quot; hose (together with yellow trailer connection coupling head)</td>
</tr>
<tr>
<td>3</td>
<td>Pressure sensor adapter + &quot;Yellow coupling head” pressure sensor</td>
</tr>
<tr>
<td>4</td>
<td>&quot;CTU to pressure sensor adapter&quot; cables (2x)</td>
</tr>
<tr>
<td>5</td>
<td>Treadle (double contactor)</td>
</tr>
<tr>
<td>6</td>
<td>Cable pull for treadle</td>
</tr>
<tr>
<td>7</td>
<td>Actuator for treadle</td>
</tr>
<tr>
<td>8</td>
<td>&quot;Test connection to pressure sensor adapter&quot; hose (2x)</td>
</tr>
<tr>
<td>9</td>
<td>500 ml test volume</td>
</tr>
</tbody>
</table>
Together with the basic package, the “Trailer” expansion package is particularly suitable for trailer manufacturers, because with these, the CTU can for example also be used for system verifications and optimisation.

The “trailer expansion” package comprises:

- the simulator for simulating the towing vehicle behaviour (in accordance with ECE R 13 attachment to Annex 6),
- ensures the pneumatic supply to the trailer vehicle
- generates suddenly occurring braking
- various cables
- components for trailer verification in accordance with ECE R 13
- for the compressed air supply to the reservoir from an in-house unit (or from a towing vehicle)

The measurement recorder components required for connecting to the wheel brake cylinder are provided in the basic package. The components of the “Trailer” expansion package are accommodated in the accessories case in which the simulator is located.

The “Trailer” expansion package consists of the following components:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simulator</td>
</tr>
<tr>
<td>2</td>
<td>Pressure sensor</td>
</tr>
<tr>
<td>3</td>
<td>Reservoir 30 litres</td>
</tr>
</tbody>
</table>

![Diagram of the “Trailer” expansion package]
3.4 Description of components

This table provides an overview of the individual components with their part number and brief description.

<table>
<thead>
<tr>
<th>PART NUMBER / ILLUSTRATION</th>
<th>COMPONENT / DESCRIPTION</th>
<th>BASIC PACKAGE</th>
<th>EXPANSION PACKAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>446 310 019 0</td>
<td>Case</td>
<td>446 310 010 0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>■ Component list for basic package and “Towing vehicle” expansion package.</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>446 310 000 0</td>
<td>CTU</td>
<td>446 310 013 0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>■ central control unit for the measurements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>446 310 022 0</td>
<td>USB stick</td>
<td>446 310 011 0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>■ with measuring software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>446 310 016 2</td>
<td>ISO 7638 adapter set</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>■ consisting of: ISO 7638 insertion adapter K1a 446 310 017 2, cable K1b 446 310 018 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ Plug adapter for ISO 7638 port including data transmission code and CTU power supply connector</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
### CTU Concept

<table>
<thead>
<tr>
<th>PART NUMBER / ILLUSTRATION</th>
<th>COMPONENT / DESCRIPTION</th>
<th>BASIC PACKAGE</th>
<th>EXPANSION PACKAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>446 310 010 0</td>
<td>446 310 013 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>446 310 011 0</td>
</tr>
<tr>
<td>446 310 021 2</td>
<td>Data transmission cable &quot;PC to CTU&quot;</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>446 310 014 4</td>
<td>USB-RS232 adapter</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adapter for establishing a data connection via the computer's USB port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>435 201 790 2</td>
<td>Actuator (435 201 790 2)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>435 201 410 2</td>
<td>consisting of: Hook with clamping device</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cable pull (435 201 410 2)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>consisting of: Steel cable with tension spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>446 310 015 2</td>
<td>Treadle</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triggering the measurement process in the towing vehicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>446 310 300 2</td>
<td>&quot;Pressure sensor to CTU&quot; connector cable</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>894 600 001 0</td>
<td>Pressure sensor</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Pressure measurement unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>893 600 021 0</td>
<td>Hose</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with yellow coupling head to connect the towing vehicle and pressure measurement point</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### CTU concept

<table>
<thead>
<tr>
<th>PART NUMBER / ILLUSTRATION</th>
<th>COMPONENT / DESCRIPTION</th>
<th>BASIC PACKAGE</th>
<th>EXPANSION PACKAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>893 600 022 0</td>
<td>Hose with red coupling head to connect the towing vehicle and pressure measurement point</td>
<td>446 310 010 0</td>
<td>446 310 013 0</td>
</tr>
<tr>
<td>893 600 024 0</td>
<td>Connector elements to connect the wheel brake cylinder and pressure measurement point</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>446 310 023 0</td>
<td>Simulator case Component list for the “Trailer” expansion package</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>446 310 025 2</td>
<td>Simulator Triggering the measurement process on the trailer and pneumatic towing vehicle simulation</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>446 310 024 2</td>
<td>“Simulator to CTU” data transmission cable</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>893 600 023 0</td>
<td>Hose with yellow coupling head to connect to the trailer</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>446 310 016 4</td>
<td>500 ml test volume for towing vehicle pressure container test</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Correct measurements can only be achieved if WABCO hoses are used. The use of non-certified hoses and cables can lead to incorrect measurements.

**Case 446 310 019 0**
The case can accommodate the components of the basic package 446 310 010 0 and the “Towing vehicle” expansion package 446 310 013 0.
If only basic package 446 310 010 0 is ordered, the relevant spaces for the components of the "Towing vehicle" expansion package remain empty.

**CTU 446 310 000 0**

The CTU is the central control unit for the measurements.

**USB-RS232 adapter 446 310 014 4**

The USB RS232 adapter can be used for PCs without a COM port.

**Insertion adapter 446 310 017 2**

The ISO 7638 insertion adapter is connected to the ISO 7638 connector/socket, depending on the design of the vehicle. This adapter provides access to the ISO 7638 port on the vehicle. The connections for the ISO 7638 plug connection are diverted to the laterally-mounted connector and connected to the CTU.

Together with the connected "ISO adapter power supply line" cable, the ISO 7638 insertion adapter comprises the ISO 7638 adapter set 446 310 016 2.

**Power supply cable ISO adapter 446 310 018 2**

The ISO adapter power supply line cable is connected to the laterally mounted connector and connects the ISO 7638 adapter with the CTU to enable data transfer. The cable also has an outlet with a coaxial socket - the CTU can thus be provided with power if needed, see chapter “4.5 Power supply” on page 26.

**“PC to CTU” data transmission cable 446 310 021 2**

The "PC to CTU" cable is connected to the CTU's RS232 socket and connects the CTU with the PC.

**Treadle 446 310 015 2**

The cable from the treadle (double contactor) is connected to the CTU's "Treadle" connector and connects the CTU with the double contactor on the treadle. The double contactor triggers the START and STOP signals for time measurement and disconnection testing on the towing vehicle.

**Actuator 435 201 790 2**

The actuator consists of a hook with clamping device. Together with cable pull 435 201 410 2 (steel cable with tension spring), this forms part of the “Towing vehicle” expansion package. The actuator and cable pull can be mounted on one side of the double contactor, on the other side of the steering wheel, and thus determine the actuation start and end points of the brake pedal.

**“Pressure sensor to CTU” data transmission cable 446 310 300 2**

The "Pressure sensor to CTU" cables are connected to connectors "Pressure sensor 1" to "Pressure sensor 3" and connect the CTU with the relevant pressure sensors.

**Pressure Sensor 894 600 001 0**

The pressure sensors 894 600 001 0 measure the pressure at the measurement points and are connected to the connector element 893 600 024 0 and/or the ends of the hoses 893 600 021 0 (to the yellow coupling head) and 893 600 022 0 (to the red coupling head). Each pressure sensor is connected to the CTU by means of a cable 446 310 300 2.

**Hose 893 600 021 0**

The hose has a dual function when used for towing vehicle or trailer measurements.
Measurements on towing vehicles: The hose is connected to the yellow coupling head of the towing vehicle. The yellow coupling head is of the same design as the one used on the trailer. There is a coupling at the other end of the hose, to which is connected the pressure sensor which is used to measure the braking pressure to the trailer control system. The hose has a volume of 385 ± 5cm³ and thus corresponds to the trailer’s dead volume, as required by ECE R 13.

Measurements on trailers: The hose is connected to the simulator’s "Air supply connection / Druckluftversorgung" connector. The simulator can now be supplied with compressed air via the coupling head.

**Hose 893 600 022 0**

The hose has a dual function when used for towing vehicle or trailer measurements.

Measurements on towing vehicles: The hose is connected to the red coupling head. There is a coupling at the other end of the hose, to which is connected the pressure sensor which is used to measure the supply pressure to the trailer control system.

Measurements on trailers: The hose provides the connection from the simulator’s supply pressure connector to the trailer’s red coupling head.

**Connecting element 893 600 024 0**

The connecting element is connected to the test connector of the least favourably positioned wheel brake cylinder. There is a coupling tip at the other end of the hose, to which is connected the pressure sensor which is used to measure the braking pressure in the wheel brake cylinder.

The connector piece can also be used to connect a pressure sensor adapter with a supply pressure reservoir.

**Case with simulator 446 310 023 0**

The simulator 446 310 025 2 forms a major part of the case, as this ensures pneumatic supply and control functions during measurements on trailer vehicles.

Further components of the case are the components of the “Trailer” expansion package 446 310 011 0.

The simulator container (30 litres) must be drained before each use.

**Simulator connector plate 446 310 025 2**

The CTU data and power supply connector 446 310 000 0 can be seen on the upper left-hand side. This port on the one hand enables the data exchange for controlling the simulator, and on the other, it ensures the power supply to the solenoid valves inside the simulator. The cable 446 310 024 2 from the CTU connector “simulator” is connected to this.

On the lower left, the "Coupling head, control line trailer / Kupplungskopf, Bremsleitung" connector is connected to hose 893 600 023 0, which leads to the trailer's yellow coupling head. This connection passes the braking pressure to the trailer's yellow coupling head.

On the upper right, the "Coupling head, supply line trailer / Kupplungskopf, Vorratsleitung" connector is connected to hose 893 600 022 0, which leads to the trailer's red coupling head. This connection passes the supply pressure to the trailer's red coupling head.

On the lower right can be seen the "Air supply connection / Druckluftversorgung" connector, which supplies the simulator with compressed air.
air. This can be achieved by means of an in-house plant or by means of a towing vehicle. Hose 893 600 021 0 can be used in the latter case, as it is here for example connected from the towing vehicle’s red coupling head.

“Simulator to CTU” data transmission cable 446 310 024 2
This cable connects the CTU (simulator connector) to the simulator.

Hose 893 600 023 0
The hose is connected to the trailer’s yellow coupling head. The yellow coupling head is of the same design as the one used on the towing vehicle. At the other end of the hose, there is a coupling tip to which the "Coupling head, control line trailer / Kupplungskopf, Bremsleitung" simulator input is connected; this is provided for the trailer control system.

USB-RS232 adapter 446 310 014 4
If the PC has no COM port, a connection can also be established using the computer’s USB port. A USB-RS232 adapter is used for this purpose.

500 ml test volume
The 500 ml test volume simulates the pneumatic control line of a connected trailer when measuring the volume of the towing pressure reservoir. The reservoir with the test volume is connected to the towing vehicle via a yellow coupling head during the measurement.
4 Start-up

The following tasks must be completed before performing the measurement:

– Connect the CTU to the PC, see chapter “4.1 Connection to the computer” on page 19.
– Start the PC.
– Supply the CTU with power, see chapter “4.5 Power supply” on page 26.
– Install and start the measurement program, see chapter “5 The measurement program” on page 29.
– Follow the measurement program instructions.

The measurement program supports the establishment of the measurement structure. Should any cabling/tubing/calibration be required during the measurement process, the user is provided with appropriate action instructions.

4.1 Connection to the computer

Connection via COM port

– Check whether your PC has a COM port.
– Connect the data cable between the CTU and the PC’s COM port.
– If your PC has no COM port, then proceed as described in the “Connection via USB port” section below.

Connection via USB port

– Connect the data cable to the COM port of the USB RS232 adapter.
– Connect the USB RS232 adapter to a free USB port on your computer.

Driver installation

– Insert the disk for the USB RS232 adapter into your PC’s DVD drive.
– Follow the instructions for the USB RS232 adapter in the enclosed user’s manual.

⇒ Once the installation is successfully completed, the port simulated by the adapter is shown in the operating system’s device manager.
### 4.2 Connecting the basic package

The cabling of the basic package essentially provides the basic electrical structure for all of the tests.

The CTU must – wherever possible – be wired together with the power supply, the PC, the measurement recorder and the actuators.

The corresponding connection names are marked on the CTU.

**Meaning of the connection designations**

- **24V**: Connection for the power supply, see chapter “4.5 Power supply” on page 26 – possible are: power supply line with cable “ISO 7638 adapter - ECU” 446 310 018 2
- **RS232**: Connects the data line to the PC RS232 port (cable 446 310 021 2) and/or to the USB RS232 adapter
- **ISO 7638**: Connects the data line from the ISO 7638 adapter (cable 446 310 018 2)
- **Simulator**: Connects the data line to the simulator (only required for measurements on trailers - cable 446 310 021 2 forms part of the scope of supply of the trailer expansion package)
- **Pressure sensors**: Connects the cable for the external pressure sensors (only required for measurements on towing vehicles or trailers – cables 446 310 300 2 form part of the scope of supply of the basic and towing vehicle expansion packages)
- **Treadle**: Connects the cable to the treadle (only required for measurements on towing vehicles - cable 446 310 015 2 forms part of the scope of supply of the towing vehicle expansion package).

When assembling the basic package, the CTU’s “24V”, “RS232” and “ISO 7638” connectors must be wired up.

**Plugging in the plug connection**

- Plug the ISO 7638 adapter on the ISO 7638 5- or 7-pole plug connection to the vehicle to be tested (towing vehicle or trailer).
- Lock the ISO 7638 adapter onto the ISO 7638 5- or 7-pole plug connection to the vehicle to be tested (towing vehicle or trailer). The other side of the ISO 7638 adapter can remain free, as long as this is not required for the power supply.
- Insert the bayonet connector of the cable “ISO 7638 Adapter – ECU” 446 310 018 2 into the side-mounted socket of the ISO 7638 adapter.

The basic package cabling is complete when no further towing vehicle or “Trailer” expansion package requires connection.

**Preparations for measurement**

- Switch on the CTU power supply.
- Start the measurement program on the PC.
- You can now perform the measurements which are possible with this set-up.
Connecting the “Towing vehicle” expansion package

When performing time measurements on a towing vehicle (except for disconnection tests), the components of the “Towing vehicle” expansion package must be inserted into the measurement set-up. The description given here is applicable to a fully equipped vehicle. The required installation work may in particular instances not be possible (e.g. trailer measurement point cabling for solo vehicles) – these may then be regarded as not relevant, and unnecessary.

Installation of actuator and cable pull

- Suspend the spring from the double contactor stop pins.
- Insert the end of the steel cable into the other end of the spring.
- Secure the other end of the steel cable to the end of the hook.
- Secure the hook to the steering wheel.

Setting the double contactor

- Set the spring force so that the first contactor is triggered at the start of pedal actuation, and the second contactor is triggered at the end of pedal actuation.

Assembling the treadle

- Ensure that the basic package components are wired up.
- Secure the treadle to the brake pedal.

Standing pedals

With standing pedals this should easily be possible with the included lashing strap.

Suspended pedals

When suspended brake pedals are used, the design of the pedal can lead to problems. Here, spacers – which are not included in the scope of supply – can be of use beneath the pedal.

- Fix the treadle to the steering wheel using the cable pull (with spring) and the hook-shaped actuator (with clamping tappet for the cable pull end).
  - Both switches must be open when not actuated.
- Check the settings of the internal treadle switch as follows:
  - After the start of actuation, Switch 1 must close.
  - When fully actuated, Switch 2 must be closed – this is achieved by tightening the cable pull, which is clamped to the actuator by means of the tappet.
  - When released, first Switch 2 and then Switch 1 must open.
Connecting the pressure sensor adapter

- Connect the hose “Test connection – pressure sensor adapter” 893 600 024 0 from the basic package to the test connector of the least favourably positioned wheel brake cylinder.
- Set the wheel brakes of the vehicle under test as tightly as possible.
  ➞ This must however not come into contact, meaning that it must still be possible to turn the wheels easily when the brakes are not actuated.
- Connect the hose “Yellow coupling head” 893 600 021 0 to the “Towing vehicle” expansion package using the towing vehicle’s yellow coupling head.
- Connect the hose “red coupling head” 893 600 022 0 from the basic package using the towing vehicle’s red coupling head.

Once coupled to the coupling heads, the system is pressurised.

Vehicle with braking force control

- Set the braking force control such that the "fully laden" operating condition is simulated.

Braking force is controlled for example mechanically or pneumatically by an LSV regulator, or electronically by a pressure transducer, by the software or the braking system. When wiring up the “Towing vehicle” expansion package, the CTU’s RS232 and “ISO 7638” connections, as well as its “Pressure sensor 1”, “Pressure sensor 2” and “Pressure sensor 3” connections must be wired up.
- To do this, remove the “CTU-pressure sensor adapter” cable from the basic package and the “Towing vehicle” expansion package.

In order to prevent incorrect measurements, use the following configuration:

- At the test port of the wheel brake cylinder positioned least favourably: pressure sensor from CTU connection “Pressure sensor 1”
- At the yellow coupling head of the towing vehicle: pressure sensor from CTU connection “Pressure sensor 2”
- At the red coupling head of the towing vehicle: pressure sensor from CTU connection “Pressure sensor 3”

Cabling and measurement

- Connect the cables from the basic package and the “Towing vehicle” expansion package to the pressure sensor adapters.
- Connect the pressure sensor adapters with the prepared adapter connectors.
- Switch on the CTU power supply.
- Start the measurement program on the PC.
  ➞ You can now perform the measurements which are possible with this set-up.

4.3.1 Performing the disconnection test (not required for solo vehicles)

When performing a disconnection test on a towing vehicle, a modification to the set-up described above is required. The set-up process for the disconnection test on the towing vehicle time measurement set-up is described below.
Establishing the set-up for the disconnection test

– Disconnect hose 893 600 021 0, which is connected to the yellow coupling head.

– Modify a coupling head so that it becomes possible to simulate a hose disconnection.

The figure provides an example of how a hose disconnection adapter might appear.

The hose disconnection adapter is not included in the scope of supply of the measurement device.

A pipe section is fitted to a coupling head 452 200 022 0 or 952 200 022 0, through which the air can be exhausted. The pipe diameter on the exhaust side should be at least 8 mm.

4.3.2 Connecting the “Trailer” expansion package

Before performing time measurements on a trailer, the components of the “Trailer” expansion package must be inserted into the measurement set-up. For this purpose, the components of the basic package must be connected as described above.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simulator (internal pressure sensor)</td>
</tr>
<tr>
<td>2</td>
<td>Simulator (internal pressure sensor)</td>
</tr>
<tr>
<td>3</td>
<td>ISO 11992 Simulator / Tester</td>
</tr>
<tr>
<td>4</td>
<td>Pressure sensor</td>
</tr>
</tbody>
</table>

Securing pneumatic supply to the trailer in order to fulfil the connection conditions

– Connect the hose (e.g. hose “yellow coupling head” 893 600 021 0 from the “Towing vehicle” expansion package) to the “air supply connection / Druckluftversorgung” connection, which is located on the simulator connection plate.

⇒ This will secure the air supply connection to the simulator.
The supply is implemented through the pressure system on site, a towing vehicle – red coupling head or similar.

- Connect the hose “Simulator - yellow coupling head” 893 600 023 0 to the “Trailer” expansion package using the trailer's yellow coupling head.
- Then also connect the hose "Simulator - yellow coupling head" 893 600 023 0 using the "coupling head, control line trailer / Kupplungskopf, Bremsleistung" connector to the simulator's connector plate.
- Connect the hose “red coupling head” 893 600 022 0 from the basic package using the trailer's red coupling head.
- Then also connect the hose "red coupling head" 893 600 022 0 using the "coupling head, supply line trailer / Kupplungskopf, Vorratsleitung" connector to the simulator's connector plate.
- Connect the hose "Test connection – pressure sensor adapter" 893 600 024 0 from the basic package using the pressure sensor adapter connector to the test connector of the least favourably positioned wheel brake cylinder.

Generally speaking, the wheel brakes of the vehicle under test must be tightened as much as possible for the measurement, but must not however come into contact, meaning that the wheels must still turn easily when in unactuated condition.

Vehicle with braking force control

Braking force control can be achieved either mechanically or pneumatically by means of an LSV controller.

If a braking force control system is fitted: Position the vehicle such that its "fully laden" operating condition is simulated. The braking system software achieves braking force control electronically by means of a pressure transducer.

- Connect the cable 446 310 300 2 to the CTU “Pressure sensor” connector.
- Connect the cable 446 310 024 2 to the CTU “Simulator” connector.
- Connect the “CTU pressure sensor adapter” to the cable the pressure sensor adapter 894 600 001 0.
- Connect the cable with the pressure sensor adapter to the prepared adapter connector on the wheel brake cylinder.
- Switch on the CTU power supply.
- Boot the PC on which the measurement program is installed.

.defineProperty('You can now perform the measurements which are possible with this set-up.', 'You can now perform the measurements which are possible with this set-up.');
4.4 Pressure sensor adjustment

At various points in the measurement program, the user has the opportunity to adjust the pressure sensors – at some points, pressure sensor adjustment is required before the program can continue to run. Pressure sensor adjustment is the same in all cases. A reference to the explanation given here is made at appropriate points in the program description.

A pressure sensor adjustment consists of adjusting the pressure sensors for atmospheric pressure. Within the program, it is assumed that an increase in pressure sensor readings above the pressure range of 0 ... ...12 bar to be measured will proceed on a continuous, linear basis.

The measurement program differentiates between 5 pressure sensors:

- **Pressure sensor 1**: external sensor to which CTU output “Pressure sensor 1” is assigned
- **Pressure sensor 2**: external sensor to which CTU output “Pressure sensor 2” is assigned
- **Pressure sensor 3**: external sensor to which CTU output “Pressure sensor 3” is assigned
- **Pressure sensor 4**: internal sensor mounted on the control pressure output of the simulator downstream of the diaphragm (diameter 4.0 to 4.3 mm), which measures the braking pressure on the yellow trailer coupling head when performing trailer measurements
- **Pressure sensor 5**: internal sensor which is mounted on the container (30 litres) in the simulator, which measures the trailer supply pressure in the simulator tank when performing trailer measurements

Pressure sensors 1 to 3 are similar. These are numbered according to their connections to the CTU.

External pressure sensors are sensors which are connected to the CTU. As there is a risk of confusion following any measurement set-up or alteration, the external pressure sensors must be calibrated every time the measurement program is loaded.

Internal pressure sensors are sensors which are fixed in position in the simulator. As these represent no risk of confusion, the internal pressure sensors must be adjusted daily (i.e. this must be performed once daily, before the start of measurement).
4.5 Power supply

The CTU must be supplied with power during the measurement. The power supply required will depend on the desired use of the CTU as well as on the vehicle to be tested. The power supply can be provided by the towing vehicle, by a battery vehicle or by a mains unit providing a constant or adjustable power output.

4.5.1 Power supply by means of a 24 V mains unit with a constant power supply

A 24 V mains unit with constant power supply is required for the testing of solo towing vehicles (e.g. cement mixers, fire brigade or vehicles with a tail lift, etc.), as in such cases power draw-off via the ISO 7638 7-pole trailer socket is not an option. Of course, towing vehicles for truck-trailers or trailers can also be tested with mains units of this kind. This version is completely sufficient for vehicles in the conventional vehicle sector, but in contrast, not all of the required tests for vehicles with CAN ports (under-voltage test) can be completed using a mains unit of this kind.

The mains unit and the power supply cable do not form part of the scope of supply of the CTU. The power supply cable can be provided by the user themselves.

The CTU port is standardised (positive pole - ring pin / negative pole - contact pin).
4.5.2 Power supply from the towing vehicle by means of an ISO 7638 port

In towing vehicles fitted with an ISO 7638 port, the power supply for the CTU control electronics can be drawn off in exactly the same way as in trailers fitted with an ISO 7638 port and which are supplied with power from a towing vehicle or battery vehicle. This thus provides for the complete testing of a wide range of conventionally braked vehicles as well as EBS-braked towing vehicles. Restrictions are applicable for the verification of EBS-braked trailers, as the undervoltage test in accordance with ECE R 13 Annex 17 Item 4.2.2.2.1.2. and verification of the warning lamp switching sequence are no longer possible in this case.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Insertion adapter</td>
</tr>
<tr>
<td>b</td>
<td>Power supply and data line</td>
</tr>
<tr>
<td>c</td>
<td>CTU</td>
</tr>
</tbody>
</table>

! In a special instance in which "the power supply to the trailer via the ISO 7638 7-pole socket from the towing vehicle, which sends CAN data over this 7-pole socket", this can lead to problems with the data lines (pins 6 and 7 of the 7-pole socket). If in doubt, it must be ensured that no data can be sent from the towing vehicle side to the trailer.

4.5.3 Supply from an adjustable mains unit by means of an ISO 7638 port

In order to perform a complete verification of a trailer with a ISO 7638 CAN data port, a power supply from an adjustable mains unit will be required (e.g. an ES030-10 mains unit manufactured by Delta Elektronika BV - see also http://www.delta-elektronika.nl. This will enable the undervoltage test in accordance with ECE R 13 Annex 17 Item 4.2.2.2.1.2. and the verification of the warning lamp switching sequence to be performed. Of course, a power supply of this kind can also be used to perform complete tests in all other cases.
Using an adjustable mains unit

If an adjustable mains unit is used, the power supply outlet must be connected to the connector adapter 446 310 017 2. Additional power supply must be provided in the manner already described in Section 3.2.4.2.

The power supply cable between the mains unit and the adapter input do not form part of the scope of supply for the CTU, but can however be ordered separately from WABCO or produced from the VCS power supply cable itself with a certain degree of skill.

Note that the power supply cables for drawbar trailers and semitrailers differ, as drawbar trailers are fitted with an ISO 7638 connector, while semitrailers are fitted with an ISO 7638 socket.

The power supply cable between the mains unit and the 7-pole trailer socket does not form part of the supply scope of the CTU, but can however be ordered from WABCO.

The required power supply (III) for a drawbar trailer is shown below. The power supply for semitrailers is the same. Please note the mirror-image location of the pins in the socket.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>ISO 7638 socket</td>
</tr>
<tr>
<td>b</td>
<td>Power supply cable</td>
</tr>
<tr>
<td>c</td>
<td>Adjustable mains unit (10 A)</td>
</tr>
</tbody>
</table>
The test is performed with the help of the PC. Once the preparations listed in the “Start-up” chapter have been completed, the measurement program can be started.

5.1 Start screen – Program module

The measurement program is modular in layout. The desired test is started by clicking the menu on the start page.

At the bottom right of the welcome screen the status of the warning lamp is (pin 5, ISO 7638) is indicated.

It is also possible to select program modules from the command bar. The command bar offers a relatively wider selection of clickable program modules compared to the buttons. The description below follows the numbering of the program modules.

Following a measurement, a measurement log can be printed out. It is also possible to save the data and print out the log at a later date.

5.1.1 Module 1: Time measurement for trailers with pneumatic brake line

This test measures and evaluates the response time of a trailer with pneumatic braking system and pneumatic control.

This test is not described separately, as this is also included in the time measurement for trailer vehicles with pneumatic and electrical brake lines, and is described in the next item. Only the electrical control system is missing here.

5.1.2 Module 2: Time measurement for trailers with pneumatic and electrical brake line

This test measures and evaluates the response time of a trailer with pneumatic braking system and electrical and pneumatic control. This also includes a test for a trailer with pneumatic braking system and pneumatic control systems.

Make sure that the pressure in the trailer reservoir does not exceed a maximum of 6.5 bar. Higher pressures will not be recognised by the measurement system. This may lead to improved time responses and thus to non-compliant results.

Once the completion of start-up has been confirmed, calibration will be required. Following the end of the test, the pressure flow at the pressure sensors and the electronic actuation of the control signals flow are shown in the diagrams on the monitor.

The measurement results are displayed immediately following the end of the measurement.

5.1.3 Module 3: Testing the compatibility of a trailer with electrical brake line

This test of the CAN connection is only required for trailers which issue CAN data in accordance with ISO 11992 to the ISO 7638 port (7-pole trailer socket).
The measurement program

This includes a review of the data blocks in accordance with the requirements of ECE R 13 Annex 17. This therefore comprises an electronic test, which can already be performed with the basic package. In order to provide brake cylinder control, the trailer must however be supplied with compressed air.

The towing vehicle simulator from the “Trailer” expansion package is required for the trailer test in accordance with Annex 17.

This test is only required if no appropriate certificate is available from the brake system supplier (EBS certificate). A detailed understanding of the statutory provisions is required for the performance of this test.

Before starting measurement, the preparation tasks for a trailer with electrical control lines must have been completed. Program queries are triggered at the start of the test, and these must be confirmed by pressing the NEXT button.

After inputting the required data, the system is ready to start measurement, and the test can then be performed.

– Follow the measurement program instructions.

5.1.4 Module 4: Time measurement for towing vehicles without trailer control

This test is also included in the time measurement for towing vehicles with pneumatic and electrical trailer control, see chapter “5.1.6 Module 6: Time measurement for towing vehicle with pneumatic and electrical brake line” on page 30. This does not include the complete review of the trailer port.

In the displayed results, the diagrams and tables for verifying the trailer pneumatic and electrical ports are left empty.

5.1.5 Module 5: Time measurement for towing vehicles with pneumatic trailer control

This test measures and evaluates the response time of a towing vehicle with pneumatic trailer control. This is not described separately, as this is included in the time measurement for towing vehicles with pneumatic and electrical trailer control, see chapter “5.1.6 Module 6: Time measurement for towing vehicle with pneumatic and electrical brake line” on page 30. This does not include the review of the trailer electrical port.

In the displayed results, the diagrams and tables for verifying the trailer pneumatic port are left empty.

5.1.6 Module 6: Time measurement for towing vehicle with pneumatic and electrical brake line

This test measures and evaluates the response time of a towing vehicle with pneumatic and electrical trailer control. This test is the most comprehensive time measurement and includes both of the tests described above.

When performing the measurement on the towing vehicle, it can be useful to involve a second person, as support tasks such as actuating the brake pedals and replenishing the service brake circuit pressures, or even the pressure regulator starting pressure during the measurement.
5.1.7 Module 7: Testing response to hose disconnection

This test measures and evaluates the response time of a towing vehicle with pneumatic trailer control in the event of the disconnection of the control line (yellow coupling head). This test is not required for solo vehicles.

The measurement set-up is similar to the program operation for towing vehicles with pneumatic trailer control. A major difference is that the pneumatic control line to the trailer is not connected, and as a result, the yellow coupling head on the towing vehicle is in the open position.

5.1.8 Module 8: Compatibility of a towing vehicle with electrical trailer control

Testing of the CAN connection is only required for towing vehicles which issue CAN data in accordance with ISO 11992 to the ISO 7638 port (7-pole trailer socket). This therefore comprises a purely electronic test, which can already be performed with the basic package. In order to provide brake cylinder control, the towing vehicle must be supplied with compressed air.

5.2 Further program modules

In contrast to the previously described program modules 1 - 8, the program modules described in the text below have no button on the measurement program interface, and can only be activated using the command bar.

5.2.1 Menu item: ISO 11992

The section below describes the possible tests on the basis of ISO 11992-2:2003 and ISO 11992-2:2003/Amd.1:2007 on the ISO 7638 port. These are purely display functions for testing the communication between the towing vehicle and the trailer vehicle.

– You should connect the insertion adapter 446 310 017 2 to the ISO 7638 port for this purpose.

⇒ The power supply can – where required – preferably be taken from the port.

5.2.1.1 Display text blocks

This test allows the display of the CAN text blocks (similar to the CAN text blocks, see chapter “6.1 CAN-Botschaften” on page 40) which arrive at the ISO 7638 trailer port. It is therefore possible to monitor the CAN port of a towing vehicle or a trailer. If the ISO 7638 adapter is used between the 7-pole socket and the 7-pole connector, the text block exchange over the port can also be observed.

The “Receive all CAN text blocks” option can be switched on or off to display the CAN text blocks sent to the port.

If this option is selected, all CAN text blocks which are received or receivable over the port are displayed. Recognised CAN identifiers (meaning that these identifiers stored in a matrix in the CTU program and can thus be “recognised”) are displayed together with their text block names.
If this option is switched off, a check is performed in accordance with the aforementioned matrix that the CAN text blocks which should be received by the port are actually received.

5.2.1.2 Display data contents

The “Display data contents” test alternatively allows the display of the data content for recognised “EBS” and “RGE” (Running Gear Equipment) type CAN text blocks which arrive at the ISO 7638 trailer port. It is therefore possible to monitor the CAN port of a towing vehicle or a trailer. If the ISO 7638 adapter is used between the 7-pole socket and the 7-pole connector, data which passes over the port can also be observed. The displayed data is automatically updated with each applicable computer cycle.

5.2.1.3 Text block time behaviour

This test displays the repetition times for recognised “EBS” and “RGE” type CAN text blocks which arrive at the ISO 7638 trailer port. It is possible to monitor the CAN port of a towing vehicle or a trailer. If the ISO 7638 adapter is used between the 7-pole socket and the 7-pole connector, data which passes over the port can also be observed. The displayed running times are re-determined and displayed each time that the refresh button is pressed on the program interface.

The determined repetition times of the recognised “EBS” and “RGE” (Running Gear Equipment) type CAN text blocks are measured and compared with the ISO 11992 requirements.

The program is embedded with a display and evaluation of the repetition times for the sent, recognised “EBS” and “RGE” type CAN text blocks in accordance with ISO 11992 requirements.

5.2.1.4 Bus loading

The “Bus loading” test shows the loading of the CAN data bus at the ISO 7638 trailer port. It is possible to monitor the CAN port of a towing vehicle or a trailer.

5.2.2 Menu item: Tools

The “Tools” area defines the processes which are required for the verification of the measurement equipment hardware and for setting up the PC. The hardware verification is partly required by ECE R 13 (comp. Annex 6 Item 3.3.3) and must therefore be able to be performed at any time.

The following individual menu items can be selected:

- Testing the CTU hardware calibration: This allows the verification and performance of the calibration functions for all internal and external pressure sensors, the verification of the treadle (double contactor) contacts as well as the warning lamps, the pre-setting of CAN line status (e.g. short circuits, transmission of EBS trailer text blocks, etc.), the control of the simulator solenoid valves and the pre-setting of the simulator reservoir pressure.

The external pressure sensors must be calibrated before each measurement and/or after setting up the measurement test prior to recording the measurement values, and daily calibration is required for internal pressure sensors.
The measurement program

- Pressure sensor adjustment: This item forms part of the CTU hardware calibration and is only used to calibrate the pressure sensors.

The external pressure sensors must be calibrated before each measurement and/or after setting up the measurement test prior to recording the measurement values, and daily calibration is required for internal pressure sensors.

- Pneumatic testing of the simulator: In this section, the simulator can be tested in accordance with the requirements of ECE R 13 Annex 6 Item 3.3.3.

5.2.2.1 Testing the CTU hardware

This segment of the program allows the verification and performance of zero point adjustments for all internal and external pressure sensors, the verification of the treadle (double contactor) contacts as well as the separate brake pedal actuation time measurement, the status of the yellow warning lamp (pin 5 of the ISO 7638 plug connection), the pre-setting of CAN line status (e.g. short circuits, transmission of EBS trailer text blocks), the control of the simulator solenoid valves and the pre-setting of the simulator reservoir pressure.

These test functions are used to verify the measurement structure hardware and can be performed without a vehicle. Only pressure control for the compressed air reservoir must be provided during these simulator function verifications.

5.2.2.2 Adjust the simulator pressure sensors

This enables the calibration (= zero point adjustment) of the internal pressure sensors to be performed. This calibration is identical to the calibration of the internal pressure sensors, see chapter “5.2.2.1 Testing the CTU hardware” on page 33.

This test function is used to verify the measurement structure hardware and can be performed without a vehicle. Only pressure control for the compressed air reservoir must be provided during this calibration.

In the example given here, the program recognises a connected simulator. A non-connected simulator will be recognised and issued as information.

In order to perform the zero point adjustment for the simulator’s internal pressure sensors, the simulator must be connected electrically and pneumatically to the CTU. The zero point adjustment is started by pressing the “Simulator zero adjustment” button. The simulator will be vented during the automatically-performed zero adjustment. It must therefore be ensured that pressure “Pressure sensor 4” and “Pressure sensor 5” are at atmospheric pressure. The zero point adjustment will then be performed.

Pressing the OK button will then return you to the measurement program start screen.

5.2.2.3 Pneumatic testing of the simulator

The WABCO simulators comply with the statutory requirements in terms of the flow behaviour of control pressure for pneumatic trailer braking. The definition of flow behaviour provides an accurately defined pressure build-up, and avoid multiple actuations with final interpolation and evaluation calculation in pneumatic trailer investigations - in contrast to pneumatic towing vehicle investigations.
The legislation stipulates in ECE R 13 Annex 6 Item 3.3.3 how the simulator should be designed. In this section, the simulator can be tested in accordance with the requirements of ECE R 13 Annex 6 Item 3.3.3.

The following tasks are required for simulator testing:

- Establishing the electrical connection between the simulator and CTU
- Connection of a test volume of 385 cm³ to the control pressure output
- Establishing the pressure supply for the simulator

### 5.2.2.4 Settings

The “Settings” area allows various PC-specific settings to be applied:

- The PC serial port to which the CTU is connected.
- The directories in which measurement data is saved.
- User data and the measurement program's serial number.
- Language selection for the program.

### 5.2.3 Menu item: Trailer

This test according to ISO 11992 is only possible for trailers which issue CAN data in accordance with ISO 11992 to the ISO 7638 port (7-pole towing vehicle socket).

This displays text blocks, determines the repetition times for the transmitted EBS and RGE text blocks and tests the towing vehicle port for non-specified text blocks. This therefore comprises a purely electronic test, which can already be performed with the basic package.

Before starting measurement, the preparation tasks for a trailer with electrical control lines must have been completed. (The towing vehicle's ISO 7638 7-pole trailer socket can be connected to the ISO 7638 adapter – if the CTU electronic system must be supplied with power from the towing vehicle.)

If the measurement system is connected to a towing vehicle with EBS, duplicate messages occur on the CAN bus (CTU and towing vehicle). Using a 5-pole coiled cable, for example, can correct this.

In the measurement program, this test is not listed directly on the main program page, but rather on the command bar, under the menu item "Trailer". In order to ensure the required preparatory tasks have been completed, program queries are triggered at the start of the test, and these must be acknowledged by pressing the NEXT button. The measurements are performed and the values displayed in accordance with a procedure which is defined in the program.

### 5.2.3.1 Capacity test of the supply reservoirs

This involves a capacity test of the supply reservoirs in accordance with ECE R 13 Annex 7 Item A.1.3.

- Indicate on the displayed menu whether the trailer vehicle is fitted with an electrical control line.
- Click "Next" and follow the instructions in the measurement program.

### 5.2.3.2 Additional capacity test of the supply reservoirs for vehicles equipped with ABS

As an alternative to the capacity test according ECE R 13 Annex 13 Item 6.1, the test will be carried out according to ECE R 13 Annex 20 Item 7.3.”
5.2.3.3 Testing in accordance with ISO 11992

This involves the display of CAN data blocks in accordance with ECE R 13 Annex 17 Item 4.1.4.

– Click on "Next" to show the repetition times and to display the non-authorised data blocks.
  ⇢ At the end of the program segment, you can print the log, or save this to be printed later.

– Click "OK" to return to the start menu.

5.2.3.4 Towing vehicle simulation

The towing vehicle simulation is a process by which CAN text blocks for a towing vehicle are fed using the PC via the ISO 7638 insertion adapter to the trailer. This allows the trailer’s reaction to be evaluated.

It is also possible to control the pneumatic control and supply systems using the simulator.

In the measurement program, this test is not listed directly on the main program page, but rather on the command bar, under the menu item "Trailer".

5.2.4 Menu item: Towing vehicle

This menu item allows additional towing vehicle tests to be performed. The measurement program explains these tests in the main dialogue box.

Before starting measurement, the preparation tasks for a towing vehicle with electrical trailer brake control must have been completed.

In the measurement program, this test is not listed directly on the main program page, but rather on the command bar, under the menu item "Towing vehicle". In order to ensure the required preparatory tasks have been completed, program queries are triggered at the start of the test, and these must be acknowledged by pressing the NEXT button. The measurements are performed and the values displayed in accordance with a procedure which is defined in the program.

5.2.4.1 Capacity test of the supply reservoirs

This involves verifying the capacity test of the supply reservoirs in accordance with ECE R 13 Annex 7 Item A.1.2.

– Input the following data into the displayed menu:
  ■ Supply pressure for front and rear axles as per manufacturer’s specifications.
  ■ The minimum pressure set by the manufacturer which must be present in order to obtain the prescribed minimum auxiliary brake output.
  ■ Whether the vehicle is fitted with a pneumatic control line.
  ■ The pressure with full actuation at the yellow coupling head if the supply reservoir has a nominal pressure according to the manufacturer’s specifications.

– Click "Next" and follow the instructions in the program.

5.2.4.2 Testing in accordance with ISO 11992

This involves the display of CAN data blocks in accordance with ECE R 13 Annex 17 Item 3.1.3.
5.2.4.3 Trailer simulation

This comprises a purely electronic test, which – as for the towing vehicle test in accordance with ISO 11992 – can already be performed with the basic package.

The trailer simulation is a process by which CAN text blocks for a trailer are fed using the PC via the ISO 7638 insertion adapter to the towing vehicle. This allows the towing vehicle reaction to be evaluated.

In the measurement program, this test is not listed directly on the main program page, but rather on the command bar, under the menu item "Towing vehicle".

5.2.5 Menu item: Help

The "User's manual" item allows you to open the user's manual. If the user's manual is not available in your language, use the program link to the WABCO homepage, with references for the brochures.
6 Appendix

6.1 CAN messages

In order to test the CAN data blocks, it may be necessary to know the identifier display for authorised text blocks.

The table provides a summary of the specified towing vehicle and trailer text blocks which are authorised for the ISO 7638 trailer port. The authorised values for text block repetition times in accordance with ISO 11992 are also given.

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>REPETITION TIME [MS]</th>
<th>IDENTIFIER</th>
<th>IDENTIFIER DEZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBS11</td>
<td>10</td>
<td>0C02C820</td>
<td>201508896</td>
</tr>
<tr>
<td>EBS12</td>
<td>100</td>
<td>18FEC920</td>
<td>419350816</td>
</tr>
<tr>
<td>EBS21</td>
<td>10</td>
<td>0C0320C8</td>
<td>201531592</td>
</tr>
<tr>
<td>EBS22</td>
<td>100</td>
<td>18FEC4C8</td>
<td>419349704</td>
</tr>
<tr>
<td>EBS23</td>
<td>100</td>
<td>18FEC6C8</td>
<td>419350216</td>
</tr>
<tr>
<td>EBS24</td>
<td>1000</td>
<td>18FD9AC8</td>
<td>419273416</td>
</tr>
<tr>
<td>EBS25</td>
<td>50</td>
<td>18F020C8</td>
<td>418390216</td>
</tr>
<tr>
<td>EBS26</td>
<td>10</td>
<td>0CF01FC8</td>
<td>217063368</td>
</tr>
<tr>
<td>RGE11 (GFM12)</td>
<td>100</td>
<td>18E4C820</td>
<td>417646624</td>
</tr>
<tr>
<td>RGE21 (GFM22)</td>
<td>100</td>
<td>18E520C8</td>
<td>417669320</td>
</tr>
<tr>
<td>RGE22</td>
<td>100</td>
<td>18FE5CC8</td>
<td>419323080</td>
</tr>
<tr>
<td>REGE23</td>
<td>1000</td>
<td>18FE5EC8</td>
<td>419323592</td>
</tr>
<tr>
<td>TD11</td>
<td>1000</td>
<td>18FEE620</td>
<td>419358240</td>
</tr>
<tr>
<td>GFM11</td>
<td>100</td>
<td>18E2C820</td>
<td>417515552</td>
</tr>
<tr>
<td>GFM12 (RGE11)</td>
<td>100</td>
<td>18E4C820</td>
<td>417646624</td>
</tr>
<tr>
<td>GFM21</td>
<td>100</td>
<td>18E120C8</td>
<td>417407176</td>
</tr>
<tr>
<td>GFM22 (RGE21)</td>
<td>100</td>
<td>18E520C8</td>
<td>417669320</td>
</tr>
<tr>
<td>GFM23</td>
<td>100</td>
<td>18FEC6C8</td>
<td>419350216</td>
</tr>
<tr>
<td>GFM24</td>
<td>100</td>
<td>18FEC8C8</td>
<td>419350728</td>
</tr>
</tbody>
</table>
Appendix

6.2 EC declaration of conformity

EC – declaration of conformity

The following named product:

<table>
<thead>
<tr>
<th>Product name:</th>
<th>Measurement Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>CTU 3 HW Version 3</td>
</tr>
<tr>
<td>Part- Nr.:</td>
<td>446 310 000 0</td>
</tr>
</tbody>
</table>

complies according to the following Council Directives on approximation of laws of the EEC Member States

Electromagnetic compatibility (EMC) 2004/108/EC

Changes of the product that are not confirmed by the manufacturer causes that this declaration will loose their validation

The conformity with the requirements of this directive is verified by the following harmonised European standards:

- EN 61000–6–2 : 2005
- EN 61000–6–2 CENELEC-Cor. (June 2011)

This declaration is issued by the responsibilies of the manufacturer:

imo-elektronik GmbH
Edisonstraße 19
33689 Bielefeld
Germany

from:

[Signatures]

Bielefeld, 01.06.2012
WABCO (NYSE: WBC) is a leading global supplier of technologies and services that improve the safety, efficiency and connectivity of commercial vehicles. Founded nearly 150 years ago, WABCO continues to pioneer breakthrough innovations for advanced driver assistance, braking, stability control, suspension, transmission automation and aerodynamics. Partnering with the transportation industry as it maps a route towards autonomous driving, WABCO also uniquely connects trucks, trailers, drivers, cargo, and fleet operators through telematics, as well as advanced fleet management and mobile solutions. WABCO reported sales of $2.6 billion in 2015. Headquartered in Brussels, Belgium, WABCO has 12,000 employees in 39 countries. For more information, visit www.wabco-auto.com