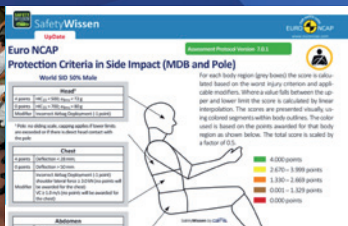
SAFETY COMPANION 2015

carhs.
Empowering Engineers





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Dummy & Crashtest
Engineering & Simulation

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Haven't found what you need? Get in touch with us!

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Legend

- ▶ Seminar/Event that focusses on this topic
- ▷ Seminar/Event that deals with this topic (among others)

Sem Gui

Car Bodies

Interiors

Restraint Systems

Regulations and Requirements

Accident Avoidance

Materials

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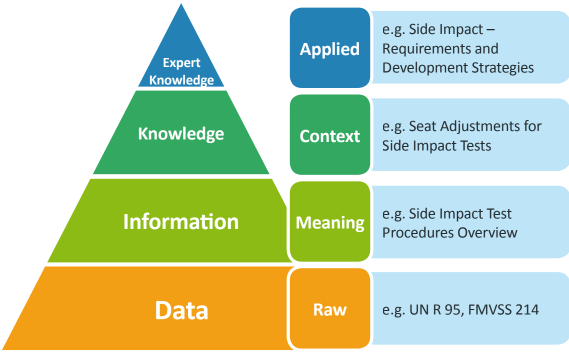
Companion or Compendium?

SAFETY COMPANION 2015

SafetyWissen on more than 50 pages

more than 130 seminars & events

The SafetyCompanion is both! It serves as a navigator through the jungle of worldwide safety requirements and supports you in quickly finding and providing the right answers. But it is not only about finding the requirements. The SafetyCompanions' aim is to have the correct information and knowledge handy at any time. This is the claim of the SafetyCompanion and we work hard to fulfill this claim.



Expert knowledge is based on daily experiences, information and knowledge derived from vast amounts of data which we are exposed to every day. Our trainings and practice-oriented conferences with their current topics and expert lecturers will help you expand your expert knowledge. The work in automotive safety is becoming ever more challenging due to increasing system complexity and continuously updated or new requirements. We are supporting you in building the right knowledge base.

We look forward to welcoming you to our trainings and conferences in 2015 and wish you much success and inspiration from the SafetyCompanion 2015.

For the team of carhs.training

Rainer Hoffmann
President & CEO

Ralf Reuter
Executive Vice President

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„At BMW we faced the challenge to train a large number of employees with different professional backgrounds as simulation engineers for crash and occupant safety. Based on the successful CAE Intensive Training program carhs.training developed an individual multi week training program for us. This training program combined theory, software and project training in an ideal manor. We were very pleased about the success and the professional handling of the project. We can recommend carhs.training to companies that have individual and complex training needs as a partner for the design and execution of the training."

Dr. Wolf Bartelheimer

Manager Frontal Protection Small Cars

BMW AG

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Contact persons

Dr. Dirk Ulrich
Tel. 06023-96 40 - 66
dirk.ulrich@carhs.de

Teresa Will
Tel. 06023-96 40 - 78
teresa.will@carhs.de

References:

ACTS, Adam Opel, Audi, AZOS, Bentley Motors, Bertrandt, BMW, Bosch, Brose, CATARC, Continental, CSI, Daimler, Dalphimetal, Delphi, Dura Automotive, EDAG, Faurecia, Ford, Global NCAP, Grammer, HAITEC, Honda, IAV, Idiada, IEE, JCI, IVM, Lear, Magna, Mahindra & Mahindra, MBtech, Messring, Open Air Systems, PATAC, P+Z, SAIC, SMP, SMSC, Seat, Siemens, TAKATA, TASS, Tecosim, TRW, TTTech, VIF, Volkswagen.

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80%	from the 21st Participant

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automotive CAE GRAND CHALLENGE 2015

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- ► Influence of manufacturing processes on durability
- ► Acoustic material parameters in NVH
- ► Airbag simulation: Unfolding, contacts, gas dynamics, FSI
- ► Material models for metals including failure for sheet metal forming
- ► SpecialSession: Face the HPC challenge

Conference Language: English

Congress Park Hanau, Germany
March 31 - April 1, 2015

more information www.carhs.de/grand-challenge


PraxisConference
Rear Impact ▪ Seats ▪ Whiplash
in co-operation with:
ADAC
November 24 - 25, 2015
more information www.carhs.de/pkh


SAFETYUPDATE
2015.2 - GRAZ
KNOWLDEGE
FOR TOMORROW'S
AUTOMOTIVE ENGINEERING
in co-operation with
Prof. Dr. Steffan
VSI
With simultaneous
translation into English
September 22 -23, 2015
more information www.carhs.de/gsu

Introduction to Passive Safety of Vehicles

Course Description

Ever increasing requirements regarding vehicle safety have led to rapid developments, with major innovations in the field of Active and Passive Safety. Especially legal requirements in the USA (FMVSS 208, 214), the consumer information tests U.S. NCAP, Euro NCAP and IIHS, as well as pedestrian protection should be mentioned here. So far an end of this development is not in sight. The seminar provides an introduction to Passive Safety of Vehicles. Passive Safety is about initiatives and legal provisions for the limitation of injuries following an accident. All important topics are covered in the seminar, from accident statistics and injury-biomechanics, which are decisive parts of accident research, to the crash-rules and regulations that are derived from the latter, and also to consumer information-tests with protection criteria and test procedures, and eventually to crash tests, where the compliance with the compulsory limits is tested and proven in test procedures. Specific attention is given to dummies, with which the potential loads on a person in an accident can be measured. Finally the basic principles of occupant protection are explained, and the components of occupant protection systems, respectively restraint-systems in motor vehicles such as airbags, belt-system, steering wheel, seat, interior, stiff passenger compartment and others, as well as their increasingly complex interaction, also in terms of new systems, will be discussed.

Course Objectives

It is the primary objective of this seminar to communicate an understanding for the entire field of Passive Safety with all its facets and correlations, but also for its limits and trends. In the seminar you are going to learn about and understand the most important topics and can then judge their importance for your work. With the extensive, up-to-date documentation you obtain a valuable and unique reference book for your daily work.

Who should attend?

The seminar addresses everybody who wants to obtain an up-to-date overview into this wide area. It is suited for novices in the field of Passive Safety of Vehicles such as university graduates, career changers, project assistants, internal service providers, but also for highly qualified technicians from the crash-test lab.

Course Contents

- Introduction to vehicle safety
  - Overview active and passive safety
  - Crash physics
- Accident research
  - General accident research
  - Classification
  - Statistics
- Biomechanics
  - Human anatomy
  - Injury mechanisms and injury criteria
- Dummy technology
  - Dummy family
- Crash testing
  - Crash test systems and components
  - Test methods
- Crash rules and regulations
  - Institutions
  - Rules and regulations
  - NCAP tests
  - Latest trends
- Protection principles, occupant protection systems
  - Protection principles of passive safety
  - Occupant protection systems with sensors technology, ECU, airbag, belt system
  - Passenger compartment, interior with steering wheel and steering column, seat
  - OOP, pre crash, post crash, sensor system, vehicle body
  - Optimization of restraint systems, adaptive systems
  - Integrated safety

Course Instructor:

Dipl.-Ing. Rainer Hoffmann, carhs gmbh

Rainer Hoffmann has been involved in automotive safety throughout his career. After graduating from Wayne State University, where he worked at the Bioengineering Center with Prof. Albert King, he joined a research group on passive safety at Porsche where he was involved in many aspects of automotive safety including accident research, occupant simulation, crash testing and safety engineering. Mr. Hoffmann advanced safety simulation by introducing new techniques like airbag simulation, airbag folding and Finite-Element dummy modeling during his subsequent work with ESI Group. As the head of the simulation department of PARS (now Continental Safety Engineering), Mr. Hoffmann led the R&D efforts for some of the first series production side airbag developments. In 1994 Mr. Hoffmann founded EASi Engineering GmbH, which in 2006 became carhs GmbH. He has authored numerous technical papers and has been granted German and international patents in the automotive safety field.

Date	Course ID	Venue	Duration	Price	Language
22.-23.04.2015	2563	Landsberg	2 Days	1.290,- EUR till 25.03.2015, thereafter 1.540,- EUR	
20.-21.07.2015	2577	Shanghai	2 Days	6.900,- RMB	
03.-04.08.2015	2457	Alzenau	2 Days	1.290,- EUR till 06.07.2015, thereafter 1.540,- EUR	
15.-16.10.2015	2454	Alzenau	2 Days	1.290,- EUR till 17.09.2015, thereafter 1.540,- EUR	

This course is available as an in-house seminar in English and German!

Model Based Head Injury Criteria for Innovative Protection Design

Course Description

To prevent injuries resulting from head impacts inside and outside the car, the next generation of head protection design will have to be based on improved model based head injury criteria including virtual or coupled experimental and virtual methods. These novel approaches will consider linear and rotational head acceleration and take into account a range of head injury mechanisms. By implementing recent research into new design methods, it will be possible in a near future, to propose protective structures and panels to be optimized against biomechanical injury criteria including the challenging aspect of mild brain injury.

Course Objectives

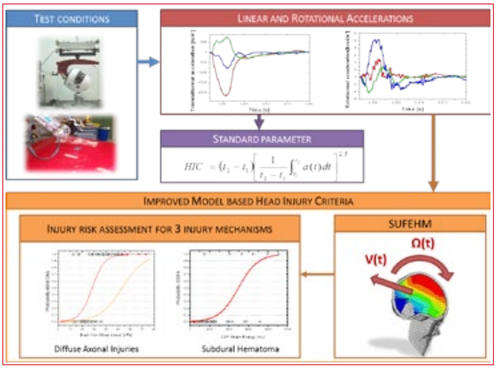
The objective of this course is to provide an overview of head trauma biomechanics and existing head injury criteria. Focus will then be on the state of the art in the domain of human head modeling, both its limitations and its achievements. Special attention will be paid to real world head trauma reconstruction and the derivation of model based head injury criteria. Finally a novel head injury prediction tool will be presented as well as its application to head injury risk assessment both in a protection design context and within the virtual testing environment.

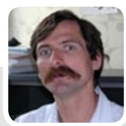
Who should attend?

This seminar is especially suited for engineers and technicians who work on the development of vehicle interior parts or pedestrian protection who want to prepare the next generation of head protection design based on virtual methods.

Course Contents

- Introduction
- Human head surrogates and existing head injury criteria
- Overview of head protection standards
- The state of the art in human head FE modeling
  - Overview of existing head models
  - Model validation issues
- Real world head trauma simulation
  - Head trauma database
  - Victim kinematics and head impact conditions
  - FE modeling of the head trauma
- Model based head injury criteria
  - Methodology
  - Injury criteria for different injury mechanisms
  - Age dependent issues (elderly and children)
- Application to head protection
  - Optimization against biomechanical injury criteria
  - Implementation in virtual testing
- Conclusion and next steps





Course Instructor:

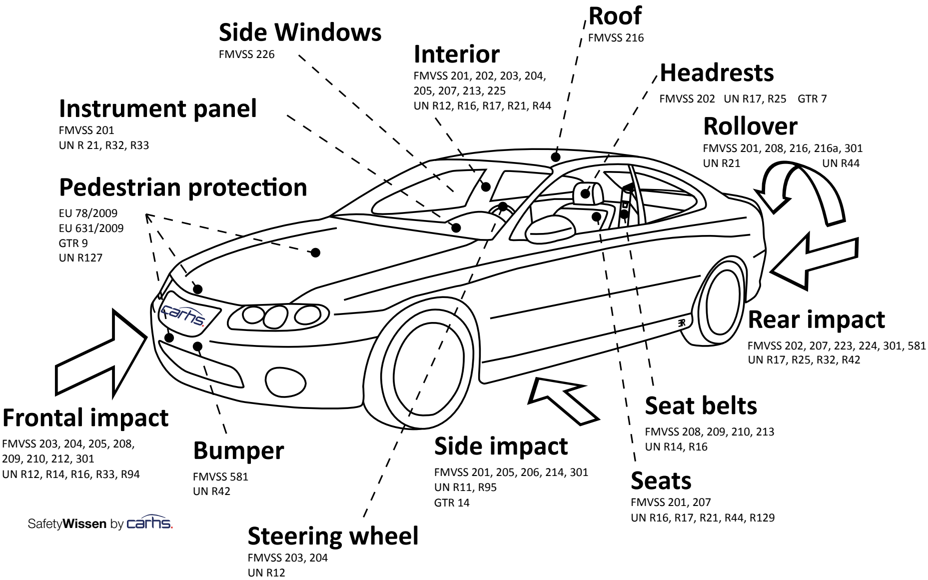
Prof. Dr. Remy Willinger, University of Strasbourg

Since 1990 Remy Willinger leads a research group focusing on head & neck impact biomechanics at Strasbourg University, Strasbourg, France. The research activity of this lab focuses on experimental characterization of biological tissue, head and neck FE modeling and injury mechanisms investigation via accident simulation. Development of injury criteria and protection systems modeling and optimization are also part of his skills. This group contributed to seven EU projects and conducted no less than 70 contracts with public institutions and private companies.

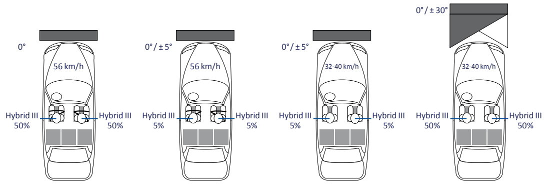
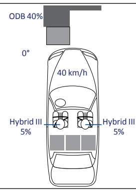
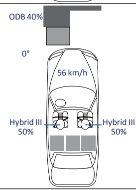
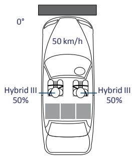
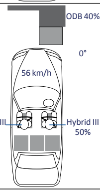
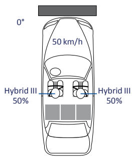
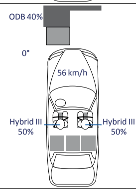
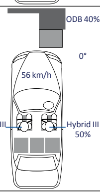
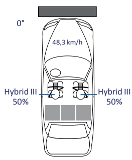
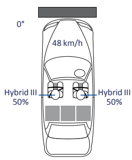
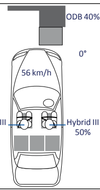
Date	Course ID	Venue	Duration	Price	Language
11.06.2015	2501	Alzenau	1 Day	740,- EUR till 14.05.2015, thereafter 890,- EUR	English

This course is available as an in-house seminar in English and French!

Crash-Regulations in Europe and USA



Rules and Regulations on Occupant Protection

	Full Width Frontal		Offset Frontal	
USA	FMVSS 208		FMVSS 208	
Europe			UN R94	
Japan	Art. 18 Attachmt. 23		Art 18	
China	GB11551-2014		GB 20913-2007	
India			AIS-098/F	
South Korea	KMVSS 102			
Australia	ADR 69/00		ADR 73/00	

<table>
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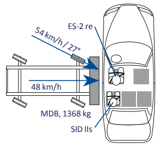
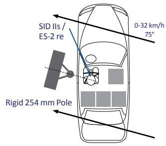
</td><td>FMVSS 214
</td><td></td><td>FMVSS 202a
FMVSS 301</td><td>FMVSS 201U</td><td>Tilted Ramp:
FMVSS 208
Roof Crush:
FMVSS 216a
Ejection Mitigation:
FMVSS 226</td></tr>
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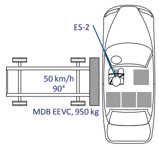</td><td></td><td>R (EC) 78/2009
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UN R127</td><td>UN R32</td><td>UN R21</td><td></td></tr>
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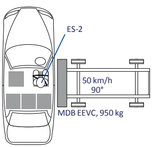</td><td></td><td>Article 18
Attachment 99</td><td>Article 18
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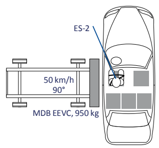</td><td></td><td>GB/T 24550-2009</td><td>GB 20072-2006</td><td></td><td>Roof Crush:
GB26134-2010</td></tr>
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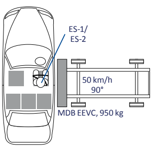</td><td></td><td>AIS-100</td><td>AIS-101</td><td></td><td></td></tr>
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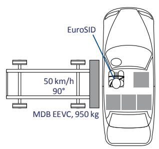</td><td></td><td>KMVSS 102-2</td><td></td><td></td><td></td></tr>
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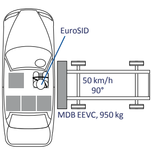</td><td></td><td></td><td></td><td></td><td></td></tr>
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International Safety and Crash-Test Regulations: Current Status and Future Developments

Course Description

Passive Safety regulations play a central role in vehicle development. Crash tests and other assessment procedures must adhere to mandatory national and international regulations that set performance requirements and design restrictions. Project managers and engineers must contend with a host of requirements (e.g., UN Regulations, EU directives and regulations, FMVSS) that often differ significantly across markets. Moreover, product plans and investment decisions must anticipate future laws, guidelines, and regulations as early as possible in order to reduce risks and capture opportunities. Indeed, customer demand is often driven by specific regulatory mandates.

During the first day, the seminar provides a comparative review of the current body of vehicle safety regulations and the drivers behind their development across major vehicle markets (e.g., US, EU, Japan, China, India). The course looks at the various regulatory systems and the policy priorities in major markets. In addition, the seminar explores global cooperation efforts and especially the impact on national and regional requirements of the UN World Forum for the Harmonization of Vehicle Regulations (WP.29) in producing uniform test procedures and performance requirements for worldwide application.

During the second day, the seminar turns its attention to key current and future regulations. In particular, the seminar draws on specific passive-safety case studies with an emphasis on crash testing requirements to focus in detail on critical differences across national and regional requirements. (The course focuses on government-mandated manufacturer requirements with only marginal reference to consumer-oriented tests (NCAP systems) since the latter are addressed extensively by other seminars.) This segment finishes with an overview of emerging priorities for future regulatory action, covering new technologies, accident categories, and global harmonization efforts.

Course Objectives

The course ultimately aims to provide participants with a working knowledge of regulatory systems and priorities across the major automotive markets that can be applied to product development plans and technology roadmaps towards meeting and anticipating customer needs. In addition, the course provides practical guidance to enable manufacturers to build from the seminar in following and, where warranted, by participating in these regulatory developments.

Who should attend?

This seminar addresses the interests of product-development and project managers and engineers, safety-test managers and specialists, regulatory compliance officers, and others whose work requires an up-to-date understanding of global regulatory requirements and future directions in a compact course.

Course Contents

- Rulemaking overview and contexts:
  Historical and legal traditions that underpin regulations and their enforcement (e.g., type approval, self-certification, product liability)
- Institutions, rulemaking processes, and priorities:
  From safety concern to regulatory requirement: how policymakers and regulatory agencies (e.g., BASt, EC, NHTSA, CATARC, MoRTH) establish test procedures and performance requirements; current regulatory priorities comparison
- Current passive-safety and crash-testing regulations:
  Overview of current requirements (e.g., UN Regulations, EC Directives, FMVSS), case studies highlighting differences and conflicts across test procedures and performance thresholds
- Future trends and priorities in passive-safety:
  Outlook for new and emerging regulatory priorities (e.g., collision-avoidance, driver-assist systems, autonomous vehicles, pedestrian safety, interactive communications, electric/hydrogen vehicles, and global harmonization)

Course Instructor (english course):

John Creamer, GlobalAutoRegs.com

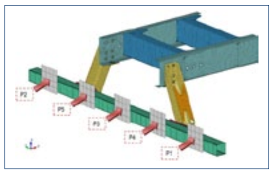
John Creamer is the founder of GlobalAutoRegs.com and a partner in The Potomac Alliance, a Washington-based international regulatory affairs consultancy. In his client advisory role, Mr. Creamer is regularly involved with meetings of the UN World Forum for the Harmonization of Vehicle Regulations (WP.29). Previously, he has held positions with the US International Trade Commission and the Motor & Equipment Manufacturers Association (representing the US automotive supplier industry), as the representative of the US auto parts industry in Japan, and with TRW Inc. (a leading global automotive safety systems supplier).

Date	Course ID	Venue	Duration	Price	Language
05.-06.02.2015	2460	Alzenau	2 Days	1.290,- EUR till 08.01.2015, thereafter 1.540,- EUR	German flag
15.-16.06.2015	2443	Alzenau	2 Days	1.290,- EUR till 18.05.2015, thereafter 1.540,- EUR	UK flag
17.-18.09.2015	2461	Alzenau	2 Days	1.290,- EUR till 20.08.2015, thereafter 1.540,- EUR	German flag

This course is available as an in-house seminar in English and German!

DTC Dynamic Test Center AG

Your partner in vehicle and aircraft safety



New test track

- Vehicle dynamics analyses
- Noise measurements
- Brake tests
- Analysis of driver assistance
- systems
- Testing of Emergency Brake Assist systems (EBA)

Crash test facilities

- Static and dynamic component tests
- Pedestrian protection tests
- Sled tests
- Full vehicle crash tests

Test facilities

- Operational stability analyses
- Endurance tests
- Vibration and oscillation analyses
- 3D laser scanning

Numerical simulation

- Engineering
- Homologation
  e.g. underride guard testing

SWISS ACCREDITATION
sas.admin.ch STS 0492

DTC Dynamic Test Center AG
Route principale 127
CH-2537 Vauffelin
www.dtc-ag.ch
Phone: +41 32 321 66 00

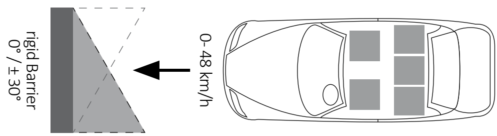
FMVSS 305: Safety Requirements for Electric Vehicles

Scope:
Cars, busses, trucks with a GVWR of 4536 kg or less that use electrical components with working voltages higher than 60 volts direct current (VDC) or 30 volts alternating current (VAC), and whose speed attainable is more than 40 km/h.

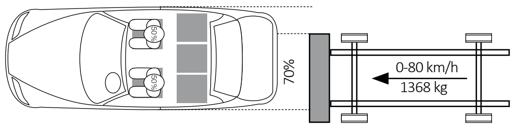
Requirements:
Under the test conditions described below (impact test and subsequent static rollover)
- max. 5 litres of electrolyte may spill from the batteries,
- there shall be no evidence of electrolyte leakage into the passenger compartments,
- all components of the electric energy storage/conversion system must be anchored to the vehicle,
- no battery system component that is located outside the passenger compartment shall enter the passenger compartment,
- electrical isolation must be greater than or equal to:
  - 500 ohms/V for all DC high voltage sources without isolation monitoring and for all AC high voltage sources,
  - 100 ohms/V for all DC high voltage sources with continuous monitoring of electrical isolation,
- the voltage of the voltage source (Vb, V1, V2) must be less than or equal to 30 VAC for AC components or 60 VDC for DC components.

Test Conditions:

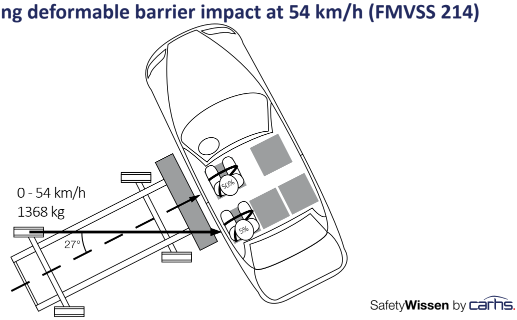
Frontal impact against a rigid barrier at 48 km/h



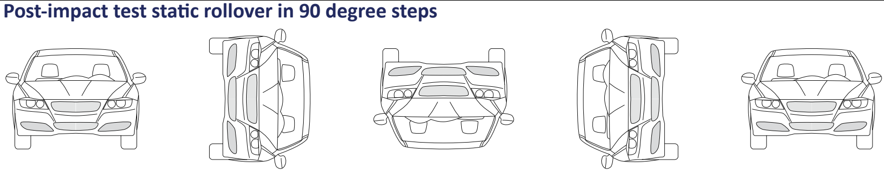
Rear moving barrier impact at 80 km/h (FMVSS 301)



Side moving deformable barrier impact at 54 km/h (FMVSS 214)



Post-impact test static rollover in 90 degree steps



Crashworthiness of Vehicles with Alternative Drive Systems

Course Description

During recent years, vehicles with alternative drive systems have achieved an ever-increasing importance for the automotive market. In addition to gas-powered vehicles, which have already been existing for many years on the manufacturer and retrofit market, a wide range of hybrid vehicles has also established meanwhile. Even for pure electric vehicles, the first acquirable products are already on the market. By decision of the German government, one million electric vehicles should be found driving on German roads by the year 2020. Only the future will show whether a fundamental paradigm change is thereby taking place or an alternative offering is just evolving. It is clear, however, that the automotive electrification cannot be stopped anymore.

With this new technology, new challenges for vehicle safety arise.

Electric shock risks on high-voltages systems, fire hazards in case of lithium-ion batteries and risks of rupture in case of gas tanks are the most important issues here. For every mode of drive, specific drive components and their particular safety requirements are described. In addition to common rules and standards, specific needs based on real-life accidents are being discussed. For all relevant vehicle components the respective safety requirements, safety concepts and exemplary safety initiatives will be discussed. The state of the art concerning test standards, verification methods and possibilities for virtual safety will be shown. Future trends will be presented with the help of current research projects and results. Practical experience of rescuing, recovering and towing of electric vehicles complete the spectrum of accident safety.

Course Objectives

Participants will get an overview about automotive safety for alternative drive systems and will learn the special challenges and solutions which come along. Participants will be able to apply test methods and safeguarding concepts and to pursue development strategies in a target-oriented way.

Who should attend?

The seminar addresses development and research engineers as well technicians in the fields of testing and engineering. Due to its current relevance the course suits young professionals as well as experienced engineers who want to deepen their knowledge in this field.

Course Contents

- Overview alternative drive systems: gas, hybrid, electric vehicles
- Challenges for vehicle safety
- Legal requirements and standards for safety
- Requirements for real-world accidents
- Safety of high voltage systems
- Battery safety
- Gas tank safety
- Fuel cell safety
- Structural safety
- Safety concepts
- Rescuing, recovering and towing of electric vehicles

Course instructor:

Dipl.-Ing. Rainer Justen, Daimler AG

Rainer Justen has more than 25 years of experience in the field of vehicle safety. After his studies in mechanical engineering with a focus on automotive engineering he started his career in 1987 in the automotive development for Mercedes-Benz at Daimler AG. Several career milestones in the fields of vehcile safety, project management, safety concepts and active safety / driver assistance systems made him an expert on all relevant topics of automotive safety. Since 2008 he is working in the field of safety for alternative drive systems. Rainer Justen is author of numerous publications and papers on this topic.

Date	Course ID	Venue	Duration	Price	Language
22.-23.04.2015	2480	Alzenau	1.5 Days	1.050,- EUR till 25.03.2015, thereafter 1.250,- EUR	
26.-27.10.2015	2481	Alzenau	1.5 Days	1.050,- EUR till 28.09.2015, thereafter 1.250,- EUR	

This course is available as an in-house seminar in English and German!

Virtual Type Approval Tests in Vehicle Homologation

Course Description

For most of today's type approval procedures in the field of vehicle safety tests with physical prototypes are employed. A few regulations allow performing type approval tests with virtual vehicle models. This saves cost, and more important, it gives a higher temporal flexibility for the overall approval process.

This seminar provides an overview on the current status regarding the possibilities of virtual testing within type approval procedures. It will be pointed out for which regulations the use of virtual testing is already possible. Using concrete examples it will be shown that virtual methods have already been applied successfully. For some of these examples the necessary procedures are illustrated in detail.

For several other safety regulations virtual testing for vehicle homologation seems to be possible. Due to the complexity of the models and the test procedures open questions still need to be resolved before the introduction of virtual testing for these regulations. The seminar depicts the current state of discussion on this. In this context results from the recently completed European research project IMVITER will be shown. Furthermore, the current state of international research on virtual testing is presented.

Course Objectives

The seminar gives a comprehensive overview on the current state of the application of virtual testing in type approval procedures. After participating to the seminar participants will be in a position to decide whether virtual admission procedures are applicable in their specific work area, or if open questions still need to be resolved before they can possibly use virtual testing in their field.

Who should attend?

The seminar is aimed at decision-makers, project managers and development engineers of the automotive industry who wish to gain an overview on the possibilities of virtual type approval. Furthermore, the seminar is also of interest for analysis engineers of the automotive industry, who want to learn about methods to validate simulation models fulfilling the requirements that are to be applied in a virtual admission procedure. Also, all experts from the automotive industry and technical services, whose work includes vehicle homologation, can inform themselves about the latest developments on virtual type approval procedures.

Course Contents

- Introduction to virtual testing for type approval
  - Motivation
  - Legal principles and guidelines
- Detailed examples of regulations that can already be checked virtually
  - Geometric requirements (e.g. field of view, wheel coverage)
  - Proof of strength (e.g. towing devices, under-ride protection)
- Status of the international working groups on virtual testing
  - ISO WG4
  - EEVC WG22
- Findings from the IMVITER EU project (Implementation of Virtual Testing in Safety Regulations)
  - Extended validation methods
  - Example of pedestrian head impact protection
  - Cost-benefit considerations

Course instructor:

Dr.-Ing. Andre Eggers, German Federal Highway Research Institute (BASt)

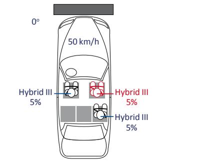
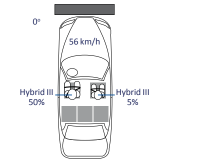
Andre Eggers studied mechanical engineering at the Technical University of Hamburg-Harburg and Biomedical Engineering at Wayne State University. In 2013 he completed his doctorate at the Technical University of Berlin. Since 2006 he is employed as a researcher at the German Federal Highway Research Institute. He is responsible for the areas of biomechanics, evaluation of new dummies and human models. He is the German representative in the bodies EEVC WG12 "Biomechanics" and WG22 "Virtual Testing". In the EC funded project IMVITER (Implementation of Virtual Testing in Safety Regulations) he was leader of the work package "Proposal for a Virtual Testing based Homologation Procedure".

Date	Course ID	Venue	Duration	Price	Language
22.09.2015	2445	Alzenau	1 Day	740,- EUR till 25.08.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

NCAP-Tests in Europe & America

2015 2016 2017 2018

<table>
<tr><th></th><th>Euro NCAP</th><th>U.S. NCAP</th><th>IIHS</th><th>Latin NCAP</th></tr>
<tr><td>Full Width</td><td>
</td><td>
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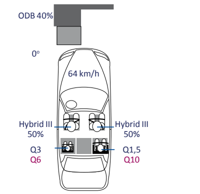
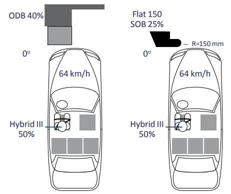
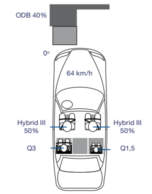
<tr><td>ODB / SOB</td><td>
</td><td></td><td>
</td><td>
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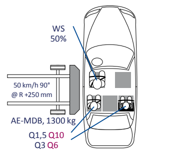
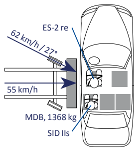
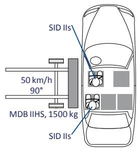
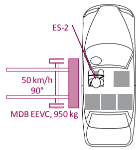
<tr><td>MDB</td><td>

■ Far Side Occupant Protection</td><td>
</td><td>
</td><td>
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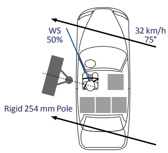
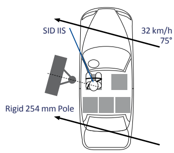
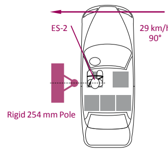
<tr><td>Pole</td><td>
</td><td>
</td><td></td><td>

(prerequisite for 5 star rating)</td></tr>
<tr><td>Rollover</td><td></td><td>■ SSF</td><td>■ Roof Crush</td><td></td></tr>
<tr><td>Pedestrian</td><td>■ Flex PLI
■ Upper Legfom
■ Headforms
■ AEB VRU</td><td colspan="2" rowspan="2">Find all details in:

</td><td>■ Award</td></tr>
<tr><td>Child Safety</td><td>■ Frontal ODB
■ Side MDB
■ CRS- Installation
■ Vehicle based assessment</td><td>■ Frontal ODB
■ CRS- Installation
■ Vehicle based assessment</td></tr>
<tr><td>Whiplash</td><td>■ static front / rear
■ dynamic (3 pulses)
■ AEB City</td><td></td><td>■ static
■ dynamic (1 pulse)</td><td></td></tr>
<tr><td>Other</td><td>■ Assistance systems: SBR, SAS, ESC, AEB, ...</td><td>■ FCW, LDW, Rear View Cameras</td><td>■ FCW / AEB</td><td>■ SBR, ABS (prerequisite for 5 star rating)
■ ESC</td></tr>
</table>

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NCAP-Tests in Asia / Australia

2015 2016 2017 2018

<table>
<tr><th></th><th>JNCAP</th><th>C-NCAP</th><th>KNCAP</th><th>ASEAN NCAP</th><th>ANCAP</th></tr>
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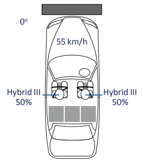
<td>
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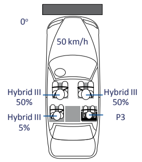
<td>
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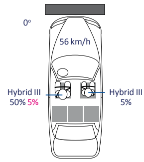
<td>
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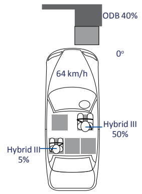
<td>
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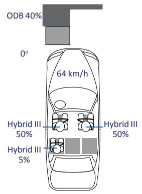
<td>
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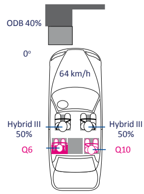
<td>
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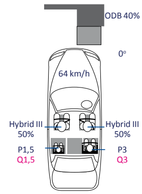
<td>
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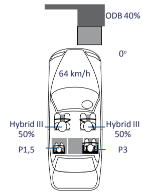
<td>
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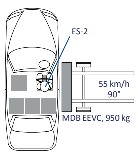
<td>
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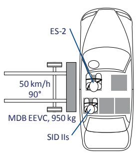
<td>
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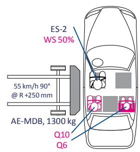
<td>
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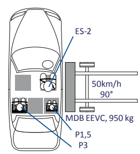
<td>
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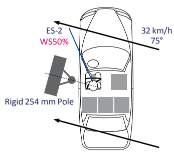
<td>
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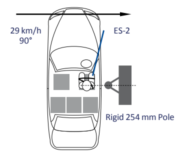
<td>
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■ Headforms
■ AEB Pedestrian</td><td></td><td>■ Flex PLI
■ Upper Legform (on bumper only)
■ Headforms
■ AEB Pedestrian</td><td></td><td>■ EEVC Legform
■ Upper Legform
■ Headforms</td></tr>
<tr><td>Child Safety</td><td></td><td>■ P3 in Full Width Frontal</td><td>■ Q6, Q10 in ODB and MDB</td><td>■ Frontal
■ CRS-based assessment
■ Vehicle based ass.</td><td>■ ODB, MDB (no assessment)</td></tr>
<tr><td>Whiplash</td><td>■ dynamic (1 pulse)</td><td>■ dynamic (1 pulse)</td><td>■ static
■ dynamic (1 Pulse)
■ rear seats dynamic</td><td></td><td>■ static
■ dynamic (1 pulse)</td></tr>
<tr><td>Other</td><td>■ Brakes, SBR, Usability rear belts, LDW, AEB, LKA, Around View</td><td>■ ESC
■ SBR
■ AEB, FCW, LDW</td><td>■ Brakes, SBR, FCWS, LDWS, SLD, AEBS, AEBS City, ACC, LKAS</td><td>■ ESC, SBR (prerequisite for 5 star rating)</td><td>■ Assistance systems</td></tr>
</table>

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Euro NCAP and global Tests for Consumer Protection through Active and Passive Safety

Course Description

More than 35 years ago the U.S. Senate demanded with a decree by the Department of Transportation (DOT) to comparatively examine new vehicles under economical and safety aspects and to publish the results. This was to motivate automakers in their competition to optimize the safety level of the vehicles beyond legal minimum standards.These approaches have been taken up by several organizations since then (Euro NCAP, ADAC, AMS, IIHS, ANCAP, NASVA, JNCAP) and partly developed further with different main focuses.The multitude of tests and especially the differences in the assessment of crash tests have quite often led to uncertainties with consumers. Some tests have thus been harmonized in recent years. Since its introduction in 1997 the Euro NCAP has has been taking a leading role in Europe and also has gained significant influence on other countries. In the beginning the tests that were carried out were frontal impact tests and side impact tests with a moving barrier. In the last few years the lateral pole impact as well as tests for pedestrian protection have been added, child safety was added in 2003. A rear impact test has been added in 2008.

In this seminar, after a short look at the history of NCAP testing and an overview over the responsible organizations, you are going to learn about the different tests. The current crash-tests are going to be compared and discussed, and the stipulated tests are going to be included as well. The assessment criteria (points, star-rating and especially the modifiers) will be explained in detail.The main focus is on the current Euro NCAP. An outlook on the future development of Euro NCAP with an extension of the tests towards Active Safety (Beyond NCAP) and global harmonization completes the seminar.

Who should attend?

The seminar addresses specialists from the field of crash, engineers and technicians from numerical simulation and testing departments, project engineers and managers who want to have a first-hand, up-to-date overview over consumer information tests with current topics and future trends in a compact seminar.

Course Contents

- Overview over crash-tests for consumer information
- U.S. NCAP: Frontal impact with full overlap, side impact, new rating scheme, crash avoidance technolgogies rating
- IIHS: Frontal impact with offset, side impact, headrest, roof crush, small overlap
- Euro NCAP: General information, frontal impact ODB & full-width, side impact (barrier & pole), whiplash test, modifiers, safety assist systems (SBR, SAS, ESC, AEB, LDW...), overall assessment, the new rating scheme, road map
- Child seat assessment in Euro NCAP, JNCAP
- Pedestrian protection-assessment: Euro NCAP
- Australasian NCAP
- JNCAP: Frontal impact full-width and offset, side impact, overall assessment
- Korea NCAP
- China NCAP
- Latin NCAP / ASEAN NCAP
- Future development of the NCAP-Tests: Harmonization
- Global NCAP

Course Instructor:

Direktor & Professor Andre Seeck, German Federal Highway Research Institute (BASt)

Andre Seeck is head of the division “Vehicle Technology” with the German Federal Highway Research Institute (BASt). In this position he is responsible for the preparation of European Safety Regulations. He also represents the German Federal Ministry of Transport and Digital Infrastructure in the Board of Directors of Euro NCAP. These positions enable him to gain deep insight into current and future developments in vehicle safety.

Date	Course ID	Venue	Duration	Price	Language
20.-21.04.2015	2470	Alzenau	2 Days	1.290,- EUR till 23.03.2015, thereafter 1.540,- EUR	
13.-14.07.2015	2490	Alzenau	2 Days	1.290,- EUR till 15.06.2015, thereafter 1.540,- EUR	
01.-02.10.2015	2471	Alzenau	2 Days	1.290,- EUR till 03.09.2015, thereafter 1.540,- EUR	

This course is available as an in-house seminar in English and German!  

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- Algorithm development for cooperative safety systems
- Crash and structure computations, passenger simulation
- Subsystem safety testing
- Predictive, active and passive pedestrian protection
- Integration of new NCAP requirements
- Sensor selection for active and passive systems
- Crash and catapult testing, pre-crash testing

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Euro NCAP
Protection Criteria in Frontal Impact

For each body region (grey boxes) the score is calculated based on the worst injury criterion and applicable modifiers. Where a value falls between the upper and lower limit the score is calculated by linear interpolation. The scores are presented visually, using colored segments within body outlines. The color used is based on the points awarded for that body region as shown below. The total score is scaled by a factor of 0.5.

- (green) 4.00 points
- (yellow) 2.67 – 3.99 points
- (orange) 1.33 – 2.66 points
- (brown) 0.01 – 1.32 points
- (red) 0.00 points

Hybrid III 50% Male

Head	
4 points	HIC_{15} < 500; a_{3ms} < 72 g
0 points	HIC_{15} > 700; a_{3ms} > 80 g
Modifier	unstable airbag/steering wheel contact (-1 point) Hazardous Airbag Deployment (-1 point) Incorrect Airbag Deployment (-1 point) Steering column displacement (-1 point)

Neck		
4 points	$M_{y,extension}$	< 42 Nm
	$F_{z,tension}$	< 2.7 kN @ 0 ms < 2.3 kN @ 35 ms < 1.1 kN @ 60 ms
	$F_{x,shear}$	< 1.9 kN @ 0 ms < 1.2 kN @ 25 – 35 ms < 1.1 kN @ 45 ms
0 points	$M_{y,extension}$	> 57 Nm
	$F_{z,tension}$	> 3.3 kN @ 0 ms > 2.9 kN @ 35 ms > 1.1 kN @ 60 ms
	$F_{x,shear}$	> 3.1 kN @ 0 ms > 1.5 kN @ 25 – 35 ms > 1.1 kN @ 45 ms

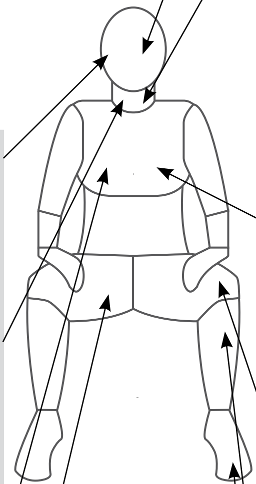
Chest	
4 points	Deflection < 22 mm; VC < 0.5 m/s
0 points	Deflection > 42 mm; VC > 1.0 m/s
Modifier	Displacement of the A Pillar (-2 points) Passenger Compartment Integrity (-1 point) Steering Wheel Contact (-1 point) Incorrect Airbag Deployment (-1 point) Shoulder belt load > 6kN (-2 points)

Femur	
4 points	Axial $Force_{Compression}$ < 3.8 kN
0 points	Axial $Force_{Compression}$ > 9.07 kN > 7.56 kN @ 10 ms

Knee	
4 points	Displacement < 6 mm
0 points	Displacement > 15 mm
Modifier	Variable contact (-1 point) Concentrated Loading (-1 point) Incorrect Airbag Deployment (-1 point)

Tibia	
4 points	TI < 0,4; Axial $Force_{Compression}$ < 2 kN
0 points	TI > 1.3; Axial $Force_{Compression}$ > 8 kN
Modifier	Upward Displacement of the Worst Performing Pedal (-1 point)

Foot	
4 points	Pedal rearward displacement < 100 mm
0 points	Pedal rearward displacement > 200 mm
Modifier	Footwell Rupture (-1 point) Pedal Blocking (-1 point)



SafetyWissen by carhs

Hybrid III 5% Female

Head	
4 points	HIC_{15} < 500; a_{3ms} < 72 g
0 points	HIC_{15} > 700; a_{3ms} > 80 g
Modifier	unstable airbag/steering wheel contact (-1 point) Hazardous Airbag Deployment (-1 point) Incorrect Airbag Deployment (-1 point) Steering column displacement (-1 point) Exceeding forward excursion line* (-4 points)

Neck		
4 points	$M_{y,extension}$	< 36 Nm
	$F_{z,tension}$	< 1.7 kN
	$F_{x,shear}$	< 1.2 kN
0 points	$M_{y,extension}$	> 49 Nm
	$F_{z,tension}$	> 2.62 kN
	$F_{x,shear}$	> 1.95 kN

Chest	
4 points	Deflection < 18 mm; VC < 0.5 m/s
0 points	Deflection > 42 mm; VC > 1.0 m/s
Modifier	Steering Wheel Contact (-1 point) Incorrect Airbag Deployment (-1 point) Shoulder belt load > 6kN (-2 pointa)

Femur	
4 points	Axial $Force_{Compression}$ < 2.6 kN
0 points	Axial $Force_{Compression}$ > 6.2 KN
Modifier	Submarining (-4 points) Incorrect Airbag Deployment (-1 point)

* Rear Passenger only

Doors	
Modifier	Door Opening during the Impact (-1 point/ door)*

* modifier will be applied to the overall score for that test

Assessment Protocol Version 7.0.1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Assessment Protocol Version 7.0.1

Euro NCAP
Protection Criteria in Side Impact (MDB and Pole)

World SID 50% Male

Head[1]	
4 points	$HIC_{15} < 500$; $a_{3ms} < 72$ g
0 points	$HIC_{15} > 700$; $a_{3ms} > 80$ g
Modifier	Incorrect Airbag Deployment (-1 point)

[1] Pole: no sliding scale, only capping if $HIC_{15} > 700$ or $a_{res, peak} > 80$ g or direct head contact with the pole.

Chest	
4 points	Deflection < 28 mm;
0 points	Deflection > 50 mm
Modifier	Incorrect Airbag Deployment (-1 point) shoulder lateral force ≥ 3.0 kN (no points will be awarded for the chest) VC ≥ 1.0 m/s (no points will be awarded for the chest)

Abdomen	
4 points	Deflection < 47 mm;
0 points	Deflection > 65 mm
Modifier	VC ≥ 1.0 m/s (no points will be awarded for the abdomen)

Pelvis	
4 points	PSPF < 1.7 kN
0 points	PSPF > 2.8 kN

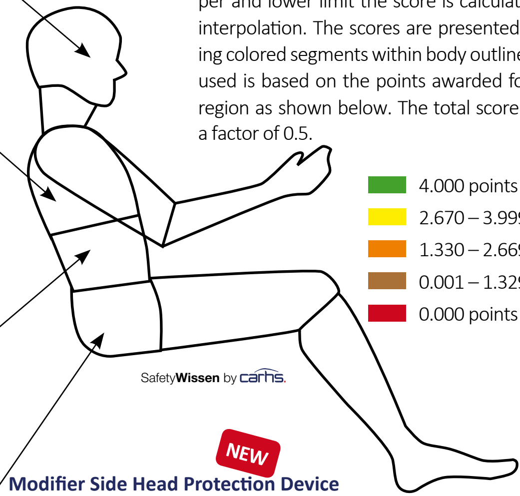
Side Head Protection Device	
Modifier	insufficient protection in the ‚Head Protection Device Assessment Zone' (-4 points)*

* modifier will be applied to the overall pole impact score.

Doors	
Modifier	Door Opening during the Impact (-1 point/door)*

* modifier will be applied to the overall score for that test

For each body region (grey boxes) the score is calculated based on the worst injury criterion and applicable modifiers. Where a value falls between the upper and lower limit the score is calculated by linear interpolation. The scores are presented visually, using colored segments within body outlines. The color used is based on the points awarded for that body region as shown below. The total score is scaled by a factor of 0.5.

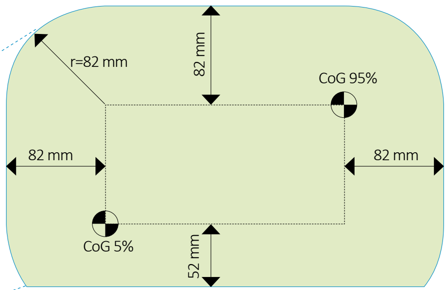


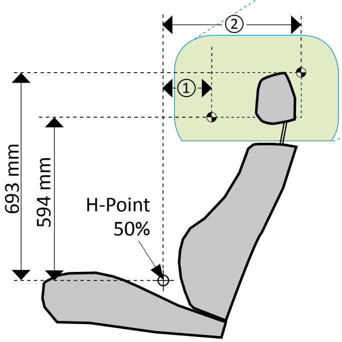
- 4.000 points
- 2.670 – 3.999 points
- 1.330 – 2.669 points
- 0.001 – 1.329 points
- 0.000 points

NEW

Modifier Side Head Protection Device

Inside the ‚Head Protection Device Assessment Zone' (green) the head protection system's coverage is assessed. If the coverage is insufficient a 4 point modifier is applied the overall pole impact score. Areas outside the Daylight Opening (FMVSS 201) are excluded from assessment. Seams are not penalized if the un-inflated area is no wider than 15mm. Any other un-inflated areas that are no larger than 50mm in diameter (or equivalent area) are not penalized.

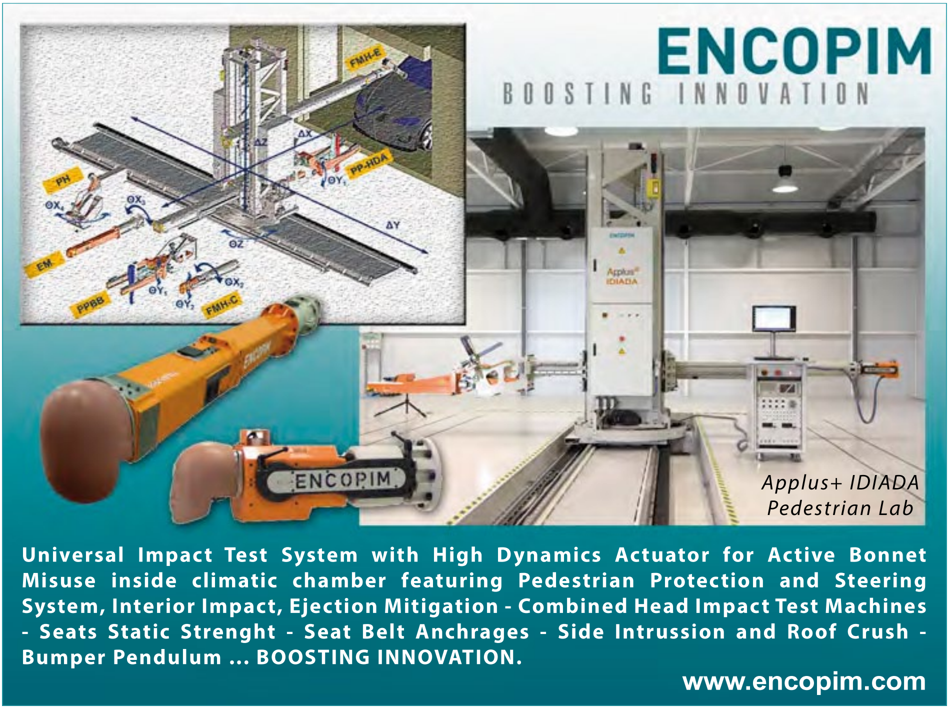




The head protection device (HPD) evaluation zone (green) is defined as a rounded rectangle around the head CoG box (defined by the head CoGs of the 5% female and 95% male occupants) at a distance of 82 mm from the upper and fore/aft edges and 52 mm below the bottom edge. The x-position of the CoG is defined relative to the H-Point of the 50% male:

Front seats:
① = H-Point(x) + 126 mm - seat travel(5th%ile-50th%ile)
② = H-Point(x) + 147 mm + seat travel(50th%ile-95th%ile)

Rear seats:
① = H-Point(x) + 126 mm - seat travel
② = H-Point(x) + 147 mm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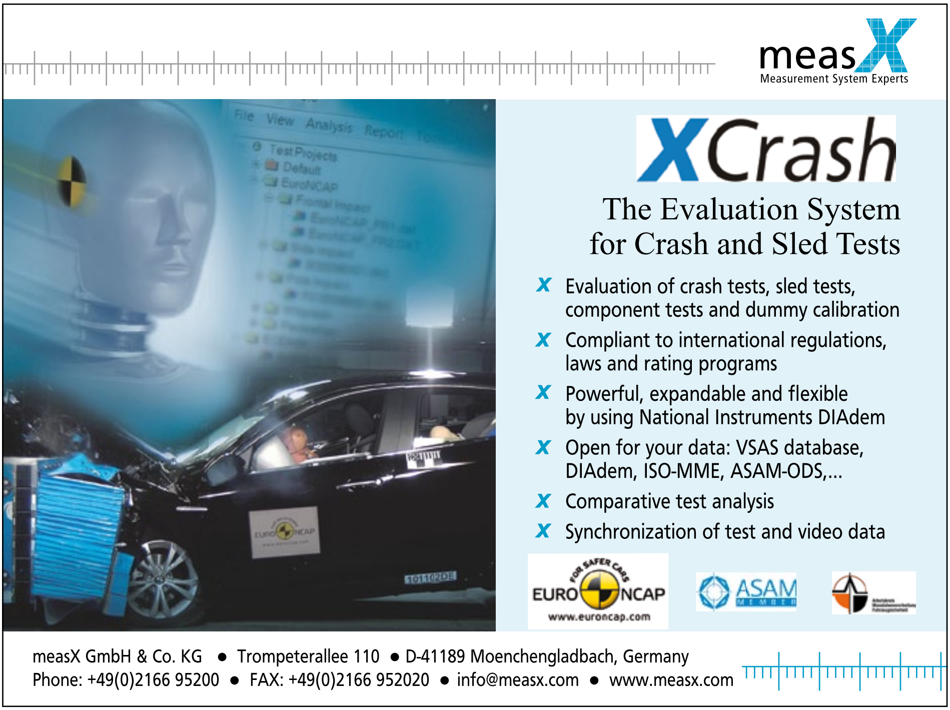
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Euro NCAP Roadmap: 2015 - 2016

	Adult Occupant Prot.			Child Occupant Prot.			Pedestrian Protection			Safety Assist			2015 Safety Assist fitment requirement
		2015	2016		2015	2016		2015	2016		2015	2016	
	Test			Test			Test			Test			
	Offset Frontal impact ➲ page 32	8	8	Dyn. Tests Frontal ➲ page 96	16	16	Head Impact ➲ page 85	24	24	Seat Belt Reminder ➲ page 114	3	3	100%
	Full-width Frontal impact ➲ page 32	8	8	Dyn. Tests Side ➲ page 96	8	8	Leg Impact ➲ page 85	6	6	Speed Assi-stance Syst. ➲ page 114	3	3	70%
	Side impact (MDB) ➲ page 34	8	8	CRS Installation ➲ page 96	12	12	Upper Leg Impact ➲ page 85	6	6	ESC ➲ page 114	3	3	100%
	Side impact (Pfahl) ➲ page 34	8	8	Vehicle ➲ page 96	13	13	AEB VRU ➲ page 120	-	6	LDW / LKD ➲ page 114	1	1	50%
	Whiplash Front ➲ page 94	2	2							AEB Inter-Urban ➲ page 122	3	3	50%
	Whiplash Rear ➲ page 92	1	1										
	AEB City ➲ page 119	3	3										
max. score (1)	∑	38	38	∑	49	49	∑	36	42	∑	13	13	
normalised score (2)	actual score / (1)			actual score / (1)			actual score / (1)			actual score / (1)			
weighting (3)		40%	40%		20%	20%		20%	20%		20%	20%	Overall Score (5)
weighted score (4)		(2) x (3)			(2) x (3)			(2) x (3)			(2) x (3)		∑(4)
Rating	minimum normalised score (2) by box for the respective star rating												minimum overall score (5):

	Adult 2015	Adult 2016	Child 2015	Child 2016	Pedestrian 2015	Pedestrian 2016	Safety Assist 2015	Safety Assist 2016	Overall 2015	Overall 2016
★★★★★	80%	80%	75%	75%	65%	65%	70%	70%	75%	75%
★★★★	70%	70%	60%	60%	50%	55%	60%	60%	65%	65%
★★★	50%	50%	30%	30%	40%	40%	40%	40%	50%	50%
★★	30%	30%	25%	25%	20%	20%	20%	20%	40%	40%
★	20%	20%	15%	15%	10%	10%	10%	10%	30%	30%

Dual Rating (as of 2016) NEW

As of 2016 Euro NCAP will issue a base rating for standard equipment only. Fitments rates for safety assist technologies will no longer be considered. Optionally manufacturers who agree to actively promote the star rating can apply for a secondary rating of a model equipped with an optional safety package that meets a certain market installation rate (25% in the first 3 years and 55% in the subsequent 3 years). The safety package must be available, at least as an option, on all variants in the model range.

UpDate Seminar: Euro NCAP 2016+

Description

Euro NCAP currently is the globally leading program for vehicle safety assessment. The continuous further development of the program from passive towards active safety was initiated in 2013 and led to the assessment of autonomous emergency braking systems for vehicle-to-vehicle collisions in 2014 (AEB City and Inter-Urban). In 2016 the assessment of autonomous emergency braking systems for pedestrians (AEB VRU) will be added to the rating system.

Moreover there have been numerous additions and modifications in the passive safety assessment:

All rating categories underwent significant changes. In adult occupant protection a full width rigid wall crash was added. Also new dummies, barriers and crash configurations are used. In pedestrian protection the Flex PLI and the grid method were introduced. In child occupant protection new dummies and a new CRS installation test were introduced. In 2016 the current dummies will be replaced by the Q6 and Q10 dummies representing more grown up children.

In the summer of 2014 Euro NCAP has published the guidelines for the development of the program until 2020. The implementation of the **Roadmap 2020** will start in 2016 aiming at further improvement in vehicle safety by means of advanced but feasible technical solutions.

A fundamental change is the **Dual Rating**: As of 2016 a base rating will be given to the model with the lowest safety specification. A secondary rating reflects the performance of a model equipped with an optional (paid for) safety package.

In the occupant protection domain a new frontal impact against a mobile barrier (replacing the current ODB crash) and a test method for the protection of far side occupants in side impacts will be developed. The AEB tests will be updated in terms of test scenarios. In the lateral assist domain initially a test procedure for lane keep assist systems will be developed and implemented. In a second step this method will be extended to take into account unintended road departures with potential crashes into fixed objects as a result. In addition to this modifications of the rating (e.g. regarding speed assistance systems) are planned and campaigns and awards aim at pushing the development of new safety technologies.

After a review of the experiences that have been made since the start of the implementation of the Road Map 2016 in 2013, the seminar provides an informed outlook on the upcoming changes:

The changes planned for 2016 (AEB-VRU, Q6 & Q10, Dual Rating) will be presented in detail. For the changes planned in the 2017-2020 period the Euro NCAP experts report on the current state of the discussions and provide insight into the backgrounds, motivations and guidelines that will determine the new assessment methods.

Course Contents

- Experiences since 2013
- Updates 2016
- Roadmap 2020
  - Occupant protection ind frontal and side crashes
    - New frontal crash
    - Protection of far side occupants in side crashes
    - Q6 and Q10 Dummy in child protection
    - SBR update
  - Update of AEB tests and HMI guidelines
  - Lateral guidance systems (Lane Keep Assist test)
  - Update of Speed Assist System assessment

Who should attend?

This seminar is suited for automotive engineers who are involved in the development and verification of active and passive safety technologies. Moreover it is an opportunity for managers in charge of the development of such technologies to become familiar with Euro NCAP's goals and methods.





Course Instructors:

Dirk-Uwe Gehring, Managing Director BGS Böhme & Gehring GmbH

Dr. Michiel van Ratingen, Secretary General of Euro NCAP

Andreas Rigling, Project Manager Passive Safety & Consumer Protection, ADAC Technik Zentrum Landsberg

Volker Sandner, Division Manager Passive Safety, ADAC Technik Zentrum Landsberg

Direktor und Professor Andre Seeck, Member of the Board of Directors, Euro NCAP

Date	Course ID	Venue	Duration	Price	Language
26.-27.10.2015	2587	Frankfurt	2 Days	1.450,- EUR till 28.09.2015, thereafter 1.690,- EUR	

Knee Mapping Workshop
The Euro NCAP Test Procedure

Course Description

Euro NCAP plays a leading role among the tests assessing the passive safety of vehicles in Europe. Its influence now also extends to other countries. Recently the knee impact test procedure within the Euro NCAP frontal impact test was modified, the goal being a less subjective assessment. A hard contact or a sharp edge in the knee area implies the danger for a car manufacturer to be punished with a so-called knee modifier (reduction in points). The knee modifier is the most frequent penalty within the Euro NCAP and impairs some vehicles' otherwise 5-star ratings. The allocation of a knee modifier often is a controversial decision. If a knee modifier has been allocated by the Euro NCAP inspector the car manufacturer has the possibility of proving - by means of a complex sled test procedure - that the modifier was not justified.
After a short introduction the main focus of the workshop is on the current Euro NCAP assessment procedure for frontal impact in the knee area (knee mapping). The current requirements will be explained in detail, in particular the knee modifiers 'Variable Contact' and 'Concentrated Loading', the areas of inspection and the threshold values. Positive / negative examples will facilitate the participants' understanding of the requirements and the assessment procedure. Participants will learn how to avoid a modifier. The sled test procedure will also be explained and discussed in detail.
In the afternoon a demo vehicle, which can be provided by participants, will be analyzed. Ralf Ambos, a trained Euro NCAP inspector, can give valuable hints here.
A perspective regarding the future development of the test procedure will be given at the end of the seminar.

Who should attend?

The seminar addresses specialists from the field of crash, engineers and technicians from numerical simulation and testing, project engineers and managers who want to have a first-hand, up-to-date information and hints on how to avoid knee modifiers in Euro NCAP.

Course Contents

- Overview of Euro NCAP crash tests
- Euro NCAP requirements in the knee area
- Knee modifier, knee mapping test procedure
- Sled test procedure for knee impact
- Discussion of the assessment procedure and possibilities of interpretation
- Workshop with analysis of test vehicles, which can be provided by participants
- Future development of the test procedure

„The workshop was very informative and relevant. The final analysis of a test vehicle was very helpful."
Ray Longbottom,
SAIC Motor UK Technical Centre Ltd., UK

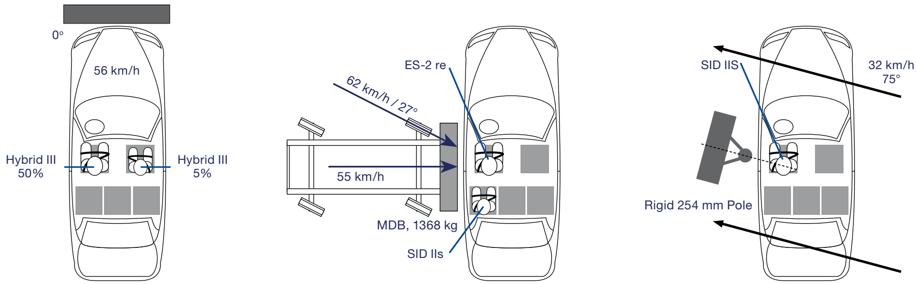
Course Instructor:
Dipl.-Ing. Ralf Ambos, DEKRA Automobil GmbH

Ralf Ambos studied automotive technology at the university for technology and economy in Dresden, Germany. He has worked as a project manager in passive vehicle safety for eight years. In 2004 he was trained as an inspector for Euro NCAP. In 2009 he joined DEKRA Automobil GmbH.

Date	Course ID	Venue	Duration	Price	Language
19.06.2015	2442	Alzenau	1 Day	740,- EUR till 22.05.2015, thereafter 890,- EUR	English

This course is available as an in-house seminar in English and German!

U.S. NCAP
Tests and Criteria

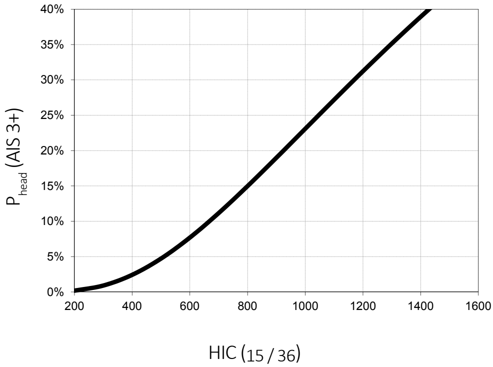


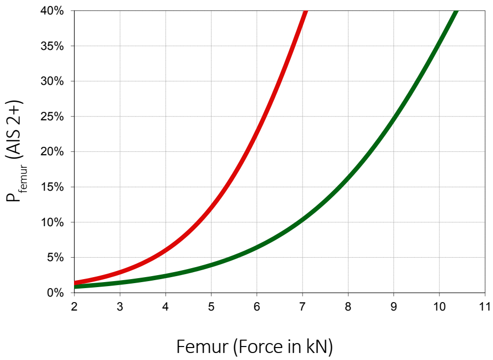
Injury Criteria	Injury Risk Curves	
FRONTAL IMPACT		
	Hybrid III 50% (Driver)	**Hybrid III 5% (Passenger)**
Head (HIC_{15})	$P_{head}(AIS\,3+) = \Phi\left(\frac{\ln(HIC15) - 7.45231}{0.73998}\right)$ *where* Φ = cumulative normal distribution	$P_{head}(AIS\,3+) = \Phi\left(\frac{\ln(HIC15) - 7.45231}{0.73998}\right)$ *where* Φ = cumulative normal distribution
Chest (deflection in mm)	$P_{chest\_defl}(AIS\,3+) = \frac{1}{1 + e^{10.5456 - 1.568*(ChestDefl)^{0.4612}}}$	$P_{chest\_defl}(AIS\,3+) = \frac{1}{1 + e^{10.5456 - 1.7212*(ChestDefl)^{0.4612}}}$
Femur (force in kN)	$P(AIS\ 2+) = \frac{1}{1 + e^{5.795 - 0.5196\,Femur\_Force}}$	$P(AIS\ 2+) = \frac{1}{1 + e^{5.7949 - 0.7619\,Femur\_Force}}$
Neck (N_{ij} and tension/ compression in kN)	$P_{neck\_Nij}(AIS\,3+) = \frac{1}{1+e^{3.2269 - 1.9688\,Nij}}$ $P_{neck\_Tens}(AIS3+) = \frac{1}{1+e^{10.9745 - 2.375\,Neck\_Tension}}$ $P_{neck\_Comp}(AIS3+) = \frac{1}{1+e^{10.9745 - 2.375\,Neck\_Compression}}$ $P_{neck} = \max imum(P_{neck\_Nij}, P_{neck\_Tens}, P_{neck\_Comp})$	$P_{neck\_Nij}(AIS\,3+) = \frac{1}{1+e^{3.2269 - 1.9688\,Nij}}$ $P_{neck\_Tens}(AIS3+) = \frac{1}{1+e^{10.958 - 3.770\,Neck\_Tension}}$ $P_{neck\_Comp}(AIS3+) = \frac{1}{1+e^{10.958 - 3.770\,Neck\_Compression}}$ $P_{neck} = \max imum(P_{neck\_Nij}, P_{neck\_Tens}, P_{neck\_Comp})$
	$P_{joint} = 1-(1-P_{head})x(1-P_{neck})x(1-P_{chest})x(1-P_{femur})$	
SIDE IMPACT (MDB & Pole Test)		
	ES-2re 50%	**SID-IIs 5%**
Head (HIC_{36})	$P_{head}(AIS3+) = \Phi\left(\frac{\ln(HIC36) - 7.45231}{0.73998}\right)$ *where* Φ = cumulative normal distribution	$P_{head}(AIS3+) = \Phi\left(\frac{\ln(HIC36) - 7.45231}{0.73998}\right)$ *where* Φ = cumulative normal distribution
Chest (rib deflection in mm)	$P_{chest}(AIS3+) = \frac{1}{1+e^{5.3895 - 0.0919*\max.\,rib\ deflection}}$	
Abdomen (total abdominal force in N)	$P_{abdomen}(AIS3+) = \frac{1}{1+e^{6.04044 - 0.002133*F}}$ *where F =total abdominal force (N) in ES-2re*	
Pelvis (Force)	$P_{pelvis}(AIS3+) = \frac{1}{1+e^{7.5969 - 0.0011*F}}$ *where F is the pubic force in the ES-2re in Newtons*	$p_{pelvis}(AIS2+) = \frac{1}{1+e^{6.3055 - 0.00094*F}}$ *where F is the sum of acetabular and iliac force in the SID – IIs dummy in Newtons*
SafetyWissen by carhs.	$P_{joint} = 1-(1-P_{head})x(1-P_{chest})x(1-P_{abdomen})x(1-P_{pelvis})$	$P_{joint} = 1-(1-P_{head})x(1-P_{pelvis})$

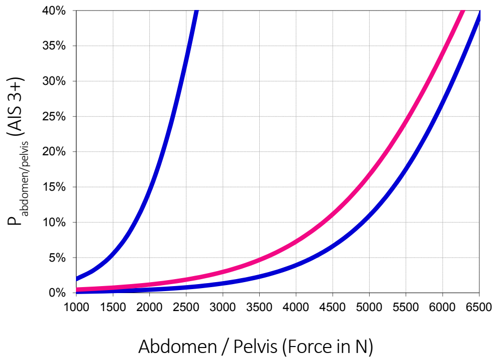
U.S. NCAP: Injury Risk Curves

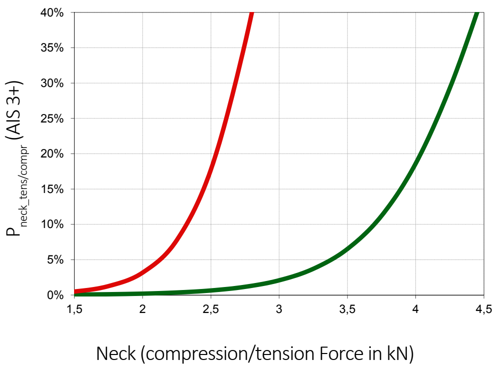
- Hybrid III 50%
- Hybrid III 5%
- multiple Dummys
- ES-2re 50%
- SID-IIs 5%

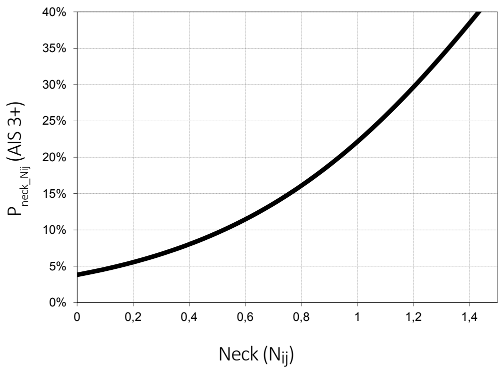
SafetyWissen by carhs.











U.S. NCAP: Rating Scheme

<table>
<tr><td colspan="2">Frontal Crash Test</td><td>Side Pole Test</td><td colspan="2">Side MDB Test</td><td>Rollover Test</td></tr>
<tr><td>Driver</td><td>Passenger</td><td>Front Seat</td><td>Front Seat</td><td>Rear Seat</td><td></td></tr>
<tr><td>Injury Criteria</td><td>Injury Criteria</td><td>Injury Criteria</td><td>Injury Criteria</td><td>Injury Criteria</td><td></td></tr>
<tr><td>Probabilty of Injury (Risk Curves) P_{joint}</td><td>Probabilty of Injury (Risk Curves) P_{joint}</td><td>Probabilty of Injury (Risk Curves) P_{joint}</td><td>Probabilty of Injury (Risk Curves) P_{joint}</td><td>Probabilty of Injury (Risk Curves) P_{joint}</td><td>Probabilty of Rollover P_{roll}</td></tr>
<tr><td>$RR^{*}=P_{joint}/base^{**}$</td><td>$RR^{*}=P_{joint}/base^{**}$</td><td>$RR^{*}=P_{joint}/base^{**}$</td><td>$RR^{*}=P_{joint}/base^{**}$</td><td>$RR^{*}=P_{joint}/base^{**}$</td><td>$RR^{*}=P_{roll}/base^{**}$</td></tr>
<tr><td rowspan="2">Driver Stars (50%)</td><td rowspan="2">Passenger Stars (50%)</td><td>Stars (20%)</td><td>Stars (80%)</td><td rowspan="2">Rear Seat Stars (50%)</td><td rowspan="3">Overall Rollover Star Rating (3/12)</td></tr>
<tr><td colspan="2">Front Seat Stars (50%)</td></tr>
<tr><td colspan="2">Overall Frontal Star Rating (5/12)</td><td colspan="3">Overall Side Star Rating (4/12)</td></tr>
<tr><td colspan="6">Vehicle Safety Score (VSS)
SafetyWissen by carhs.</td></tr>
</table>

*RR = relative risk; **base = baseline risk = 15%

Rating procedure

Using the Injury Risk Curves on ➲ page 40 and page 42, the risk of a serious injury (AIS 3+) can be calculated from the injury criteria measured in the crash test. The joint risk for an occupant can be determined using the following formulae:

Frontal Impact: $P_{joint} = 1 - (1 - P_{head}) \times (1 - P_{neck}) \times (1 - P_{chest}) \times (1 - P_{femur})$

Side Impact: $P_{joint} = 1-(1-P_{head})\times(1-P_{chest})\times(1-P_{abdomen})\times(1-P_{pelvis})$

This risk is compared to a so called baseline risk which was set to 15 %. This ratio is called relative risk (RR) from which the star rating is determined using the following table:

RR	0	0.67	1	1.33	2.67
Stars	★★★★★	★★★★	★★★	★★	★

IIHS Rating
Frontal Impact

Testing Protocol Version XV (May 2014)

SafetyWissen by carhs	Good	Acceptable	Marginal	Poor
Head/Neck				
HIC_{15}	≤ 560	≤ 700	≤ 840	> 840
N_{ij}	≤ 0.80	≤ 1.00	≤ 1.20	> 1.20
$F_{z,tension}$ (kN)	≤ 2.6	≤ 3.3	≤ 4.0	> 4.0
$F_{z,compression}$ (kN)	≤ 3.2	≤ 4.0	≤ 4.8	> 4.8
$a_{res\ peak}$	Values > 70 g result in downgrading			
Chest				
a_{3ms}	≤ 60	≤ 75	≤ 90	> 90
Deflection (mm)	≤ 50	≤ 60	≤ 75	> 75
Deflection rate (m/s)	≤ 6.6	≤ 8.2	≤ 9.8	> 9.8
VC (m/s)	≤ 0.8	≤ 1.0	≤ 1.2	> 1.2
Legs & Feet				
Femur Axial Force (kN) (Force duration corridors)	≤ 7.3 @ 0ms ≤ 6.1 @ 10ms	≤ 9.1 @ 0ms ≤ 7.6 @ 10ms	≤ 10.9 @ 0ms ≤ 9.1 @ 10ms	>10.9 @ 0ms > 9.1 @ 10ms
Knee Displacement (mm)	≤ 12	≤ 15	≤ 18	> 18
TI (upper, lower)	≤ 0.80	≤ 1.00	≤ 1.20	> 1.20
Tibia Axial Force (kN)	≤ 4.0	≤ 6.0	≤ 8.0	> 8.0
Foot acceleration (g)	≤ 150	≤ 200	≤ 260	> 260

Seat / Head restraints

Testing Protocol Version 3 (Mar 2008)

SafetyWissen by carhs	Good	Acceptable	Marginal	Poor
Static Assessment				
Backset (mm)	≤ 70	≤ 90	≤ 110	> 110
Distance from top of head (mm)	≤ 60	≤ 80	≤ 100	> 100
Dynamic Assessment (➲ page 94)				
Vector sum of the standardized shear (F_x) and tension (F_z) values $\{F_x / 315\}^2 + \{(F_z - 234) / 1131\}^2$	< $\{0.450\}^2$	$\{0.450\}^2$ - $\{0.825\}^2$	> $\{0.825\}^2$	
Time to head restraint contact (ms)	for values > 70 ms the rating is reduced by one level*			
T1 acceleration (g)	for values > 9.5 the rating is reduced by one level*			
	* only if both exceed the given level			

The overall rating equals the static or dynamic rating. whichever is worse. Exceptions:
If the static rating is „acceptable“ but the backset is sufficient for a „good“ rating and the dynamic rating is „good“ then the overall rating is also „good“.
If the static rating is „marginal“ or „poor“ no dynamic test is made and the overall rating is „poor“.

IIHS Rating
Side Impact

Testing Protocol Version VII (May 2014)

SafetyWissen by carhs.	Good	Acceptable	Marginal	Poor
Head/Neck				
HIC_{15}	≤ 623	≤ 779	≤ 935	> 935
$F_{z,tension}$ (kN)	≤ 2.1	≤ 2.5	≤ 2.9	> 2.9
$F_{z,compression}$ (kN)	≤ 2.5	≤ 3.0	≤ 3.5	> 3.5
Brust/Torso				
Shoulder deflection (mm)	Values > 60 result in downgrading			
Ø Rib deflection (mm)	≤ 34	≤ 42	≤ 50	> 50
Worst Rib deflection (mm)			51 - 55	> 55
Deflection rate (m/s)	≤ 8.20	≤ 9.84	≤ 11.48	> 11.48
VC (m/s)	≤ 1.00	≤ 1.20	≤ 1.40	> 1.40
Pelvis & Left Femur				
Acetabulum force (kN)	≤ 4.0	≤ 4.8	≤ 5.6	> 5.6
Ilium force (kN)	≤ 4.0	≤ 4.8	≤ 5.6	> 5.6
Combined acetabulum and ilium force (kN)	≤ 5.1	≤ 6.1	≤ 7.1	> 7.1
Femur A-P force (3 ms clip, kN)	≤ 2.8	≤ 3.4	≤ 3.9	> 3.9
Femur L-M force (3 ms clip, kN)	≤ 2.8	≤ 3.4	≤ 3.9	> 3.9
Femur A-P bending moment (3 ms clip, Nm)	≤ 254	≤ 305	≤ 356	>356
Femur L-M bending moment (3 ms clip, Nm)	≤ 254	≤ 305	≤ 356	>356

Roof Crush (➲ page 60)

Testing Protocol Version II (Dec 2012)

SafetyWissen by carhs.	Good	Acceptable	Marginal	Poor
$SWR = F_{max} / m \times g$	≥ 4.00	≥ 3.25	≥ 2.50	< 2.5

	IIHS TOP SAFETY PICK	IIHS TOP SAFETY PICK+
Year	TSP Criteria	TSP+ Criteria
2015	■ "Good" rating in the categories: Frontal Impact, Head Restraint, Side Impact, Roof Crush ■ At least "Acceptable" rating in Small Overlap	■ TSP Criteria ■ at least "advanced" rating for AEB/Forward Collision Warning (see page 100)

IIHS Rating: Small Overlap

Testing Protocol Version III (May 2014)

Structure Rating ❶	Good	Acceptable	Marginal	Poor
Lower Occupant Compartment Intrusions in mm				
lower hinge pillar (resultant)	≤ 150	≤ 225	≤ 300	> 300
footrest (resultant)				
left toepan (resultant)				
brake pedal (resultant)				
parking brake pedal (resultant)				
rocker panel (lateral)	≤ 50	≤ 100	≤ 150	> 150
Upper Occupant Compartment Intrusions in mm				
steering column (longitutinal)	≤ 50	≤ 100	≤ 150	> 150
upper hinge pillar (resultant)	≤ 75	≤ 125	≤ 175	> 175
upper dash (resultant)				
left instrument panel (resultant)				

Injury Rating				
Head/Neck ❷	**Good**	**Acceptable**	**Marginal**	**Poor**
HIC_{15}	≤ 560	≤ 700	≤ 840	> 840
N_{ij}	≤ 0.80	≤ 1.00	≤ 1.20	> 1.20
$F_{z,tension}$ (kN)	≤ 2.6	≤ 3.3	≤ 4.0	> 4.0
$F_{z,compression}$ (kN)	≤ 3.2	≤ 4.0	≤ 4.8	> 4.8
$a_{res\ peak}$	Values > 70 g result in downgrading			
Chest ❸	**Good**	**Acceptable**	**Marginal**	**Poor**
a_{3ms} (g)	≤ 60	≤ 75	≤ 90	> 90
Deflection (mm)	≤ 50	≤ 60	≤ 75	> 75
Deflection rate (m/s)	≤ 6.6	≤ 8.2	≤ 9.8	> 9.8
VC (m/s)	≤ 0.8	≤ 1.0	≤ 1.2	> 1.2
Thigh and Hip ❹	**Good**	**Acceptable**	**Marginal**	**Poor**
KTH Injury Risk (%)	≤ 5	≤ 15	≤ 25	> 25
Leg & Foot ❺	**Good**	**Acceptable**	**Marginal**	**Poor**
Knee Displacement (mm)	≤ 12	≤ 15	≤ 18	> 18
TI (upper, lower)	≤ 0.80	≤ 1.00	≤ 1.20	> 1.20
Tibia Axial Force (kN)	≤ 4.0	≤ 6.0	≤ 8.0	> 8.0
Foot Acceleration (g)	≤ 150	≤ 200	≤ 260	> 260

IIHS Rating: Small Overlap

Restraints & Dummy Kinematics Rating	
Rating system based on a demerit system	**Demerits**
Frontal Head Protection	
Partial frontal airbag interaction	1
Minimal frontal airbag interaction	2
Excessive lateral steering wheel movement (>100 mm)	1
Two or more head contacts with structure	1
Late deployment or non deployment of frontal airbag	automatic Poor
Lateral Head Protection	
Side head protection airbag deployment with limited forward coverage	1
No side head protection airbag deployment	2
Excessive head lateral movement	1
Front Chest Protection	
Excessive vertical steering wheel movement (>100 mm)	1
Excessive lateral steering wheel movement (>150 mm)	1
Occupant containment and miscellaneous	
Excessive occupant forward excursion (>250 mm)	1
Occupant burn risk	1
Seat instability	1
Seat attachment failure	automatic Poor
Vehicle door opening	automatic Poor

Restraints & Kinematics ❻	Good	Acceptable	Marginal	Poor
Sum of Demerits	≤ 1	≤ 3	≤ 5	> 5

Small Overlap Overall Rating

Rating system based on a demerit system. Demerits result from the injury, structure and restraints & kinematics ratings.

Component Rating	Good	Acceptable	Marginal	Poor
Vehicle Structure Rating ❶	0	2	6	10
Head/Neck Injury Rating ❷	0	2	10	20
Chest Injury Rating ❸	0	2	10	20
Thigh and Hip Injury Rating ❹	0	2	6	10
Leg and Foot Injury Rating ❺	0	1	2	4
Restraints / Kinematics Rating ❻	0	2	6	10

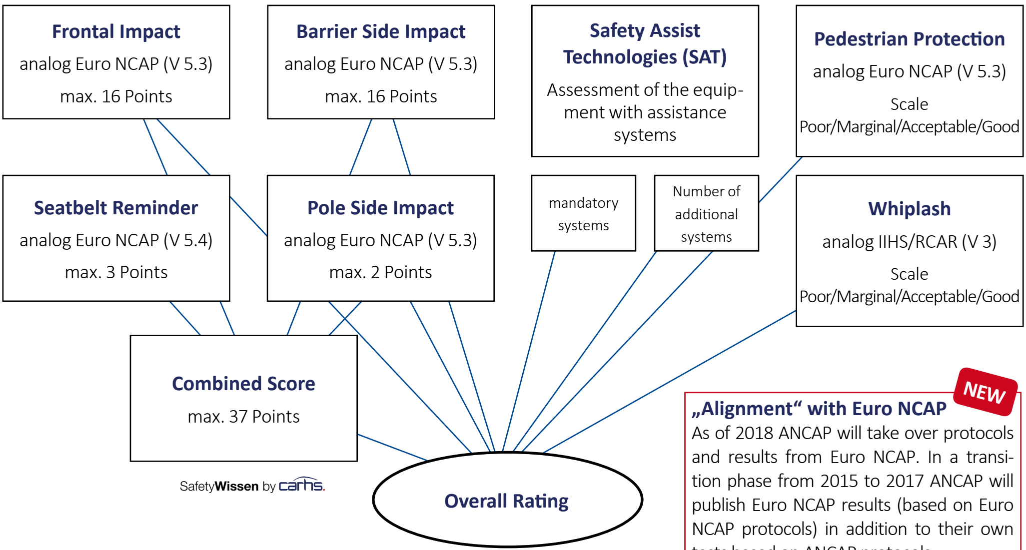
The overall rating depends on the sum of demerits

Overall Rating	Good	Acceptable	Marginal	Poor
Sum of demerits	≤ 3	≤ 9	≤ 19	> 19

Australasian NCAP (ANCAP)

Roadmap Update 23. April 2014

ANCAP was harmonized with Euro NCAP until 2009. The harmonization ended with the introduction of Euro NCAP's overall rating in 2009. ANCAP has now developed a new overall rating scheme that will be introduced in the period from 2011 -2017.



NEW

„Alignment" with Euro NCAP

As of 2018 ANCAP will take over protocols and results from Euro NCAP. In a transition phase from 2015 to 2017 ANCAP will publish Euro NCAP results (based on Euro NCAP protocols) in addition to their own tests based on ANCAP protocols.

The requirements on which the overall rating is based are increasing until 2017 according to the following scheme:

Score required for the respective star rating	Frontal- and Barrier-Side-Impact each	Pole-Side-Impact		Combined Score	Pedestrian Protection			Whiplash			mandatory SAT			additional SAT		
as of 20..	15	15	17	15	15	16	17	15	16	17	15	16	17	15	16	17
★★★★★	12.5	1	1	32,5	Acc	Acc	Acc	Good	Good	Good	ESC + 3PSB[1] + HPT[2] + SBR[1+3] + EBA	2015	2015 + TT	5	6	6
★★★★	8,5	-	1	24,5	Acc	Acc	Acc	Acc	Good	Good	ESC + 3PSB + HPT[1] + SBR[1] + EBA	2015 + HPT[2]	2016 + SBR[3] + TT	3	4	5
★★★	4,5	-	-	16,5	-	Marg	Acc	-	Acc	Acc	ESC + 3PSB	2015 + HPT[1]	2016 + SBR[1] + EBA + TT	2	3	4
★★	1,5	-	-	8,5	-	-	Marg	-	-	Acc	ESC	2015 + 3PSB	2016 + SBR[1] + HPT[1] + TT	1	2	3
★	-	-	-	0,5	-	-	Marg	-	-	Acc	-	ESC	2016 + 3PSB + SBR[1] + TT	-	-	2

SafetyWissen by carhs.

[1] front (1st row of seats)
[2] 2nd row of seats
[3] fixed seats in 2nd row of seats

ESC: Electronic Stability Control
SBR: Seat Belt Reminder
HPT: Head-protecting technology - side airbags

3PSB: 3-Point Seat Belts
EBA: Emergency Brake Assist
TT: Top Tether

More details, including a list of additional SAT, are available in the „ANCAP RATING ROAD MAP 2011-2017" which can be downloaded from http://www.ancap.com.au/media or can be found in the **SafetyWissen App.**

Latin NCAP Rating in Adult- and Child-Occupant Protection

Adult-Occupant Protection

Assessment Protocol Version 2.0

Star Rating	Required Score (out of max. 16 (ODB) + 1 (SBR) = 17 points)*
★★★★★	≥ 14+1**
★★★★	≥ 11
★★★	≥ 8
★★	≥ 5
★	≥ 2

SafetyWissen by carhs.

If the dummy response exceeds the lower performance limit head, neck or chest, the rating is limited to no more than 1 star regardless of the total number of points scored.

* 16 points from frontal ODB impact + 1 point for seat-belt reminders on front seats

** To be eligible for 5 stars the car must score over **14 points in the ODB test**. In addition, it must have the **full point on SBR**, 4-Channel ABS and offer some side impact performance protection (UN R95 specifications must be met).

Child-Occupant Protection (➲ page 98)

Assessment Protocol Version 3.0

Star Rating	Required Score (out of max. 49 points)
★★★★★	≥ 43
★★★★	≥ 36
★★★	≥ 25
★★	≥ 14
★	≥ 8

SafetyWissen by carhs.

ASEAN NCAP Rating in Adult- and Child-Occupant Protection

Adult-Occupant Protection

Assessment Protocol Version 1.0

Star Rating	Required Score (out of max. 16 points)
★★★★★	≥ 14
★★★★	≥ 11
★★★	≥ 8
★★	≥ 5
★	≥ 2

SafetyWissen by carhs.

A one star downgrade is applied if a dummy response exceeds the lower performance limit head, neck or chest (= 0 points, see p. 32)

* to qualify for 5 stars the vehicle must be equipped with **SBR** for driver front front passenger and with **ESC**.
  to qualifiy for 3 or more stars the vehicle must meet the **UN R95 MDB** side impact requirements.

Child-Occupant Protection (➲ page 98)

Assessment Protocol Version 1.0

Star Rating	Required Score (out of max. 49 points)
★★★★★	≥ 43
★★★★	≥ 34
★★★	≥ 25
★★	≥ 15
★	> 0

SafetyWissen by carhs.

China NCAP

Protocol 2015 (as of July 2015)

Frontal Impact with 100% overlap at 50 km/h

Dummy	Region	Points	Criteria
H III 50% front	Head	5	HIC_{36} < 650; a_{3ms} < 72 g
		0	HIC_{36} > 1000; a_{3ms} > 88 g
	Neck	2	$M_{y.extension}$ < 42 Nm $F_{z.tension}$ < 2.7 kN @ 0 ms / < 2.3 kN @ 35 ms / < 1.1 kN @ 60 ms $F_{x.shear}$ < 1.9 kN @ 0 ms / < 1.2 kN @ 25 – 35 ms / < 1.1 kN @ 45 ms
		0	$M_{y.extension}$ > 57 Nm $F_{z.tension}$ > 3.3 kN @ 0 ms / > 2.9 kN @ 35 ms / > 1.1 kN @ 60 ms $F_{x.shear}$ > 3.1 kN @ 0 ms / > 1.5 kN @ 25 – 35 ms / > 1.1 kN @ 45 ms
	Chest	5	Deflection < 22 mm; VC < 0.5 m/s
		0	Deflection > 50 mm; VC > 1.0 m/s
	Femur/Knee	2	Axial $Force_{compression}$ < 3.8 kN; Displacement < 6 mm
		0	Axial $Force_{compression}$ > 9.07 kN @ 0 ms / > 7.56 @ 10 ms; Displacement > 15 mm
	Tibia	2	TI < 0.4; Axial $Force_{compression}$ < 2 kN
		0	TI > 1.3; Axial $Force_{compression}$ > 8 kN
H III 5% rear	Head	0.8	HIC_{15} < 500
		0	HIC_{15} > 700
	Neck	0.2	$F_{x.shear}$ < 1200 N; $F_{z.tension}$ < 1700 N; $M_{y.extension}$ < 36 Nm
		0	$F_{x.shear}$ > 1950 N; $F_{z.tension}$ > 2620 N; $M_{y.extension}$ > 49 Nm
	Chest	1	Deflection < 23 mm
		0	Deflection > 48 mm
❶	max. total	18	SafetyWissen by carhs.

Frontal Impact with 40% overlap at 64 km/h

Dummy	Region	Points	Criteria
H III 50% front	Head, Neck	4	HIC_{36} < 650, a_{3ms} < 72 g $M_{y,extension}$ < 42 Nm $F_{z,tension}$ < 2.7 kN @ 0 ms / < 2.3 kN @ 35 ms / < 1.1 kN @ 60 ms $F_{x,shear}$ < 1.9 kN @ 0 ms / < 1.2 kN @ 25 – 35 ms / < 1.1 kN @ 45 ms
		0	HIC_{36} > 1000, a_{3ms} > 88 g $M_{y,extension}$ > 57 Nm $F_{z,tension}$ > 3.3 kN @ 0 ms / > 2.9 kN @ 35 ms / > 1.1 kN @ 60 ms $F_{x,shear}$ > 3.1 kN @ 0 ms / > 1.5 kN @ 25 – 35 ms / > 1.1 kN @ 45 ms
	Chest	4	Deflection < 22 mm; VC < 0.5 m/s
		0	Deflection > 50 mm; VC > 1.0 m/s
	Femur/Knee	4	Axial $Force_{compression}$ < 3.8 kN, Displacement < 6 mm
		0	Axial $Force_{compression}$ > 9.07 kN @ 0 ms / > 7.56 @ 10 ms, Displacement > 15 mm
	Tibia	4	TI < 0.4, Axial $Force_{compression}$ < 2 kN
		0	TI > 1.3, Axial $Force_{compression}$ > 8 kN
H III 5% rear	Head, Neck	1	HIC_{15} < 500, $F_{x,shear}$ < 1200 N, $F_{z,tension}$ < 1700 N, $M_{y,extension}$ < 36 Nm
		0	HIC_{15} > 700, $F_{x,shear}$ > 1950 N, $F_{z,tension}$ > 2620 N, $M_{y,extension}$ > 49 Nm
	Chest	1	Deflection < 23 mm
		0	Deflection > 48 mm
❷	max. total	18	SafetyWissen by carhs.

China NCAP

Protocol 2015 (as of July 2015)

Barrier Side Impact at 50 km/h

Dummy	Region	Points	Criteria
ES-2 front	Head	4	HIC_{36} < 650, a_{3ms} < 72 g
		0	HIC_{36} > 1000, a_{3ms} > 88 g
	Chest	4	Deflection < 22 mm, VC < 0.32 m/s
		0	Deflection > 42 mm, VC > 1.0 m/s
	Abdomen	4	$Force_{compression}$ < 1.0 kN
		0	$Force_{compression}$ > 2.5 kN
	Pelvis	4	PSPF < 3.0 kN
		0	PSPF > 6.0 kN
SID-IIs rear	Head	1	HIC_{15} < 500
		0	HIC_{15} > 700
	Pelvis	1	Pelvis Force< 3500 N
		0	Pelvis Force > 5500 N
❸	max. total	18	SafetyWissen by carhs.

Whiplash Test at 15.65 km/h

Dummy	Region	Points	Criteria
BioRID II	NIC	2	< 8 m²/s²
		0	> 30 m²/s²
	Upper Neck	1	F_{x+}<340 N F_{z+}< 475 N M_y < 12 Nm
		0	F_{x+}> 730 N F_{z+}> 1130 N M_y > 40 Nm
	Lower Neck	1	F_{x+}<340 N F_{z+}< 475 N M_y < 12 Nm
		0	F_{x+}> 730 N F_{z+}> 1130 N M_y > 40 Nm
	max. dyn. seatback deflection	-2	> 19°
	dyn. seat displacement	-4	> 20 mm
	HRMD interference	-2	Y/N
❹	max. total	4	SafetyWissen by carhs.

Where a value falls between the upper and lower limit, the score is calculated by linear interpolation.

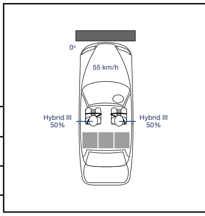
Additional Points

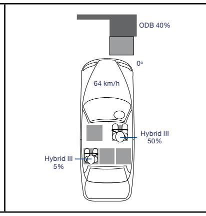
		Points	
SBR	Passenger	1	Visual / Audio Signal with occupant detection
		0.5	Visual / Audio Signal without occupant detection
Side Protection		1	Side / Curtain-Airbag
ESC		1	acc. GTR 8 or FMVSS 126 or UN R13H
❺	max. total	3	SafetyWissen by carhs.

Overall Rating

Total Score ❶+❷+❸+❹+❺	Stars	
≥ 60	5+	★★★★★☆
≥ 54 ... < 60	5	★★★★★
≥ 48 ... < 54	4	★★★★
≥ 36 ... < 48	3	★★★
≥ 24 ... < 36	2	★★
< 24	1	★

JNCAP





Frontal Impact

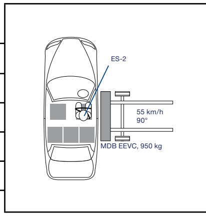
Dummy	Region	Weight	Points	Criteria
H III 50% front	Head	0.923	4	$HIC_{36} < 650$
			0	$HIC_{36} > 1000$
	Neck	0.231	4	$M_{y,extension} < 42$ Nm $F_{z,tension} < 2.7$ kN @ 0 ms / < 2.3 kN @ 35 ms / < 1.1 kN @ 60 ms $F_{x,shear} < 1.9$ kN @ 0 ms / < 1.2 kN @ 25 – 35 ms / < 1.1 kN @ 45 ms
			0	$M_{y,extension} > 57$ Nm $F_{z,tension} > 3.3$ kN @ 0 ms / > 2.9 kN @ 35 ms / > 1.1 kN @ 60 ms $F_{x,shear} > 3.1$ kN @ 0 ms / > 1.5 kN @ 25 – 35 ms / > 1.1 kN @ 45 ms
	Chest	0.923	4	Deflection < 22 mm, $a_{3ms} < 38$ g
			0	Deflection > 50 mm, $a_{3ms} > 60$ g
	Femur	0.923	2	Axial $Force_{compression} < 7$ kN
			0	Axial $Force_{compression} > 10$ kN
	Tibia	0.923	2	TI < 0.4
			0	TI > 1.3
	max. total		12	after weighting

Dummy	Region	Weight	Points	Criteria
H III 5% rear	Head	0.8	4	$HIC_{15} < 500$
			0	$HIC_{15} > 700$
	Neck	0.2	4	$F_{x,shear} < 1200$ N, $F_{z,tension} < 1700$ N, $M_{y,extension} < 36$ Nm
			0	$F_{x,shear} > 1950$ N, $F_{z,tension} > 2620$ N, $M_{y,extension} > 49$ Nm
	Chest	0.8	4	Deflection < 23 mm
			0	Deflection > 48 mm
	Abdomen	0.8	4	4 points awarded by default
	Femur	0.4	4	Axial $Force_{compression} < 4.8$ kN
			0	Axial $Force_{compression} > 6.8$ kN
	max. total		12	after weighting

Rating Scheme Frontal & Side Impact, Whiplash:

Level	Required Score
5	≥ 10.5
4	≥ 9
3	≥ 7.5
2	≥ 6
1	< 6

Side Impact



Dummy	Region	Weight	Points	Criteria
ES-2 front	Head	1.0	4	$HIC_{36} < 650$
			0	$HIC_{36} > 1000$
	Chest	1.0	4	Deflection < 22 mm
			0	Deflection > 42 mm
	Abdomen	0.5	4	$Force_{compression} < 1.0$ kN
			0	$Force_{compression} > 2.5$ kN
	Pelvis	0.5	4	PSPF < 3.0 kN
			0	PSPF > 6.0 kN
	max. total		12	after weighting

Whiplash Test

Dummy	Criteria		Weight	Points	Limits
BioRID II	NIC		1	4	< 8 m²/s²
				0	> 30 m²/s²
	Upper Neck F_{x+}	score is calculated based on the worst injury criterion	2	4	<340 N
				0	> 730 N
	Upper Neck F_{z+}			4	< 475 N
				0	> 1130 N
	Upper Neck M_y Flexion			4	< 12 Nm
				0	> 40 Nm
	Upper Neck M_y Extension			4	< 12 Nm
				0	> 40 Nm
	Lower Neck F_{x+}			4	<340 N
				0	> 730 N
	Lower Neck F_{z+}			4	< 257 N
				0	> 1480 N
	Lower Neck M_y Flexion			4	< 12 Nm
				0	> 40 Nm
	Lower Neck M_y Extension			4	< 12 Nm
				0	> 40 Nm
			max. total	12	after weighting

SafetyWissen by carhs.

Where a value falls between the upper and lower limit, the score is calculated by linear interpolation (sliding scale).

Overall Rating

	max. score	weight	max. weighted score	total	total
Occupant Protection					208 ★★★★★≥170 ★★★★≥150 ★★★≥130 ★★≥110 ★<110
Full-width Frontal				100	
Driver	12	1.250	15		
Passenger	12	1.250	15		
Offset Frontal					
Driver	12	1.250	15		
Passenger (rear)	12	1.250	15		
Side Impact					
Driver	12	1.042	12.5		
Passenger*	12	1.042	12.5		
Whiplash					
Driver	12	0.625	7.5		
Passenger	12	0.625	7.5		
Pedestrian Protection (➲ page 86)					
Head Impact	4	18.750	75	100	
Leg Impact	4	6.250	25		
Seat Belt Reminder					
Front	50	0.08	4	8	
Rear	50	0.08	4		

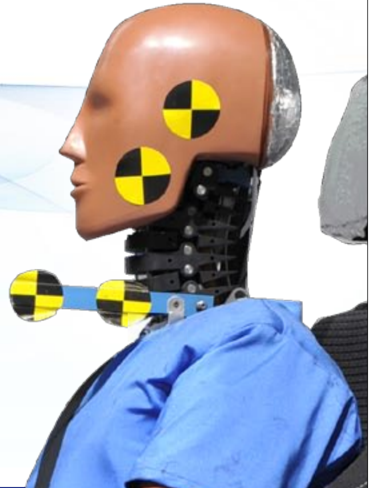
SafetyWissen by carhs.

*for the passenger the same score as for the driver is assumed

Restraint Systems Simulation, Test & Validation

CTAG

- Complete CAE & validation (Seats, dashboards, doors…)
- CAE Occupant protection
- Inverse catapult Sled Testing (Frontal, Side and Rear Impact)
- Full Airbag development and validation
- Energy absorption tests
- EuroNCAP Knee mapping tests
- Knee impact subsystem tests
- High speed intrusion tests
- EuroNCAP lab for whiplash tests EURO NCAP FOR SAFER CARS



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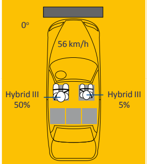
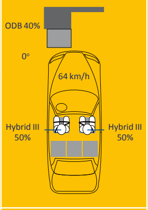
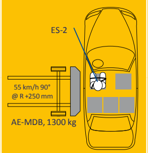
KNCAP

KNCAP Korean New Car Assessment Program

Overall Rating 2015

Category	Crashworthiness				Pedestrian Protection ➲ page 86	Driving Safety ➲ page 114
	Frontal FWRB 	Frontal ODB 	Side MDB 	Whiplash 16 km/h BioRID II	Head Impact 24 Points	Rollover 5 Points
					Leg Impact 6 Points	Brakes 5 Points
max. score (1)	16 Points	16 Points	16 Points	10 Points	30 Points	10 Points
max. total score (2)	58 Points				30 Points	10 Points
normalized score (3)	actual score / (2)				actual score / (2)	actual score / (2)
weighting (4)	65%				25%	10%
weighted score (5)	(3) x (4)				(3) x (4)	(3) x (4)
sum (6)	Σ (5) (max. 100)					
additional scores (7)	Side Pole 2 Points Safety Assistance (FCW 0.4 Points, LDW 0.2 Points, SBR 0.4 Points) 1 Point					
total (8)	(6)+(7) (max. 103)					

Overall classification: Minimum total score (8) per rating class	
Class 1	≥ 86.1
Class 2	≥ 81.1
Class 3	≥ 76.1
Class 4	≥ 71.1
Class 5	≤ 71.0

Balancing: Minimum normalized score per category (3) per rating class

Category	Crashworthiness	Pedestrian Protection
Class 1	≥ 90.1 %	≥ 60.1 %
Class 2	≥ 83.1 %	≥ 50.1 %
Class 3	≥ 76.1 %	≥ 40.1 %
Class 4	≥ 69.1 %	≥ 35.1 %
Class 5	≤ 69.0 %	≤ 35.0 %

Static Vehicle Safety Tests in Automotive Development

Course Description

When thinking about vehicle safety testing people first think about dynamic crash tests of the full vehicle or crash simulations performed on a sled test facility. In addition to these dynamic tests, however, numerous other tests on the car body and components such as seats, steering, instrument panel, pillars, bumpers, etc.have to be performed during the development of a car. At first sight, these experiments perhaps are less spectacular, but in practice they are also very complex.
The seminar provides an introduction to static vehicle safety testing. Static vehicle safety tests serve the determination of criteria to minimize injury that may occur due to an accident. The seminar covers the entire field of static vehicle safety testing, ranging from biomechanical research to legal regulations and consumer protection related requirements. It discusses the required test equipment (impactors, test facilities) and the typical load cases of the experiments. Finally, the testing specifications, including the protection criteria are explained.

Course Objectives

After participating in the seminar "Static Vehicle Safety Tests in Automotive Development", the participants have gained an overview of the static vehicle safety tests to be performed on the car body and the components. They have acquired knowledge about the essential procedures in Europe and North America as well as their backgrounds and gained insight into equipment necessary to carry out the experiments.

Who should attend?

The seminar is aimed at specialist from crash-related car body and component development, engineers and technicians from test and analysis departments as well as project engineers and managers.

Course Contents

- Introduction
- Static roof crush according to FMVSS 216a
- Static door intrusion according to FMVSS 214
- Test procedures for exterior and interior parts FMVSS 201U, UN R21 & R42
- Testing of seats and head restraints according to FMVSS 202 and UN R17, R21 and R25
- Test procedures on seat-belts according to UN R14 and R21
- Test procedures for steering systems according to FMVSS 203, UN R12
- Test procedures for child seat anchors (ISOFIX) of FMVSS 225

Course instructor:

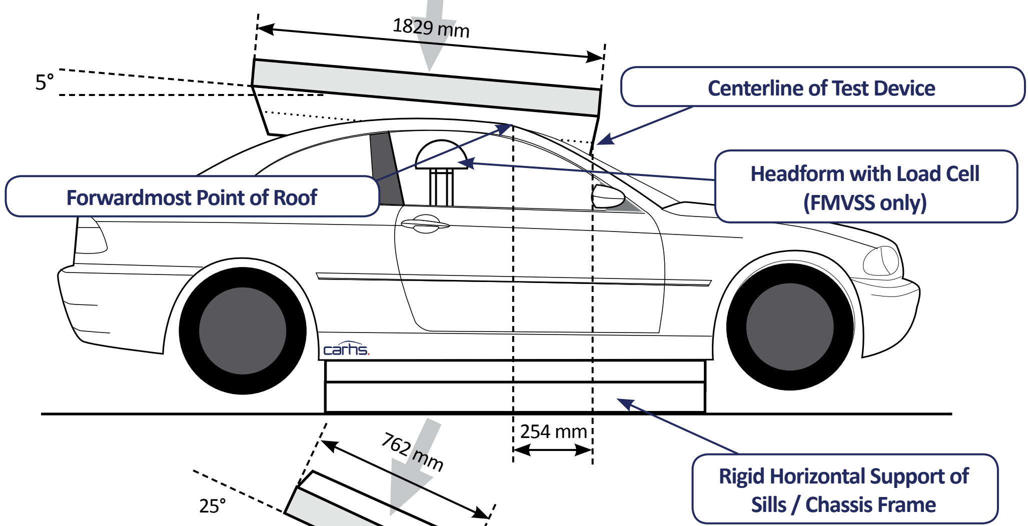
Alexander Martellucci, ACTS GmbH & Co. KG

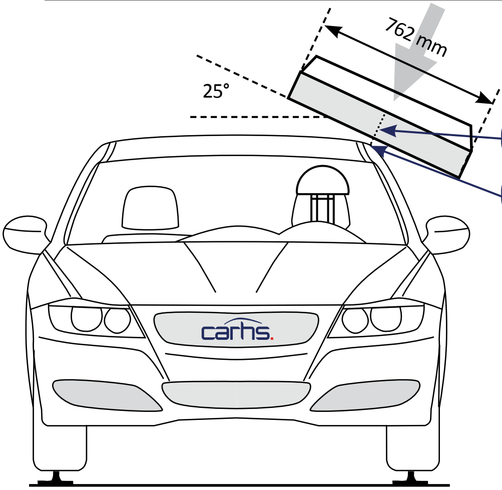
Alexander Martellucci began his professional career in physical laboratories in the pharmaceutical industry. Since 1992 he is involved in the testing of components for vehicle safety. Until 1995 he worked in the steering wheel laboratory and until 1998 he headed the airbag testing at TRW. Since 1998 he has been with ACTS GmbH & Co. KG until 2002 as head of the component laboratory, and since then as manager Technology & Testing Services.

Date	Course ID	Venue	Duration	Price	Language
20.03.2015	2494	Alzenau	1 Day	740,- EUR till 20.02.2015, thereafter 890,- EUR	
12.10.2015	2495	Alzenau	1 Day	740,- EUR till 14.09.2015, thereafter 890,- EUR	

This course is available as an in-house seminar in English and German!

Roof Crush





IIHS

Testing Protocol Version II (Dec 2012)

Platen Displacement: 127 mm

Feed Rate: 5 mm/s

Single Side Test: Lab selects worst case

Assessment:
based on Strength-to-weight ratio (SWR) = F_{max} / m x g

SWR	Rating
≥ 4.00	Good
≥ 3.25 till <4.00	Acceptable
≥ 2.50 till <3.25	Marginal
< 2.50	Poor

A „Good“ rating in the roof crush test is a requirement for the Top-SafetyPick award. ➲ page 46

SafetyWissen by carhs.

FMVSS 216a

SafetyWissen by carhs.

Application:
Vehicles with a GVWR ≤ 4536 kg

Applied Force:
for vehicles with a GVWR ≤ 2722 kg:
F = 3.0 x GVWR x 9.8 m/s²
for vehicles with a GVWR > 2722 kg:
F = 1.5 x GVWR x 9.8 m/s²

Feed Rate: ≤ 13 mm/s

Double Sided Test

Requirements:
Platen displacement ≤ 127 mm
Load on headform located at head position of 50% male ≤ 222 N

Phase-In for GVWR ≤ 2722 kg:

Manufacturing Period	%*
01.09.2012-30.08.2013	25%
01.09.2013-30.08.2014	50%
01.09.2014-30.08.2015	75%
on or after 01.09.2015	100%

* in % of the production of the respective period or in % of the average production of the 3 previous years

Introduction for GVWR > 2722 kg: 01.09.2016

Crashworthy Car Body Design - Design, Simulation, Optimization

Course Description

In the development of a car body different - sometimes conflicting - design requirements have to be met. Fulfilling crash regulations is a key task. Therefore it is mandatory that designers have a good understanding of the crash behavior of mechanical structures. The combination of knowledge about mechanics and the ability to use modern design tools allows for an efficient development process without unnecessary design iterations. The objective of the seminar is to present new methods for crashworthy car body design.

At the beginning of the course the mechanical phenomena of crash events will be discussed. Subsequently modern development methods (CAD design and crash simulation) will be treated. Thereafter modern implementations of safety design measures will be presented. Mathematical optimization of structural design - which is increasingly used in industry - will be covered at the end of the course.

Who should attend?

This 2 day course addresses designers, test and simulation engineers as well as project leaders and managers working in car body development and analysis.

Course Contents

- Mechanics of crash events
  - Accelerations during collisions
  - Structural loading during collisions
  - Examination of real crash events
  - Stability problems
  - Plasticity
- Design methods
  - Functional based design
  - Car body design
  - CAE conform design
- Crash simulation
  - Finite Element modelling of a car body
  - Finite Element analysis with explicit methods
  - Possibilities and limitations
- Technical implementation of safety measures
  - Energy absorbing members
  - Car bodies
  - Safety systems
  - Pedestrian protection
  - Post crash
- Use of mathematical optimization procedures on real world applications
  - Approximation techniques
  - Optimization software & strategies
  - Shape and topology optimization

Course Instructor:

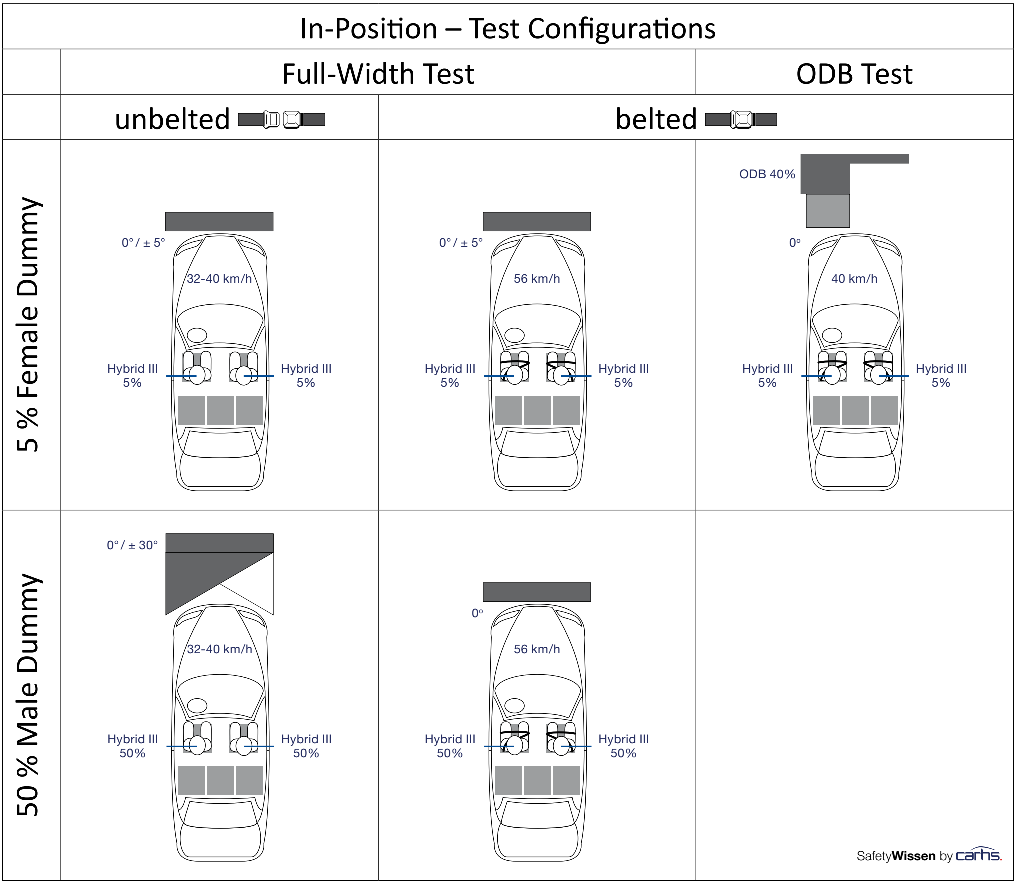
Prof. Dr.-Ing. Axel Schumacher, University of Wuppertal

Prof. Dr.-Ing. Axel Schumacher studied mechanical engineering at the universities of Duisburg and Aachen. He received his doctorate on structural optimization from the University of Siegen. Following research projects for Airbus were focused on the optimization of aircraft structures. Thereafter he worked in the CAE methods development department of Adam Opel AG as project leader for structural optimization. From 2003 - 2012 he was a professor at the University of Applied Sciences in Hamburg and taught structural design, passive safety and structural optimization. Since 2012 he has been professor at the University of Wuppertal, where he holds the chair for Optimization of mechanical structures.

Date	Course ID	Venue	Duration	Price	Language
11.-12.03.2015	2410	Alzenau	2 Days	1.290,- EUR till 11.02.2015, thereafter 1.540,- EUR	German
15.-16.07.2015	2484	Alzenau	2 Days	1.290,- EUR till 17.06.2015, thereafter 1.540,- EUR	English

This course is available as an in-house seminar in English and German!

FMVSS 208: Frontal Impact Requirements: In-Position



FMVSS 208: Frontal Impact Requirements: Out of Position

Front seat	Dummy	Test configuration
Driver side	HIII 5% female dummy	chin on airbag module in steering wheel chin on top of steering wheel
Passenger side	CRABI 12m	in 23 defined CRS / positions
	HIII 3 y/o	chest on instrument panel head on instrument panel
	HIII 6 y/o	chest on instrument panel head on instrument panel

SafetyWissen by carhs.

Development of Frontal Restraint Systems meeting Legal and Consumer Protection Requirements

Course Description

Belts, belt-load limiters, airbags, steering column, knee bolster, seat... - only if all the components of a frontal restraint system are in perfect harmony it is possible to meet the different legal limit values as well as the requirements of consumer tests. However, these requirements, e.g. FMVSS 208, U.S. NCAP, Euro NCAP et.al. are manifold and extensive, partly contradict each other, or the requirements superpose each other. Therefore it is a challenge for every development engineer to develop a restraint system by a clear, strategic procedure; time-saving and target-oriented with an optimal result.
In this 2-day seminar this strategic way of development will be shown. You will learn a procedure how to ideally solve the complex development task of a typical frontal restraint-system design within the scope of the available tools test and simulation. Especially the importance and the influence of individual system components (e.g. belt-load limiters) for the accomplishment of development-sub tasks (e.g. minimum chest deflection) will be covered. In addition the influence of the airbag module design on the hazards of Out-of-Position (OoP) situations is going to be discussed, and a possible development-path for the compliance with the OoP requirements according to the FMVSS 208 legislation will be shown. The possibilities and limits of the development tools test and simulation will be discussed and communicated. Last but not least tips and tricks for a successful overall system design will be part of this seminar.

In this seminar you will become familiar with a procedure for the successful development of a frontal restraint system. Furthermore you will learn which development tool, simulation or test, is best suited for the respective sub task. Moreover you will be made aware of the influence of the individual components of a restraint system (belts, belt-load limiters, airbags, steering column, knee bolster, seat,...) on the efficiency of the entire system.
Finally future topics such as the compatibility of vehicles as well as pre-crash preparation and prevention of accidents are going to be integrated into the seminar.

Who should attend?

The seminar addresses simulation and test engineers, project engineers and project managers as well as the heads of development departments in the field of passive safety who work with the design of restraint-systems in vehicles.

Course Contents

- Identification of the relevant development load cases
- Procedures for the development of a restraint system
- Influence and importance of individual system components on the overall performance
- Development strategy for UN regulations and NAR restraint systems
- Development path for the conformance to the OoP requirements according to FMVSS 208

Course Instructor:

Dipl.-Ing. Kai Golowko, Bertrandt Ingenieurbüro GmbH

Dipl.-Ing. Kai Golowko has been working in the area of vehicle safety since 1999. He started his career as a test engineer for passive safety at ACTS. Since 2003 he has been working as senior engineer for occupant safety and pedestrian protection. Since 2005 he manages the department vehicle safety at Bertrandt in Gaimersheim. In this position he is responsible for component development and validation and integrated safety.

Date	Course ID	Venue	Duration	Price	Language
05.-06.03.2015	2558	Alzenau	2 Days	1.290,- EUR till 05.02.2015, thereafter 1.540,- EUR	German
01.-02.07.2015	2560	Alzenau	2 Days	1.290,- EUR till 03.06.2015, thereafter 1.540,- EUR	English
09.-10.11.2015	2559	Alzenau	2 Days	1.290,- EUR till 12.10.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Protection Criteria for Frontal Impact Tests

Configuration	Criterium	Rigid Barrier In-Position			Deformable Barrier In-Position		Out of Position			
Requirements		CMVSS 208 (old), ADR 69/00, FMVSS 208 (old)	FMVSS 208 CMVSS208		UN R94, ADR 73/00, FMVSS 208 (old)	FMVSS 208 CMVSS 208	FMVSS 208 CMVSS 208			
Dummy		Hybrid III	Hybrid III	Hybrid III	Hybrid III	Hybrid III	Hybrid III	Hybrid III	Hybrid III	CRABI
Size		50% male	50% male	5 % female	50% male	5 % female	5 % female	6 year	3 year	1 year
Head	HIC_{36} / HPC_{36} [-]	1000 (FMVSS. ADR)			1000					
	HIC_{15} [-]	700 (CMVSS)	700	700		700	700	700	570	390
	a_{3ms} [g]				80					
Neck	N_{ij} [-]		1.0 (4 Values)	1.0 (4 Values)		1.0 (4 Values)	1.0 (4 Values)	1.0 (4 Values)	1.0 (4 Values)	1.0 (4 Values)
	$F_{x,shear}$ [kN]				3.1 @ 0 ms 1.5 @ 25-35 ms 1.1 @ ≥ 45 ms					
	$F_{z,tension}$ [kN]		4.17	2.62	3.3 @ 0 ms 2.9 @ 35 ms 1.1 @ ≥ 60 ms	2.62	2.07	1.49	1.13	0.78
	$F_{z,compr.}$ [kN]		4.0	2.52		2.52	2.52	1.82	1.38	0.96
	M_y [Nm]				57					
Chest	a_{3ms} [g]	60 g	60	60		60	60	60	55	50
	Deflection [mm]	76.2 (FMVSS. ADR) 50 (CMVSS)	63	52	50	52	52	40	34	30* * currently no measurement possible
	VC [m/s]				1.0					
Femur	Axial Force [kN]	10	10	6.805	9.07 @ 0 ms 7.58 @ > 10 ms	6.805	6.8			
Knee	Displacement [mm]				15					
Tibia	TI [-]				1.3 (4 Values)				SafetyWissen by carhs.	
	Axial $Force_{compr.}$ [kN]				8.0					

Basics of Occupant Protection in Frontal Crashes: Mechanics, Energy Considerations, Protection Criteria and Application Examples

Course Description

Constant changes of requirements - in particular in the consumer protection tests - let the design of restraint systems continuously seem more and more complex. The safety of rear seat occupants, for example, is playing an important role in the restraint system development today. Therefore, a deep understanding of the complete system vehicle - restraint system - dummy is necessary to successfully adjust the system. A profound knowledge of the mechanisms causing dummy loading and the parameters influencing and enabling their optimization is essential. In this 2-day seminar, the mechanics of occupant restraining and the idea of energy considerations, as well as the most important occupant protection criteria and strategies for their reduction, are discussed. This knowledge is then put in a context of legal requirements and ratings. The seminar focuses on the influence of the seat belt, whereas unbeltet load cases and an in depth analysis of airbag concepts is not part of this seminar.

The seminar approaches occupant safety both from a theoretical basis as well a from the interpretation of experimental data. You will learn about the phases of retention, the main parameters influencing occupant loading and approaches for computing the balances of the restraint forces acting on the occupant. Another topic of the seminar is the rear seat occupant protection, in particular because new dummies (Q6, Q10) will be introduced here by Euro NCAP. The aim of the seminar is to gain an understanding about the forces involved in energy absorption and their effects on the occupants.

Who should attend?

The course is intended for simulation engineers, systems engineers, project engineers, project managers and the heads of teams or departments in the crash area, dealing with the development of restraint systems or the analysis of crash data.

Course Contents

- Mechanical basics of frontal impact
- Dummies in frontal crash: HIII 50%, HIII 5%, Q6 and Q10
- Short overview of new regulations and consumer tests
- Energy considerations - force balances
- Phases of retention: Coupling and controlled retention
- Relevant criteria for occupant protection: mechanisms and parameters for their reduction
- Priorities in the design of retraint systems for front and rear seats
- Application examples and tips

Course Instructor:

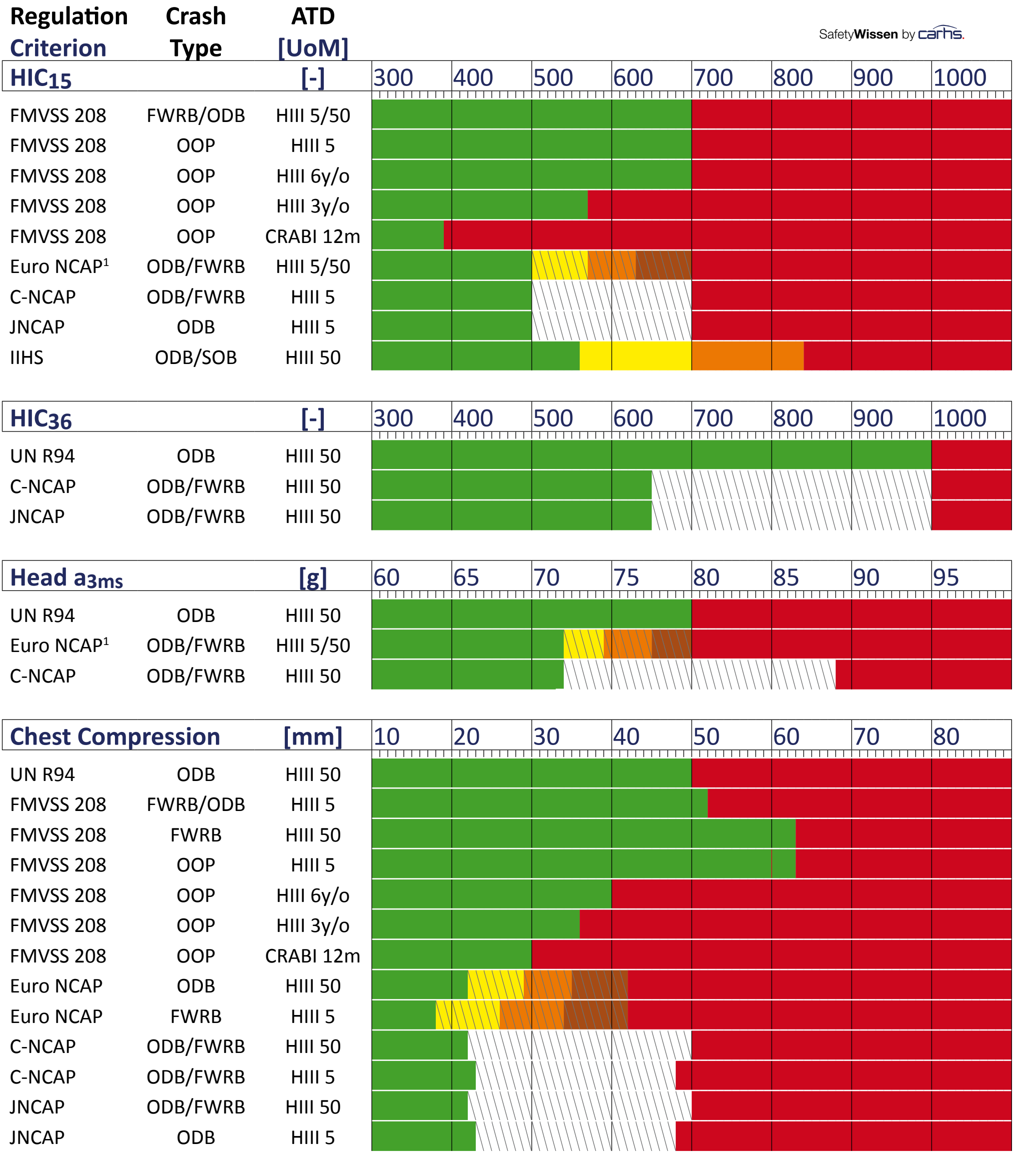
Dr.-Ing. Burkhard Eickhoff, Autoliv B.V. & Co. KG

Burkhard Eickhoff studied mechanical engineering in Hannover (Germany) focusing on vehicle engineering and applied mechanics. Starting from 1999 he worked with Autoliv B.V. & Co. KG as a test engineer for sled and crash tests. Since 2003 he has been project manager in systems development (safety belt) of the same company. Since 2012 he has worked as a group leader at Autoliv. He is involved in the definition and assessment of new restraint systems and he conducts feasibility studies using system simulation as well as dynamical tests. Moreover he has a consultant role regarding restraint system design. He finished his doctoral thesis at the Helmut Schmidt University Hamburg in 2012 on the reduction of belt induced thorax deflection in frontal crashes.

Date	Course ID	Venue	Duration	Price	Language
26.-27.02.2015	2403	Alzenau	2 Days	1.290,- EUR till 29.01.2015, thereafter 1.540,- EUR	German
05.-06.10.2015	2482	Alzenau	2 Days	1.290,- EUR till 07.09.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Frontal Impact Protection Criteria Compared



Please note that the values indicated in this graph may be rounded and that additional criteria may exist. Please take exact values and additional criteria from the tables for the respective regulation.

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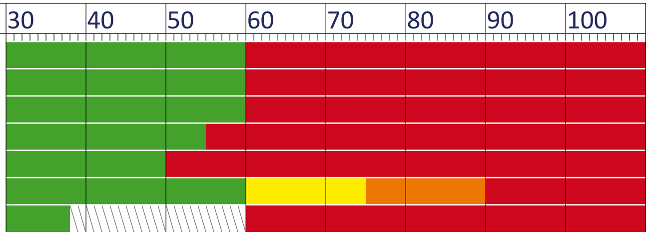
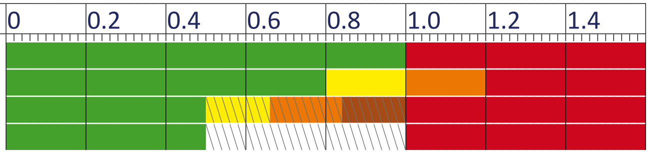
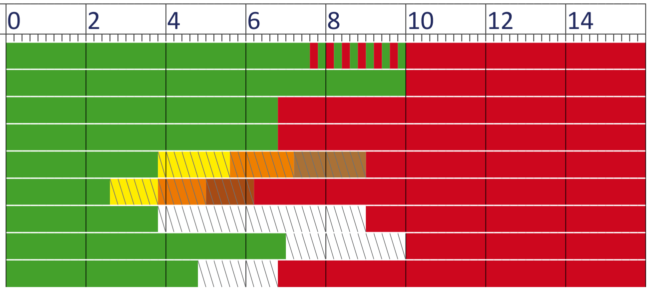
Regulation Criterion	Crash Type	ATD [UoM]
Chest a3ms		**[g]**
FMVSS 208	FWRB/ODB	HIII 5/50
FMVSS 208	OOP	HIII 5
FMVSS 208	OOP	HIII 6y/o
FMVSS 208	OOP	HIII 3y/o
FMVSS 208	OOP	CRABI 12m
IIHS	ODB/SOB	HIII 50
JNCAP	ODB/FWRB	HIII 50



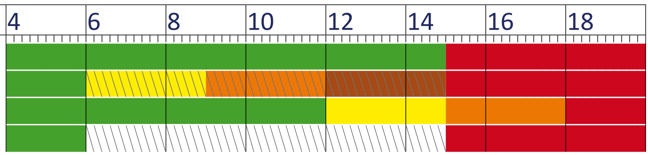
Regulation	Crash Type	ATD
Chest VCmax		**[m/s]**
UN R94	ODB	HIII 50
IIHS	ODB/SOB	HIII 50
Euro NCAP	ODB/FWRB	HIII 5/50
C-NCAP	ODB/FWRB	HIII 50



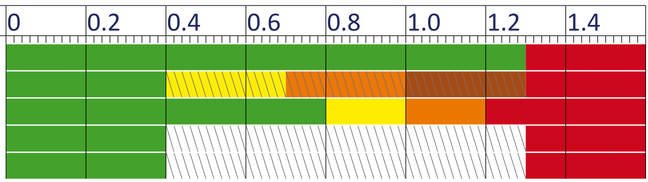
Regulation	Crash Type	ATD
Femur Faxial		**[kN]**
UN R94	ODB	HIII 50
FMVSS 208	ODB	HIII 50
FMVSS 208	ODB/FWRB	HIII 5
FMVSS 208	OOP	HIII 5
Euro NCAP	ODB	HIII 50
Euro NCAP	FWRB	HIII 5
C-NCAP	ODB	HIII 50
JNCAP	ODB/FWRB	HIII 50
JNCAP	ODB	HIII 5



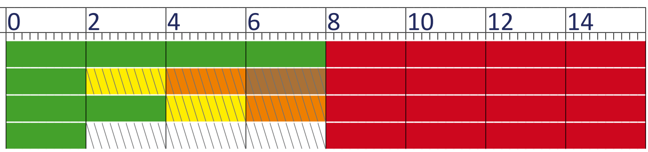
Regulation	Crash Type	ATD
Knee Displacement		**[mm]**
UN R94	ODB	HIII 50
Euro NCAP	ODB	HIII 50
IIHS	ODB/SOB	HIII 50
C-NCAP	ODB/FWRB	HIII 50



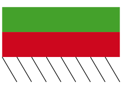
Regulation	Crash Type	ATD
Tibia Index		**[-]**
UN R94	ODB	HIII 50
Euro NCAP	ODB	HIII 50
IIHS	ODB/SOB	HIII 50
C-NCAP	ODB/FWRB	HIII 50
JNCAP	ODB/FWRB	HIII 50



Regulation	Crash Type	ATD
Tibia Compression		**[kN]**
UN R94	ODB	HIII 50
Euro NCAP	ODB	HIII 50
IIHS	ODB/SOB	HIII 50
C-NCAP	ODB/FWRB	HIII 50



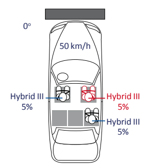
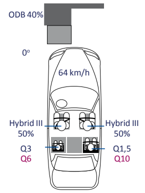
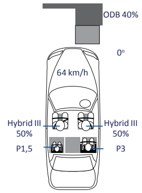
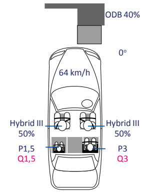
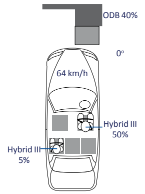
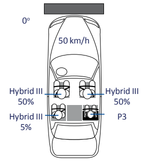
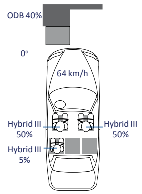
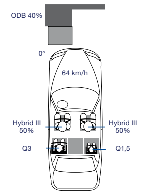
Legend::

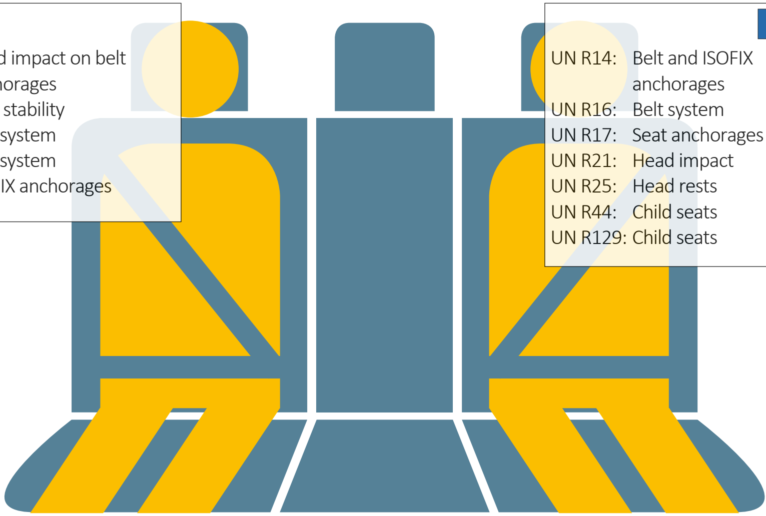


Regulations: requirements are met / NCAP: maximum score
Regulations: requirements not met / NCAP: zero score
Linear interpolation of the score between the upper and lower limit

Safety Requirements for Rear Seats and Restraint Systems

Frontal impact tests with rear seat occupants

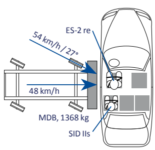
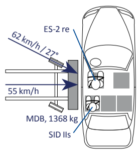
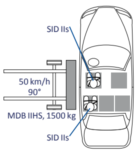
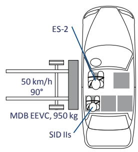
Euro NCAP FWRB	Euro NCAP ODB	ANCAP ODB	ASEAN NCAP ODB
			
JNCAP ODB	**C-NCAP FWRB**	**C-NCAP ODB**	**Latin NCAP ODB**
			



FMVSS 201: Head impact on belt anchorages
FMVSS 207: Seat stability
FMVSS 208: Belt system
FMVSS 209: Belt system
FMVSS 225: ISOFIX anchorages

UN R14: Belt and ISOFIX anchorages
UN R16: Belt system
UN R17: Seat anchorages
UN R21: Head impact
UN R25: Head rests
UN R44: Child seats
UN R129: Child seats

Side impacts tests with rear seat occupants

FMVSS 214	U.S. NCAP	IIHS	C-NCAP
			

Rear Seat Occupant Protection in Frontal Impact

Course Description

Rear seat occupant protection has been at a low priority until the recent announcement of the planned introduction of safety assessment for rear adult and child occupants by Euro NCAP. Now it has moved into the focus of research and development.

In addition to the Euro NCAP requirements, further NCAP ratings as well as legal requirements need to be considered in the design of the restraint systems. And real world aspects cannot be neglected either.

During the 1-day seminar legal and NCAP requirements for rear seat occupant protection in frontal impact will be discussed. Furthermore the dummies used in the assessment will be presented with an empasis on the Q6 and Q10 child dummies. For the most important load cases the relevant criteria and possible influcening parameters of the restraint system will be discussed and explored. Finally solutions for the design of the restraint system on rear seat will be shown.

Course Objectives

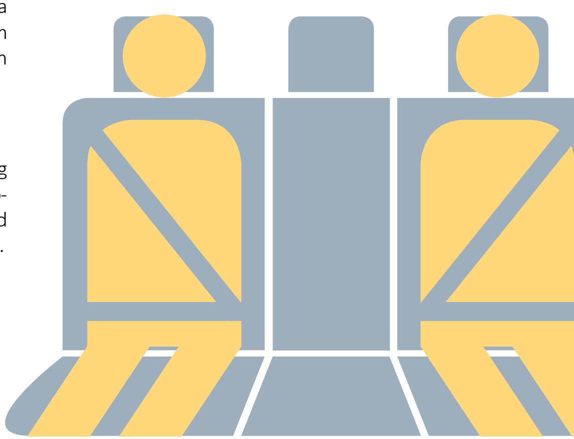
The objective of the seminar is to provide an understanding of the requirements and specifics in rear seat occupant protection, to provide the knowledge of test configurations and dummies, and to provide a view on state-of-the-art solutions.

Who should attend?

The seminar addresses simulation and test engineers, project engineers and project managers as well as the heads of development departments in the field of passive safety who work in R&D of occupant restraint-systems.

Course Contents

- Legal Requirements
- Requirements from consumer testing
- Dummies on the rear seat; Q6 and Q10 Child Dummies
- Relevant protection criteria for the most important load cases
- Solutions for restraint system design and optimization



Course Instructor:

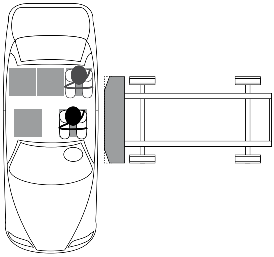
Dr.-Ing. Burkhard Eickhoff, Autoliv B.V. & Co. KG

Burkhard Eickhoff studied mechanical engineering in Hannover (Germany) focusing on vehicle engineering and applied mechanics. Starting from 1999 he worked with Autoliv B.V. & Co. KG as a test engineer for sled and crash tests. Since 2003 he has been project manager in systems development (safety belt) of the same company. Since 2012 he has worked as a group leader at Autoliv. He is involved in the definition and assessment of new restraint systems and he conducts feasibility studies using system simulation as well as dynamical tests. Moreover he has a consultant role regarding restraint system design. He finished his doctoral thesis at the Helmut Schmidt University Hamburg in 2012 on the reduction of belt induced thorax deflection in frontal crashes.

Date	Course ID	Venue	Duration	Price	Language
10.09.2015	2483	Alzenau	1 Day	740,- EUR till 13.08.2015	German (flag)

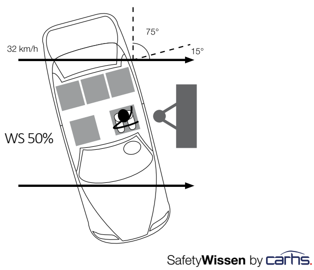
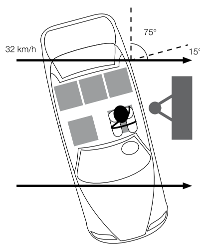
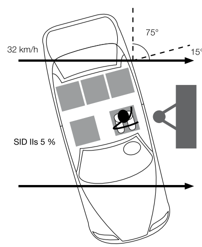
This course is available as an in-house seminar in English and German!

MDB Side Impact Test Procedures

Requirement	UN R95	Euro NCAP	IIHS	
Impact angle	lateral 90°			
MDB velocity	50 km/h			
Barrier (MDB)	EEVC	AE-MDB	IIHS	
Mass	950 kg	1300 kg	1500 kg	
Ground clearance	300 mm	300 mm (bumper 350 mm)	379 mm (bumper 430 mm)	
Upper edge height	800 mm	800 mm	1138 mm	
Width	1500 mm	1700 mm	1676 mm	
Dummy	1 ES-2 frontal seat on impact side	1 WS 50% frontal seat on impact side[1] on rear seat Q1,5 on impact side and Q3 far side	2 SID IIs on impact side	
Protection Criteria	Head HPC < 1000 Chest VC < 1,0 m/s Rib deflection D < 42 mm Abdomen sum of APF < 2,5 kN Pelvis PSPF < 6,0 kN	➲ page 34	Different weight in assessment driver and passenger values for HIC_{15}, Neck-Tens./Compr., Head kinematics, Shoulder, Chest deflection, VC, Pelvis and Femur; Car body evaluation, B-pillar ➲ page 46	

[1] Q6 on the far side and the Q10 on the impact side on the rear seats from 2016 onwards

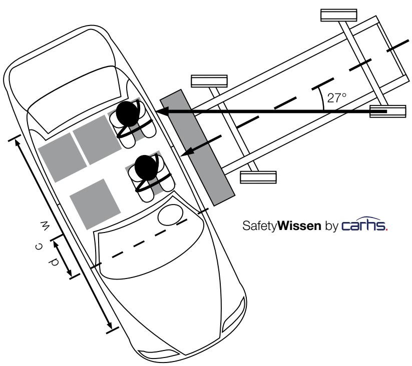
Pole (Side) Impact Tests according to Euro NCAP, GTR 14 and FMVSS 214 new

Requirement	Euro NCAP	GTR 14	FMVSS 214 neu („Oblique Pole Test")	U.S. NCAP
Vehicle Velocity (on Flying Floor)	32 km/h	up to 32 km/h (26 km/h for vehicles up to 1.5 m width)	up to 32 km/h	32 km/h
Impact angle	oblique 75° on fixed pole			
Pole diameter	254 mm			
Dummy	WorldSID 50% on impact side		ES-2 re or SID IIs (Build Level D) on impact side	SID IIs 5 % on impact side
Protection Criteria	➲ page 34	Head HIC_{36} < 1000 Shoulder $F_{lateral}$ < 3,0 kN Chest deflection < 55 mm Abdomen deflection < 65 mm Lower Spine Acc. < 75 g PSPF < 3,36 kN	SID IIs: HIC_{36} < 1000 Lower Spine Acc. < 82 g Pelvis Force < 5,525 kN ES-2 re: HIC_{36} < 1000 Chest deflection < 44 mm Abdominal Force < 2,5 kN PSPF < 6 kN	➲ page 40
Test Configuration				

Side Impact Test Procedures

MDB - Side Impact Tests according to FMVSS 214 / U.S. NCAP

Requirement	FMVSS 214 old rule	FMVSS 214 new rule	U.S. NCAP
Impact angle	lateral 90°, 27° crab angle		
Impact velocity	53±1 km/h (33,5 mph) (~47 km/h in 90° direction)		61.9 ±1 km/h (~55 km/h in 90° direction)
Barrier	NHTSA MDB		
Mass	1368 kg		
Ground clearance	279 mm (bumper 330 mm)		
Upper edge height	838 mm		
Width	1676 mm		
Dummy	2 DOT-SID	Front seat: ES-2 re / Back seat: SID IIs (Build Level D) (impact side)	Front seat: ES-2 re / Back seat: SID IIs (Build Level D) (impact side)
Protection Criteria	Chest TTI < 85 g (4-doors) Chest TTI < 90 g (2-doors) Pelvis acceleration < 130 g	SID IIs: HIC_{36} < 1000 Chest acceleration < 82 g Pelvis force < 5.525 kN ES-2 re: HIC_{36} < 1000 Chest deflection < 44 mm Abdominal force < 2.5 kN Pelvis force < 6 kN	➲ page 40 SafetyWissen by carhs.

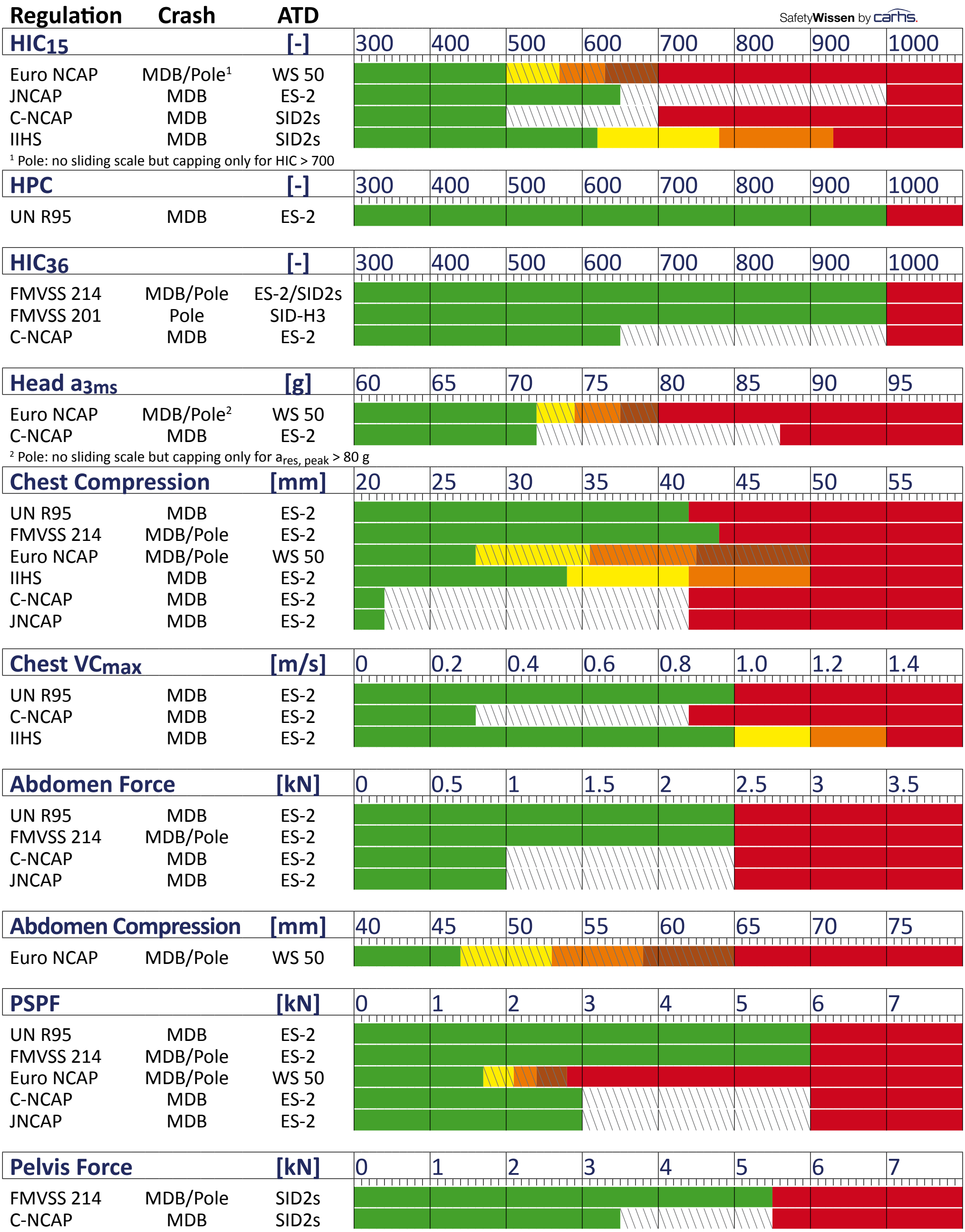


Phase-In Schedule FMVSS 214 new rule

SafetyWissen by carhs. Production Period	Pole				MDB
	Test speed	Vehicles with GVWR > 8500 lbs (3855 kg) excluded	Convertibles excluded	Percentage that must comply	Percentage that must comply
1.9.2010 - 31.8.2011	26 - 32 km/h	yes	yes	20 %	20 %
1.9.2011 - 31.8.2012	26 - 32 km/h	yes	yes	40 %	40 %
1.9.2012 - 31.8.2013	26 - 32 km/h	yes	yes	60 %	60 %
1.9.2013 - 31.8.2014	26 - 32 km/h	yes	yes	80 %	80 %
after 1.9.2014	0 - 32 km/h	yes	yes	100 %	100 %
after 1.9.2015	0 - 32 km/h	no	no	100 %	100 %
after 1.9.2016	0 - 32 km/h	no	no	100 %*	100 %*

* incl. altered and multistage vehicles

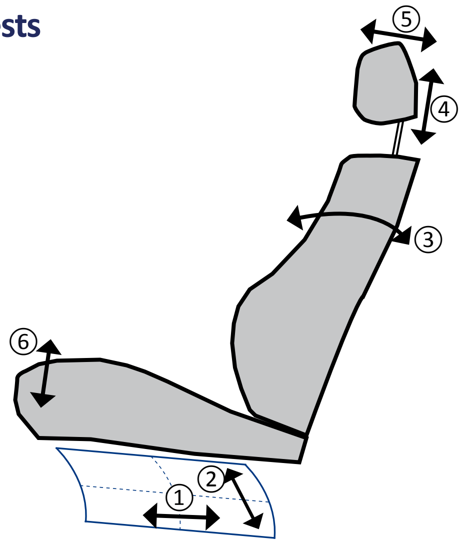
Side Impact Protection Criteria Compared



Legende:
- (green) Regulations: requirements are met / NCAP: maximum score
- (red) Regulations: requirements not met / NCAP: zero score
- (hatched) Linear interpolation of the score between the upper and lower limit

Please note that the values indicated in this graph may be rounded. Please take exact values and additional criteria from the tables for the respective regulation.

Seat Adjustments for Side Impact Tests



	① Seat Fore/Aft	② Seat Height	③ Seat Back Angle	④ Head Restraint Height	⑤ Head Restraint Fore/Aft	⑥ Seat Base Tilt
Euro NCAP MDB	mid + 20 mm	lowest	manuf. design position or 23°	mid	mid[1]	mid
Euro NCAP Pole	mid + 20 mm	lowest	manuf. design position or 23°	mid	mid[1]	mid
UN R95	mid	height of non-adjustable passenger seat or mid	manuf. design position or 25°	top surface level with head COG or uppermost	mid	mid
U.S. NCAP / FMVSS 214 ES-2RE	mid	lowest[2]	manuf. design position or 25°	uppermost	most forward	„absolute" mid[2]
U.S. NCAP / FMVSS 214 SID-2s	most forward position	mid	head at 0°	lowest	most forward	„absolute" mid[2]
ISO WorldSID 50	mid + 20 mm	lowest	manuf. design position or 23°	uppermost or manuf. design position.		

[1] If there is any interference with the rear of the dummy head, move the HR to the most rearward position..

[2] seat base tilt adjustment ⑥ has priority w.r.t. seat height adjustment ②

Side Impact – Requirements and Development Strategies

Course Description

In addition to the protection in a frontal impact, the protection in a side impact has a fixed place in the development of vehicles. Continuous aggravation of consumer tests and legal regulations, e.g. due to e.g. new pole tests, enhanced deformable barriers and the prospective introduction of World-SID-Dummies (5 / 50%ile) are causing a need to further improve side impact protection. In order to achieve this enhancement, it is necessary to get a much more profound understanding of the highly complex phenomena and modes of action in a side impact which goes far beyond the simple application of additional airbags.
The seminar provides a comprehensive overview of today's standard test procedures including country-specific variations, the legal regulations and the requirements of consumer protection as well as an outlook on changes in the near future. In addition, tools, measuring methods and criteria, and especially virtual methods such as crash and occupant simulation, as well as the analysis of the performance of the restraint systems will be discussed. Furthermore it will be explained how a target-oriented use of CAE-simulation and hardware tests can lead to optimal passenger values, while at the same time obeying to boundary conditions such as costs, weight and time-to-market. A part of the workshop with crash-data analysis finally deepens the understanding.

Who should attend?

The seminar addresses development engineers who are new in the field of side crash, or who have already gained some experience in the field of safety, as well as developers of assemblies that have to fulfil a crash-relevant function. Furthermore it is especially interesting for project managers and managers, who deal with side impact and who would like to gain a deeper understanding of this topic in order to use it for an improvement of procedures.

Course Contents

- Challenges of side impacts
- Overview of current regulations and test procedures: Side impact-relevant protection criteria. Legal tests (FMVSS 214, UN R95,..). Other tests (NCAP, Euro NCAP, IIHS, car manufacturer-specific tests).
- Development methods and tools: Crash and occupant simulation, range of application and limitations.
- Performance of restraint systems in side impact: Analysis of the performance of protection and restraint systems in side impact. Discussion of the limitations, conflicts and problems.
- Development strategy for an optimal restraint system for side impact
- Target-oriented use of CAE-simulation and hardware tests
- Workshop with analysis of crash-data and discussion of the results


Course Instructors:

Dipl.-Ing. (FH) Stephanie Wolter, M.Sc. Bart Paul Peeters Weem, BMW Group

Stephanie Wolter, Dipl.-Ing. (FH) studied Engineering Physics at the University of Applied Sciences Munich. Since 1995 she has been working at BMW AG in different functions in the field of side protection, such as pre-development, development of side airbags and as a project engineer in various car lines. Moreover, she represents BMW-Group in various national and international bodies that deal with side impact and other aspects of side protection, e.g. German Side Impact Working Group, ISO Working Groups, etc.

Bart Peeters Weem, MSc. studied mechanical engineering at the University of Technology in Eindhoven with focus on system and control of multibody systems. Since 2003 he has worked at BMW on passive safety development. First as Simulation Engineer, later as project engineer and team leader. Since 2011, he has been project referent for all passive safety topics of several current and future BMW and MINI projects.

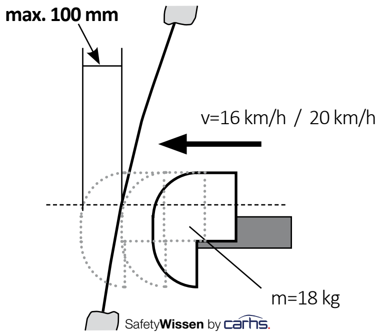
Date	Course ID	Venue	Duration	Price	Language
03.-04.03.2015	2450	Alzenau	2 Days	1.290,- EUR till 03.02.2015, thereafter 1.540,- EUR	
29.-30.06.2015	2498	Alzenau	2 Days	1.290,- EUR till 01.06.2015, thereafter 1.540,- EUR	
11.-12.11.2015	2451	Alzenau	2 Days	1.290,- EUR till 14.10.2015, thereafter 1.540,- EUR	

This course is available as an in-house seminar in English and German!

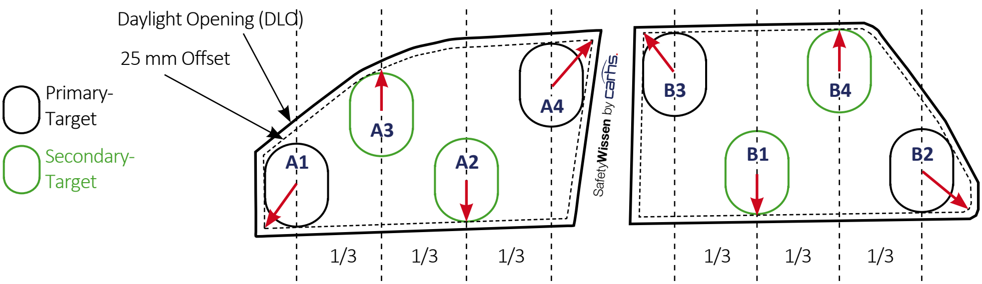
FMVSS 226 - Ejection Mitigation

Requirements:

- At up to 4 impact test locations on each side window in the first 3 rows of seats the head excursion may not exceed 100 mm
- Tests at two impact velocities: 16 km/h and 20 km/h
- Head protection systems (e.g. curtain airbags) must be fired before the impact:
  - at 20 km/h with a time delay of 1.5 s prior to the impact
  - at 16 km/h with a time delay of 6 s prior to the impact
- Tests are done without glazing or with pre-damaged glazing
  - pre-damage: perforation in a 75 mm grid pattern
- Valid for vehicles with GVWR ≤ 4536 kg
- Phase-In: 2013 - 2017



Locating Targets:



Steps	Front Row Window	Rear Row Windows SafetyWissen by carhs.
1	Set Primary Target A1 in lower front corner	Set Primary Target B3 in upper front corner
2	Set Primary Target A4 in upper rear corner	Set Primary Target B2 in lower rear corner
3	Divide horizontal distance between A1 and A4 in thirds	Divide horizontal distance between B3 and B2 in thirds
4	Move A3 at the first third vertically upward	Move B1 at the first third vertically downward
5	Move A2 at the second third vertically downward	Move B4 at the second third vertically upward
6	Measure Distances D_x (horizontal) and D_z (vertical) of the target center points	
7	If D_x (A2 - A3) < 135 mm and D_z (A2 - A3) < 170 mm ⇨ Eliminate A3	If D_x (B1 - B4) < 135 mm and D_z (B1 - B4) < 170 mm ⇨ Eliminate B4
8	If D_x (A4 - A3) (or A2 if A3 was eliminated in step 7) < 135 mm and D_z (A4 - A3/2) < 170 mm ⇨ Eliminate A3/2	If D_x (B3 - B4) (or B1 if B4 was eliminated in step 7) < 135 mm and D_z (B3 - B4/1) < 170 mm ⇨ Eliminate B4/1
9	If D_x (A4 - A2) (or A3 if A2 was eliminated in step 8) < 135 mm and D_z (A4 - A2/3) < 170 mm ⇨ Eliminate A2/3	If D_x (B2 - B1) (or B4 if B1 was eliminated in step 8) < 135 mm and D_z (B2 - B1/4) < 170 mm ⇨ Eliminate B1/4
10	If D_x (A1 - A4) < 135 mm and D_z (A1 - A4) < 170 mm ⇨ Eliminate A4	If D_x (B3 - B2) < 135 mm and D_z (B3 - B2) < 170 mm ⇨ Eliminate B3
11	If only 2 targets remain: Measure absolute distance D the center points of the targets	
12	If D > 360 mm, set additional 3rd target on the center of the line connecting the targets	
13	If less than 4 targets remain, repeat steps 1-12 with the impactor rotated by 90 degrees. If this results in a higher number of targets use the rotated targets.	
14	If no target is found rotate the impactor in 5 degree steps, until it is possible to fit the impactor in the DLO-offset. Then place the center of the target as close to the geometric center of the DLO as possible.	

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Ejection Mitigation: FMVSS 226
Requirements - Testing - Development Strategies

Course Description

In 2011, the U.S.legislation adopted - with the Federal Motor Vehicle Safety Standard (FMVSS) 226 - a new safety rule, which aims at reducing the risk to be thrown out of the vehicle during a car crash, especially in a rollover. The regulation calls for appropriate safety measures to secure the side windows of cars so that passengers can't lean out further than allowed. To verify this, impactor tests are carried out on the side windows of the standing vehicle. For these tests, a new specially designed impactor has been developed. In these tests curtain airbags are usually employed as protective systems. For the tests specific requirements on the duration of the inflation of the air bag are introduced, since the impact of the impactor takes place up to 6 seconds after the ignition of the airbag. Additional retaining effects can be achieved using laminated safety glass for the side windows. However, these must be pre-damaged before testing.

The seminar begins with the requirements of the new regulation. This includes demands on vehicle performance, as well as requirements for the test rig (accuracy, stability, friction etc.) and rules for the preparation and execution of the test. In the second part of the course, the testing procedure is described in detail. This includes the preparation of the test vehicle, if necessary the perforation of the side windows and the determination of the impact points. The actual implementation of the test, and the evaluation and documentation of results are also discussed. A description of the measurement equipment and practical hints on the experimental procedure complete this section. The last part of the seminar focuses on development strategies to meet the legal requirements. Here it is shown with which basic measures the performance can be improved with regard to the requirements of FMVSS 226. Finally conflicts with other safety requirements are identified and discussed.

Who should attend?

The seminar is aimed at development, test and simulation engineers who have to deal with the requirements of FMVSS 226 and want to get a comprehensive overview on the topic.

Course Contents

- The requirements of FMVSS 226
  - Performance requirements on the vehicle
  - Special requirements for non-standard vehicles
  - Requirements for the test bench
  - Requirements regarding test preparation and execution
- Testing procedure
  - Vehicle preparation
  - Pre-damaging of laminated glass side windows
  - Determination of impact points
  - Measurement equipment
  - Implementation and evaluation of the tests
  - Practical hints
- Development strategies for the fulfillment of the regulation
  - Design of appropriate airbags
  - Benefits and effectiveness of safety glass windows
  - Dealing with fixed side windows
  - Conflicts with other safety requirements

Course Instructor:

Dipl.-Ing. Valentin Zimmermann, Bertrandt Ingenieurbüro GmbH

Since 2009 Valentin Zimmermann has worked at Bertrandt Ingenieurbüro GmbH in Munich in the area of vehicle safety testing services. A main focus of his work as Lead Engineer in vehicle safety development is on testing for FMVSS 226.

Date	Course ID	Venue	Duration	Price	Language
09.09.2015	2491	Alzenau	1 Day	740,- EUR till 12.08.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

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Head Impact on Vehicle Interiors

UN R21

Test Procedure

A pendulum equipped with a spherical impactor (165 mm) hits the interior parts in front of the driver and passenger (side, pedal and steering wheel excluded) with a velocity of 24.1 km/h.

Protection Criteria

a_{3ms} < 80 g; no failure of structure and sharp edges in impact zone

Pendulum test is not necessary, if it can be shown that there is no contact between head and the instrument panel in case of a frontal impact.

This can be done by crash tests, sled tests and/or numerical occupant simulation.
(See app. 8 of UN R21)

FMVSS 201U

Test Procedure

A Free Motion Headform (FMH) impactor hits the upper interior parts with a velocity of 24 km/h (A-, B-, C-pillar, roof etc.).

FMH Impactor Data

Mass of FMH impactor: 4.54 kg
Head form according to SAE J 921 and J 977 including triaxial acceleration sensor.

Protection Criteria

HIC Calculation

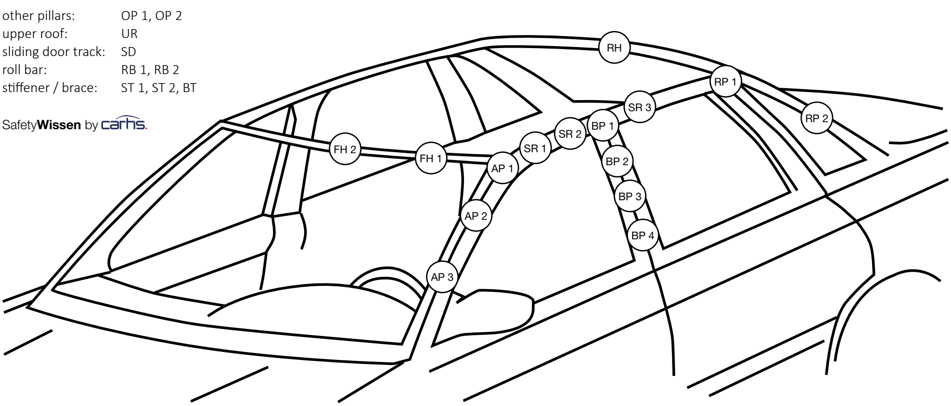
$$HIC = sup_{t_1,t_2} \left\{ \left[\frac{1}{(t_2-t_1)} \int_{t_1}^{t_2} a dt \right]^{2,5} (t_2-t_1) \right\}$$

$t_2-t_1 < 36$ ms; a [g]; t [s]

HIC value for FMH $HIC(d) = 0.75446\ HIC + 166.4$

HIC(d) must not exceed 1000.

24 points defined for impact according Test Procedure TP-201 (each side, left and right)



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Head Impact on Vehicle Interiors

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Head Impact on Vehicle Interiors FMVSS 201 and UN R21

Course Description

To prevent injuries resulting from impacts of the occupants' heads on vehicle interior parts, these parts need to be designed in a way which allows sufficient deformation space to reduce the loads on the head. Internationally there are two important regulations regarding the design of interiors, such as cockpits, roof and door liners: The U.S. FMVSS 201 and the Regulation UN R21. Both regulations stipulate requirements concerning the maximum head acceleration or the HIC in impacts on interior parts.

The objective of this course is to provide an overview of the legal requirements and to show how these can be fulfilled. The focus of the seminar is on the development process and the development tools and methods. In particular the interaction of testing and simulation will be described and different design solutions will be discussed. Typical conflicts of objectives in the design - e.g. to fulfil NVH requirements, static stiffness, or misuse, while fulfilling the safety standards at the same time - are addressed in this seminar. Examples of practical solutions will be shown and discussed.

In addition, the development according to the head impact requirements in the overall-context of vehicle development is described in this seminar.

In a workshop exemplary head impact locations in a vehicle interior and impact areas on a dashboard are determined.

Who should attend?

This seminar is especially suited for engineers and technicians who work on the development of vehicle interior parts and who want to become familiar with the safety requirements that are relevant for these parts.

Course Contents

- Introduction
- Rules and regulations concerning head impact
  - FMVSS 201
  - UN R21
- Development tools
  - Numerical Simulation
  - Test
- Workshop: Determination of impact locations in a vehicle
- Development process and methods
  - Solving of conflicts of objectives
  - Typical deformation paths, padding materials

Course Instructor:

Dipl.-Ing. Torsten Gärtner, Adam Opel AG

Since 1997 Torsten Gärtner has worked as a simulation expert. From numerous projects he has extensive experience in the field of occupant simulation and interior safety. He is a Technical Integration Expert for vehicle safety with Adam Opel AG. Before that he worked as department manager for safety with Tecosim GmbH and he spent 10 years in various management positions with carhs gmbh.

Date	Course ID	Venue	Duration	Price	Language
13.03.2015	2415	Alzenau	1 Day	740,- EUR till 13.02.2015, thereafter 890,- EUR	German
12.06.2015	2446	Alzenau	1 Day	740,- EUR till 15.05.2015, thereafter 890,- EUR	English
30.10.2015	2447	Alzenau	1 Day	740,- EUR till 02.10.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

Pedestrian Protection

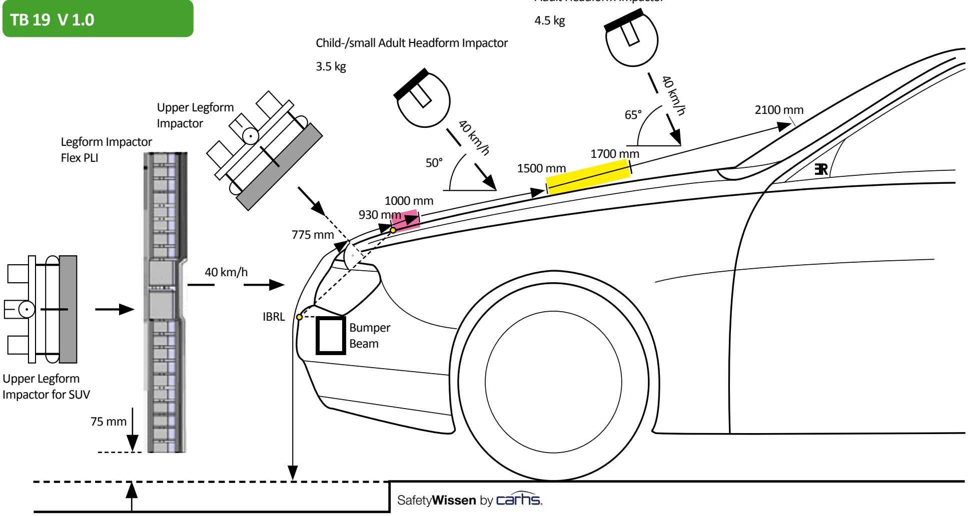
Pedestrian Protection Test Procedures in Euro NCAP

Protocol Version 8.0

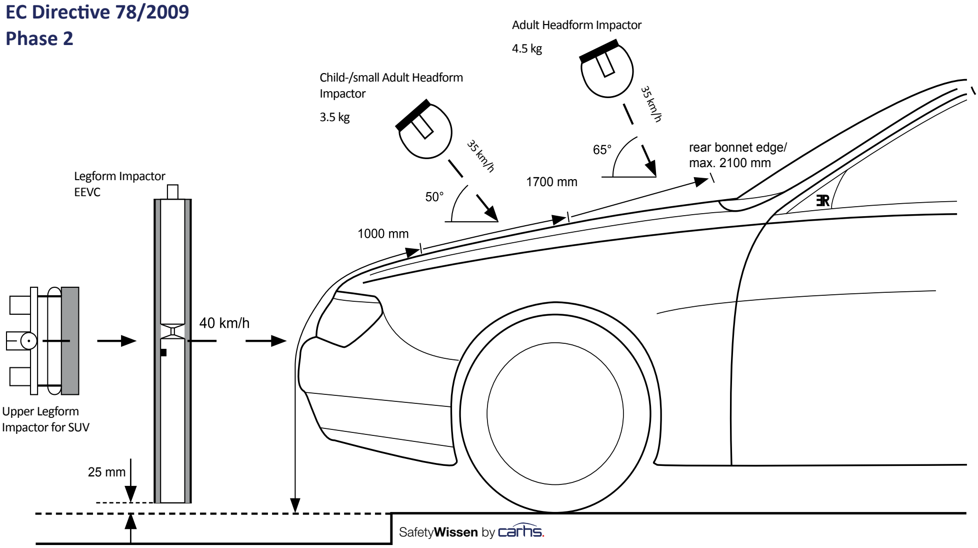
TB 19 V 1.0

Where the bonnet leading edge reference line (BLERL) is located between WAD 930 mm and WAD 1000 mm, an additional test with the child headform will be performed on the BLERL at a speed of 40 km/h under 20°.

Points to be tested that lie between WAD 1500 und 1700 are tested with child-/small adult headform impactor, if the points are on the moveable/hinged bonnet top. Otherwise the adult headform is used.



Pedestrian Protection Test Procedures according to EC Directive 78/2009 Phase 2



more about the impactors ➲ page 110

Test Procedures and Protection Criteria for Pedestrian Protection

Test method	Parameter	Europe Directives 78/2009 and 631/2009		Euro NCAP		JNCAP		KNCAP		Japan Article 18 Attachment 99	GTR No. 9
		Phase 1	Phase 2	max. score	zero score	max. score	zero score	max. score	zero score		
EEVC lower legform impactor to bumper	Velocity	40 km/h	40 km/h							40 km/h	40 km/h
	Impact angle	0°	0°							0°	0°
	Acceleration	200 g	170 g (250 g)							170 g (250 g)	170 g (250 g)
	Bending	21°	19°							19°	19°
	Shearing	6 mm	6 mm							6 mm	6 mm
Flex PLI to bumper	Velocity			40 km/h		40 (44)[5] km/h		40 km/h		40 km/h	40 km/h
	Impact angle			0°		0°		0°		0°	0°
	Tibia Bending			282 Nm	340 Nm	224 Nm	380 Nm	282 Nm	340 Nm	340 Nm(380 Nm)	340 Nm [2]
	MCL Elongation			19 mm	22 mm	16.4 mm	22 mm	19 mm	22 mm	22 mm	22 mm [2]
	ACL/PCL Elong.			10 mm	10 mm	0 mm	13 mm	10 mm	10 mm	13 mm	13 mm [2]
upper legform impactor to bumper	Velocity	40 km/h	40 km/h	40 km/h				40 km/h		40 km/h	40 km/h
	Impact angle	0°	0°	0°				0°		0°	0°
	Sum force	7.5 kN	7.5 kN	5 kN	6 kN			5 kN	7,5 kN	7.5 kN	7.5 kN
	Bending	510 Nm	510 Nm	285 Nm	350 Nm			300 Nm	510 Nm	510 Nm	510 Nm
upper legform impactor to bonnet leading edge	Velocity	20 - 40 km/h	20 - 40 km/h	20 - 33 km/h							
	Impact angle	10° - 47°	10° - 47°	90° w.r.t. IBRL - WAD 930							
	Sum force	5 kN [1]	5 kN [1]	5 kN	6 kN						
	Bending	300 Nm [1]	300 Nm [1]	285 Nm	350 Nm						
small adult headform impactor to bonnet	Velocity	35 km/h									
	Impact angle	50°									
	Diameter	165 mm									
	Mass	3.5 kg									
	HPC	1000 (2/3) 2000 (1/3)									
adult headform impactor, child headform impactor to windscreen	Velocity	35 km/h		40 km/h		35 km/h		40 km/h			
	Impact angle	35°		65° (AH) / 50° (CH)		40° / 40° / 45° (AH + CH)		65° (AH) / 50° (CH)			
	WAD (mm)	–		1500-2100 (AH) / 1000-1500 (CH)		1700-2100 (AH) / 1000-1700 (CH)		1700-2100 (AH) / 1000-1700 (CH)			
	Diameter	165 mm		165 mm		165 mm (AH + CH)		165 mm			
	Mass	4.8 kg		4.5 kg (AH) / 3.5 kg (CH)		4.5 kg (AH) / 3.5 kg (CH)		4.5 kg (AH) / 3.5 kg (CH)			
	HPC	1000 [1]		650	1700	650	2000	650	1700		
adult headform impactor to bonnet	Velocity		35 km/h	40 km/h		35 km/h		40 km/h		35 km/h	35 km/h
	Impact angle		65°	65°		65° / 90° / 50°		65°		65°	65°
	WAD (mm)		1700 - 2100	1700 - 2100		1700 - 2100		1700 - 2100		1700 - 2100	1700 - 2100
	Diameter		165 mm	165 mm		165 mm		165 mm		165 mm	165 mm
	Mass		4.5 kg	4.5 kg		4.5 kg		4.5 kg		4.5 kg	4.5 kg
	HPC		1000 (2/3) [3] 1700 (1/3) [3]	650	1700	650	2000	650	1700	1000 (2/3) [3] 1700 (1/3) [3]	1000 (2/3) [3] 1700 (1/3) [3]
child headform impactor to bonnet	Velocity		35 km/h	40 km/h		35 km/h		40 km/h		35 km/h	35 km/h
	Impact angle		50°	50°		65° / 60° / 25°		50°		50°	50°
	WAD (mm)		1000 - 1700	1000 - 1700		1000 - 1350 / 1350 - 1700		1000 - 1700		1000 - 1700	1000 - 1700
	Diameter		165 mm	165 mm		165 mm		165 mm		165 mm	165 mm
	Mass		3.5 kg	3.5 kg		3.5 kg		3.5 kg		3.5 kg	3.5 kg
	HPC		1000 (1/2) [4] 1700 (1/2) [4] or (only for [4]) 1000 (2/3) [3] 1700 (1/3) [3]	650	1700	650	2000	650	1700	1000 (1/2) [4] 1700 (1/2) [4] or (only for [4]) 1000 (2/3) [3] 1700 (1/3) [3]	1000 (1/2) [4] 1700 (1/2) [4] or (only for [4]) 1000 (2/3) [3] 1700 (1/3) [3]
active interventions			BAS alternative: Collision Avoidance System	AEB VRU as of 2016		AEB Pedestrian as of 2016		AEB Pedestrian as of 2017		SafetyWissen by carhs.	

[1] Monitoring only
[2] injury criteria proposed by GRSP Flex-TEG
[3] entire bonnet
[4] child headform area
[5] test velocity will be increased when leg impact is introduced in legal test (J-MLIT)

Table based on O. Zander, BASt

Euro NCAP - Pedestrian Protection: Head Impact Grid Method

Protocol Version 8.0

Between WAD 1000 and WAD 2100 impact points are located on a fixed 100 mm grid, the selection of „Worst Case“ points by the test institute is no longer required. The manufacturer provides a result prediction (points) for the Grid-Points. Euro NCAP verifies 10 randomly selected points, the manufacturer can nominate up to 10 additional randomly selected points. A tolerance of 10 % is applied to the verification tests, i.e. even if the actual HIC is 10 % above or below the margins of the predicted score, the predicted score is applied. At the verification points the actual test result is divided by the manufacturer's prediction. This so called correction factor is applied to all the grid points to obtain the final score:

$$\frac{\text{Actual tested score}}{\text{Predicted score}} = \text{Correction Factor}$$

Per Grid-Point 0 - 1 points are available according to the following scheme:

	HIC_{15}	< 650	1.00 Point
650 ≤	HIC_{15}	< 1000	0.75 Points
1000 ≤	HIC_{15}	< 1350	0.50 Points
1350 ≤	HIC_{15}	< 1700	0.25 Points
1700 ≤	HIC_{15}		0.00 Points

„Default“ Results

Grid points on the A-pillars are defaulted to red = 0 points. Grid points on the windscreen that have distance of more than 165 mm from the windscreen base are defaulted to green = 1 point. Defaulted locations are not included in the random selection of verification tests. Where the vehicle manufacturer can provide evidence that shows an A-pillar is not red, those grid points will be considered in the same way as other points.

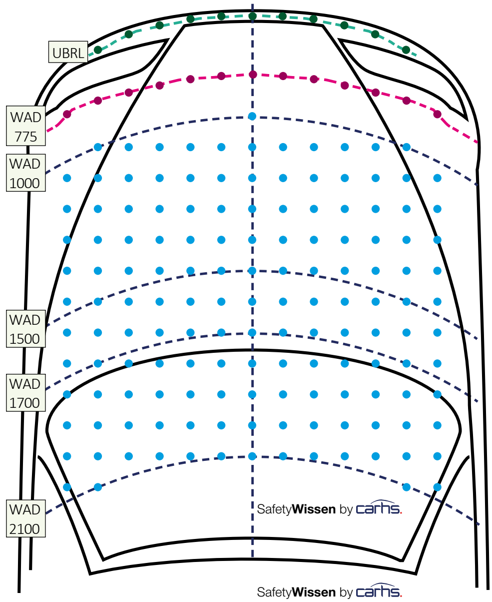
Unpredictable Grid Locations: blue Zones

In the following areas

- Plastic scuttle
- Windscreen wiper arms and windscreen base
- Headlamp glazing
- Break-away structures

the manufacturer may define a „blue zone“ consisting of up to 2 adjacent grid points, for which no prediction is made. A maximum of eight zones may be blue over the entire headform impact area.

The laboratory will choose one blue point to assess each zone. The test results of blue points will be applied to all the grid point(s) in each zone.



Total score:

The total score will be calculated as follows:

	∑ Predicted Score x Correction Factor
+	∑ Default Scores
+	∑ Scores from Blue Zones
=	Total
÷	Number of Grid Points
=	Percentage of max. achievable score
x	24 (Maximum achievable score)
=	Total Score for Headform Test

Leg Impact

For leg impact a 100 mm grid on WAD 775 (Upper Legform) respectively on Upper Bumper Reference Line (Flex PLI Legform) is used. Euro NCAP selects either the centerline point or an adjacent point as a starting point for testing. Starting from this position every second grid point will be tested. Symmetry is applied across the vehicle. Grid points that have not been tested will be awarded the worst result from one of the adjacent points. Manufacturers may sponsor additional test for those points that are not tested (in advance). Per Grid point up to 1 point is awarded. For the Upper Legform the score is based upon the worst performing parameter (Sum of Forces / Bending moment). For the Legform the 1 point per grid point is divided into two independent assessment areas of equal weight (0.5 Pts./each): Tibia moments and ligament elongations.

more about the impactors ➲ page 110

Pedestrian Protection - Development Strategies

Course Description

Phase 2 of the EU regulation on pedestrian safety was introduced, Japan recognizes the UN Regulation 127 and Euro NCAP annually adjusts details in its pedestrian rating protocols. Currently, the greatest challenge regarding pedestrian protection in the vehicle development process is to generate a facelift of successor model based on a car that had received a 5 star Euro NCAP rating prior to 2010, that will be type approved according to phase 2 of the European regulation and also continue to receive a 5 star rating according to Euro NCAP's latest protocols. Stricter injury criteria, modified testing areas and the testing of vehicles that were previously not tested because of their weight, require the thorough knowledge of the requirements and a strict implementation of the requirements in the development process.

In the introduction the seminar informs you about the different impactors that are used for pedestrian safety testing. Thereafter the various requirements (regulations and consumer tests) are explained and compared.

The focus of the seminar is on the development strategy: which decisions have to be taken in which development phase? What are the tasks and priorities of the person in charge of pedestrian protection? As a background, ideas and approaches towards the design of a vehicle front end in order to meet the pedestrian protection requirements are discussed.

In addition to that, the seminar explains how the function of active bonnets can be proven by means of numerical simulation. This includes both, the pedestrian detection that need to be proven with various impactors or human models, as well as the prove that the bonnet is fully deployed at the time of impact.

Who should attend?

The seminar is intended for development-, project- or simulation- engineers working in the field of vehicle safety, dealing with the design of motor vehicles with regard to pedestrian protection.

Course Contents

- Introduction with an overview of current requirements regarding pedestrian protection
  - Legal requirements (EU, UN Regulations, Japan, GTR)
  - Consumer tests (Euro NCAP, JNCAP, KNCAP)
- Presentation and discussion of the design and application of the impactors
  - Leg Impactors (Flex PLI, EEVC, Upper Legform)
  - Head Impactors (Child head, Adult head)
- Methods in numerical simulation, testing and system development
- Requirements on the design of vehicle front ends for pedestrian protection
- Solutions to fulfill the requirements
  - Passive solutions
  - Active solutions (active bonnets, airbags)
- Development strategy
  - Interaction between simulation and testing
  - Integration in the vehicle development process

Course Instructor:

Dipl.-Ing. (FH) Maren Finck, carhs.training gmbh

Dipl.-Ing. (FH) Maren Finck is a Project Manager at carhs.training gmbh. From 2008 - 2015 she worked at EDAG as a project manager responsible for passive vehicle safety regarding pedestrian safety. Previously, she worked several years at carhs GmbH and TECOSIM as an analysis engineer with a focus on pedestrian safety and biomechanics.

Date	Course ID	Venue	Duration	Price	Language
30.03.2015	2412	Alzenau	1 Day	740,- EUR till 02.03.2015, thereafter 890,- EUR	German
13.11.2015	2479	Alzenau	1 Day	740,- EUR till 16.10.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

hirtenberger is the market leader for pyrotechnic actuators for pedestrian protection systems and provides solutions for:
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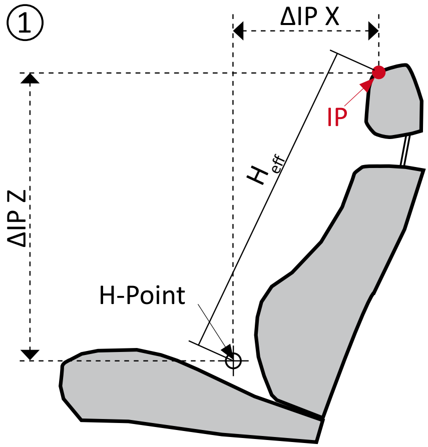
Rear Impact: Euro NCAP Rear Whiplash Assessment

①



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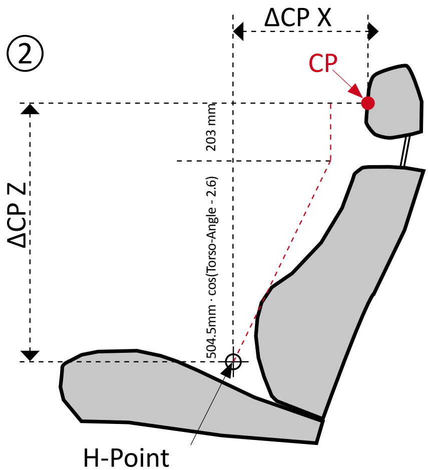

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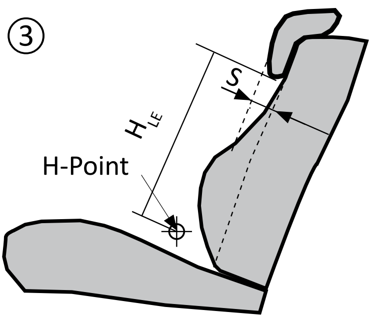


Assessment Protocol Version 7.0.1

① Effective Height H_{eff} requirements for the headrest:
in highest position ≥ 770 mm
and
in worst case position ≥ 720 mm

Calculation of H_{eff}:
H_{eff}= ΔIP X · sin (Torso-Angle) + ΔIP Z · cos (Torso-Angle)
IP: Intersection Point

Determination of IP X and IP Z:
IP X = 88.5 · sin (Torso-Angle- 2.6) + 5 + CP X
IP Z = uppermost intersection of the headrest contour in the seat centerline with a vertical line through IP X

② Backset ΔCP X requirements for the headrest
in mid position
and
in worst case position:

ΔCP X ≤ 7.128 · Torso-Angle + 153
CP: Contact Point

③ Requirements for the non-use position of the headrest:
1) > 60° rotation of the headrest in non-use position
2) Δ Torso-Angle use / non-use > 10°
3) Height of lower edge of the headrest H_{LE}:
   250 mm≤ H_{LE} ≤ 460 mm
   with H_{LE} = ΔX · sin (Torso-Angle) + ΔZ · cos (Torso-Angle)
4) Thickness of the lower edge of the headrest S ≥ 40 mm

Score if the requirements (see above) are met:
The outboard seating positions of rear seating rows are assessed. Any centre seating position needs to comply with the requirements of UN R17-08.

Parameter	Points per seat
① H_{eff}	1.5
② ΔCP X_{mid}	1*
② ΔCP $X_{worstcase}$	0.5*
③ Non-Use	1*
Summe max.	4
Scaling	1/4n (n=number of seats)

* only if H_{eff} requirements are met

Euro NCAP Whiplash Seat Test

Assessment Protocol Version 7.0.1

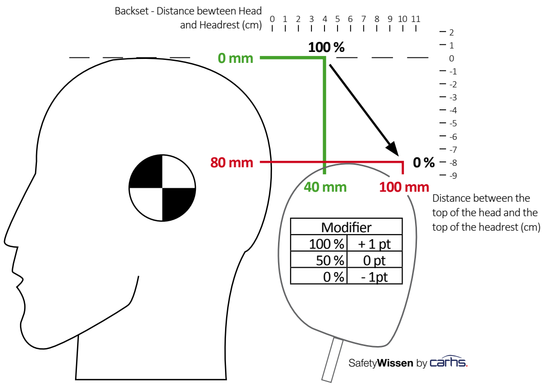
Seat Performance Criteria

SafetyWissen by carhs	Low Severity Pulse			Medium Severity Pulse			High Severity Pulse		
	Higher performance	Lower performance	Capping Limit	Higher performance	Lower performance	Capping Limit	Higher performance	Lower performance	Capping Limit
NIC	9.00	15.00	18.30	11.00	24.00	27.00	13.00	23.00	25.50
Nkm	0.12	0.35	0.50	0.15	0.55	0.69	0.22	0.47	0.78
Rebound velocity (m/s)	3.0	4.4	4.7	3.2	4.8	5.2	4.1	5.5	6.0
Upper Neck Shear Fx (N)	30	110	187	30	190	290	30	210	364
Upper Neck Tension Fz (N)	270	610	734	360	750	900	470	770	1024
T1 acceleration* (g)	9.40	12.00	14.10	9.30	13.10	15.55	12.50	15.90	17.80
T-HRC (ms)	61	83	95	57	82	92	53	80	92

* up to T-HRC (=Time to Head Restraint Contact)

If the Higher Performance Limit is reached, 0.5 Points are awarded per criterion. A sliding scale is used between Higher and Lower Performance Limit (0.5 .... 0 Points). Only the maximum score from either T1 acceleration or head restraint contact time (T-HRC) is used in the assessment. If the capping limit is exceeded by one criterion, the entire test is rated with zero points.

Geometry assessment



Worst Case Geometry

1/n points (where n = the number of front seats) will be available for each front seat scoring more than 0 points in the worst case (= lowest and rearmost position) geometry assessment.

Seat Stability Modifier

The high severity pulse is subject to an additional seatback deflection assessment where a 3 point penalty is applied to seats with a rotation of 32° or greater

Dummy Artefact Modifier

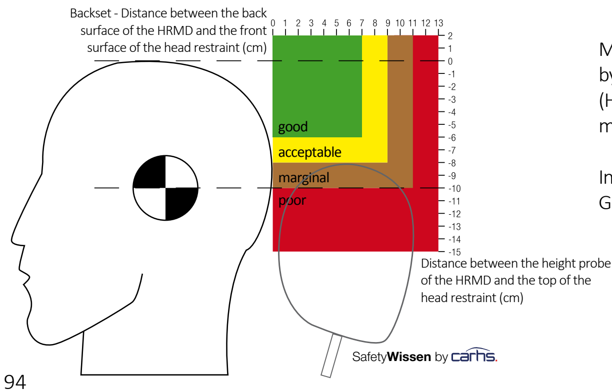
A two point negative modifier is applied as a means of penalising any seat that, by design, places unfavourable loading on other body areas or exploits a dummy artefact.

The assessment is based on the worst performing parameter from either the height or backset.

Overall Rating

For the overlall rating the total of max. 11 points (3 per pulse + 1 Geometry + 1 Worst Case Geometry) is scaled by the factor 2/11 and is part of the Adult Occupant Protection rating.

Static Geometry Assessment by IIWPG / IIHS



Measurement of the head restraint position by a „Head Restraint Measuring Device" (HRMD) and rating in good, acceptable, marginal and poor.

International Insurance Whiplash Prevention Group (IIWPG)

Learn more about IIHS's static and dynamic assessment ➲page 44

Whiplash Testing and Evaluation in Rear Impacts

Course Description

In real-world accidents, distortions of the cervical spine or so-called whiplash injuries following a rear impact are among the most expensive injuries for the insurance industry. About 75 % of all injury costs of the insurers are caused by whiplash injuries in highly-motorized countries. About 80 % of all injuries in a rear impact are whiplash-injuries. This is why this type of injury – even though it is neither very serious nor lethal – has reached a high priority in the endeavors to develop test procedures and assessment criteria which help in designing constructive measures in the car in order to avoid this type of injury.

As an introduction, this seminar is going to refer to the different accident data for whiplash injuries, which offer many realizations but no consistent pattern with regard to the biomechanical injury mechanisms. However, some organizations – mainly from the field of consumer information and insurance institutes – are working on the development of test procedures and assessment criteria. The most active ones are Thatcham (UK) and IIHS (USA) which are united in the group IIWPG (International Insurance Whiplash Prevention Group), SNRA and Folksam (Sweden) and the German ADAC.

In 2008 Euro NCAP has introduced a whiplash test procedure as part of its rating system. In 2014 an additional assessment for the rear seats will be added. The Euro NCAP assessment will be explained in detail in the seminar. Furthermore, the EEVC working group 20 is active as a consulting authority concerning whiplash injuries for the legislation in Europe.

The new Global Technical Regulation No. 7 (Head Restraints) is unsatisfactory from the European point of view. Therefore the United Nations work on a second phase of this regulation. The focus of this work is on improving the BioRID dummy and on the definition of so called Seat Performance Criteria.

All discussions about the assessment of whiplash injuries within the framework of consumer information have in common, that the protection effect in a rear-end impact needs to be examined in an isolated vehicle seat by means of a sled test using a generic acceleration pulse. It turns out to be problematic, however, that presently there is no traumato-mechanical explanation of the phenomenon "whiplash injury" and that all the currently discussed dummy-criteria with the respective limit values follow a so-called "black-box approach". Experts try to correlate the measured dummy criteria with the findings from accident data and to thus derive limit values. In this context the available dummy-technology with the different measuring devices and criteria, as well as the proposed limit values are going to be presented.

In the last part of the seminar different seat design concepts (energy-absorbing, respectively geometry-improving), subdivided into active and passive systems will be introduced, and their advantages and disadvantages will be discussed.

Who should attend?

The seminar addresses development engineers who are new in the field of rear impacts or who have already got some experience in the field of safety, as well as developers of subassemblies which have to fulfill a crash-relevant function. It is furthermore especially interesting for project managers and managers who deal with the topic of rear-end impacts and who would like to obtain a better knowledge of this subject in order to use it for an improvement of procedures.

Course Contents

- Introduction into the characteristics of a rear-end impact
- Overview of the most important whiplash requirements
- Introduction into the applied injury criteria
- Dummy-technology for rear impacts
- Presentation of the Euro NCAP and FMVSS202-dynamic test procedures
- Outlook on possible harmonization-tendencies
- Explanation of the possible design measures in car seats

Course instructor:

Dipl.-Ing. Thomas Frank, LEAR Corporation GmbH

Thomas Frank joined the passive safety department of Lear Corporation in 2002 after graduating from the Technical University of Berlin in physical engineering sciences. At Lear Thomas Frank initially worked as a test engineer in crash testing, later he developed head rests. Today he is expert for low speed rear impact safety. In his position he guides the seat development with respect to meet whiplash protection requirements in regulations and consumer tests.

Date	Course ID	Venue	Duration	Price	Language
23.02.2015	2464	Alzenau	1 Day	**740,- EUR till 26.01.2015, thereafter 890,- EUR**	German
21.09.2015	2465	Alzenau	1 Day	**740,- EUR till 24.08.2015, thereafter 890,- EUR**	German

This course is available as an in-house seminar in English and German!

Child Occupant Protection Assessment in Euro NCAP

Protocol Version 6.5

Requirements for points for Child Protection Rating: child seats (CRS[1]) must be recommended by the vehicle manufacturer. CRS must be available for purchase within 5 working days. CRS must be type approved and evaluated by ETC or similar programs with a "good" performance rating.

Group	Criterion	Condition	Dummy	Q1½		Q3	
max. 49 points	**Dynamic assessments**						
	Requirements for Points in Dynamic Assessments: no partial or full ejection of child dummy out of CRS / CRS must not be partially or wholly unrestrained by any of the vehicle interfaces						
max. 24 points			Dummy	Q1½		Q3	
	Head Contact with the vehicle: any head contact with the vehicle results in 0 points for the head performance						
	Frontal Impact						
			points	4	0	4	0
worst score from	**no head contact with CRS** **head contact with CRS**	no direct evidence + Head a_{res} peak Head $a_{res\ 3ms}$	g g	< 80 ≤ 72	≥ 88	< 96 ≤ 87	≥ 100
worst score from	**Forward Facing CRS**						
worst score from	**Forward Facing CRS receive 0 points for the** Q1½		points	0	0	4	0
worst score from	**forward head excursion**	relative to Cr point	mm			≤ 549	≥ 550
worst score from	**Rearward Facing CRS**						
worst score from	**head exposure**	no compressive load on top of head, head fully restrained within CRS	points	4	0	4	0
	Forward Facing CRS receive 0 points for the Q1½		points	2	0	2	0
	neck tension	upper neck F_z	kN	≤ 1.7	≥ 2.62	≤ 1.7	≥ 2.62
			points	2	0	2	0
	chest acceleration	$a_{res\ 3ms}$	g	≤ 41	≥ 55	≤ 50	≥ 66
	Side Impact						
	Requirements for Points in Side Impact: head containment within shell of CRS, also there must be no fracturing of the CRS						
			points	4	0	4	0
	no head contact with CRS **head contact with CRS**	no direct evidence + Head $a_{res\ peak}$ Head $a_{res\ 3ms}$	g g	< 80 ≤ 72	≥ 88	< 80 ≤ 72	≥ 88
	Installation of CRS						
max. 12 pt.	**universal seats**		points	5			
max. 12 pt.	**semi-universal seats**		points	5			
max. 12 pt.	**recommended seats**		points	2			
	Vehicle Based Assessment						
max. 13 points	**provision of three-point seat belts**		if any passenger seat is not equipped with a 3 point belt 0 points are awarded for the vehicle based assessment				
max. 13 points	**compatibility of 2nd row outboard seats with Gabarit according to UN ECE R16.06**		points	1			
max. 13 points	**compatibility of all other passenger seats with Gabarit according to UN ECE R16.06**		points	1			
max. 13 points	**3 seating positions that can simultaneously accommodate any top pick CRS**		points	1			
max. 13 points	**3 seating positions that can simultaneously accommodate i-Size CRS**		points	1			
max. 13 points	**2 passenger seats meet i-Size usability requirements**		points	1			
max. 13 points	**2 seating positions comply with requirements for largest size of rearward facing ISOFIX seats**		points	1			
max. 13 points	**passenger airbag warning and automatic disabling**		points	4			
max. 13 points	**passenger airbag warning and manual disabling**		points	2			
max. 13 points	**1 integrated CRS**		points	1			
max. 13 points	**2 integrated CRS**		points	1			
max. 13 points	**1 integrated "Group I-III" CRS**		points	1			

[1] CRS = Child Restraint System

The KING II ATS actively watches over your child from the moment they sit down to the moment you arrive.

It helps you check that your child starts off with the harness correctly tensioned. It adjusts as you drive, dynamically retracting the harness to keep the tension exactly as it should be. It constantly monitors the harness tension, alerting you if there's any problem.

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Child Occupant Protection Assessment in Latin NCAP

Protocol Version 3.0

Requirements for points for Child Protection Rating: child seats (CRS) must be recommended by the vehicle manufacturer. CRS must be available for purchase from dealers, in the 3 big Latin NCAP markets (Argentina, Brazil, Mexico). CRS must be available at the 3 most important cities of each of the 3 big markets in at least 2 retailers per city. The CRS manufacturer must be officially represented locally in each one of the 3 big markets.

					Dummy	Q1½		Q3	
max. 49 points		**Dynamic assessment:** Frontal Impact							
		Requirements for Points in Dynamic Assessments: no partial or full ejection of child dummy out of CRS / CRS must not be partially or wholly unrestrained by any of the vehicle interfaces							
	max. 16 points	**Head Contact with the vehicle:** any head contact with the vehicle results in 0 points for the head performance							
					points	4	0	4	0
		worst score from	**no head contact with CRS** **head contact with CRS**	no direct evidence + Head a_{res} peak Head $a_{res\,3ms}$	g	< 80 ≤ 72	≥ 88	< 96 ≤ 87	≥ 100
			Forward Facing CRS		points	4	0	4	0
			forward head excursion	relative to Cr point	mm	≤ 549	≥ 550	≤ 549	≥ 550
			Rearward Facing CRS						
			head exposure	no compressive load on top of head, head fully restrained within CRS	points	4	0	4	0
			neck tension	upper Neck F_z	points kN	2 ≤ 1.7	0 ≥ 2.62	2 ≤ 1.7	0 ≥ 2.62
			chest acceleration	$a_{res\,3ms}$	points g	2 ≤ 41	0 ≥ 55	2 ≤ 50	0 ≥ 66
		Installation of CRS							
	max. 12	CRS from the reference list			points	10			
		CRS recommended by the manufacturer			points	2			
		Vehicle Based Assessment							
	max. 21 points	3-point belts meeting UN or FMVSS standards on all seats			points	5			
		compatibility of all passenger seats with Gabarit according to UN ECE R16.05			points	2			
		3 seating positions that can simultaneously accommodate any reference list CRS			points	1			
		3 seating positions that can simultaneously accommodate i-Size CRS			points	1			
		2 passenger seats equipped with ISOFIX according to UN R14			points	1			
		+ these 2 passenger seats meet ISOFIX labeling requirements			points	+1			
		+ these 2 passenger seats meet i-Size requirements			points	+1			
		2 seating positions comply with requirements for largest size of rearward facing ISOFIX seats			points	2			
		no passenger airbag			points	2			
		passenger airbag warning and disabling			points	max. 5			
		1 integrated CRS			points	1			
		1 integrated "Group I-III" CRS			points	1			

Child Occupant Protection Assessment in ASEAN NCAP

Protocol Version 1.0

					Dummy	P1½		P3	
max. 49 points	max. 24 points	**Dynamic assessment:** Frontal Impact							
			chest acceleration	resultant acc. (3ms) and absolute vertical acc. (3ms), worse value counts	points g	6 a_{res} ≤ 41 a_{vert} ≤ 23	0 a_{res} ≥ 55 a_{vert} ≥ 30	6 a_{res} ≤ 41 a_{vert} ≤ 23	0 a_{res} ≥ 55 a_{vert} ≥ 30
					points	3	0	6	0
		schlechtester Wert zählt	**no head contact with CRS** **head contact with CRS**	no direct evidence + Head a_{res} peak Head $a_{res\,3ms}$	g	< 80 ≤ 72	≥ 88	< 80 ≤ 72	≥ 88
			Forward Facing CRS		points	3	0	6	0
			forward head excursion	relative to Cr point	mm	≤ 549	≥ 550	≤ 549	≥ 550
			Rearward Facing CRS						
			head exposure	no compressive load on top of head, head fully restrained within CRS	points	3	0	6	0
			neck	Head $a_{vert3ms}$ (rearward facing CRS only)	points g	3 ≤ 20	0 ≥ 40		
	12	**CRS Based Assessment**							
	13	**Vehicle Based Assessment**							

Child Protection in Front and Side Impacts - Current and Future Requirements

Course Description

For the transport and the protection of children in cars, child protection systems have been on the market since the 70ies. It was, however, only after the introduction of the European test regulation UN Regulation No. 44 in 1980, that their quality and effectiveness have reached a minimum standard that was acceptable at that time. Further developments of the legal regulations along with additional tests of different European consumer protection organizations - e.g. the German Stiftung Warentest, ICRT (International Consumer Research and Testing; governing body of the European product testers), Öko Test - and also the motor press (auto motor und sport, ADAC, Auto Bild, ÖAMTC) finally led to a significant decrease in the number of accident victims among children. Unfortunately the applied test setups and rating procedures in the sled tests vary greatly and partly lead to significantly diverging results, which can cause misunderstandings among consumers, manufacturers and developers.

Right from the start Euro NCAP has also tested child protection systems in full-size-front and side-impact tests and has introduced a separate test and assessment protocol for the evaluation of the protective effect of Child Restraint Systems (CRS). However, hereby only CRS recommended by the automotive OEMs are used in the tests.

The endeavours for research and harmonization of the New Programme for the Assessment of universal Child Seats (NPACS), founded in 2002, can be seen as the latest development on an European level. Members of NPACS are ICRT, ADAC and several European governments. In an initial phase, the test procedures of the ADAC and ICRT are to be harmonised.

Euro NCAP has revised it's child occupant assessment. As of 2013 Q dummies are used in the dynamic assessment. In addition a CRS installation test has been introduced. A significant change will be the consideration of older children (Q6 and Q10) than in the current protocol from 2015 onwards. This will enable Euro NCAP to better assess the performance of the vehicle's restraint systems.

Course Objectives

In this seminar you will learn to understand the specific problems in child safety and you will become familiar with the approaches concerning child safety with which you can meet the different requirements.

Who should attend?

The seminar addresses engineers who deal with the development and design of child restraint systems and their integration into the passenger protection systems.

Course Contents

- Introduction: historical development of child safety, accident statistics, usage rates of child protection systems, injury biomechanics of children
- Child dummies: P-series, Q-series
- Legal requirements: UN R44, R129 and other legal requirements, sled tests, full-size front and side impact tests with special requirements concerning child protection
- Consumer protection tests, other tests, harmonization: Euro NCAP, NPACS;
- ISO suggestion side impact, AMS, ADAC, others
- Child protection systems: types and classifications, standards, ISO-FIX, Top Tether, Ease of Use/Misuse

Course Instructor:

Dipl.-Ing. Britta Schnottale, German Federal Highway Research Institute (BASt)

Britta Schnottale is working as a scientific assistant in the department for „Passive Safety and Biomechanis" of the German Federal Highway Research Institute (BASt). Here she is responsible for questions regarding the safety of children in vehicles. This includes, apart from national research projects, working in EU projects for child safety. Moreover she is a representative in the EEVC working group 18 (child safety) as well as in NPACS (New Programme for the Assessment of Child restraint Systems).

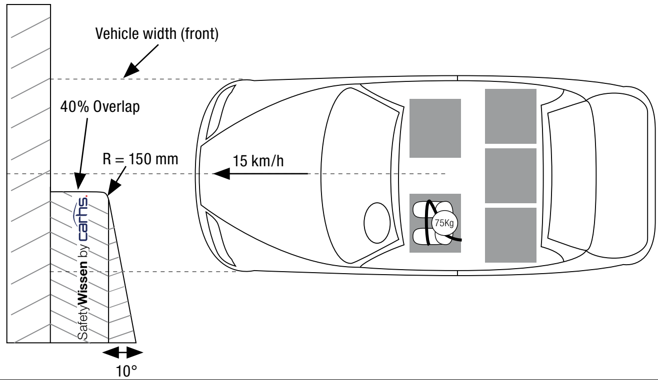
Date	Course ID	Venue	Duration	Price	Language
17.04.2015	2502	Alzenau	1 Day	740,- EUR till 20.03.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

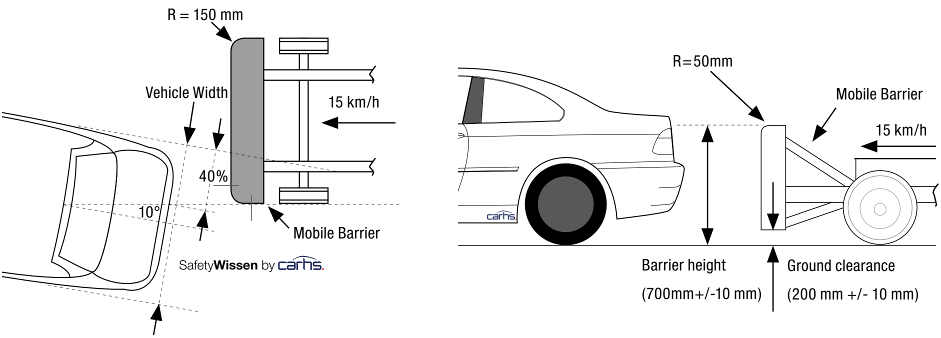
RCAR Insurance Tests

Lowspeed Structural Crash Tests

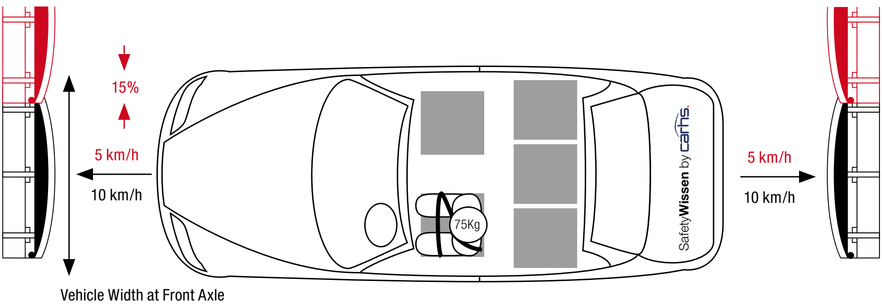
Front



Rear



Bumper Test



Barrier ground clearance measured from the track surface to the lower surface of the bumper barrier:

Test	Ground Clearance	Remarks
Front 100%	$455^{\pm3}$ mm	
Rear 100 %	$405^{\pm3}$ mm or $455^{\pm3}$mm	EU and Asia (AZT...) 405 mm, USA (IIHS) 455 mm
Front / Rear 15%	$405^{\pm3}$ mm or $455^{\pm3}$mm	Asia (IAG...) and USA (IIHS) 405 mm

Introduction to Data Acquisition in Safety Testing

Course Description

Sensor technology and data acquisition are central elements of safety testing. A 100 % reliability of the used technology in combination with the highest accuracy of the employed sensors are the basis for the success and usefulness of the tests in vehicle development.

The course first presents a short overview on the historical development of data acquisition technology in the safety field and continues to go into details of current technologies of sensors, data acquisition as well as dummy and vehicle instrumentation.

Based on the procedures of a safety test, the different tasks of calibration and certification of sensors, filtering and evaluation of signals, as well as the calculation and evaluation of measurement errors will be explained.

This introduction course aims at new test engineers and project engineers as well as engineers from simulation departments. The course provides the basic knowledge in crash data acquisition and gives a comprehensive overview on the procedures employed in data acquisition in the crash testing environment.

Course Objectives

The course participants will learn about the technology and terminology of sensor and data acquisition technology used in safety testing. They will be qualified to define tests, to supervise tests and to interpret and evaluate test results.

Who should attend?

The course is targeted towards project-, test- and simulation-engineers at automotive OEMs, suppliers and engineering service providers.

Course Contents

- Sensors
  - Basic sensor principles
  - Sensors in safety testing
  - Selection of sensor systems
- Systems for data acquisition (DAS)
  - State of the art in DAS technology
  - InDummy and Onboard DAS
  - Filtering
- Instrumentation
  - Overview dummy instrumentation
  - Overview vehicle instrumentation
  - Overview instrumented barriers
- Evaluation & Measuring Errors
  - Error calculation (set-up of sensors, sensors, DAS, evaluation...)
  - Sources of errors in crash testing
  - Interpretation of signals
- Calibration and Certification
  - Dummy certification
  - Sensor calibration
  - SAE J211
- Procedures
  - Test preparation
  - Test execution
  - Test evaluation

Course Instructor:

Dipl.-Ing. Thomas Wild, Continental Safety Engineering International GmbH

Thomas Wild studied Electrical and Tele-Communications Engineering at the Technical University Darmstadt. Since 1996 he has been employed at Continental Safety Engineering International as a measurement engineer. 1998 - 2001, he assumed additional responsibilities as an application engineer in the algorithm development. Since 2003 he is team leader measurement and video technology. Since 1997 he works in the working group Data Processing in Vehicle Safety (MDVFS).

Date	Course ID	Venue	Duration	Price	Language
27.-28.04.2015	2472	Alzenau	1.5 Days	1.050,- EUR till 30.03.2015, thereafter 1.250,- EUR	
06.-07.07.2015	2474	Alzenau	1.5 Days	1.050,- EUR till 08.06.2015, thereafter 1.250,- EUR	
19.-20.10.2015	2473	Alzenau	1.5 Days	1.050,- EUR till 21.09.2015, thereafter 1.250,- EUR	

This course is available as an in-house seminar in English and German!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Current Dummy Landscape

		Frontal Impact Dummies			Side Impact Dummies				Rear Impact Dummies		Child Dummies				
		HIII 50%	HIII 5%	HIII 95%	ES-2	ES-2re	SID-IIs	World SID	HIII 50%	BioRID II	Crabi	Cami	HIII	P Series	Q Series
Europe	UN R94	●													
	UN R95				●										
	UN R44													●	1)
	UN R129														●
	Euro NCAP	●	●					●		●					●
America	FMVSS 208	●	●								●		●		
	FMVSS 214					●	●	1)							
	FMVSS 213										●	●	●	●	1)
	FMVSS 202a								●						
	U.S. NCAP	●	●			●	●	1)							
	IIHS	●					●			●					
	Latin NCAP	●			●										●
Asia	Japan Trias 47 (1-4)	●			●										
	JNCAP	●	●		●					●					
	China Regulation	●			●										
	China NCAP	●	●		●		●			●				●	
	Korean NCAP	●	●		●			●		●					●
	ASEAN NCAP	●												●	1)
AUS	ADR (Frontal, Side)	●			●										
	Australian NCAP	●			●					●				●	
GTR	GTR 7	●								●					
	GTR 14 (Pole Side)							●							

SafetyWissen by carhs.

2015 2016 2017 2018

1) planned (no date specified)

Overview Dummies
Weights, Dimensions and Instructions for Calibration

Adult Dummies for Frontal / Rear Impact

	Weight (kg)	Seating Height (cm)	Instruction for Calibration
Hybrid II 50 % Male	74.4	90.7	CFR 49 Part 572, Subpart B
Hybrid III 5 % Female	49.1	78.7	SAE Engineering Aid 25 CRF 49 Part 572, Subpart O
Hybrid III 50 % Male	77.7	88.4	CFR 49 Part 572, Subpart E 1999/98/EG
Hybrid III 95 % Male	101.2	93.5	SAE Engineering Aid 26
BioRID II	77.7	88.4	User Manual

Adult Dummies for Side Impact

	Weight (kg)	Seating Height (cm)	Instruction for Calibration
Eurosid 1	72.0	90.4	Eurosid 1 Certification Procedure 96/27/EG, UN R95
ES-2	72.0	90.9	FTSS - User Manual / UN R95
ES-2 re	72.0	90.9	CFR 49 Part 572, Subpart U
US-SID	76.7	89.9	CFR 49 Part 572, Subpart F
US-SID/Sid-H3	77.2	89.9	CFR 49 Part 572, Subpart M
SID IIs	44.5	79.0	User Manual
SID IIs FRG	44.0	78.7	CFR 49 Part 572, Subpart V
WorldSID 5% Female	48.27		User Manual
WorldSID 50% Male	74.88	87.0	User Manual

Child Dummies

	Weight (kg)	Seating Height (cm)	Instruction for Calibration
P0, P¾, P6, P10	3.4 - 32.0	34.5 - 72.5	User Manual
P1½	11.0	49.5	P1½ User Manual
P3	15.0	56.0	User Manual
Q1	9.6	47.9	Q1 User Manual
Q1½ (18m)	11.1	49.9	Q1,5 User Manual
Q3	14.5	54.4	Q3 User Manual
Q6	23.0	63.6	Q6 User Manual
Q10	35.5	73.4	Q10 User Manual (Rev. A Draft)
CRABI 12m	10.0	46.4	CFR 49 Part 572, Subpart R
Hybrid II - 3 y/o	15.1	57.2	CFR 49 Part 572, Subpart C
Hybrid II - 6 y/o	21.5	64.5	CFR 49 Part 572, Subpart I
Hybrid III - 3 y/o	16.7	54.6	CFR 49 Part 572, Subpart P
Hybrid III - 6 y/o	23.4	63.5	CFR 49 Part 572, Subpart N
Hybrid III - 10 y/o	35.2	72.39	CFR 49 Part 572, Subpart T

Source: BGS-Seminar

Dummy – Training

Course description

The seminars give you the opportunity to gain efficiency and security in the use and handling of dummies.
After a short theoretical introduction you are going to be trained in the handling of the respective dummy-type in a dummy lab in practical exercises in work groups.

Course contents

- Introduction of the respective dummy-type
  History, development, assemblies, standard instruments, optional measuring points, recent modifications, regulations for application/test, calibration
- Complete disassembly of the dummies in work groups
  Explanation of the functions of the assemblies and the individual parts, special features, deviations from other dummy-types, practical hints for the handling of individual assemblies, sensors and cabling, special tools, other devices, cleaning
- Complete assembly of the dummies in work groups
  work steps, possible assembly errors, mounting of the sensors, cabling, adjustments of joints, storing/transport
- Dummy calibration
  Demonstration and explanation of the calibration tests

Aims

- Efficiency and security in use and handling of dummies
- Exact knowledge about assembly, mechanics and sensor positions
- Understanding of the measuring possibilities and limits

Who should attend

- Project and test engineers, technicians, mechanics

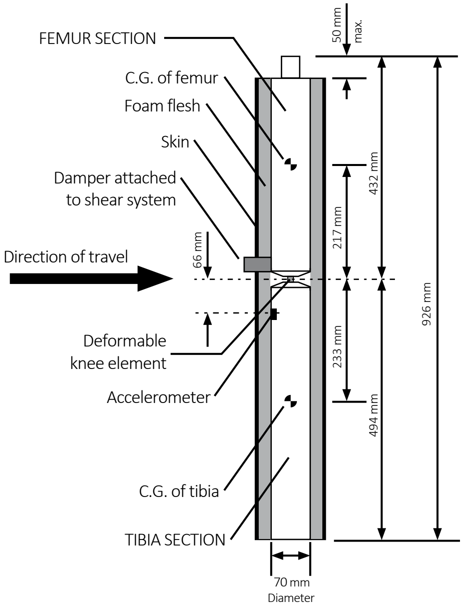
DUMMY	Hybrid III 5%, 50%, 95%	
DATE	15.-16.03.15	26.-27.10.15
COURSE ID	2507	2508
PRICE	1.290,- EUR (each)	
DUMMY	THOR NEW	
DATE	23.-24.04.15	19.-20.11.15
COURSE ID	2525	2525
PRICE	1.490,- EUR (each)	
DUMMY	BioRID II	
DATE	18.-19.03.15	28.-29.10.15
COURSE ID	2509	2510
PRICE	1.290,- EUR	
DUMMY	WorldSID 50% NEW	
DATE	13.-14.04.15	09.-10.11.15
COURSE ID	2515	2516
PRICE	1.490,- EUR (each)	
DUMMY	WS 50% Test Preparation	
DATE	15.04.15	11.11.15
COURSE ID	2517	2518
PRICE	je 990,- EUR	
DUMMY	ES-2 / ES-2re	
DATE	23.-24.03.15	02.-03.11.15
COURSE ID	2511	2512
PRICE	1.290,- EUR (each)	
DUMMY	SID IIs	
DATE	25.-26.03.15	04.-05.11.15
COURSE ID	2513	2514
PRICE	1.290,- EUR	
DUMMY	P-/Q-Child Dummys	
DATE	21.04.15	17.11.15
COURSE ID	2521	2522
PRICE	740,- EUR (each)	
DUMMY	Q10 NEW	
DATE	22.04.15	18.11.15
COURSE ID	2523	2524
PRICE	740,- EUR (each)	
DUMMY	Hybrid III 3 & 6 y/o	
DATE	20.04.15	16.11.15
COURSE ID	2519	2520
PRICE	740,- EUR (each)	
VENUE	Bergisch Gladbach	
LANGUAGE		

Course Instructors:
Dummy Specialists, BGS Böhme & Gehring GmbH

BGS operates the dummy calibration laboratory of the German Federal Highway Research Institute (BASt). BGS calibrates crash test dummies for the automotive industry. The seminars are held by experienced engineers from BGS' team.

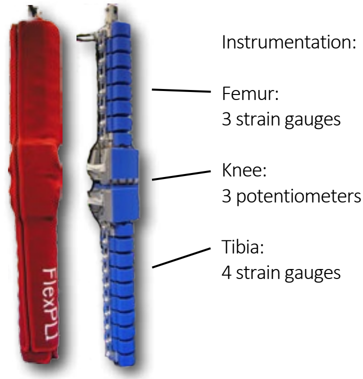
Impactors for Pedestrian Protection

Lower Legform (EEVC)



Length	Diameter	Mass
926 mm	ca. 132 mm	13.4 kg

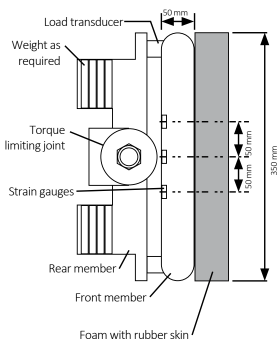
Flexible Pedestrian Legform: Flex PLI



- New Legform Impactor for pedestrian testing
- Flexible Femur and Tibia
- Knee with „Ligaments“
- Developed by JARI (Japan Automobile Research Institute)
- To be used for global technical regulation GTR
- more realistic assessment of injury risks

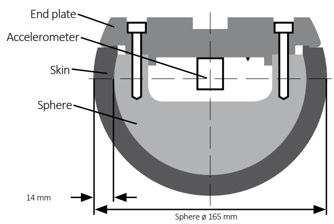
Length	Diameter	Mass
975 mm	132-140 mm	13.4 kg

Upper Legform



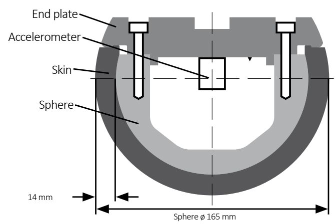
Length	Width	Mass
350 mm	~ 155 mm	11 to 18 kg

Adult Headform



	Diameter	Mass
Adult Headform	165 mm	4.5 kg

Child Headform



	Diameter	Mass
Child Headform	165 mm	3.5 kg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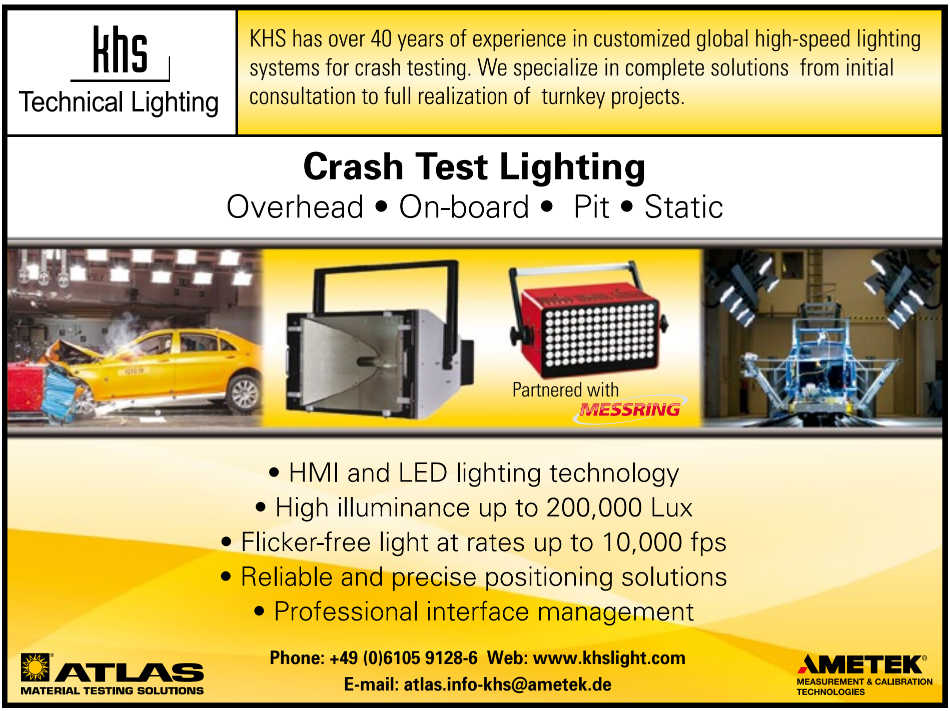
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MEASUREMENT & CALIBRATION TECHNOLOGIES

Pedestrian Protection - Test Procedures

Course Description

A basic prerequisite for successful implementation of pedestrian protection is a detailed knowledge of test requirements. This seminar provides the complete knowledge regarding the test methods as defined by the EU Directive on pedestrian protection and Euro NCAP's pedestrian protection assessment in theory and praxis.
Compact presentations explain the basics and technical details of the regulation and the test protocols. Practical exercises the BASt's test laboratory include test preparation, vehicle marking, selection of test points, handling of the impactors and the actual testing with head and legform impactors.

Course Contents

- Basics and current status of the regulations (presentations)
- Euro NCAP - Rating (presentation)
- Test preparation according to Euro NCAP Testing Protocol and EU Directives (practical exercises)
- Test demonstrations: Head, Upper Legform and Legform impact (demonstrations and practical exercises)
- Discussion

Who should attend?

- Project-, test- and simulation engineers,
- Technicians, mechanics

Date	Course ID	Venue	Duration	Price	Language
03.-05.03.2015	2538	Bergisch Gladbach	3 Days	1.790,- EUR	German
22.-24.09.2015	2539	Bergisch Gladbach	3 Days	1.790,- EUR	German

Pedestrian Protection Workshop: Flex PLI

Course Objectives

- Detailed Knowledge of the new Impactor
- Experience with Handling and Usage of the Impactor
- Understanding of the Impactor's Functionality

Course Contents

- History, Biomechanics, Evaluation, Legislation
- Assembly, Transducers, Onboard Data Acquisition, Technical Details
- Disassembly along with Comments on Function of Components
- Assembly along with practical Tips and Pointers to Specialities and possible Mistakes
- Adjustments of the Compound Springs, Clamping Bolts, Stopper Cables, etc.
- Demonstration of both Certification Procedures
- Data Analysis and Interpretation of Test Results

Who should attend?

- Project-, test- and simulation engineers,
- Technicians, mechanics

Date	Course ID	Venue	Duration	Price	Language
26.02.2015	2544	Bergisch Gladbach	1 Day	740,- EUR	German
17.09.2015	2545	Bergisch Gladbach	1 Day	740,- EUR	German

Pedestrian Protection Workshop: Euro NCAP Grid Procedure

Course Objectives

- Experience with the new Vehicle Markup
- Certainty in its Application
- Deep Understanding of the Procedure

Course Contents

- Basics, Background and Development of the Procedure
- Test Area Determination, Borders, Exemption Zones, Special Cases
- Necessary Laboratory Equipment, Helpful Tools
- Exemplification by a complete Mark-up of a Vehicle
- Colour Scheme, Manufacurer's Predictions, allowed Tolerances
- Default Green / Default Red Definitions
- Result Analysis, Point Assessment
- Adaption of the Principle to Upper- and Lowerleg Areas

Who should attend?

- Project-, test- and simulation engineers,
- Technicians, mechanics

Date	Course ID	Venue	Duration	Price	Language
25.02.2015	2542	Bergisch Gladbach	1 Day	740,- EUR	German
16.09.2015	2543	Bergisch Gladbach	1 Day	740,- EUR	German

This course is available as an in-house seminar in English and German!

NCAP Tests for Active Safety and Driver Assistance

U.S. NCAP

- Assessment of the rollover risk (as part of the Vehicle Safety Score, more ➲ page 43)
  - Calculation of the Static Stability Factor (SSF) = track width / 2* CoG height
  - Dynamic Test: Fishhook Maneuver
  - Rollover Rating based on statistical model
- Forward Collision Warning (confirmation test for existence of FCW systems, not part of the Vehicle Safety Score)
  - Test 1: approach to standing vehicle at 72 km/h - Criterium: Warning at ≥ 2.1 s TTC
  - Test 2: approach to decelerating vehicle (30 m ahead, -0.3g) at 72 km/h, - Criterium: Warning at ≥ 2.4 s TTC
  - Test 3: approach to slower (32 km/h) vehicle at 72 km/h - Criterium: Warning at ≥ 2.0 s TTC
- Lane Departure Warning (confirmation test for existence of LDW systems, not part of the Vehicle Safety Score)
  - 5 tests at 72 km/h and 0.5 m/s lateral velocity per departure direction (left/right) and line type (solid/dashed/Bott's Dots) (a total of 30 tests)
  - Criteria: Lane departure alert must occur in a corridor of 0.75 m before and 0.3 m after crossing the lane line.
  - To be awarded an overall passing grade, the LDW system must satisfy the pass criteria for 3 of 5 individual trials for each combination of departure direction and lane line type (60 percent), and pass 20 of the 30 trials overall (66 percent).
- Rear View Video Systems (confirmation test for existence of rear view systems, not part of the Vehicle Safety Score)

IIHS

- AEB (part of the Top Safety Pick+ rating) more ➲ page 46
  - approach to standing vehicle at 20 km/h and 40 km/h
  - assessment of the speed reduction:

	20 km/h Test			40 km/h Test			
Speed reduction	< 8 km/h	8-14 km/h	≥ 15 km/h	< 8 km/h	8-14 km/h	15 - 34 km/h	≥ 35 km/h
Poinst	0	1	2	0	1	2	3

  - 1 additional point for FCW (Forward Collision Warning) meeting the U.S. NCAP criteria
  - Rating: 1 point: BASIC, 2-4 points: ADVANCED, 5-6 points: SUPERIOR

Euro NCAP

Safety Assist Assessment based on:

- Seat Belt Reminder (SBR):
  - On all front row seats 2 Points
  - additionally on all rear seats 1 Point
- Speed Assist Systems

	SLIF Speed Limit Information Function	MSA Manual Speed Assistance	ISA Intelligent Speed Assistance
Communicating Speed Limit	1.5 (Camera <u>and</u> Map based) 0.5 (Camera <u>or</u> Map based)		1.5 (Camera <u>and</u> Map) 0.5 (Camera <u>or</u> Map)
Warning Function		1	2
Speed Limitation		1	1

The final score for the overall rating will be scaled from maximum of 4.5 points to a maximum of **3 points**.

- ESC
  - if ESC is standard or optional on <u>each</u> variant and
  - passes the "sine with dwell" test described in UN R13H: **3 Points** more ➲ page 126
- Lane Support Systems:
  - systems meeting U.S. NCAP criteria (see above): **1 Point**
- AEB Inter-Urban: **max. 3 Points** more ➲ page 122
- AEB City: **max. 3 Points (as part of the Adult Occupant assessment)** more ➲ page 119
- AEB VRU (as of 2016): **max. 6 Points (as part of the Pedestrian Protection assessment)** more ➲ page 120

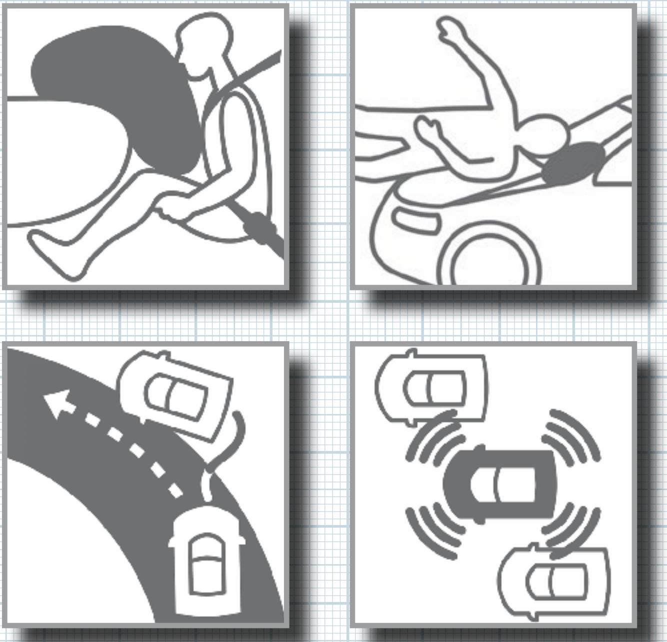
JNCAP

- Brake Performance Tests: Measurement of the stopping distance from 100 km/h on dry and wet road.
- Publication of results without further evaluations: *http://www.nasva.go.jp*
- SBR: **8 Points**
- Award: AEB, LDW, Around view more ➲ page 55

KNCAP

- Rollover assessment like in U.S. NCAP (see above): **5 Points**
- Braking Performance Tests: Measurement of the stopping distance from 100 km/h on dry and wet road. Check if vehicle stays within the 3,5 m wide track while braking: **5 Points**
- LDWS + FCWS + SBR: **1 point** more ➲ page 58

Occupant protection. Active safety. Driver assistance.



Autoliv

Driven for Life.

Advanced Driver Assistance and Crash Avoidance Systems

Course Description

After the quantum leaps in passive safety in the last three decades, the hope for further improvements is on accident avoidance. A major step is already underway with the implementation of the Electronic Stability Control (ESC) and the Brake Assist. Similar benefits are anticipated through Advanced Driver Assistance Systems (ADAS) which support and unburden the driver to address driver errors which are responsible for 90 % of all accidents. Sensors (cameras, radar, laser, ultrasonic) monitor the traffic to provide safety relevant information to the driver and warn him of any accident hazards before ultimately intervening to mitigate a crash. Systems like the Adaptive Cruise Control even enable semi-autonomous driving in specific traffic scenarios.

The seminar describes today's and tomorrow's active safety systems, their requirements, modes of operation, and the utilized sensors. After introducing of the vehicle dynamic systems (ABS, ESC, Brake Assist, Active Steering), the driver assistance systems are discussed according to the escalation strategy 1. informing -, 2. warning -, 3. intervening -, and 4. autonomous systems. Based on the findings of accident analysis, the systems are consistently mirrored on real world accidents in order to understand the accident causes, and how the system can avoid the accident. The seminar also provides an outlook how today's ADAS systems will be enhanced step by step to temporary autonomous driving.

In addition to these technical aspects, the seminar discusses the system's interactions with the driver. A key topic is the Human Machine Interface (HMI), the driver acceptance of the system, his reactions and behavior. A major issue however is the conflict between the system and the driver, the warning and intervention dilemma in particular. Other points of interest are legal barriers such as the Vienna Convention, the functional safety, and the test and validation procedures. Finally, new architectures are discussed which are needed due to the increased system complexity, as well as the synergies and advantages resulting from system networking, both the functional and packaging aspects of integrated safety.

Who should attend?

The seminar addresses technicians and engineers working in research and development in the automotive industry, especially systems engineers, project engineers and project managers as well as all experts from vehicle safety, who would like to get an overview of the current and future solutions and methods in Active Vehicle Safety.

Course Contents

- Active Safety: accident analysis, legislation, market trends, customer expectations
- The sensors of Active Safety
- Vehicle dynamic control: ABS, ESC, brake assist, active steering
- Driver assistance:
  - Informing systems
  - Warning systems
  - Intervening systems
  - Autonomous systems
- System / driver interaction: HMI, dilemmas, conflicts
- Functional safety
- Integrated safety

Course Instructor:

Dr. rer. nat. Lothar Groesch, Groesch Automotive Safety Consulting

Dr. Lothar Groesch has been working in safety engineering for more than 37 years, both at one of the leading OEMs in Passive & Active Safety, and with a major supplier in pioneering new automotive safety sensors & systems. From 2000 to 2009, he worked in the United States as a Product Director for Automotive Safety Systems, thus he is particularly familiar with U.S. specific requirements. Although he only joined the carhs team quite recently, he has a long experience in guest teaching at several universities in the U.S. & Germany, as well as in company internal training seminars, technical marketing, customer presentations & workshops. In 2009 Dr. Grösch has founded Groesch Automotive Safety Consulting and is primarily working in driver assist and accident avoidance systems.

Date	Course ID	Venue	Duration	Price	Language
08.-09.06.2015	2550	Alzenau	2 Days	1.290,- EUR till 11.05.2015, thereafter 1.540,- EUR	English (UK flag)
24.-25.11.2015	2549	Alzenau	2 Days	1.290,- EUR till 27.10.2015, thereafter 1.540,- EUR	German (German flag)

This course is available as an in-house seminar in English and German!

Towards Autonomous Driving

Course Description

After the successful introduction of Advanced Driver Assistance Systems (ADAS) by virtually all automobile manufacturers, some OEMs and suppliers have announced to offer systems in the near future which enable partially or highly automated driving in specific traffic scenarios. This is particularly true for the automated driving in traffic jams, or the autonomous cruising on highways. Furthermore, the number of accidents shall be reduced significantly by automatic interactions of the auto-pilot in critical situations.

The seminar starts with the motivations, drivers and benefits of autonomous driving, going on with the legal barriers, along with the resulting conflicts of goals. While consumers will buy auto-pilots in order to do something else during driving, however the driver must take again the control of the vehicle in certain situations. This dilemma will have major consequences on the requirements to autonomous systems and the technologies utilized. Particularly challenging is the driver behavior when to be brought back into-the-loop, along with the communication between driver and vehicle, including the driver monitoring potentially needed. Starting with the available technologies, both in self-driving prototypes and systems in production, the technical requirements and gaps to be closed will be discussed in order to enhance ADAS to partially or fully automated driving. This includes not only the technologies enabling autonomous driving, but also the changes in the design of future automobiles, resulting from the new utilization possibilities. Finally, the potential of auto-pilots to prevent accidents is described extensively.

The seminar offers an introduction in the world auf automated driving, not only the legislative and technical gaps to be closed, but also the new possibilities to use future vehicles. As a result, it is useful for all experts working on automobiles and traffic systems, be it sensors, safety technologies, Human-Machine-Interface, communication systems, interior design, vehicle equipment or traffic planning.

Who should attend?

Everybody who is interested in automated driving.

Course Contents

- Motivations, drivers and benefits of automated driving
- Legal barriers and conflicts of goals: what does the driver want to do, what is he allowed to do during driving?
- Human-Machine-Interface, driver monitoring and recording
- Scenarios and limits of automated driving
- Roadmap from ADAS to temporary autonomous driving
- Requirements and gaps to be closed
- Potentials of auto-pilots to avoid accidents
- Usage of auto-pilot, and the resulting changes to future automobiles

Course Instructor:

Dr. rer. nat. Lothar Groesch, Groesch Automotive Safety Consulting

Dr. Lothar Groesch has been working in safety engineering for more than 37 years, both at one of the leading OEMs in Passive & Active Safety, and with a major supplier in pioneering new automotive safety sensors & systems. From 2000 to 2009, he worked in the United States as a Product Director for Automotive Safety Systems, thus he is particularly familiar with U.S. specific requirements. Although he only joined the carhs team quite recently, he has a long experience in guest teaching at several universities in the U.S. & Germany, as well as in company internal training seminars, technical marketing, customer presentations & workshops. In 2009 Dr. Grösch has founded Groesch Automotive Safety Consulting and is primarily working in driver assist and accident avoidance systems.

Date	Course ID	Venue	Duration	Price	Language
27.03.2015	2553	Alzenau	1 Day	740,- EUR till 27.02.2015, thereafter 890,- EUR	
09.10.2015	2554	Alzenau	1 Day	740,- EUR till 11.09.2015, thereafter 890,- EUR	

Euro NCAP Test Methods for Autonomous Emergency Brake Systems

AEB City

Approach to stationary target

v_0=10 km/h ... 50 km/h in 5 km/h steps   v=0 km/h

<table>
<tr><th>v_0 (km/h)</th><th>Points for Accident Avoidance</th><th>Remarks</th></tr>
<tr><td>10</td><td>1</td><td rowspan="3">Prerequisites for scoring in AEB City:
■ minimum 1.5 points (out of 2) from the whiplash assessment of front seats (see page 81)
■ up to 20 km/h accidents must be completely avoided</td></tr>
<tr><td>15</td><td>2</td></tr>
<tr><td>20</td><td>2</td></tr>
<tr><td>25</td><td>2</td><td rowspan="6">For v_0 > 20 km/h accident mitgation is rewarded. The score is calculated from the remaining impact velocity v_I
Points for Accident Avoidance * $(v_0 - v_I)/v_0$
Example: At v_0=30 km/h the target is impacted at a remaining velocity of v_I=10 km/h:
2 Points * (30 km/h - 10 km/h) / 30 km/h = 1.333 Points</td></tr>
<tr><td>30</td><td>2</td></tr>
<tr><td>35</td><td>2</td></tr>
<tr><td>40</td><td>1</td></tr>
<tr><td>45</td><td>1</td></tr>
<tr><td>50</td><td>1</td></tr>
<tr><td colspan="2">HMI Assessment</td><td>AEB City systems, that are default ON at the start of every journey and can not be de-activated by the driver with a single push on a button are awarded 2 Points</td></tr>
</table>

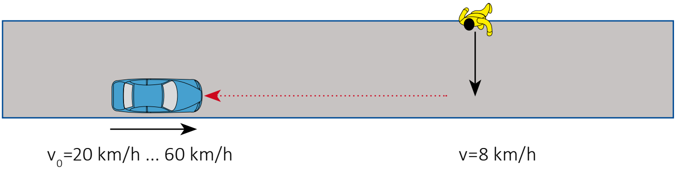
The raw score of a maximum of 14 points from the AEB test is scaled down to a maximum of 2.5 points (scaling factor 0.179). The HMI points are scaled to a maximum of 0.5 points (scaling factor 0.25). The total **maximum score for AEB City is 3 points** and is part of the **Adult Occupant Rating**.

Euro NCAP Test Methods for Autonomous Emergency Brake Systems

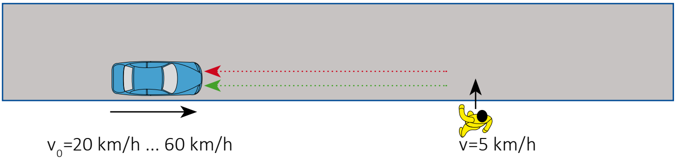
AEB VRU

2016

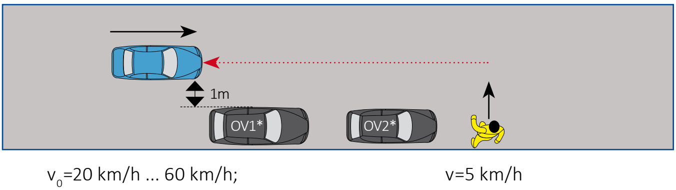
Adult, Farside, Impact at 50% of the Vehicle Width



Adult, Nearside, Impact at 25 & 75 % of the Vehicle Width



Child, Obscured, Nearside, Impact at 50 % of the Vehicle Width



Remarks

- Prerequisite for scoring AEB VRU points: at least 21 points for passive pedestrian protection
  - in the range from 21 - 23.1 points for passive pedestrian protection the AEB VRU score is halved
  - for passive pedestrian protection scores ≥ 23.1 points the full AEB VRU score is applied
- AEB VRU systems must be capable of detecting pedestrians moving at speeds from 3 to 8 km/h
- AEB VRU systems must operate from 10 km/h and may not automatically switch off below 60 km/h
- Dummy is moved by a platform (no gantry)
- HMI assessment will be part of the rating
- Scoring table for all 3 scenarios:

v_0 (km/h)	20	25	30	35	40	45	50	55	60
Points	1	2	2	3	3	3	2	1	1
	scoring by linear sliding scale (e.g. 40 % speed reduction → 40 % score)					min. speed reduction of 20 km/h per test PASS / FAIL			

- A **maximum of 6 points are awarded for AEB VRU** as part of the **Pedestrian Protection** assessment

The test and assessment protocols are not available at this time.

The information above is subject to change!

*Obstruction Vehicle Dimensions:

	OV 1	OV2
Length (mm)	4300 - 4700	4100 - 4400
Width (mm)	1750 - 1900	1700 - 1900
Height (mm)	1500 - 1800	1300 - 1500

Image: 4active Systems

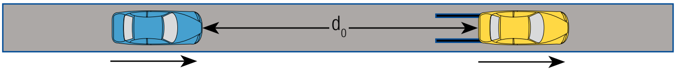
Euro NCAP Test Methods for Autonomous Emergency Brake Systems

AEB Inter-Urban

CCRs*: Approach to stationary target

CCRm*: Approach to slower target

CCRb*: Approach to braking target



v_0=50 km/h	d_0=12 m	v_0=50 km/h, a=-2 m/s²
v_0=50 km/h	d_0=40 m	v_0=50 km/h, a=-2 m/s²
v_0=50 km/h	d_0=12 m	v_0=50 km/h, a=-6 m/s²
v_0=50 km/h	d_0=40 m	v_0=50 km/h, a=-6 m/s²

* CCR: Car-To-Car Rear; s: standing; m: moving; b: braking

	stationary target (CCRs)	slower target (CCRm)		braking target (CCRb)
v_0 (km/h)	Points for FCW	Points for AEB	Points for FCW	
30	2	1	1	1 point each for AEB and for FCW per scenario
35	2	1	1	
40	2	1	1	
45	2	1	1	
50	3	1	1	
55	2	1	1	
60	1	1	1	
65	1	2	2	
70	1	2	2	
75	1	-	2	
80	1	-	2	
Σ	**18**	**11**	**11**	**2 x 4**

HMI Assessment	■ Prerequisites for HMI points: AEB and/or FCW system are default ON at the start of every journey and the FCW alert (if available) is loud and clear. ■ Systems that can not be de-activated with a single push on a button are awarded **2 Points** ■ Supplementary warning for the FCW system(e.g. head-up display, belt jerk, brake jerk): **1 Point** ■ Reversible pre-tensioning of the belt in the pre-crash phase: **1 Point**

The total AEB Inter-Urban score results from the following weighting of the normalized scores (%):
AEB Inter-Urban = FCWscore x 1.0 + AEBscore x 1.5 + HMIscore x 0.5
This results in a **maximum total score of 3 points for AEB Inter-Urban**, which is part of the **Safety Assist** assessment.
The AEBscore (respectively FCWscore) is the average score from all the scenarios.
Example:

System	FCW			AEB		HMI		
Scenario	CCRs	CCRm	CCRb	CCRm	CCRb	Deaktivierung	Warnung	Pretension
Points	15.264	8.404	4	5.078	2.700	2	0	0
Score	84.7%	76.4%	100.0%	46.2%	67.5%	50.0%		
	FCWscore = (84.7 % + 76.4 % + 100 %) / 3 = 87.0 %			AEBscore = (46.2 % + 67.5 %)/2 = 56.9 %		HMIscore=50.0%		
Total	87% x 1.0 + 56.9% x 1.5 + 50% x 0.5 = 1.974 points (out of 3)							

For systems that only offer the AEB function, the results of tests at all speeds (covering AEB and FCW) are used to calculate separate normalised AEB and FCW scores for each scenario. Where AEB and FCW test speeds are overlapping, the test result of AEB is duplicated for FCW.

DEKRA Automobile Test Center Klettwitz.

Active and passive systems for pedestrian protection.

The DEKRA Automobile Test Center at EuroSpeedway Lausitz, an integral component of the DEKRA Technology Center, is divided into four centres of excellence, so-called modules. Each one of these modules is assigned a specific key field of activity. There you will find the appropriate expertise, relevant technical facilities and equipment and your professional contact partner.

Test bench for driver assistant systems to prevent accidents

Test scenarios

- > Pedestrians crossing
- > Pedestrians walking parallel
- > Collisions between pedestrians
- > Preventing collisions

Vehicle systems

- > Mono and stereo camera systems
- > Radar and LIDAR sensors
- > Thermal detection tasks

Tasks

- > Support for development
- > Manufacturer specifications
- > Comparison test

Regulations

- > vFSS, NCAP

Test bench for head impact

Types of tests

- > Head impact tests
- > Leg and hip impact
- > Sensor tests for actively triggering systems

Tasks

- > Homologation
- > CoP tests
- > Support for development
- > Manufacturer specifications

Regulations

- > ECE, EG, GTR, NCAP, TRIAS

Test bench for hip and leg impact

Accredited as test laboratory according to ISO 17025

- > Germany – DakkS

Designated technical service

- > Germany – KBA
- > Netherlands – RDW
- > Japan – TRIAS

Certified according to ISO 27001

- > Information, safety and management systems including VDA prototype protection

DEKRA Automobil Test Center
Senftenberger Straße 30 | 01998 Klettwitz
Phone: +49 (0)35754.7344-500 | Fax: +49 (0)35754.7345-500

www.datc.de

DEKRA

On the safe side.

Automotive Safety Sensors – Requirements, Features, Functions and Applications

Course Description

Sensors are the crucial sensory organs of vehicle safety systems: Recognizing accident hazards and events in milliseconds, they activate and control crash avoidance and occupant protection systems accurately, reliable and effectively. Micromechanical oscillators feel vibrations due to shocks, thus controlling seat belt pre-tensioners and airbags according to the crash type and severity. Micro-mechanical gyroscopes register any vehicle rotations, thus stabilizing the vehicle path and movement as needed. Driver assistance systems controlled by cameras keep the vehicle in the lane and recognize a pedestrian surfacing in front of the vehicle.Radar and laser beams are scanning the road for frontal, side and rear collisions.

In order to adequately control restraint systems, crash sensors must accurately discriminate frontal crashes, side impacts, rear-end collisions and vehicle rollover. New tests such as the lateral pole crash or the small overlap frontal crash continuously increase the requirements to the crash sensors and the intelligent restraint control. Utilizing predictive sensors will effectively increase the effectiveness of occupant protection systems. During multiple collisions, the restraint controller can activate the vehicle brakes in order to reduce the crash severity. Interior sensors recognize the presence, position (out-of-position), size and weight of the occupants, thus tailoring the protection specifically to each occupant.

Driver assistance and crash avoidance systems are utilizing three types of sensors:

1. Inertial sensors to monitor the vehicle movements, both accelerations along and rotations around the vehicle axes. Utilizing micro-electro-mechanical systems (MEMS) smaller that one tenth of a millimeter, they are extremely sensitive to control the vehicles intended path by activating the steering and braking system.
2. Surround sensors such as radar, laser, ultrasonic and cameras scan the vehicle environment for any hazards, not only for driver information and warning, rather to avoid accidents by activating the brakes and the steering. Even today, autonomous driving in specific situations is possible, such as the adaptive cruise control
3. Communication with satellites (GPS), from car-to-car- and from car-to-infrastructure (C2C2X) along with digital maps will play an important role in the future of automotive safety systems.

The seminar illustrates comprehensibly and simple the physical principles of these sensor and measuring systems, their characteristics, their advantages and drawbacks with respect to specific applications, along with their applications in today's and future vehicle safety systems.

Who should attend?

The seminar addresses technicians and engineers working in research and development in the automotive industry, especially systems engineers, project engineers and project managers as well as all experts from vehicle safety, who would like to get an overview of the sensors used in current and future automotive safety systems.

Course Contents

- Introduction: Automotive sensor systems
- Physical sensor and measurement principles
- Requirements and applications in automotive safety systems
- Passive Safety:
  - Crash sensors, rollover sensing, pedestrian impact sensors, predictive crash sensors, sensor topologies and configurations
  - Interior sensing, occupant sensing
  - Intelligent restraint control, restraint triggering algorithms, structure and functions of restraint controllers
- Active Safety:
  - Radar-, laser- and ultrasonic sensors, sensor data analysis and evaluation, system control algorithms
  - Monocular and stereo camera, Photon-Mixing Device, digital image processing
  - Communication systems
  - Sensor fusion

Course Instructor:

Dr. rer. nat. Lothar Groesch, Groesch Automotive Safety Consulting

Dr. Lothar Groesch has been working in safety engineering for more than 37 years, both at one of the leading OEMs in Passive & Active Safety, and with a major supplier in pioneering new automotive safety sensors & systems. From 2000 to 2009, he worked in the United States as a Product Director for Automotive Safety Systems, thus he is particularly familiar with U.S. specific requirements. Although he only joined the carhs team quite recently, he has a long experience in guest teaching at several universities in the U.S. & Germany, as well as in company internal training seminars, technical marketing, customer presentations & workshops. In 2009 Dr. Grösch has founded Groesch Automotive Safety Consulting and is primarily working in driver assist and accident avoidance systems.

Date	Course ID	Venue	Duration	Price	Language
22.-23.07.2015	2552	Alzenau	2 Days	1.290,- EUR till 24.06.2015, thereafter 1.540,- EUR	English
26.-27.11.2015	2551	Alzenau	2 Days	1.290,- EUR till 29.10.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

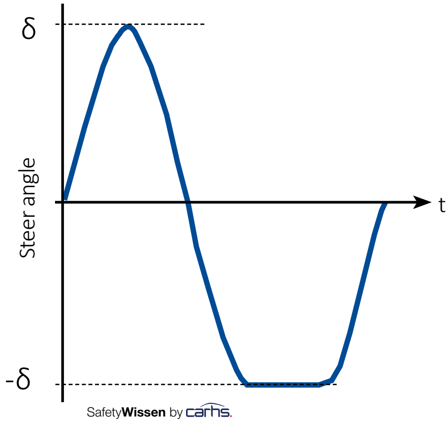
Test of ESC Systems in UN R13H and FMVSS 126

Step 1: Slowly-Increasing-Steer Manoeuvre to determine parameter A

At a constant velocity of 80±2 km/h the steering angle is ramped at 13.5 deg/s until a lateral acceleration of 0.5 g is reached. Out of 2 series (1x left turn / 1x right turn) with 3 repetitions of the manoeuvre the steering angle A (in degrees) at which the lateral acceleration is 0.3 g is determined using linear regression.

Step 2: Sine with Dwell Manoeuvre to assess Oversteer Intervention and Responsiveness

At a velocity of von 80±2 km/h the vehicle is subjected to two series of test runs using a steering pattern of a sine wave at 0.7 Hz frequency with a 500 ms delay beginning at the second peak amplitude:



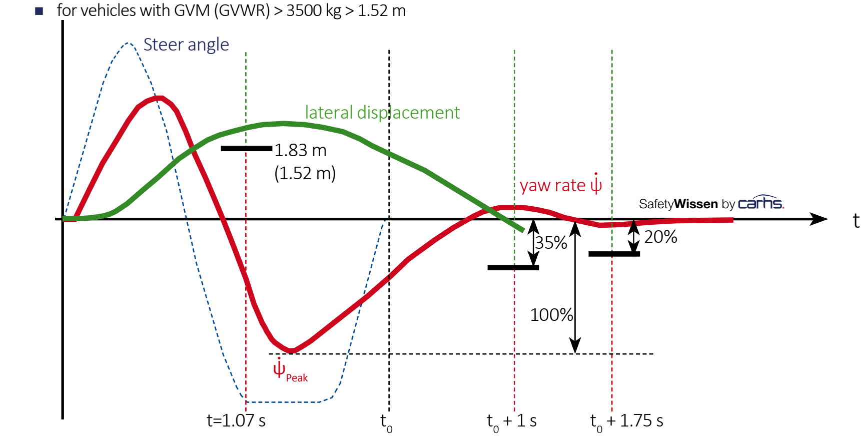
Introduction

- UN: M1 and N1 vehicle
  - New types from 1.11.2011
  - New registrations from 1.11.2013
- FMVSS: all vehicles with GVWR ≤ 4536 kg
  - from 01.09.2011 100% of the vehicles produces

One series uses counterclockwise steering for the first half cycle, and the other series uses clockwise steering for the first half cycle. In each series of test runs, the steering amplitude is increased from run to run, by 0.5 A, starting at 1.5 A. The steering amplitude of the final run in each series is the greater of 6.5A or 270 degrees, provided the calculated magnitude of 6.5A is less than or equal to 300 degrees. If any 0.5A increment, up to 6.5A, is greater than 300 degrees, the steering amplitude of the final run is 300 degrees.

Performance Requirements:

- Yaw Rate
  - 1 s after completion of the steering input (t_0) < 35 % of the first peak value of yaw rate recorded after the steering wheel angle changes sign.
  - 1.75 s after completion of the steering input (t_0) < 20 % of the first peak value of yaw rate recorded after the steering wheel angle changes sign.
- Lateral displacement of the vehicle center of gravity with respect to its initial straight path when computed 1.07 seconds after the Beginning of Steer (BOS)
  - for vehicles with GVM (GVWR) ≤ 3500 kg > 1.83 m
  - for vehicles with GVM (GVWR) > 3500 kg > 1.52 m



Car Body Design for Analysis Engineers

Course Description

In general analysis engineers have a sound knowledge on numerical methods and experience in structural analysis with the Finite Element Method. To make a valuable contribution to the vehicle development process using numerical simulation, knowledge on car body design and functional layout is required. To efficiently undertake lightweight design all fundamental requirements have to be taken into account early in the design process. These requirements will be outlined in the seminar. Additionally the characteristics of the specific organization of the development process have to be incorporated.

Course Objectives

The objective of the seminar is to transfer the knowledge needed for an analysis engineer to play a part in vehicle development. Especially the examination of design variants of existing car bodies makes the seminar descriptive and practical.

Who should attend?

This 2 day seminar is aimed at analysis engineers working in the automotive industry.

Course Contents

- Load carrying principles of lightweight design
  - Load assumptions
  - Design principles
- Technology of car body construction
  - Car body architecture
  - Structural materials and pre-products
  - Material selection
  - Manufacturing methods
  - Joining techniques
- Development process described at the example of the improvement of static properties
  - Principal structure of the development process
  - CAE-compatible CAD
  - Finite Element modelling of a car body
  - Static behaviour of the car body structure
  - Finite Element Analysis of joints
- Measures for improved dynamic behavior
  - Part dimensioning taking into account vehicle vibrations
  - Dynamic analysis of full vehicles
- Measures for improved acoustic behavior
  - Acoustic design of a car body
  - Simulation methods
- Realization of safety measures
  - Energy absorption elements
  - Vehicle car bodies
  - Safety systems
  - Pedestrian protection
  - Post crash
- Use of optimization methods in industrial applications
  - Introduction into mathematical optimization
  - Approximation techniques
  - Optimization software
  - Optimization strategies
  - Shape optimization
  - Topology optimization

Course Instructor:

Prof. Dr.-Ing. Axel Schumacher, University of Wuppertal

Prof. Dr.-Ing. Axel Schumacher studied mechanical engineering at the universities of Duisburg and Aachen. He received his doctorate on structural optimization from the University of Siegen. Following research projects for Airbus were focused on the optimization of aircraft structures. Thereafter he worked in the CAE methods development department of Adam Opel AG as project leader for structural optimization. From 2003 - 2012 he was a professor at the University of Applied Sciences in Hamburg and taught structural design, passive safety and structural optimization. Since 2012 he has been professor at the University of Wuppertal, where he holds the chair for Optimization of mechanical structures.

Date	Course ID	Venue	Duration	Price	Language
13.-14.07.2015	2486	Alzenau	2 Days	1.290,- EUR till 15.06.2015, thereafter 1.540,- EUR	English
23.-24.09.2015	2485	Alzenau	2 Days	1.290,- EUR till 26.08.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Lightweight Design Strategies for Car Bodies

Course Description

To design and develop light weight vehicles ready for series production is becoming increasingly important. Especially for fully electric vehicles with large and heavy battery packs light car bodies are indispensable. But also for other propulsion concepts lightweight is desirable. The focus in this seminar will be given to production ready vehicle concepts, and ideas taken from the extreme light weight design are integrated into the considerations. A symbiosis of the use of modern light-weight materials and the design of appropriate lightweight structures leads to efficient lightweight design. This multi-disciplinary task is only possible with development strategies that can simultaneously handle requirements of crash protection, vehicle dynamics, comfort, acoustics, durability and production of the vehicle. The aim of this seminar is to provide the competencies for the development of light vehicle structures.

Who should attend?

This seminar is aimed at designers, analysis engineers and project managers from car body, component and system development.

Course Contents

- Potentials of lightweight design
  - Motivation and problem definition
  - Current lightweight vehicle concepts
  - The "Lightweight Loop"
- Principles of lightweight design
  - Definition of requirements
  - Determination of design loads
  - Principal design rules
  - Approaches of bionics
  - Fail-safe, safe life, damage tolerance
  - Methodical concept finding (architecture, topology)
- Materials and their specific design rules
  - Material selection
  - Acquisition of material data
  - Steel, aluminum, magnesium
  - Fiber composites
  - Material mix and recycling
- Structures of lightweight design
  - Space-frame structures
  - Shell structures (beads, ribs, ...)
  - Foams and inlays
  - Composite sandwich structures
  - Related joining techniques (adhesive bonding, ...)
- Advanced CAE methods for lightweight design
  - Stability (buckling, ...)
  - Dynamics and Acoustics
  - Fracture mechanics, multi-scale models (observation of cracks, etc.)
  - Crash of small structures
  - Analysis of joints
  - Robustness analysis
  - Optimization of shape and dimension
- Case studies
  - Selected Vehicle Components
  - Ultra-lightweight vehicle concepts
  - Vehicle concepts for mass production

Course Instructor:

Prof. Dr.-Ing. Axel Schumacher, University of Wuppertal

Prof. Dr.-Ing. Axel Schumacher studied mechanical engineering at the universities of Duisburg and Aachen. He received his doctorate on structural optimization from the University of Siegen. Following research projects for Airbus were focused on the optimization of aircraft structures. Thereafter he worked in the CAE methods development department of Adam Opel AG as project leader for structural optimization. From 2003 - 2012 he was a professor at the University of Applied Sciences in Hamburg and taught structural design, passive safety and structural optimization. Since 2012 he has been professor at the University of Wuppertal, where he holds the chair for Optimization of mechanical structures.

Date	Course ID	Venue	Duration	Price	Language
24.-25.02.2015	2411	Alzenau	2 Days	1.290,- EUR till 27.01.2015, thereafter 1.540,- EUR	German
01.-02.09.2015	2487	Alzenau	2 Days	1.290,- EUR till 04.08.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Design of Composite Structures

Course Description

Since the mass is one of the main factors influencing the fuel consumption of vehicles, increasing demands to reduce energy usage and CO2 emissions, force the automotive industry to consider the use of alternative designs and new materials. Composite materials have proven their potential to reduce the weight of structures in many applications (e.g.in aerospace and motorsports). As composites have a special set-up and behave completely different than traditional materials, engineers must learn how to employ these materials to take advantage of their special characteristics in the design of vehicle structures. In the seminar real world examples are used to create a basic understanding of designing composite structures. Then the theoretical and practical foundations of composite design are explained.

Course Objectives

After participating in the seminar participants are able to design and develop composite structures. They understand the specific requirements of composite structures and the related design concepts. In the seminar special attention is directed to the concurrent consideration of loading, design and manufacturing related requirements. Accordingly, the different designs - integral, differential, fully laminated and sandwich - are addressed. The seminar also provides knowledge about preliminary design and detailed FE analysis based on classical laminate theory. Furthermore, participants learn to judge manufacturing and in-service defects and to develop repair measures.

Who should attend?

This seminar is especially designed for engineers and technicians that work in the development departments of automotive manufacturers, suppliers and engineering service providers and deal with the design and development of composite components.

Course Contents

- Introduction
- Elastic behavior of composites
- Failure of composite materials
- Mechanics of composite materials and structures
- Joining technologies for composites
- Design and CAD modeling of composite structures
- Damage tolerant design and repair
- Fatigue and strength of composites

Course Instructor:

Dr. Roland Hinterhölzl, Technical University of Munich

Since 2010 Dr. techn. Roland Hinterhölzl is head of the numerical simulation department of the Institute for Carbon Composites at the Technical University of Munich. The focus of his work is on process simulation and structural analysis for the automotive and aviation industries. Dr. Hinterhölzl received his doctorate in 2000 at the University of Innsbruck on the simulation of the time-dependent behavior of composite materials, after he has spent several months at the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin and CRREL (USA). Subsequently, he developed innovative composite components at the aerospace supplier FACC AG and headed the structural analysis department.

Date	Course ID	Venue	Duration	Price	Language
18.-19.03.2015	2416	Alzenau	2 Days	1.290,- EUR till 18.02.2015, thereafter 1.540,- EUR	German
10.-11.11.2015	2557	Garching	2 Days	1.290,- EUR till 13.10.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Material Models of Metals for Crash Simulation

Course Description

Besides an appropriate spatial discretisation of the structure and a profound knowledge of the required load cases, appropriate material modelling is a key ingredient for predictive crash simulations. The load carrying structure of a car today still mainly consists of metallic materials. The materials to be described are diverse.

The seminar deals with the following materials:

- mild and high strength steels,
- cold formable AHSS and UHSS steels,
- hot formable and quenchable boron steels,
- wrought Al and Mg alloys,
- cast Al and Mg alloys.

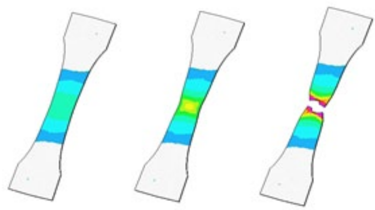
The objective of this 1 day course is to give the participants an overview of material models of metals used in crash simulation. In a first step the deformation behavior and the failure mechanisms of each material class are explained based on the material structure. The influence of strain rate on material behavior is an important aspect in the context of crash simulation and will be discussed in the seminar. In a second step phenomenological material models for crash simulation are introduced. In the third step the tests needed for the characterization of materials are described and the parameter identification for the material models is discussed. Finally and using example simulations the sensitivity of simulation results regarding the identified material parameters is shown.

Who should attend?

The course addresses engineers working in the field of crash simulation and heads of simulation departments interested in the important topic of material modelling.

Course Contents

- Overview of metallic materials used in cars
- Influence of material structure on mechanical behaviour
- Phenomenological material models for metals
- Overview of experimental methods for material characterization
- Identification of material parameters from experiments
- Discussion of the sensitivity material parameters



Course Instructor:

Dr.-Ing. Helmut Gese, MATFEM - Partnerschaft Dr. Gese & Oberhofer

In 1993 Dr.-Ing. Helmut Gese founded the engineering consultancy MATFEM (from 1999 the company has been named MATFEM partnership Dr. Gese & Oberhofer). MATFEM offers technical and scientific consultancy services at the intersection of material science and finite element methods. Besides performing FEM analysis projects the area of activity covers experimental and theoretical characterization of materials and the development of new material models for simulation.

Date	Course ID	Venue	Duration	Price	Language
22.06.2015	2562	Alzenau	1 Day	740,- EUR till 25.05.2015, thereafter 890,- EUR	
02.11.2015	2561	Alzenau	1 Day	740,- EUR till 05.10.2015, thereafter 890,- EUR	

This course is available as an in-house seminar in English and German!

Material Models of Plastics and Foams for Crash Simulation

Course Description

Numerical simulation has become a fundamental element in the development of motor vehicles. Today, many important design decisions, especially in the field of crash, are based on simulation results. During the last few years there has been an increase in the use of foam materials in vehicles. These are, due to their variety and structure, much more complicated regarding the characteristics of the materials than "simple" materials such as steel or aluminium, which can be modelled rather well. Characterization of foam materials is a great challenge for the simulation expert. Although by now there are different modelling approaches available in explicit FEM-programs such as LS-DYNA and PAM-CRASH, these are, however, often not satisfactory. The application of these special material models require a sound knowledge and experience.

The seminar provides an overview over plastics and foam materials used in automotive engineering and their phenomenology. On the first day you are going to obtain an introduction into the simulation of elastic and visco-elastic polymers, such as elastomers and elastic polymer foams with volume elements. You are thereby coming to understand the available material models in explicit finite element programs.

On the second day the focus is on the treatment of plastics, such as thermo- and duroplastics through elasto-plasticity with isotropic hardening. Non-associated deformation is going to be discussed as well. The seminar is rounded off with the development of a material law for destructible materials.

For a demonstration you are going to see examples created with the program LS-DYNA. References to material models in LS-DYNA and PAM-CRASH are going to help you in applying what you will have learnt.

Who should attend?

The seminar addresses experienced CAE engineers and heads of CAE departments with an interest in plastic and foam materials simulation. At least 1-year of experience with FEM-programs such as LS-DYNA and PAM-CRASH is suggested for participating in this course.

Course Contents

- Overview of foam materials used in vehicle construction
- Simulation of elastic and visco-elastic foam materials with volume elements
- Available material models in explicit finite element programs
- Simulation of crushable foam materials and hard foams with volume elements, available material modes in explicit computing programs
- Simulation of anisotropic (honey comb-) materials
- Overview of elasto-plasticity at finite strain
- Simulation of polymers in crash load cases
- Simulation of plastics with elasto-plastic material laws
- Simulation of plastics with visco-elastic material laws
- Simulation of plastic components

Course Instructor:

Prof. Dr.-Ing. Stefan Kolling, Giessen University of Applied Sciences

Stefan Kolling is Professor for Mechanics at the Giessen University of Applied Sciences (THM). Previously he worked as a simulation engineer at the Mercedes Technology Center in Sindelfingen. He was responsible for methods development in crash simulation. In particular he was involved in the modelling of non-metal materials such as glass, polymers and plastics. Prof. Kolling graduated from the Universities of Saarbrücken and Darmstadt, from where he also received his Ph.D. He is author of numerous publications in the field of material modeling.

Date	Course ID	Venue	Duration	Price	Language
23.-24.06.2015	2555	Alzenau	2 Days	1.290,- EUR till 26.05.2015, thereafter 1.540,- EUR	English
03.-04.11.2015	2556	Alzenau	2 Days	1.290,- EUR till 06.10.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Material Models of Composites for Crash Simulation

Course Description

Increasing demands for weight reduction paralleled by requirements for improved crash performance and stiffness of structures have strongly pushed the development of advanced composites. The use of composite materials today is not limited to niche applications or secondary parts; they are increasingly used for important load carrying structural components in series production.

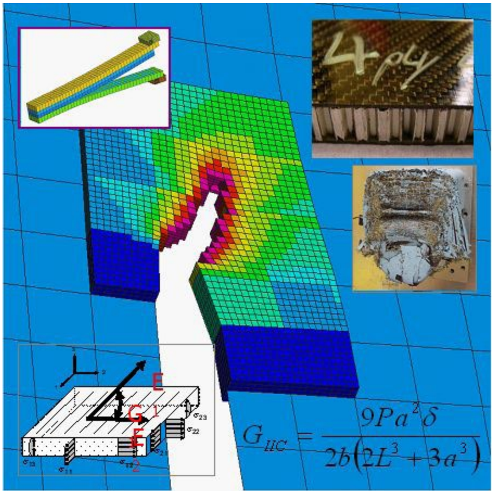
In this one day seminar Prof. Anthony Pickett presents the foundations of structural impact and crash analysis of composites with the Finite Element Method. At the beginning of the seminar an overview of current and upcoming industrial applications of composite materials is given. Thereafter concepts for the correct physical modeling of the complex load degradation and failure mechanisms in numerical simulation are presented. The course concentrates on the numerical simulation of the crash behavior of composites and is accompanied with demonstrations using the PAM-CRASH code.

Who should attend?

The course addresses simulation and project engineers, project managers as well as researchers involved in the analysis and design of composite parts and structures.

Course Contents

- Current and upcoming areas of application of composite materials
- Analysis of composite materials
- Available material models and their application
- Modelling methods for plies and laminates
- FEM modelling of composites
- Failure mechanisms and their representation
- PAM-CRASH ply and delamination models
- Necessary material tests
- Examples



Course Instructor:

Prof. Dr. Anthony Pickett, ESI Engineering System International GmbH

Prof. Anthony Pickett studied at the University of Surrey (UK) where he also received his doctorate on composite materials. He then worked at ESI GmbH for more than 15 years, during which time he led numerous industrial, national and international research projects on composites processing and composite crash simulation. From 2002 until 2007 he had a chair in composite materials at Cranfield University (UK). Currently he is scientific director at ESI GmbH and teaches composite materials modelling at the Institute of Aircraft Design at the University of Stuttgart.

Date	Course ID	Venue	Duration	Price	Language
26.06.2015	2452	Alzenau	1 Day	740,- EUR till 29.05.2015, thereafter 890,- EUR	English
06.11.2015	2453	Alzenau	1 Day	740,- EUR till 09.10.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

Simulation of Automotive Components from Short-Fibre Reinforced Plastics

Course Description

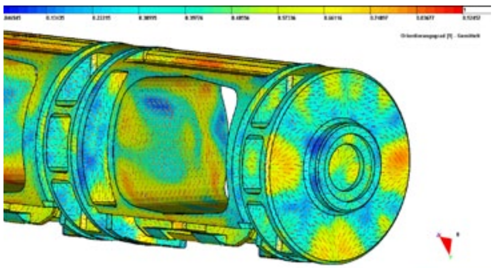
Short-fibre reinforced plastics have established themselves as a material for mechanically demanding automotive components. However they provide great challenges for the design engineer. Loading rate, temperature, and ambient media dramatically change the mechanical properties. In addition, the manufacturing process conditions of the plastic result in direction dependent mechanical deformation and failure behavior. As a consequence the simulation engineer has to use new and advanced methods in the simulation.
This one-day seminar presents simulation methods that allow the analysis of short-fibre reinforced plastics automotive components under crash, short-term and long-time mechanical loading. The focus of the seminar is on the combination of different phenomenological and micromechanical modelling approaches for the mechanical behavior of these materials. The basic knowledge of the special behavior of these materials is provided and the importance of the coupling of the manufacturing process simulation (injection moulding) with the structural simulation for meaningful simulation results will be explained. Finally, the description of the failure behavior of these materials is discussed. Practical examples are used to demonstrate the above to the seminar participants.

Who should attend?

The seminar is aimed at engineers and managers of calculation departments that already have experience in the structural simulation of automotive components and want to extend their knowledge regarding the simulation of short-fibre reinforced plastics.

Course Contents

- Fundamentals of short-fibre reinforced plastics
- Processing of short fibre reinforced plastics for automotive components
- Manufacturing process simulation
- Coupling of process and structure simulation
- Material models for the structural-mechanical description
- Simulation of the crash behavior
- Analysis of the mechanical behavior and short and long term loading
- Experimental determination of material properties
- Calibration of material models
- Failure mechanisms and strength assessment



Course Instructor:

Prof. Dr.-Ing. Markus Stommel, Saarland University

Professor Dr.-Ing. Markus Stommel studied mechanical engineering (specializing in plastics engineering) and received his PhD in the same discipline. For more than 7 years he has been Managing Director and Project Manager with PART Engineering. The company specializes on calculation and design projects for plastic and rubber products in the automotive industry. From 2007 to 2014 he has been Professor of Polymer Materials at the University of Saarland. Since 2014 he is a Professor of Plastics Processing Technology at the TU Dortmund University. One of his research focuses is on engineering of materials and failure modelling of plastics and elastomers for numerical simulation.

Date	Course ID	Venue	Duration	Price	Language
25.06.2015	2499	Alzenau	1 Day	740,- EUR till 28.05.2015, thereafter 890,- EUR	English
05.11.2015	2500	Alzenau	1 Day	740,- EUR till 08.10.2015, thereafter 890,- EUR	German

This course is available as an in-house seminar in English and German!

NEW

Static and Dynamic Analysis of Long-Fibre-Reinforced Plastics

Course Description

Due to increasingly strong social and political demands for a reduction of the energy demand of automobiles, systematic lightweight construction is becoming more and more important in this industry sector. Special opportunities are offered by the use of fibre-reinforced composites as prime materials for lightweight constructions. A major challenge of these materials is the anisotropic material behavior and its calculation. Given the fact that composites are constructed entirely different and behave completely different compared the classic metallic materials, the engineer must learn to deal with this class of materials to use the advantages of composites for the design of vehicle structures. In the seminar the attendees are first introduced to examples from practice and gain a basic understanding of the tasks. After that, the theoretical and practical aspects of computing methods are explained in order to be able to calculate statically and dynamically loaded structures of long fibre-reinforced plastics.

Course Objectives

After participating in the seminar "Static and dynamic analysis of long-fibre-reinforced plastics", participants are able to compute composite structures and to identify the effective mechanisms of the associated physics. They understand the different requirements of a fibre composite structure and the associated calculation concepts. A particular focus of the seminar is aimed at the challenges, the problems and limitations in the analysis of long-fibre-reinforced composites. Accordingly, it provides knowledge for the design and the detailed FE analysis. Furthermore, the various damage mechanisms and failure criteria are explained.

Who should attend?

The seminar is especially designed for engineers and technicians in the development and simulation departments of automobile manufacturers, suppliers and service providers dealing with the simulation and development of fibre composite components, and fibre composite structures.

Course Contents

- Introduction
- Mechanics of Composite Materials and Structures
- Characteristics and parameter determination of composite materials
- Calculation of long-fibre-reinforced plastics
- FEM modelling
- Material models for structural-mechanical description
- Calculation of static loads
- Calculation of dynamic loads
- Failure criteria of composites
- Damage and failure mechanisms of composite materials

Course Instructor:

Dr. Thomas Karall, Kompetenzzentrum - Das virtuelle Fahrzeug, Forschungsgesellschaft mbH

Dr. Thomas Karall studied mechanical engineering at the Technical University of Vienna and received his PhD as Assistant Professor at the University of Leoben in the field of fibre-reinforced plastics and the calculation by finite elements. From 2006 to 2010 he was head of department at the Austrian Research Institute for Chemistry and Technology in Vienna in the field of mechanical and thermal testing / fibre composites, and Secretary General of the Austrian Working Group for reinforced plastics. Since 2010 he works as Lead Researcher for lightweight design at Virtual Vehicle Research Center in Graz. He is also a lecturer at the Technical University of Graz and lecturer at the FH Joanneum Graz. His areas of expertise include lightweight, fibre-reinforced composites and the method of finite elements.

Date	Course ID	Venue	Duration	Price	Language
08.-09.07.2015	2492	Alzenau	2 Days	1.290,- EUR till 10.06.2015, thereafter 1.540,- EUR	English
19.-20.11.2015	2493	Alzenau	2 Days	1.290,- EUR till 22.10.2015, thereafter 1.540,- EUR	German

This course is available as an in-house seminar in English and German!

Robust Design and Stochastics for Car Body Development

Course Description

The course gives a profound introduction into robustness analysis, which assures the optimality of car body concepts and designs considering the relevant and unavoidable uncertainties. An overview of the corresponding numerical methods is given and their applications are studied in detail.

Course Objectives

Objective of this course is to enable car body developers to account in their virtual design processes for uncertainties and to assure the robustness of their designs with respect to the most relevant functional requirements. This will be achieved by first reviewing the basic theory via simple engineering examples and then by adapting these methods to the specific characteristics of car body development. Here real world examples will be studied originating from crashworthiness, NVH (noise vibration and harshness) and other disciplines.

Who should attend?

This seminary is especially suited for engineers interested in effective and accurate virtual development methods where uncertainties need to be considered. This is often the case in optimization and robustness studies for car body design (crashworthiness, NVH, durability, etc.) but applies more generally to most of the engineering fields. The seminary can hence also be recommended to other structural engineers looking for deeper understanding into methods for stochastic assessments.

Course Contents

- First Day
  - Introduction
  - Mathematical background
  - Overview of statistical methods for uncertainty and robustness assessment
  - Sources of uncertainties
  - Quantification of uncertainties
  - Robustness versus reliability
  - EXERCISE 1: Uncertainty quantification (MATLAB, Python)
  - Methods for sampling and Design of Experiments (DoE)
  - Global and local Sensitivity Analysis (correlation, ANOVA, Sobol, elementary effects etc.)
  - Methods for reduction of the complexity / improvement of efficiency
  - EXERCISE 2: DoE and Sensitivity Analysis

- Second Day
  - Revision
  - Discussion of real world problems for stochastic and robustness assessments
  - Definition of a sample problem taken from car body design
  - EXERCISE 3: Application of the methods to the sample problem and discussion
  - Methods for robustness assessments
  - Overview of optimization methods for car body design (crash & NVH)
  - Methods for robust design optimization (RDO) applied to car body design
  - Advanced methods for highly efficient RDO

Course Instructor:

Prof. Dr.-Ing. Fabian Duddeck, Technische Universität München

Since 2010, Fabian Duddeck leads the research group on optimisation and robustness at the Technische Universität München (TUM). His research is focusing on shape and topology optimization for crash, NVH (noise vibration and harshness) and other disciplines including stochastic modelling and robustness assessments. Holding the chair for Computational Mechanics at the TUM, he also teaches and directs research at Queen Mary University of London (QML) and at the French Ecole des Ponts ParisTech (ENPC). His group was and is involved in several national and international research projects, for example the EU projects FLOWHEAD (Fluid Optimisation Workflows for Highly Efficient Automotive Development Processes) and AMEDEO (Aerospace Multi-disciplinarity Enabling Design Optimisation). Prof. Duddeck has obtained his PhD (1997) and his Habilitation degree (2001) at the Technische Universität München.

Date	Course ID	Venue	Duration	Price	Language
25.-26.03.2015	2407	Alzenau	2 Days	1.290,- EUR till 25.02.2015, thereafter 1.540,- EUR	English
20.-21.07.2015	2444	Alzenau	2 Days	1.290,- EUR till 22.06.2015, thereafter 1.540,- EUR	English

This course is available as an in-house seminar in English and German!

Important Abbreviations

A

A-PCS	Advanced Pre-Collision System (Lexus)
AAA	American / Australian Automobile Association
AAAM	Association for the Advancement of Automotive Medicine
AAM	Alliance of Auto Manufacturers (OSRP, USCAR)
aBAS	Advanced Brake Assist System
ACC	Adaptive Cruise Control
ACEA	Association of European Automobile Manufacturers
ACL	Anterior cruciate ligament
ACN	Automatic Collision Notification
ACU	Airbag Control Unit
ADAC	Allgemeiner Deutscher Automobil Club(German Automobile Association)
ADAS	Advanced Driver Assistance Systems
ADOD	Average Depth of Deformation
ADR	Australian Design Rules
AE-MDB	Advanced European Mobile Deformable Barrier
AEB	Autonomous Emergency Braking
AEBS	Autonomous Emergency Brake System
AHOD	Average Height of Deformation
AHOF	Average Height of Force
AHR	Active Head Rest
AIS (1)	Abbreviated Injury Scale
AIS (2)	Automotive Industry Standards
AISC	Automotive Industry Standards Committee
ANCAP	Australasian New Car Assessment Program
AOP	Adult Occupant Protection (Euro NCAP)
APF	Abdominal Peak Force
APPO	Assessment Protocol Prove Out (Euro NCAP)
APROSYS	Advanced PROtection SYStems
APSS	Active Pedestrian Safety System
ARAI	Automotive Research Association of India
ASIC	Application-Specific Integrated Circuit
ASIL	Automotive Safety Integrity Level (functional safety)
ASIS	Adavanced Side Impact System
ATD	Anthropomorphic Test Device
AZT	Allianz Zentrum Technik

B

BAS	Brake Assist
BASt	Germany's Federal Highway Research Institute
BDA	Bonnet Deployment Actuator
BIS	Bureau of Indian Standards
BLE	Bonnet Leading Edge
BMVI	German Federal Ministry of Transport and digital Infrastructure
BoD	Board of Directors (Euro NCAP)
BOS	Beginning of Steer
BRIC	Brain Injury Criterion
BSD	Blind Spot Detection

C

C-NCAP	China New Car Assessment Programme
C2C	Car-to-Car
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAN	Controller Area Network
Cars21	A Competitive Automotive Regulatory System for the 21st Century
CAT	Computer Aided Testing
CATARC	China Automotive Technology and Research Center
CCD	Charge Coupled Device
CCIS	Co-operative Crash Injury Survey
CCR	Car to Car-Rear
CDC	Collision Deformation Classification
CEA	Comité Européen des Assurances
CFD	Computational Fluid Dynamics
CFK	
CFR	Code of Federal Regulations (USA)
CFRP	Carbon Fiber Reinforced Plastic
CIB	Crash Imminent Braking
CLEPA	Comité de liaison européen des fabricants d'equipements et de pièces automobiles
CMbB	Crash Mitigation by Braking (Ford)
CMBS	Crash Mitigation Brake System (Honda)
CMM	Coordinate Measuring Machine
CMOS	Complementary Metal Oxide Semiconductor
CMVR	Central Motor Vehicle Rules
CMVSS	Canadian Motor Vehicle Safety Standards
COG	Center of Gravity
CONTRAN	Conselho Nacional de Trânsito
COP (1)	Carry over Parts
COP (2)	Child Occupant Protection (Euro NCAP)
COS	Completion of Steer
CP	Contact Point
CRABI	Child Restraint Airbag Interaction (Child Dummy), USA
CRS	Child Restraint System
CSM	Computational Structural Mechanics
CSMA/CA	Carrier Sense Multiple Access / Collision Avoidance
CSMA/CD	Carrier Sense Multiple Access / Collision Detection
CV	Closing Velocity
CVFA	Car to Vulnerable road user Farside Adult
CVNA	Car to Vulnerable road user Nearside Adult
CVNC	Car to Vulnerable road user Nearside Child

D

DAS	Data Acquisition System
DBS	Dynamic Brake Support
DCU	Domain Control Unit
DGPS	Differential Global Positioning System
DLO	Daylight Opening
DT	Deployment Time

E

EBA	Emergency Brake Assist
EBD	Electronic Brake Force Distribution
ECE	Economic Commision for Europe (United Nations)
ECOSOC	United Nationions Economic and Social Council
EDM	Engineering Data Management
EES	Energy Equivalent Speed
EEVC	European Enhanced Vehicle-Safety Committee
ELSA	ELectric SAfety (UNECE/WP29 Working Group)
EMC	Electromagnetic Compatibility
EOU	Ease of use
ES-2 re	Euro SID 2 Rib Extension
ESC	Electronic Stability Control
ESV	Enhanced Experimental Vehicles Safety Program / Enhanced Safety of Vehicles Prog.
ETC	European Test Consortium
ETSC	European Transport Safety Council
Euro NCAP	European New Car Assessment Programme
EVPC	Electric Vehicles Post Crash
EVT	Euro NCAP Vehicle Target

Important Abbreviations

F

FARS	Fatality Analysis Reporting System
FFCW	Forward Collision Warning
FCWS	Forward Collision Warning System
FEM	Finite Element Method
FFC	Femur Force Criterion
Flex PLI	Flexible Pedestrian Legform Impactor
FMH	Free Motion Headform (FMVSS 201)
FMVSS	Federal Motor Vehicle Safety Standards
FPS	Frontal Protection System
FPSLE	Frontal Protection System Leading Edge
FRG	Floating Rib Guide
FRP	Fiber Reinforced Plastic
FSI	Fluid-Structure-Interaction
FTDMA	Flexible Time Division Multiple Access
FW	Full Width
FWDB	Full Width Deformable Barrier
FWRB	Full Width Rigid Barrier

G

G.S.R.	General Statutory Rules
GAMBIT	Generalized Acceleration Model for Brain Injury Threshold
GCS	Glasgow Coma Scale
GIDAS	German in-Depth Accident Study
GRSG	Groupe de Rapporteurs sur la Sécurité Générale (WP29 - General Safety Provisions)
GRSP	Groupe de Rapporteurs sur la Sécurité Passive (WP29 - Passive Safety)
GSR	General Safety Regulations
GTR	Global Technical Regulation
GVM	Gross Vehicle Mass
GVWR	Gross Vehicle Weight Rating

H

HBM	Human Body Model
HGV	Heavy Goods Vehicle
HIC	Head Injury Criterion
HIT	Head Impact Time
HITS	Harmonisation Interlab Test Series
HLDI	Highway Loss Data Institute
HLLC	High Level Liaison Committee
HMI	Human Machine Interface
HNT	Horizontal Negative deviation from Target cell load
HOF	Height of Force
HPC	Head Performance Criterion
HPM	H-Point Manikin
HPS	Head Protection System
HPT	Head Protecting Technology
HRC	Time to head restraint first contact
HRMD	Head Restraint Measuring Device
HRV	Head Rebound Velocity
HTD	Hardest to detect
HV	High Voltage

I

IARV	Injury Assessment Reference Value
IBRL	Internal Bumper Reference Line
ICPL	Injury Criteria Protection Level
ICRT	International Consumer Research and Testing
IG	Informal Group
IHC	Intelligent Headlight Control
IHRA	International Harmonized Research Activities
IIHS	Insurance Institute for Highway Safety
IIWPG	International Insurance Whiplash Prevention Group
INRETS	Institut National de Recherche sur les Transports et leur Sécurité
INSIA	Instituto Universitario de Investigación del Automóvil
IP	Intersection Point
IRC	Injury Risk Curve
IRCOBI	International Research Council on the Biomechanics of Impact
IRF	Injury Risk Function
ISA	Intelligent Speed Assistance
ISM	Intelligent Speed Management
ISO	International Organization for Standardization
ISS	Injury Severity Score
ITC	Inland Transport Committee (UN ECE)

J

J-MLIT	Japan: Ministry of Land, Infrastructure and Transport
JAMA	Japan Automotive Manufacturers Association
JARI	Japan Automobile Research Institute
JASIC	Japan Automobile Standards Internationalization Center
JNCAP	Japan New Car Assessment Program

K

KMVSS	Korean Motor Vehicle Safety Standards
KNCAP	Korean New Car Assessment Program
KTH	Knee - Thigh - Hip

L

LDWS	Lane Departure Warning System
LHD	Left Hand Drive
LIDAR	Light Detection and Ranging
LIN	Local Interconnect Network
LINCAP	Lateral Impact New Car Assessment Program (U.S. NCAP)
LKAS	Lane Keeping Assist System
LKD	Lane Keeping Device
LKS	Lane Keeping System
LL	Lower Leg
LNL	Lower Neck Load
LTR	Land Transport Rules (New Zeeland)

M

MAIS	Maximum AIS (Abbreviated Injury Scale)
MCL	Medial Collateral Ligament
MDB	Mobile Deformable Barrier
MOST	Media Oriented Systems Transport
MPDB	Moving Progressive Deformable Barrier
MSA	Manual Speed Assist
MTBI	Mild Traumatic Brain Injury
MVWG	Motor Vehicle Working Group (EU)

N

NASS	National Automotive Sampling System
NASS CDS	NASS Crashworthiness Data System
NASS GES	NASS General Estimates System
NASVA	National Agency for Automotive Safety & Victims' Aid (Japan)
NCAP	New Car Assessment Program
NCSA	National Center for Statistics and Analysis (an Office of NHTSA)
NHTSA	National Highway Traffic Safety Administration (USA)

Important Abbreviations

NIC	Neck Injury Criterion
NNT	Number Needed to Treat
NPACS	New Programme for the Assessment of Child-restraint Systems
NPRM	Notice of Proposed Rule Making
NTSEL	National Traffic Safety and Environment Laboratory (Japan)

O

OC	Occipital Condyles
ODB	Offset Deformable Barrier
OICA	Organisation Internationale des Constructeurs d'Automobiles
OLC	Occupant Load Criterion
OoP	Out of Position

P

PADI	Procedures for the assembly disassembly and inspection
PCL	Posterior Cruciate Ligament
PDB (1)	Partnership for Dummytechnology and Biomechanics
PDB (2)	Progressive Deformable Barrier
PDC	Park Distance Control
PDI	Pedestrian Detection Impactor
PEAS	Primary Energy Absorbing Structure
PLI	Pedestrian Legform Impactor
PMD	Photonic Mixer Device
PMHS	Post Mortem Human Subjects
PMTO	Post Mortal Test Object
PNCAP	Primary New Car Assessment Programme
PoC	Point of Collision
PP	Pedestrian Protection (Euro NCAP)
PPAD	Partner Protection Assessment Deformation
PSPF	Pubic Symphysis Peak Force
PTS	Poly Trauma Score

R

Radar	Radio Detection and Ranging
RCAR	Research Council for Automobile Repairs
RE	Rib Extension (for EuroSID II)
RFCRS	Rearward Facing Child Restraint System
RHD	Right Hand Drive
RID	Rear Impact Dummy

S

S.O	Statutory Order
SA	Safety Assist (Euro NCAP)
SAE	Society of Automotive Engineers
SAS	Speed Assistance System
SAT	Safety Assist Technology
SB	Seat Back
SBR	Seat Belt Reminder
SCOE	Standing Committee on Implementation of Emission Legislation
SEAS	Secondary Energy Absorbing Structure
SgRP	Seating Reference Point
SID	Side Impact Dummy
SINCAP	Side Impact New Car Assessment Program (U.S. NCAP)
SLD	Speed Limitation Device
SLIF	Speed Limit Information Function
SMA	Shape Memory Alloy
SOB	Small Overlap Barrier (IIHS)
SRA	Swedish Road Administration
SRP	Seat Reference Point
SRS	Supplementary Restraint System
SSF	Static Stability Factor (U.S. NCAP)
SSR	Speed Sign Recognition
ST	Sensing Time
STNI	Soft Tissue Neck Injury
SUV	Sports Utility Vehicle
SWR	Strength-to-weight ratio (roof crush)

T

TCMV	Technical Committee - Motor Vehicles (EU)
TDM	Time Division Multiplex
TDMA	Time Division Multiple Access
TEG	Technical Evaluation Group
TF BTA	Task Force Bumper Test Area
ThCC	Thoracic Compression Criterion, also TCC
THOR	Test Device for Human Occupant Restraint
THUMS	Total Human Model for Safety
TRL	Transport Research Laboratory (UK)
TRT	Total Reaction/Response Time
TSP	Top Safety Pick (IIHS)
TT	Top Tether
TTB	Time to Brake
TTC	Time to Collision
TTD	Time to Decision
TTI	Thoracic Trauma Index
TTP/A	Time-Triggered Protocol Class A
TTP/C	Time-Triggered Protocol Class C
TTS	Time to Steer

U

U.S. NCAP	United States New Car Assessment Program
UART	Universal Asynchronous Receiver Transmitter
UBM	Upper Body Mass
UMTRI	University of Michigan Transportation Research Institute
UN	United Nations
USCAR	The United States Council for Automotive Research

V

VAN	Vehicle Area Network
VC	Viscous Criterion
VDC	Vehicle Dynamics Control
VERPS	Vehicle Related Pedestrian Safety
vFSS	Advanced Forward Looking Safety Systems (Working Group)
VNT	Vertical Negative deviation from Target cell load
VR	Virtual Reality
VRTC	Vehicle Research & Test Center (NHTSA)
VRU	Vulnerable Road User
VSS	Vehicle Safety Score (U.S. NCAP)

W

WAD (1)	Wrap Around Distance
WAD (2)	Whiplash Associated Disorders
WG	Working Group
WP	Working Party
WPI	Worchester Polytechnic Institute
WS	World SID
WS5F	World SID 5th%ile Female Dummy
WSTC	Wayne State University Tolerance Curve
WSU	Wayne State University

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Seminar Calendar 2015

Knowledge for Tomorrow's Automotive Engineering

January	February	March	April	May	June
1 T	1 S	1 S	1 W Grand Challenge	1 F	1 M
2 F	2 M	2 M Structural Mechanics www	2 T	2 S	2 T
3 S	3 T	3 T Side Impact P. 77	3 F	3 S	3 W
4 S	4 W	4 W	4 S	4 M	4 T
5 M	5 T Internat. Safety and Crash P. 22	5 T Development of Frontal	5 S	5 T	5 F
6 T	6 F Regulations / num. Simul. www	6 F Restraint Systems P. 64	6 M	6 W	6 S
7 W	7 S	7 S	7 T	7 T	7 S
8 T	8 S	8 S	8 W	8 F	8 M Advanced Driver Assistance P. 116
9 F	9 M Introduction to Fatigue www	9 M Dummy Certification HIII www	9 T	9 S	9 T and Crash Avoidance
10 S	10 T Analysis	10 T Vehicle Vibration www / www	10 F	10 S	10 W
11 S	11 W Quality Assurance in CAE www	11 W Crashworthy / Lightweight Summit	11 S	11 M	11 T Head Injury Criteria
12 M	12 T	12 T Car Body Design P. 62	12 S	12 T	12 F Head Impact
13 T	13 F	13 F Head Impact P. 84	13 M Structural Optimization in www	13 W	13 S
14 W	14 S	14 S	14 T Automotive Design	14 T	14 S
15 T	15 S	15 S	15 W Project Management in www	15 F	15 M International Safety and P. 22
16 F	16 M	16 M Product Liability in the www	16 T Engineering	16 S	16 T Crash Regulations
17 S	17 T	17 T Automobile Industry	17 F Child Protection P. 99	17 S	17 W Car Body Design for Analysis P. 128
18 S	18 W	18 W Design of Composite P. 132	18 S	18 M	18 T Engineers
19 M	19 T	19 T Structures	19 S	19 T SAFETYWEEK – DIE ZUKUNFT DER FAHRZEUGSICHERHEIT	19 F Knee Mapping Workshop
20 T	20 F	20 F Static Vehicle Safety Tests P. 59	20 M Euro NCAP and global Tests P. 30	20 W	20 S
21 W	21 S	21 S	21 T for Consumer Protection	21 T	21 S
22 T	22 S	22 S	22 W Crashworthiness / Passive	22 F	22 M Material Mod. Metals
23 F	23 M Whiplash Test & Evaluation P. 95	23 M Occupant Simulation & www	23 T altern. Drives / Safety P. 17	23 S	23 T Material Mod. Plastics
24 S	24 T Lightweight Design P. 130	24 T Validation	24 F	24 S	24 W PraxisConference P. 15
25 S	25 W Strategies for Car Bodies	25 W Robust Design & P. 140	25 S	25 M	25 T Pedestrian Protection
26 M	26 T Occupant Protection in P. 66	26 T Stochastics	26 S	26 T	26 F Material Mod. Composites
27 T	27 F Frontal Crash / Airbag Sim. www	27 F Autonomous Driving P. 118	27 M Introduction to Data Acqui- P. 102	27 W	27 S
28 W	28 S	28 S	28 T sition in Safety Testing	28 T	28 S
29 T		29 S	29 W Functional Safety www	29 F	29 M Side Impact P. 77
30 F		30 M Pedestrian Prot. Strategy P. 90	30 T	30 S	30 T
31 S		31 T automotive CAE P. 13		31 S	

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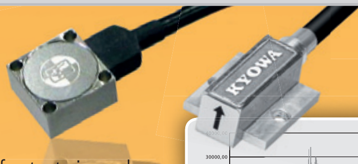

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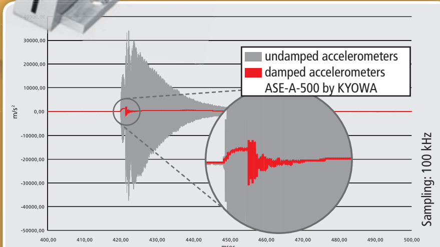

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