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MAHA special

1/2011

Using the laptop, not just the screwdriver:
effective electronics testing in HU inspections

Improved cost efficiency:
less work despite increasing test scope



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mechatronic
vehicle testing

MAHA
spezial
1/2011

Publisher:
Schlütersche Verlagsgesellschaft
mbH & Co. KG
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Production:
Heike Lokay, lokaydesign.de

Bank Account:
IBAN DE 41 2505 0180 001 0199 00
BIC SPKHDE 2H

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Jurisdiction and Place of Fulfilment:
Hannover

Printing: CW Niemeyer Druck GmbH
Böcklerstraße 13, 31789 Hameln

**Overview Magazines of Automotive
Department:**

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Leading the way

Automotive technology has developed so rapidly in recent years that garages are not the only ones who are having trouble keeping up. Test engineers involved in vehicle testing as part of regular technical vehicle (HU) inspections also face increasing challenges. Automotive technicians working on more modern vehicle generations know that communication with the vehicle electronics system is vital, even in the most straightforward of service work. Not to mention tasks that involve restoring the function of assistance and safety systems.

Nevertheless, the test procedures used for electronic safety systems in regular technical vehicle inspections are lagging miles behind the current state of technology. The tests continue to focus on mechanics. Nothing more than a visual check is provided for electronic systems. Fortunately, the relevant authorities have recognised that this needs to change and the testing of safety-relevant electronic vehicle system is now anchored in the relevant guidelines. But it will take some time before this change is implemented across the board. Maha, the workshop fitter and testing specialist based in Haldenwanger, is leading the way here, as it has done before in other areas. The mechatronic vehicle testing system that it has been developing is now ready for use. In this special booklet, we present the background and the details of this new test procedure that aims to greatly increase road traffic safety.

Richard Linzing

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Assistant Editor-in-Chief amz



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Greater safety with mechatronic vehicle testing

— Klaus Burger, Maha manager and president of the ASA association on the necessity and the benefits of mechatronic vehicle inspections for testing organisations, garages and drivers.



Klaus Burger, manager of and president of the ASA associations.

Automotive technology is constantly increasing in complexity. Vehicle assistance systems do improve vehicle safety, but they also increase the requirements of regular technical inspections of vehicles (HU inspections). This is because the level of interaction between the mechanical and the electrical components increases. When one individual component fails, this affects the entire system's ability to function. In regular technical vehicle inspections, the testing of electronic safety systems currently only involves a visual inspection of the error lamp in the instrument cluster. As a method for judging whether a safety system is ready to be implemented, this is insufficient.

Data linking

The aim of the mechatronic vehicle test is to check, with speed and efficiency, that all safety-relevant components are functioning correctly. A special device that is connected to the vehicle's OBD interface reads the system's fault memory and its relevant sensor data. The HU tool has been designed spe-

cifically for regular technical vehicle inspections and can be integrated into modern data networks by means of a wireless interface.

The mechatronic vehicle test links information from the OBD to the automobile manufacturer's system date and the test values recorded at the brake test bench. This enables the test engineers to not only reliably test the correct functioning of safety-relevant vehicle systems in the regular technical vehicle inspections, but to also quickly determine whether the braking forces required by legislation or by the vehicle manufacturer are being adhered to.

Effective test sequence

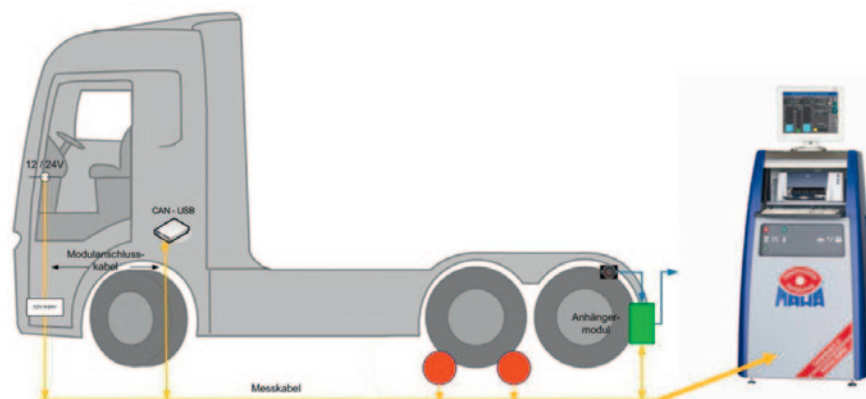
The mechatronic vehicle test also has other benefits. It allows the test sequence to be designed in a way that saves time and increases efficiency, despite widening test scopes and increasing levels of analysis. Vehicle-related information such as the vehicle ID number (VIN) and mileage can thus be read automatically. Copying this information from the approval documents and other sources by hand, a time-consuming process that is prone

to errors, is thus a thing of the past. The automatic comparison of test results with the required limits also makes it easier for the test engineer to judge whether the vehicle meets the safety requirements. When the testing process has been completed, the test results are documented automatically and can be printed in a comprehensive report. All these individual measures reduce the time required for the regular technical vehicle inspections, so the driver is spared any higher costs.

A solution with more safety

A further aim of the mechatronic vehicle test is to reduce the amount of work and the costs involved in training the test engineers. The mechatronic vehicle test's automated test sequences mean that the test engineers no longer have to familiarise themselves with the workings or the details of individual systems. This knowledge is gathered from database systems and provided systematically. This enables test engineers to fully concentrate on their tasks when performing regular vehicle inspections.

The mechatronic vehicle test plays a major role in ensuring the function of safety-relevant electronic vehicle systems across a vehicle's entire service life. It thus makes a significant contribution to increasing safety on Europe's roads. This leads to a reduction in accidents and the number of people injured or killed in road traffic.



The mechatronic vehicle test makes a significant contribution to increasing safety on Europe's roads.



The mechatronic vehicle test is performed using a combination of classic test facilities and new devices for reading data from vehicle control devices.

ensures that electronic safety systems perform their tasks correctly across the vehicle's entire service life.

A Europe-wide legal basis

The relevant authorities have recognised the need for action and the relevant guidelines have been adjusted. The legal basis for the technical inspection of vehicles in Europe is Directive 2009/40/EC. It defines which vehicle groups are subject to regular inspection and specifies the EU-wide obligatory testing points. On the basis of this directive, the EU Commission passed Directive 2010/48/EU on 5 July 2010. This directive included adjustments to the regulations and test procedures to suit technical advances in automotive technology. The list of items to be tested thus now includes electronic safety systems. Furthermore, Directive 2010/48/EU also aims to make the technical inspection of automobiles in Europe cost-effective and to harmonise it further. The EU-member states must incorporate the directive into national law by 31 December 2011.

The legal course has thus been clearly set towards mechatronic vehicle tests. This means that both the mechanics and the electronics of safety-relevant systems are tested for flawless functional-

Legal arrangements for electronics testing

— The mechatronic vehicle test performed in the regular technical vehicle inspection makes a significant contribution to improving road safety. It has already been anchored in European legislation.

The aim of the regular technical vehicle inspection is to increase safety on Europe's roads. To do so, its test scope and test methods must constantly be adjusted to suit the current state of development of automobile technology. To this day, technical vehicle inspection continues to focus on mechanical assemblies. Automotive mechanics has, however, now become technically sophisticated, more resistant to wear and much less prone to faults than was the case for previous vehicle generations. Current vehicle models – across all vehicle classes – now come with numerous electronic safety and assistance systems installed. These systems help to reduce the risk of accidents and the number of people injured or killed in road traffic. With regard to vehicle and road safety, electronic vehicle systems are thus just as important as mechanical devices such as the brakes, steering or suspension – especially when you consider that the electronic and mechanical systems in modern vehicle technology are closely interlinked and mutually influence one another. It is therefore particularly important that

the regular technical vehicle inspection includes tests for the correct functioning of any vehicle electronics systems that perform safety-relevant tasks. This



Modern vehicles are fitted with numerous safety and assistance systems. If they are to prevent accidents in the long term, regular technical vehicle inspections must check that they are functioning correctly. Photo: Continental

ty. Such tests involve both classic testing facilities such as brake test benches and new devices that retrieve data from vehicle control devices for the test sequence.

Efficiency testing of safety systems

One of the main focus points of the mechatronic vehicle test is the extensive use of safety systems such as ABS and ESP. These systems are now fitted as standard in Europe. But whether they actually work cannot currently be tested in regular technical vehicle inspections. As part of the revision of the testing regulations for the technical vehicle inspection, the EU Commission therefore asked the EGEA to create a strategy for subjecting the safety systems to an efficiency test. The EGEA (European Garage Equipment Association) is the umbrella association of workshop fitters and is made up of the national European associations of device manufacturers. In response to this request, specialists from EGEA Working Group 6 (test benches) and Working Group 2 (diagnostics) within the newly founded Working Group 26 came up with a proposal for subjecting modern safety systems to a simple efficiency test by means of a roller brake test bench combined with a diagnostic device. This would involve the plausibility of the sensor signals and the efficiency of the actuators being tested in a defined sequence. "We would be very pleased if the commission could accept this proposal and integrate it into legislation. This would allow safety on Europe's roads to be improved even further," says Klaus Burger, president of the ASA association and manager of Maha.

A solution ready for launch

In Germany, the regular technical vehicle inspection (the Hauptuntersuchung, HU) is anchored in section 29 of the Road Traffic Licensing Regulations (StVZO). The regulations regarding implementation are governed by Annex VIII of this section. German legislation has also reacted to the increase in electronic safety systems in modern vehicles. With the 41st amending regu-

lation of the StVZO in 2006, the testing of electronics was added to the test scope of the HU. The electronics is tested on the basis of system data, which need to be supplied by the vehicle manufacturers and importers. The system data directive specifies which electronic safety system and functions need to be tested as part of the HU.

Up until now, electronic safety systems have only been subjected to a visual inspection in German HU inspections. The function check is limited to checking whether the indicator lamp of the system goes out when the engine is started. This is, however, nothing more than a temporary solution. Systems have been developed to enable the efficiency of electronic vehicle systems to be appraised in the HU inspec-

To date, the regular technical vehicle inspection has focused on the mechanics of the vehicle. In future, electronic safety systems will be more heavily incorporated into the test scope.

tions. These systems are about to be launched on the market. One of them is the mechatronic vehicle test (MFP) produced by Maha. The system works in conjunction with the Maha Eurosystem. The advantage of this solution is that Maha's mechatronic vehicle test does more than just fulfil specific German requirements. The test is flexible and can be adapted to suit the various national work processes and legal requirements around the world.

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In the mechatronic vehicle test, the tests on the roller brake test bench will include only brake efficiency, but also the functionality and positioning of the ABS wheel sensors.



Electronic HU inspection: Using the laptop, not just the screwdriver

In Maha's mechatronic vehicle test, the reading of data from the vehicle control devices rationalises the test procedure.

— ABS, ESP, airbag and cornering lamps – electronic systems provide better safety. Provided they work, that is. This is ensured by the electronics testing in the HU inspection. In future, data exchange with the electronics via the OBD interface will speed up the test procedure.

Electronic safety systems assist the driver in difficult situations. If these electronic aids are to actually help, they need to work – throughout the vehicle's entire service life. The vehicle's safety level must remain intact if the number of accidents and of people injured or killed in road traffic is to be reduced. This can only be ensured through regular technical vehicle inspection – such as the German HU inspection. The HU statistics of the testing organisations show how vital the inspection of electronic safety system is. For exa-

mple, they show that official automobile experts are detecting an increasing number of defective or manipulated airbag systems in HU inspections. It is relatively common for components such as airbags to be removed after an accident to avoid costly repairs.

System data directive

The legal basis for the testing of electronic vehicle systems in the HU in Germany is the system data directive. This directive was introduced with the 41st amending regulation of section 29 of the German Road Traffic Licensing Regulations (StVZO) and has been in force since 1 April 2006. The system data directive stipulates that cars, lorries, buses, motorbikes and trailers that are newly approved after this date need to have their electronically controlled systems inspected. For this reason, official experts now extend HU tests for these vehicles beyond the "classic" assemblies and also inspect electronic aids. If these aids are not functioning correctly, the official experts do not issue a test certificate. The aim is clearly defined: better safety on the road.

Safety-relevant assemblies

For the electronics testing in the HU inspection, the 41st amending regulation of section 29 of the StVZO initially covers eight safety-relevant assemblies. These are:

- the braking system,
- the steering system,
- active lighting technology (e.g. cornering lamps),
- safety belts or other retention systems,
- airbags,
- driving dynamics control systems that affect the braking system, such as ESP,
- the rollover protection, such as that found in convertibles, and
- the speed limiters.

The system data directive specifies which vehicle systems within these assemblies are classified as being safety-relevant. It stipulates that an electronically controlled vehicle system is safety-relevant if it performs at least one of the following functions:

- a deceleration of over 1.5 m/s², even at vehicle speeds of over 30 km/h,
- longitudinal, transverse and yaw stabilisation of vehicle movements, even at vehicle speeds above 15 km/h,
- vehicle retention,
- change of direction through steering angle adjustment, even at vehicle speeds of over 15 km/h,
- change of road surface illumination intensity, even at vehicle speeds of over 15 km/h,
- change of waveform of the vehicle's illumination devices, even at vehicle speeds of over 15 km/h,
- retention and/or support of road users,
- securing of survival space of road users,
- prevention of undesired activation of protection devices for road users,
- change of suspension and damping behaviour, even at vehicle speeds of over 30 km/h,
- checking of the tyre pressure and
- change of air-channelling devices, even at vehicle speeds of over 60 km/h.

Testing on the basis of system data

For safety-relevant systems, the HU tests first cover the installation, accuracy and workings of the safety systems. These tests are based on system data: parts of the functional chain are systematically inspected using system-specific test algorithms. The system data must be provided by the vehicle manufacturers and importers.

For the electronic parking brake, for example, this means that various test sequences are run on the brake test bench and the efficiency of the brakes is tested in steps. For ABS, the official experts first test whether all sensors are installed, whether they comply with the manufacturer's specifications and whether they are free from damage. Following on from this, functionality is tested beyond various self-testing steps, on the basis of model-specific data. The procedure for the airbags is similar: compliance with regulations is tested beyond elements of self-testing. This also includes checking of the sensors at the points in the vehicle specified by the manufacturer.

The official expert has an online connection with the vehicle and a database system; he can read the results on a PDA,



ESP improves driving stability in critical situations. The mechatronic vehicle test helps ESP function to be tested in the HU inspection. Photo: BMW

laptop or tablet PC directly on the vehicle and have them read into the system for the following test report. This applies to all of the new electronic HU inspection.

Data exchange accelerates test process

The next goal for electronics testing in HU inspections is the use of the vehicle interface (on-board diagnosis) for data exchange with the control devices of safety-relevant vehicle systems. This enables the system data to be compared with the tester's database, replacing complicated and time-consuming individual testing. In future, it will thus be possible to find out via the OBD interface whether the systems are present, whether the parts are original parts (this is secured using the vehicle ID number (VIN)) and whether all of a system's components are functioning flawlessly and have not been manipulated or incorrectly repaired.

Maha's HU tool has already been prepared for this new approach for the mechatronic vehicle test in connection with the Maha Eurosystem. Maha, the workshop fitter and testing specialist based in Haldenwanger, is thus providing the resources required for the HUs of the future.

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The cornering lamps light up dark areas as the vehicle is turning and greatly improves safety. They are one of the safety-relevant systems whose function needs to be tested in the HU inspection. Photo: Hella



Effective test sequence

— The HU tool, a device specially designed for the requirements of the regular technical vehicle inspection, can be used to effectively test safety-relevant vehicle systems.

In the mechatronic vehicle test, a device is required that enables communication with the safety-relevant vehicle system's safety control devices. "Such a device is subject to very demanding requirements. The targeted sampling and testing of safety-relevant electronic components must be provided

and the entire vehicle must be covered. The device must also be available at an acceptable price and it must be possible for testing organisation and automobile workshop staff to operate it without extensive instruction. In addition, the automated reading of diverse assemblies must require little time," says Manfred Rudhart, test bench product manager at Maha Maschinenbau Haldenwang GmbH & Co. KG.

Diagnostic devices for the mechatronic vehicle test?

Classic control-device diagnostics devices, offered on the market in a range of designs, are not suitable for mechatronic vehicle tests as part of regular technical vehicle inspections. Firstly, they offer a wide range of functions for the diagnosis of electronic vehicle systems, although many of these functions are not needed for the mechatronic vehicle test. Secondly, none of the universal diagnostic devices available on the mar-

The test sequence of the mechatronic vehicle test is very straightforward and intuitive. The tester is guided through the test sequence step by step.

ket offer the complete vehicle coverage that is required for regular technical vehicle inspections. They also involve high investment and follow-up costs and large amount of staff instruction. "Ultimately, the time required for reading diverse assemblies using universal diagnostic devices is too high for them to be integrated into the test procedure of a regular technical vehicle inspection at reasonable costs," says Mr Rudhart.

Maha HU tool

Against this background, Maha has worked with a development partner to produce the Maha HU tool. This is a compact device, little larger than a packet of cigarettes, that is simply plugged into the vehicle's OBD socket. The HU tool enables communication with the vehicle systems of all assemblies classified as safety-relevant by legislation. It can operate on either a 12 or a 24 V vehicle power supply, so it can be used universally across all



The HU tool enables communication with the vehicle systems of all assemblies classified as safety-relevant by legislation.

vehicle classes. As the HU tool only recalls data that are required for testing the functional chain of safety-relevant vehicle systems, data can be queried without any significant delay to the test procedure.

To make the HU tool as easy to use as possible, it has no control elements at all. It is connected to a PC or laptop via a radio link and fully controlled via the intuitive Maha Eurosystem software. This program illustrates the complete test procedure. During the mechatronic vehicle test, Eurosystem accesses databases with system data and data from the safety-relevant vehicle system during the individual test steps. This enables test engineers or workshop specialists to assess the correct functioning of sensors, actuators or the system status with no additional effort.

A guided test sequence

The test sequence of the mechatronic vehicle test is very straightforward and intuitive. It is started when the relevant function is selected in the Maha Eurosystem. Where available, the HU tool automatically retrieves the vehicle ID number (VIN), the mileage and, for utility vehicles, the setting of the speed limiter. These data are transferred to the test log without being entered manually by the tester. For older vehicles, these data can, however, be entered by hand at any time.

The tester is then guided through the test sequence step by step, in accor-



For the function test of the ISO 11992 trailer interface, a special radio adapter is provided that can be integrated into the mechatronic vehicle test.

dance with the test type and the national guidelines for regular technical vehicle inspections. Various test algorithms simultaneously run in the background, which can be used to assess the functional chain of safety-relevant vehicle systems. One of the major benefits of Maha's mechatronic vehicle test is that the PC or laptop not only functions as a display instrument – it can also be used to control the brake test bench. If the Eurosystem software has been installed on the test bench PC, the Maha radio touch screen provides useful services for mobile application in the test hall or workshop. This involves a tablet PC that has been coordinated for everyday workshop and test lab use that can provide full remote control of the test bench computer.

Great flexibility

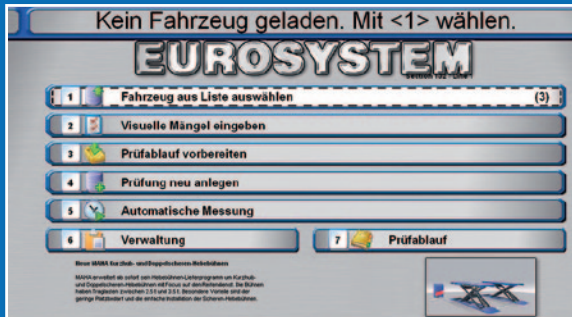
Maha's mechatronic vehicle test offers very extensive flexibility for the regular technical vehicle inspection. For example, the established Maha radio pressure sensors can be incorporated for simple recording of the pressures in compressed-air braking systems for older utility vehicles that do not yet have the OBD functionalities of current vehicle generations. The same applies for the function testing of the ISO 11992 trailer interface. The required adapter is included in Maha's THT (Truck Hand Terminal) test kit and can be integrated into the mechatronic vehicle test via radio link. Maha thus provides testing organisations and automobile workshops a system for inspecting safety-relevant vehicle systems that fulfils all the requirements of European legislation and national regulations, in terms of both functionality and the effectiveness of the test sequence.

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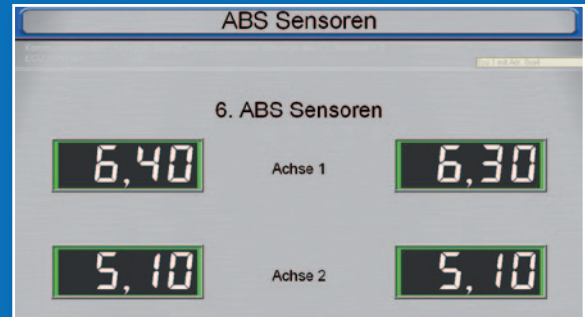


For older utility vehicles, the established Maha radio pressure sensors can be incorporated to record pressures in compressed-air braking systems.

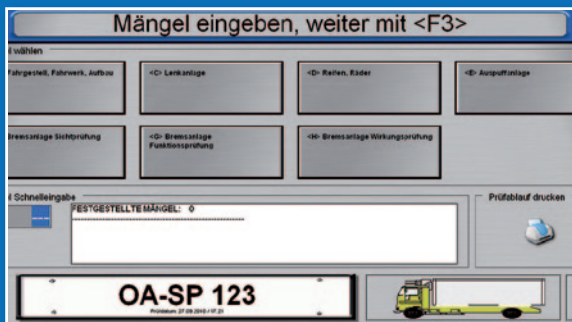
A sample mechatronic vehicle test sequence for safety tests



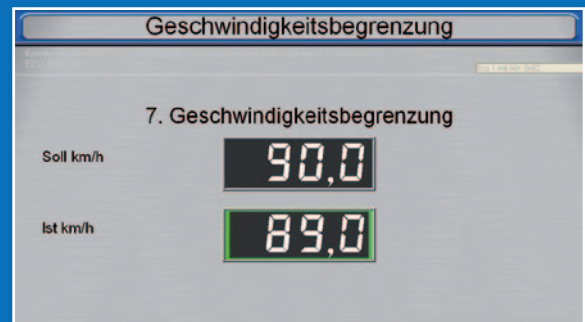
The clearly organised main menu guides the tester through the test sequence step by step.



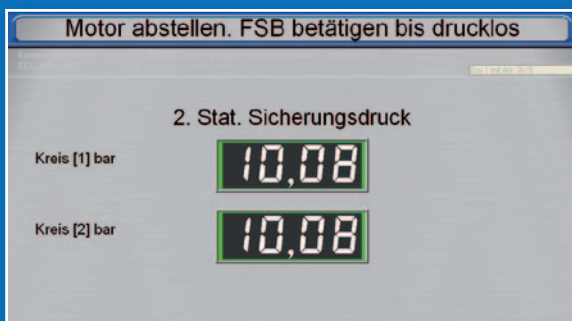
The wheel speed display allows the function and the positioning of the ABS sensors to be checked with ease.



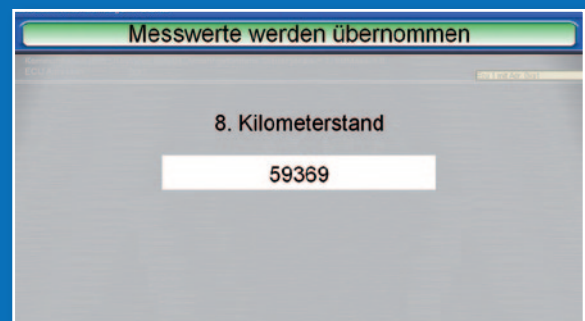
Any faults that are detected can be entered in the software directly.



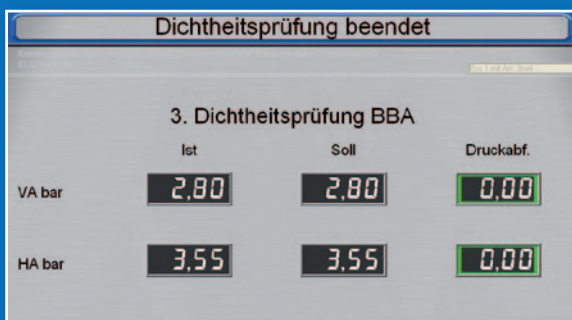
The adjustment value of the speed limiter is transferred to the test software directly.



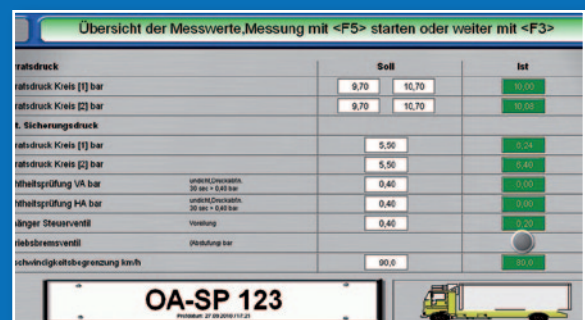
The brake pressures are taken from the OBD. There is no need for pressure transducers to be applied.



The same applies for the mileage and the vehicle ID number.



The clear presentation of pressure values enables actual and target values to be compared rapidly.



Once the test is completed, all the recorded values are presented clearly.



Maha's mechatronic vehicle test enables test sequences to have a more rational design. The reading and integration of OBD data saves a large amount of time.

Less time required for the same test quality

With the mechatronic vehicle test, Maha supports automobile companies and testing organisations to significantly gain ground without neglecting the manufacturer's specifications or the quality of the test. The program sequence of the mechatronic vehicle test covers all test points stipulated by law and by the vehicle manufacturers, in a time-saving way. For example, the vehicle ID number, the mileage and the setting of the speed limiters can be automatically read out and documented. Further on in the test sequence, pressure values are read from the OBD, so the complex application of pressure transducers can be omitted when the compressed-air braking systems are being tested.

In conjunction with a mobile display device, such as Maha's radio touch screen, the tester can enter the results of the visual inspections and function tests into the test program directly. The braking forces of the individual axes are automatically transferred from the brake test bench and entered into the relevant field. The recorded data are compared with the legally stipulated limits, enabling the tester to immediately assess whether the test has been passed.

Universally adaptable principle

According to Mr. Rudhart, this principle can be transferred to all other types of regular technical vehicle inspection tests. "By adapting the test sequences to suit relevant national legal requirements and flexibly integrating various databases, Maha's mechatronic vehicle test meets the requirements of European legislation," says the test bench expert. Maha can thus offer its customers across the world individually adjusted solutions for effective regular technical vehicle inspections for the future, adapted to the progress of vehicle technology.

Cost-effective vehicle testing

— The testing of vehicles in regular technical vehicle inspections is becoming increasingly complex. Maha's mechatronic vehicle test rationalises the test sequences and helps them to be made more cost-effective.

Modern vehicles are becoming increasingly complex. The increasing number of electronic safety and assistance systems makes driving safer. The testing of these systems in the regular technical vehicle inspection does, however, involve the risk that testing becomes more complicated and the costs for the vehicle owner increase. Yet this is precisely what needs to be avoided. Directive 2010/48/EU stipulates that the testing standards and methods should be further defined and adapted to suit technical progress "in order to improve motor vehicle roadworthiness testing in the European Union in a cost-effective manner." For political reasons, it would hardly be possible to implement higher costs for the regular technical vehicle inspection as a result of new testing standards.

The presenters the developers of systems for testing electronically controlled safety systems in the regular technical vehicle inspection with the challenge of reducing test costs while test scopes widen and levels of analysis increase. "This is precisely what we have

achieved with the mechatronic vehicle test based on the Maha Eurosystem," says Manfred Rudhart, Maha test bench product manager.

Price differences in safety tests

According to Mr Rudhart, safety test price differences can best be demonstrated using the example of the safety tests required in Germany for utility vehicles with a maximum gross laden weight of over 7.5 tons. "Legislation does precisely define the assemblies that are to be tested. The implementation of the tests themselves does, however, leave rather a lot of room for interpretation," explains Mr Rudhart. In his opinion, this leads to pricing differences on the market and, above all, to unfair competition. It is precisely those automobile companies that perform safety tests in precise accordance with the manufacturer's specifications that require much more time for their test sequence and that must then charge higher test fees. This gives them a distinct disadvantage compared with third party suppliers.



INVESTMENT FOR THE FUTURE



TESTING & SAFETY
TECHNOLOGY



Mechatronic Vehicle Test for Motor Vehicles

The aim of the electro-mechanical vehicle testing is to check the vehicle's security-relevant components for their function within short time. During this procedure, errors are readout and control modules are encouraged by an external device via OBD. Up to now, the check of security-relevant systems has been done via the control lamp (MIL) in the dashboard. This practice doesn't meet the requirements of a broad check of the components anymore as it now includes the testing of the electronic parts of the brake system, steering, headlights, lamps, rollover-protection features, belts and restraint systems, airbags, driving dynamic systems like ESP and speed limiters.

- Testing & Safety Technology
- Service Equipment
- Lifting Technology
- Dynamometer, Emission Tester