SAFETY COMPANION

Knowledge for Tomorrow's Automotive Engineering

2026

Version 0.9

carhs

Empowering Engineers

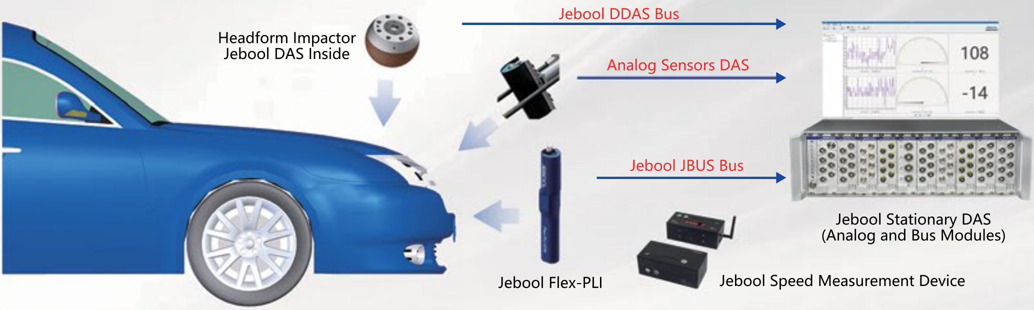
JEBOOL

Hangzhou Jebool Technology Co., Ltd.

info@jebool.com www.jebool.com

The best solution for high voltage safety testing in crash tests

More devices for pedestrian protection impact tests




Current Sensor


Voltage Sensor


Pressure Sensor


Angular Rate Sensor


Seatbelt Loadcell


Seatbelt DS. Sensor


String Pot.


H3 Dummy Chest Pot.


Knee String Pot.


Airbag Squib Timer


CAN Bus Logger


Trigger Box


Airbag Stationary Squib Device


Inflator Test Tank


aPLI/Flex-PLI Stationary and Dynamic Cal. Sys.


Speed Meas. Device


Onboard DAS

Safety**Companion** 2026

Empowering Engineers

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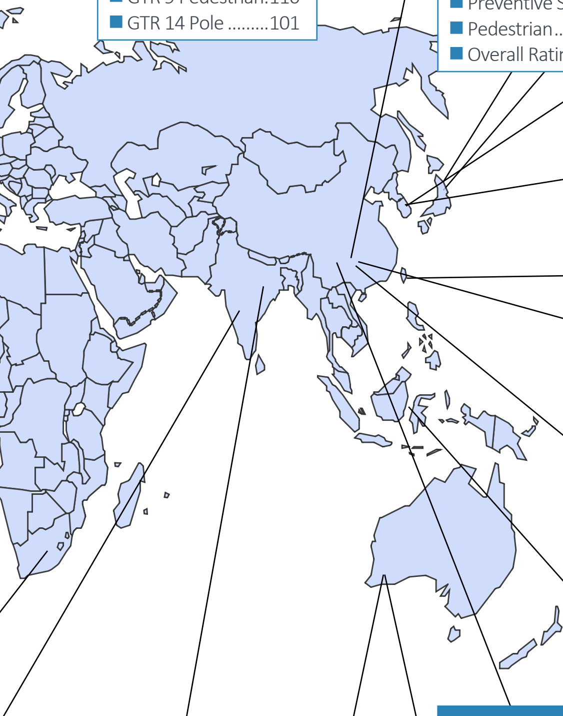
SafetyWissen Navigator



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Legend

- ► (red) Seminar/**Event** that focusses on this topic
- ► (yellow) Seminar/**Event** that deals with this topic (among others)

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

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info@carhs.de

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Dummy & Crash Testing

Active Safety & Automated Driving

Simulation & Engineering

The Human Body sets the Standards

At carhs.training, our mission has always been clear. We exist to advance automotive safety through knowledge, engineering excellence, and global collaboration. The **SafetyCompanion** is a direct extension of this mission — and a clear statement about our vision for the future of vehicle safety.

SAFETY COMPANION 2026

Safety**Wissen** on 129 pages

More than 150 seminars & events

Vehicles, roads and traffic systems are designed for people. Therefore safety standards, must be based on human biomechanics. While traffic environments may differ — from dense Asian megacities to Scandinavian winter roads to rural regions with mixed traffic — a certain degree of local adaptation is both reasonable and necessary. However the limits of the human body do not change with geography. Head, chest, spine or a child's body respond to forces in the same way everywhere in the world.

For this reason, we firmly believe that the fundamental biomechanical levels of protection must be globally aligned. Under no circumstances should safety standards be weakened to accommodate trade interests, competitive pressure or short-term business goals. Economic success must follow safety — not the other way around. This conviction aligns with the ethical foundation of Vision Zero which is based on the principle that no loss of life is acceptable in modern mobility.

Vision Zero was shaped by the visionary work of the Swedish government and Claes Tingvall. Its most significant contribution was shifting the focus from blaming individual road users to taking responsibility at the system level. Roads, vehicles, speeds and regulations must be designed so that human error does not result in fatal or life-altering injuries. At the heart of this philosophy lies a simple engineering truth: the tolerance of the human body to kinetic energy defines the design limits of every safe traffic system.

The **SafetyCompanion** was created to incorporate this concept into the daily work of engineers, safety managers, developers and decision-makers. It provides structured access to global safety requirements, consumer test protocols and regulatory frameworks — and, more importantly, it helps users understand how these systems connect across regions and where true harmonization is both possible and necessary.

We are equally convinced that continuous education is the backbone of sustainable safety progress. Regulations evolve. Injury criteria change. New insights from human body modeling, real-world accident data and simulation constantly reshape best practice. In a global industry, this knowledge must be shared, comparable and understood across borders. The **SafetyCompanion** is designed as a living learning environment to support exactly this need.

With the **SafetyCompanion**, we are not just offering a tool. We are supporting a global safety culture that respects the limits of the human body, believes in Vision Zero, and refuses to compromise safety for convenience or commerce.

For the whole team of carhs.training

Constantin Hoffmann
Managing Director

Ralf Reuter
Editor-in-Chief

Seminars at carhs.training - Your Benefits

Free parking

The carhs TrainingCenter in Alzenau offers plenty of free and secure parking spaces for our course participants. You don't have to plan any time for searching for a parking space and can start your course in a relaxed way.

Free EV charging

You can use our charging station for electric and hybrid vehicles free of charge during your course attendance at the carhs TrainingCenter in Alzenau. Two 11 kW type-2 charging stations are available at your disposal.

Electronic seminar materials

You will receive the seminar documents from us as a PDF file for storage on your computer. You can also bring your computer with you to the course and work directly in the PDF file.

Fair cancellation policy

We know that sometimes something interferes. Therefore you can cancel your seminar registration free of charge until 4 weeks before the course and until 2 weeks before the course only a lump sum of 100 Euro will be charged. You can send a substitute participant at any time. So you can register early for your seminar of choice without any risk and benefit from the → early bird rates.

Early bird rates reduce your costs

Early registrations give us and the course participants planning security. We return the favour with a significantly lower early booking price for both seminars and conferences.

All-round catering during the seminar

You don't have to bring anything: During the seminar you will be provided with snacks, fresh fruit and drinks in the breaks and we invite you to lunch with all course participants and trainers - this is the opportunity to network.

Small group sizes for maximum learning success

Our courses take place in small group sizes to ensure optimal interaction with the trainers and between students.

And WiFi?

Of course, WiFi is also available free of charge at the carhs TrainingCenter in Alzenau. However, we recommend that you not be distracted while attending the seminar. But that is of course your choice.

On Site & Online

Most of our events and seminars are available both for on-site and online attendance. You can choose if you want to talk face to face with other attendees and trainers or if you want to take part from your office or even from your home.

In-house Seminars

Seminars at your site - efficient, flexible and customized

Are you looking for an individual and customized training for your employees?
Most of the seminars from our training program can also be booked as in-house seminars in English, German or with simultaneous translation into your preferred language. Whether on your company site or at another venue of your choice, the scale of our in-house seminars is tailored to your needs.

Your advantages

- You retain full cost control. We offer attractive fixed prices for our in-house seminars, depending on the number of participants and the related service.
- Even for a small number of participants you can save a lot of money compared to the individual booking of seminars. Additionally, there are no costs for travel and time of your employees.
- We respect your target dates as far as possible – also upon short notice in „urgent cases".
- You benefit from our professional organization and the top-quality seminar manuals.
- Our lecturers answer your individual questions.
- Even if you are interested in very specific questions – we are looking for a qualified lecturer and develop the seminar.

Many of our customers have integrated our in-house seminars into their company's training program.

Take advantage of this offer, too! We will be pleased to prepare you an individual offer.

References
ACTS, AIT, ARRK, AUDI, Autoform, ARAI, AZOS, Bentley Motors, Bertrandt, BMW, Bosch, Brose, Calspan, CATARC, Continental, CSI, Daimler, Dalphimetal, Delphi, Dura Automotive, EDAG, Faurecia, Ford, F.S. Fehrer Automotive, FEV, Global NCAP, Grammer, HAITEC, Honda, Hopium, Hyundai, IAC, IAV, IABG, IDIADA, IEE, JCI, IVECO, IVM, Key Safety Systems, Kistler, Kube, LEAR, Lotus, Magna, Mahindra & Mahindra, MAHLE, MESSRING, MGA, NEVS, Next.e.GO Mobile, Nissan, Opel, Open Air Systems, PATAC, Plastic Omnium, Porsche, PSW, SAIC, SMP, SMSC, SEAT, Siemens, StreetScooter, TAKATA, TASS, Tata, TECCON, TECOSIM, TTTech, TÜV Süd, Valeo, VIRTUAL VEHICLE, Vinfast, Visteon, Volkswagen, Webasto, ZF

Attractive prices
With reference to our regular seminar fees we offer attractive discounts on our in-house seminars:

1 Day Seminar	
Discount	for the
30 %	5^{th} - 8^{th} Participant
60 %	9^{th} - 12^{th} Participant
70 %	13^{th} - 16^{th} Participant
75 %	17^{th} - 20^{th} Participant
80 %	from the 21^{st} Participant

2 Day Seminar	
Discount	for the
50 %	5^{th} - 8^{th} Participant
70 %	9^{th} - 12^{th} Participant
75 %	13^{th} - 16^{th} Participant
80 %	17^{th} - 20^{th} Participant
85 %	from the 21^{st} Participant

Your contact at carhs.training

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NEW Customer Specific Online-Seminars
Instead of an in-house-seminar, customers can now book our seminars as a customer specific online-seminar. This gives customers the option to choose the date, duration & pace of the seminar and enables them to let staff from multiple locations take part without extra travel expenses.

AUTOMOTIVE Safety Summit Shanghai 2026

Safety Requirements & Technologies for the Intelligent, Autonomous and Electrified Automobile of the Future

Since 2014, the »Automotive Safety Summit Shanghai« is attracting every year more than 400 automotive safety experts from China and beyond to discuss the latest requirements and innovations in active and passive safety. Accompanied by a comprehensive trade show with the worldwide vendors in development technologies and services, the summit is the leading event for everyone involved in automotive safety. The 2026 event will focus on automotive safety in the context of the dominating mega trends: ADAS, ADS and NEV.

Join »Automotive Safety Summit« in Shanghai, China.

Keynotes from international experts, presentations on requirements and innovations, the latest developments in testing and simulation for active and passive systems will make this event a true highlight for every decision maker and engineer in the fields of active and passive safety.

The event will have dedicated sessions on the following topics:

- Safety in Autonomous Driving Systems
- Legal Requirements for Level 3 and beyond
- Advances in World-wide NCAP Programs
- Safety of New Energy Vehicles
- Vulnerable Road Users
- New Testing Technology for ADAS and ADS
- Safety Assurance for ADS
- Human Modeling and Simulation for Safety

Who should attend?

»Automotive Safety Summit Shanghai« is addressing decision makers and experts at all stages of the development phase, managers during the conceptual phase who need to understand upcoming global requirements, design engineers, testing and simulation specialists.

Facts

15.-16.07.2026

Shanghai, CHINA & ONLINE

www.carhs.de/safetysummit

English / Chinese with simultaneous translation

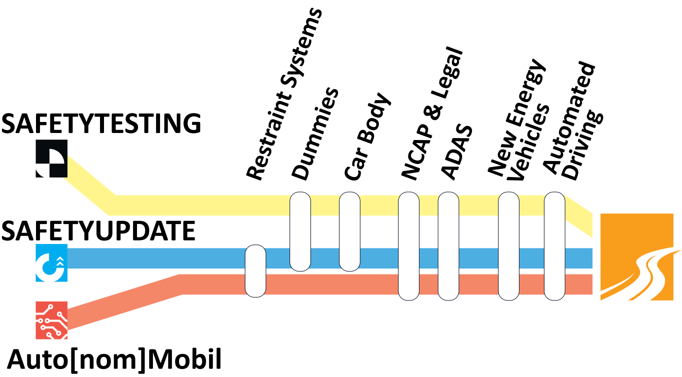
SAFETYWEEK
The Future of Automotive Safety

Supporting automotive development engineers to further improve automotive safety, that is the essence of SafetyWeek.

In a unique combination of knowledge congress, events and exhibition, SafetyWeek offers participants and visitors the opportunity, to bring their expertise up-to-date and to learn about the latest developments and technologies in product development and product verification.

In 2026 SafetyWeek will feature numerous highlights:

- The knowledge congress **SafetyUpDate** with the latest updates on requirements and solutions in active and passive safety. ➲ page 17
- The **SafetyTesting*Challenge*** with the innovations from the Leaders in Testing and Simulation of components and systems in active and passive safety. ➲ page 133
- **Auto[nom]Mobil**, the expert forum on L3 and beyond ➲ page 144
- The accompanying exhibition **SafetyExpo**, the meeting point for suppliers and decision makers in automotive safety.



Who should attend?

SafetyWeek is the meeting point for everyone involved in vehicle safety. This includes developers as well as test and simulation engineers from OEMs and suppliers, manufacturers of test systems, representatives of governments and consumer protection organizations and researchers from universities and research institutes.

Facts

14.-16.04.2026

Frankfurt/Hanau, GERMANY & ONLINE

www.carhs.de/safetyweek

SAFETYUPDATE

The concept is familiar: To keep software up-to-date you regularly make an update. The same is true for automotive safety engineering: To keep yourself up-to-date you have to attend the SafetyUpDate on a regular basis. Here you get a comprehensive overview of all relevant news in automotive safety.

Active + Passive Safety = SafetyUpDate

The SafetyUpDate reflects the close integration of active and passive safety and combines both topics in one event. It covers general topics such as the NCAP consumer tests as well as specific topics such as testing methods in active or passive safety.

Conference Topics include:

- Regulations for active & passive safety and assisted, automated & autonomous driving
- NCAP consumer protection tests
- Development tools: test & simulation
- Development strategies & solutions
- Biomechanics & accident research

From Experts for Experts

The speakers are leading experts from government agencies, consumer protection organizations, industry and universities. We consider it important that the UpDate presentations are product-neutral and practical.

Meeting Point: Expert Dialog

In addition to the presentations the SafetyUpDate encourages the communication among experts. After the presentations the speakers are available for discussions during conference breaks.

Who should attend?

The SafetyUpDate is aimed at automotive developers, who are interested in active or passive vehicle safety and want to bring their knowledge up-to-date. In addition to the knowledge update, SafetyUpDate offers excellent opportunities to build and maintain contacts in the safety community.

Facts

Date	15.-16.04.2026	21.-22.07.2026
Location	Frankfurt/Hanau, GERMANY & ONLINE	Tokyo, JAPAN
Web	www.carhs.de/safetyweek	www.carhs.de/JSU
Language	English	English, Japanese

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, C-NCAP and IIHS, as well as pedestrian protection regulations are drivers behind this trend.

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 of 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
  - Overview of accident research methods
  - Classifications & statistics
- Biomechanics
  - Human anatomy
  - Injury mechanisms & injury criteria
- Dummy technology
  - Dummy terminology
  - Dummy family
- Crash testing
  - Crash test systems and components
  - Test methods
- Crash regulations and NCAP tests
  - Institutions
  - Passive Safety regulations
  - NCAP tests
  - Insurance tests (IIHS, RCAR, C-IASI, ...)
- Protection principles, occupant protection systems
  - Protection principles of Passive Safety
  - Primary restraints - seat belt, airbag
  - Secondary restraints - interior, steering wheel, steering column, seat
  - Car body crashworthiness
  - Pedestrian protection
  - Integrated safety

Instructor

Ralf Reuter (carhs.training gmbh) studied mechanical engineering and business administration at the technical universities of Darmstadt and Eindhoven. Since 1997 he has worked for carhs in various management positions. He deals with vehicle safety issues intensively, in particular with the latest developments in rules and regulations as well as consumer testing. As he is in charge of the SafetyWissen which has been published by carhs for many years, he keeps his knowledge up-to-date and profits from the inputs of carhs' trainer and expert network.

Facts

31.03.-01.04.2026	17/4719	Alzenau	2 Days	1.450,- EUR till 03.03.2026, thereafter 1.750,- EUR
22.-25.06.2026	17/4720	Online	4 x 4 Hrs.	1.450,- EUR till 25.05.2026, thereafter 1.750,- EUR
22.-23.09.2026	17/4721	Alzenau	2 Days	1.450,- EUR till 25.08.2026, thereafter 1.750,- EUR
23.-26.11.2026	17/4722	Online	4 x 4 Hrs.	1.450,- EUR till 26.10.2026, thereafter 1.750,- EUR

KYOWA

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Email: global-marketing@d1.kyowa-ei.co.jp

International Safety and Crash-Test Regulations Current Status and Future Developments

Course Description

Since the 1960's, the regulation of vehicle safety performance has had a major impact on vehicle and system design. As automotive manufacturing has evolved into an integrated global system, understanding and anticipating legal requirements has become an immense challenge. Regulators collaborate and diverge in how they address road-safety policy goals. Regulatory changes in a single market can translate into global customer requirements. And these requirements are continuously evolving. In a compact program, this two-day seminar provides a worldwide update on the passive safety landscape, covering local, national, regional, and international policy and rulemaking developments.

The first segment of the seminar focuses on regulatory institutions and processes. By understanding the regulatory environment, including the trend towards an integrated global regulatory system, businesses can better prepare for changes that impact competitiveness and customer satisfaction.

The second segment applies this knowledge to current and future regulatory requirements. The seminar covers crashworthiness (frontal, side, rear impact, etc.) as well as pedestrian protection and new technologies.

Course Objectives

This course informs participants of recent developments and discussions within the global regulatory community concerning passive safety. The seminar explores differences in regulatory systems and philosophies, in compliance and enforcement, and in the forces behind the regulation of vehicle safety. The course provides participants with a broad understanding of current regulatory directions and guidance on how to follow, and even influence, future requirements.

Who should attend?

This seminar should be of interest to anyone involved with meeting and anticipating legal requirements for vehicle safety performance across international markets. The course provides a compact review of changes in passive safety requirements and current priorities across the international regulatory community. Moreover, the course provides knowledge critical to understanding differences in the way regulators establish and enforce these legal requirements.

Course Contents

- History of safety regulation and development of legal regimes (e.g., self-certification, type approval, product liability, in-use surveillance)
- Regulatory agencies and rulemaking processes (e.g., UN, EU, U.S. NHTSA, etc.)
- Regulatory drivers and priorities (e.g., accident data, injury dynamics, injury assessment criteria, test tools, harmonization, whole vehicle approval, competitiveness, etc.)
- Types and purposes of regulations (UN Regulations, GTR, FMVSS, EU Regulations and Directives, etc.)
- Developments in crashworthiness and occupant protection requirements (frontal impact, side impact, pole-side impact, full-width barrier, ODB, MPDB, etc.)
- Vulnerable road user (VRU) protection (e.g., pedestrian safety, cyclist safety)
- Safety of new propulsion technologies (electric vehicles, hydrogen fuel-cells, minimum vehicle noise levels)
- Passive safety implications of new safety technologies (e.g., emergency call systems, collision avoidance, VRU detection, automated driving)

Instructors

John Creamer (GlobalAutoRegs.com) 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).

Dr. Thomas Kinsky (Humanetics Europe GmbH) completed his studies of automotive engineering at TU Dresden in 1991 and received a doctorate at TU Graz in 2015. From 1999 to 2018 Dr. Kinsky worked for the car manufacturer Opel in the area of vehicle regulations. Lastly as a senior expert, he was responsible for the development of legislation on passive vehicle safety and represented Opel in the discussion with authorities and associations. Since 2018 he is Director of Business Development at Humanetics Europe GmbH. In this role he is at Humanetics the contact for all topics regarding dummy development as well as for requirements on passive and active safety at Humanetics.

Facts

04.-05.03.2026	16/4647	Alzenau	2 Days	1.450,- EUR till 04.02.2026, thereafter 1.750,- EUR
26.-29.05.2026	16/4667	Online	4 x 3 Hrs.	1.450,- EUR till 28.04.2026, thereafter 1.750,- EUR
24.-25.11.2026	16/4648	Alzenau	2 Days	1.450,- EUR till 27.10.2026, thereafter 1.750,- EUR

Crash-Regulations: Europe, United Nations, USA, China and India

Instrument Panel
UN R21, 32, 33
US FMVSS 201
IN IS 15223

Side Windows
UN R43, GTR 6
US FMVSS 205, 226

Interior
UN R12, 21, 43, GTR 6
US FMVSS 201, 203, 204, 205
CN GB 11552-2009
IN IS 15223, AIS 096

Roof
US FMVSS 216, 216a
CN GB 26134-2024

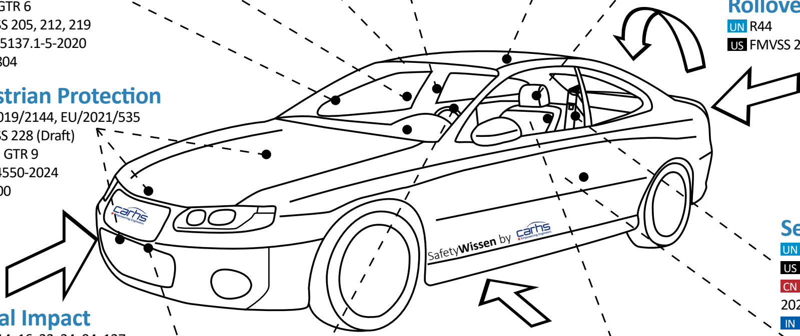
Headrests
UN R17, 25, GTR 7
US FMVSS 202a
CN GB 15083-2019
IN IS 15546

Windscreeen
UN R43, GTR 6
US FMVSS 205, 212, 219
CN GB/T 5137.1-5-2020
IN IS 15804

Rollover
UN R44
US FMVSS 201, 216, 216a, 301

Pedestrian Protection
EU EU/2019/2144, EU/2021/535
US FMVSS 228 (Draft)
UN R127, GTR 9
CN GB 24550-2024
IN AIS 100

Rear Impact
UN R17, 25, 32, 34, 42, 58, 153
US FMVSS 202a, 207, 301, 581
CN GB 18296-2019, 20072-2024
IN AIS 101



Seat Belts
UN R14, 16, 17
US FMVSS 208, 209, 210
CN GB 14166-2024, GB 14167-2024, 15083-2019
IN IS 15139, 15140

Frontal Impact
UN R12, 14, 16, 33, 34, 94, 137
US FMVSS 203, 204, 208, 209, 210, 301
CN GB 11551-2014 , 11557-2011 , 14166-2024, 14167-2024 GB/T 20913-2007, 37437-2019
IN IS 15139, 15140, AIS 096, 098, 201

Bumper
UN R42
US FMVSS 581
CN GB 17354-2024
IN IS 15901

Steering Wheel
UN R12
US FMVSS 203, 204
CN GB 11557-2011
IN IS 11939, AIS 096

Side Impact
UN R95, 135, GTR 14
US FMVSS 214
CN GB 20071-2025, GB/T 37337-2019
IN AIS 099

Seats
UN R16, 17, 21, 44, 129, 145
US FMVSS 201, 202a, 207, 213, 213a, 213b, 225
CN GB 13057-2023, 14166-2024, 15083-2019, 27887-2024
IN IS 15546, 15139, 15532, AIS 072, 182

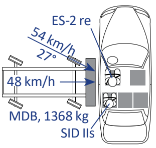
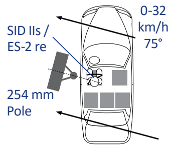
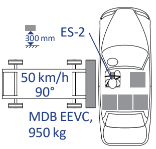
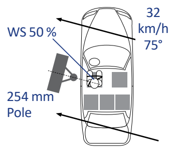
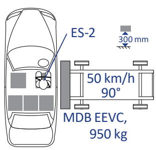
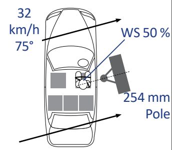
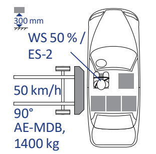
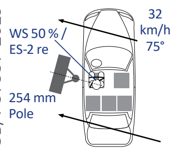
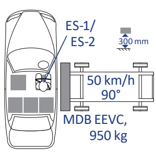
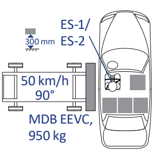
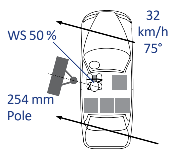
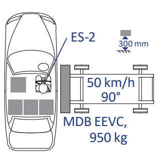
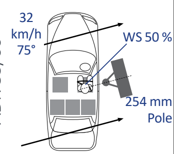
Doors
UN R11, GTR 1
US FMVSS 206
CN GB 15743-1995, 15086-2013
IN IS 14225

Rules and Regulations on Occupant Protection

		Full-width Frontal		Offset Frontal
USA	FMVSS 208	0° 56 km/h, H III 50 % / H III 50 % 0° / ± 5° 56 km/h, H III 5 % / H III 5 % 0° / ± 5° 32-40 km/h, H III 5 % / H III 5 % 0° / ± 30° 32-40 km/h, H III 50 % / H III 50 %	FMVSS 208	ODB 40 %, 200 mm, 0° 40 km/h, H III 5 % / H III 5 %
Europe	UN R137	0° 50 km/h, H III 50 % / H III 5 %	UN R94	ODB 40 %, 200 mm, 0° 56 km/h, H III 50 % / H III 50 %
Japan	Art. 18	0° 50 km/h, H III 5 % / H III 50 %	Art 18	ODB 40 %, 200 mm, 0° 56 km/h, H III 50 % / H III 50 %
China	GB 11551-2014	0° 50 km/h, H III 50 % / H III 50 %	GB/T 20913-2007	ODB 40 %, 200 mm, 0° 56 km/h, H III 50 % / H III 50 %
India	AIS-201	0° 50 km/h, H III 5 % / H III 50 %	AIS-098	ODB 40 %, 200 mm, 0° 56 km/h, H III 50 % / H III 50 %
S. Korea	KMVSS 102-3	0° 50km/h, H III 50 % / H III 5 %	KMVSS 102	ODB 40 %, 200 mm, 0° 56 km/h, H III 50 % / H III 50 %
Australia	ADR 69/00	0° 48 km/h, H III 50 % / H III 50 %	ADR 73/00	ODB 40 %, 200 mm, 0° 56 km/h, H III 50 % / H III 50 %

SafetyWissen by carhs

Ground clearance of the lower edge of the deformable barrier

Side Barrier	Side Pole	Pedestrian	Rear	Head Impact	Rollover
FMVSS 214 	FMVSS 214 	FMVSS 228 (Draft)	FMVSS 202a FMVSS 301	FMVSS 201	Roof Crush: FMVSS 216a Ejection Mitigation: FMVSS 226
UN R95 	UN R135 	UN R127 R (EU) 2019/2144[1] R (EU) 2021/535	UN R34 UN R153	UN R21	
Art. 18 	Art. 18 	Article 18	Article 22-4	Article 20	
GB 20071-2025 	GB/T 37337-2019 	GB/T 24550-2024	GB 20072-2024	GB 11552-2009	Roof Crush: GB 26134-2024
AIS-099 		AIS-100	AIS-101	IS 15223	
KMVSS 102 	KMVSS 102-4 	KMVSS 102-2	KMVSS 91 KMVSS 91-2 KMVSS 91-3	KMVSS 88	
ADR 72/00 72/01[1] 	ADR 85/00 			ADR 21/00	SafetyWissen by carhs

1 Mandatory for new types from November 1, 2025, for new registrations from November 1, 2028.

Basics of Homologation

Course Description

The seminar provides a basic understanding of homologation from the perspective of a developer who is not forced into the role of a technical service assessor or a standardized OEM process model. The first hurdles, which may exist due to unfamiliar terms and a shyness towards the "legal", are overcome together and in a way that is easy to understand. The jungle of regulations is examined with a focus on the main markets of the EU, China and the USA. We discuss the various rule sets depending on the number of units, vehicle class and other parameters for the classification of the legal scenario. We then analyze the structure of a UN regulation from a developer's perspective and filter out what is only relevant for homologation experts. Participants are welcome to express their wishes and questions for a sample regulation they have selected. With these tools, the schematic process with its dependencies between the authority, technical service, approval holder and developer (not necessarily congruent) and their suppliers - differentiated according to overall vehicle, system and component level. The most important similarities and differences between the markets in terms of a market access strategy are briefly outlined as an advanced topic.

Course Objectives

Participants understand vehicle certification/self-certification as a prerequisite for market access. They implement legal conformity in offers, specifications at vehicle, system and component level and, last but not least, in the product. They are sensitized to the distribution of roles between the approval holder, technical service, authority, development service provider if applicable and external manufacturer if applicable (timing, process, responsibility model) and concentrate on the key points of legal guidelines relevant to development, find them quickly and know sources of reference.

Who should attend?

The course is aimed at developers, project coordinators and managers, sales, vehicle manufacturers, suppliers and new OEMs.

Course Contents

- Certification / self-certification
- Main markets with an outline of a multiple access strategy
- Regulations with clarification of the EU/UN regulation mix and scope of validity of approvals
- Legislation monitoring and obligations to adapt to current legislation, including deadlines (in force, applicable, mandatory)
- Approval pyramid for component systems - complete vehicle
- EU large series, small series and individual approval
- Process flow and distribution of roles

Instructor

Christian Radt (EDAG Engineering GmbH) began his career in the automotive industry at Opel Automobile GmbH after graduating with a degree in mechanical engineering from RWTH Aachen University and starting his career in the paper industry. He worked there for 18 years at the international development center in Rüsselsheim. With different focuses ranging from drive technology and supplier qualification for selected validation tests to GM's specification system, Mr. Radt built up a broad knowledge of complete vehicle technology. Since 2019, he has been utilizing his self-motivation and willingness to learn at EDAG Engineering GmbH in Fulda in the field of homologation.

Facts

06.03.2026	206/4727	Online	1 x 3 Hrs.	415,- EUR till 06.02.2026, thereafter 495,- EUR
12.06.2026	206/4728	Online	1 x 3 Hrs.	415,- EUR till 15.05.2026, thereafter 495,- EUR
18.09.2026	206/4729	Online	1 x 3 Hrs.	415,- EUR till 21.08.2026, thereafter 495,- EUR
27.11.2026	206/4730	Online	1 x 3 Hrs.	415,- EUR till 30.10.2026, thereafter 495,- EUR

Latest info about this course

Vehicle Safety under Self-Certification Principles, Obligations, Enforcement and Remedies

Course Description

When looking at regulatory requirements across different markets, it's common to think in terms of technical specifications, checking for differences in test procedures and performance criteria. However, failure to consider how the regulations are used can be a fatal mistake because safety authorities differ in how they apply and enforce their requirements.

This seminar looks at the self-certification compliance and enforcement system which focuses heavily on monitoring the performance of vehicles in use. Compliance with the legal standards is only one part of a much larger, more complex system requiring the assurance of safety throughout the lifetime of every vehicle on the road. Manufacturers must have systems in place to detect possible safety concerns regardless of whether they relate to compliance with specific standards and must communicate continuously with safety authorities or run the risk of damaging recalls that can place the company in peril.

Course Objectives

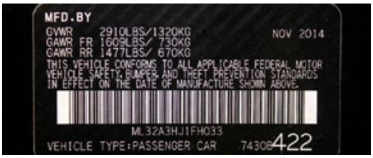
This seminar provides a review of self-certification compliance and enforcement mechanisms toward helping manufacturers avoid expensive recalls, costly penalties, and lost reputation.

Who should attend?

The seminar is aimed at employees from the development departments of automobile manufacturers and suppliers who develop vehicles for the U.S. market as well as all employees in the areas of product strategy, sales and warranty and defect management for the U.S. market.

Course Contents

- Background and origins of self-certification
- Players and processes in U.S. rulemaking
- Principles of U.S. safety compliance and enforcement
- Role of product liability laws
- Role of Federal Motor Vehicle Safety Standards (FMVSS)
- NHTSA and FMVSS compliance
- NHTSA and safety monitoring
- Non-regulatory methods to ensure safety
- Safety defects and motor vehicle recalls
- Manufacturer roles and responsibilities
- Outlook for U.S. safety policies



Images: NHTSA

Instructor

John Creamer (GlobalAutoRegs.com) 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).

Facts

23.-26.03.2026	183/4668	Online	4 x 3 Hrs.	1.450,- EUR till 23.02.2026, thereafter 1.750,- EUR	
27.-28.10.2026	183/4669	Alzenau	2 Days	1.450,- EUR till 29.09.2026, thereafter 1.750,- EUR	

Virtual Testing for Vehicle Safety Assessment in Consumer Protection Tests and Regulations

Course Description

Vehicle type approval based on virtual test procedures has been possible for some time for a limited number of specific regulations in the area of automotive safety. However, there have been very few actual applications so far. Currently the continually increasing demands of organizations in the area of consumer protection are leading to a noticeable acceleration in the development and acceptance of procedures for Virtual Testing as an alternative or supplement to physical testing. There are also corresponding efforts by legislators to directly implement virtual test procedures in new regulations for assessment of vehicle safety.

This course offers an introduction to Virtual Testing-based vehicle safety assessment for both consumer testing and regulatory requirements. The fundamental processes are discussed that ensure traceable data flow while safeguarding confidential data protection requirements that lead to acceptance of simulation results for certification, homologation or NCAP assessment. The current status of various Virtual Testing initiatives, their timelines and remaining obstacles will be explained. The validation of models and simulation tools for virtual assessments will be shown. For test procedures that can already be applied physically, approved corresponding virtual test methods are already available. However, for virtual assessments methods based on HBMs (human body models) other approaches must be developed. These will also be discussed in detail.

Course Objectives

Course participants will understand the current status of Virtual Testing for safety assessments in the automotive industry. They will be able to understand the relevant processes and learn the wording and terms to discuss with legislators and NCAP organizations. Additionally, they will understand what new requirements to expect in the future in the area of Virtual Testing based assessment for both NCAP and regulatory requirements.

Who should attend?

The course is intended for CAE managers and engineers, project and product managers at OEMs, suppliers and engineering service providers, as well as for individuals responsible for achieving vehicle safety requirements and relationships with authorities and testing organizations.

Course Contents

- Introduction to vehicle safety assessment based on Virtual Testing
  - Background, motivation, definitions of VT based testing procedures
  - Global overview, VT adoption timelines
  - Overview of EU research projects (e.g. IMVITER, OSCCAR, VIRTUAL)
  - Methods of model traceability
- Virtual Testing in consumer protection tests
  - Euro NCAP Virtual Testing: Developments and schedules (pedestrian protection CoHerent, occupant protection: Far-Side, Frontal impact, VT for evaluating active safety (crash avoidance)
  - C-NCAP and C-IASI Virtual Testing: current plans and status
  - IIHS plans to improve whiplash assessment through virtual testing
- Virtual Testing in legal requirements
  - Overview of Virtual Testing in legal regulations of vehicle safety
  - Example: UNECE Informal Working Group Deployable Pedestrian Protection Systems (DPPS)
  - Future plans and challenges of Virtual Testing in UNECE Informal Working Group Equitable Occupant Protection (EqOP)
- Human Models in Virtual Testing
  - Challenges and requirements to use Human Body Models (HBMs) for VT based assessment

Instructor

Dr.-Ing. Andre Eggers (BASt - German Federal Highway Research Institute) is a researcher at BASt (German Federal Highway Research Institute) since 2006 working in the area of biomechanics, evaluation of dummies, human models and virtual testing. He studied mechanical engineering at the Technical University of Hamburg and Biomedical Engineering at Wayne State University. 2013 he completed his doctorate at the Technical University of Berlin. He contributed to several European research projects like IMVITER, THORAX, ASSESS, SENIORS and OSCCAR. He is representing BASt in Euro NCAP working groups related to injury criteria and virtual testing.

Facts

05.-10.03.2026	204/4628	Online	6 x 4 Hrs.	1.450,- EUR till 05.02.2026, thereafter 1.750,- EUR
09.-10.06.2026	204/4652	Alzenau	2 Days	1.450,- EUR till 12.05.2026, thereafter 1.750,- EUR
10.-11.11.2026	204/4651	Alzenau	2 Days	1.450,- EUR till 13.10.2026, thereafter 1.750,- EUR

VIRTUAL TESTING

#5: AI-DRIVEN VIRTUAL TESTING

Join the fifth edition of Virtual Testing, an exclusive online seminar dedicated to the future of digital validation, simulation, and virtual product development. This edition "AI-Driven Virtual Testing" focusses on the Virtual Testing Challenges and how AI Application can facilitate the development process. Participants will gain insights into AI-Driven simulation environments, machine learning-powered data management strategies, and collaborative workflows that accelerate product validation while reducing costs and time-to-market.
Through online live presentations, interactive discussions, and expert Q&A sessions, this free event provides valuable knowledge for engineers, developers, and decision-makers across the automotive and technology sectors.

Keynote Presentations

AI-Driven Virtual Design and Testing Approach

Christian Kurzböck - VIRTUAL VEHICLE Research GmbH

- Motivation & Context
- Concept of an AI-Driven Virtual Design & Testing Workflow
- AI in Virtual Testing of Vehicle Structures
- Implementation Aspects
- Case Study
- Challenges, Limitations & Outlook

Fastlane to Innovation: AI-Powered Validation from Training to Digital Twin

Jan Christer Neimöck - T-Systems International GmbH

Event Sponsor

T Systems

Past Virtual Testing Seminars replay available on demand:

VIRTUAL TESTING #1: HUMAN MODELING IN PEDESTRIAN PROTECTION

VIRTUAL TESTING #2: SCENARIO BASED ADAS VALIDATION

VIRTUAL TESTING #3: SIMULATION OF MECHANICAL BATTERY OVERLOADING

VIRTUAL TESTING #4: APPLICATIONS, METHODS AND PROCESSES

Facts

05.02.2026, 14:00 (UTC+1)

ONLINE

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Crash Safety of Hybrid and Electric Vehicles

Course Description

During recent years, electric vehicles have achieved an ever-increasing importance for the automotive market. In addition, established OEM suffer increasing pressure by new competitors with innovative vehicle concepts. A compliance of restrictions for CO2 emissions in EU since 2020 is not possible without electrified powertrains. All major OEM offer an increasing variety of hybrid vehicles (HEV), plug-in hybrid vehicles (PHEV) and pure electric vehicles (BEV). In addition, a first offer of fuel cell electric vehicles (FCEV) is in the market. Market acceptance and consumer demands often increase delivery capacity for some models. In 2021 more than 6 million electrified vehicles (BEV and PHEV) were sold worldwide. The breakthrough of the automotive electrification is evident. For the development of future vehicle generations, the integration of electrified powertrains has not to be considered, it's the baseline.

Nevertheless, several challenges for vehicle safety arise with new these technologies. 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 will be described. In addition to common rules and standards, specific needs based on real-life accidents will be 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 of electric vehicles 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 with electric vehicles. 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

- Alternative drive systems: hybrid, electric, fuel cell, gas vehicles
- Challenges for vehicle safety
- Legal requirements and standards, 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

Instructor

Rainer Justen has more than 30 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 the automotive development at Daimler AG in 1987. Several career milestones in the fields of vehicle 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. In 2015 Rainer Justen received the SAE Automotive Safety Award for his work on the Safety of Li-ion Batteries in Electric Vehicles from the American Society of Automotive Engineers (SAE).

Facts

24.-25.03.2026	173/4690	Alzenau	2 Days	1.450,- EUR till 24.02.2026, thereafter 1.750,- EUR	
29.06.-02.07.2026	173/4691	Online	4 x 3 Hrs.	1.450,- EUR till 01.06.2026, thereafter 1.750,- EUR	
08.-09.12.2026	173/4692	Alzenau	2 Days	1.450,- EUR till 10.11.2026, thereafter 1.750,- EUR	

FMVSS 305a: Safety Requirements for Electric Vehicles

Scope:

Passenger cars, multipurpose passenger vehicles, trucks, and buses 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.

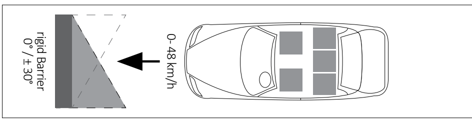
Post-crash Requirements for vehicles with a GVWR ≤ 4536 kg:

Under the test conditions described below (impact test and subsequent static rollover)

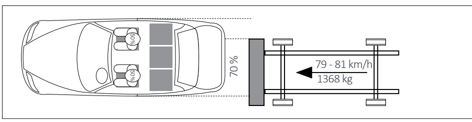
- no evidence of fire or explosion in any part of the vehicle during 1 hour after the impact,
- each HV source in the vehicle must meet one of the 4 following **electrical safety requirements**:
  - (1) **electrical isolation** must be greater than or equal to:
    - 500 ohms/V for an AC HV source,
    - 100 ohms/V for an AC HV source if it is conductively connected to a DC HV source, but only if the AC HV source meets the physical barrier protection requirements specified in the first 3 sub-items of (3)
    - 100 ohms/V for a DC HV source,
  - (2) the **voltage level** of the HV source (Vb, V1, V2) must be ≤ 30 VAC for AC components or ≤ 60 VDC for DC components.
  - (3) **physical barrier protection** against electric shock shall be demonstrated by meeting the following conditions:
    - the HV source meets protection degree IPXXB
    - resistance between exposed conductive parts of the electrical protection barrier (EPB) of the HV source and the electrical chassis is < 0.1 ohms
    - resistance between an exposed conductive part of the EPB of the HV source and any other simultaneously reachable exposed conductive parts of EPBs within 2.5 meters of it must be < 0.2 ohms
    - voltage between exposed conductive parts of the EPB of the HV source and the electrical chassis is ≤ 30 VAC or 60 VDC
    - voltage between an exposed conductive part of the EPB of the HV source and any other simultaneously reachable exposed conductive parts of EPBs within 2.5 meters of it must be ≤ 30 VAC or 60 VDC
  - (4) the **total energy** of unidirectional single impulse currents from capacitors must be < 0.2 J
- all components of the electric energy storage / conversion system must be anchored to the vehicle,
- no componentsof the electric energy storage / conversion system that is located outside the passenger compartment shall enter the passenger compartment,
- max. 5 litres of electrolyte may spill from the batteries,
- there shall be no evidence of electrolyte leakage into the passenger compartments,Test Conditions:

FMVSS 305a

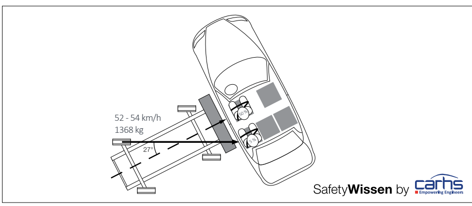
Frontal impact against a rigid barrier at 48 km/h



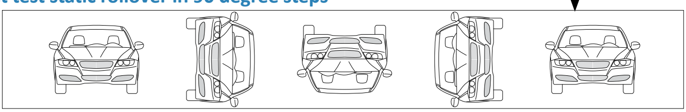
Rear moving barrier impact at 80 km/h (FMVSS 301)



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

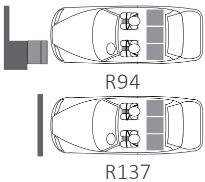


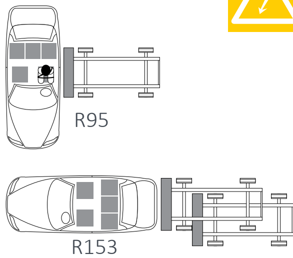
Post-impact test static rollover in 90 degree steps



UNECE: Safety Requirements for Electric Vehicles

EV-specific Provisions of UN R94 / R95 / R137 / R153:





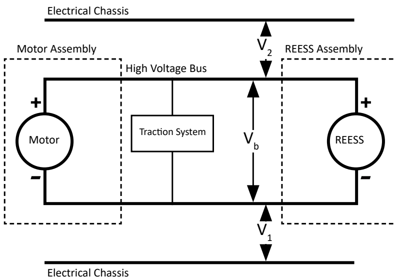
UN R94, 05 Series | **UN R137, 04 Series** | **UN R95, 06 Series** | **UN R153, 01 Series**

After crash tests according to UN R94, R95, R137 and R153 vehicles with a high voltage electrical powertrain (> 60 V DC or > 30 V AC) must meet the following requirements:

1. Protection against Electrical Shock

at least one of the four criteria specified below shall be met:

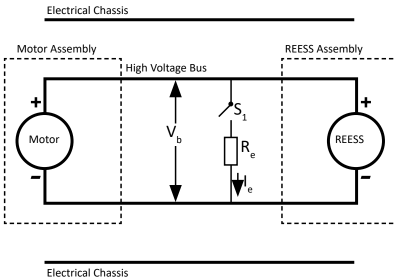
- Absence of high voltage:
  The voltages V_b, V_1 and V_2 shall be
  ≤ 30 V AC or ≤ 60 V DC :



- Low electrical energy:
  The total energy (TE) on the high voltage buses shall be < 0.2 J.
  Prior to the impact a switch S_1 and a known discharge resistor R_e is connected in parallel to the relevant capacitance.
  Not earlier than 5 s and not later than 60 s after impact S_1 shall be closed while the voltage V_b and the current I_e are recorded.
  From this TE is calculated as follows:

$$TE = \int_{tc}^{th} V_b \times I_e dt$$

with tc = time of closing S_1
th = time when voltage drops below 60 V DC



- Physical protection:
  For protection against direct contact with high voltage live parts, the protection IPXXB shall be provided.
- Isolation resistance:
  - If the AC HV buses and the DC high voltage buses are galvanically isolated from each other, isolation resistance between the HV bus and the electrical chassis shall be ≥ 100 Ω/V of the working voltage for DC buses, and ≥ 500 Ω/V of the working voltage for AC buses.
  - If the AC HV buses and the DC HV buses are galvanically connected isolation resistance between the HV bus and the electrical chassis shall be ≥ 500 Ω/V of the working voltage. (If the protection IPXXB is satisfied for all AC HV buses or the AC voltage is ≤ 30 V after the vehicle impact, the isolation resistance shall be R_i ≥ 100 Ohm/V)

2. Electrolyte Spillage

In the period from the impact until 30 minutes after no electrolyte from the REESS (Rechargeable Electrical Energy Storage System) shall spill into the passenger compartment and no more than 7 % (max. 5 l) of electrolyte shall spill from the REESS.

3. REESS Retention

REESS located inside the passenger compartment shall remain in the location in which they are installed and REESS components shall remain inside REESS boundaries. No part of any REESS that is located outside the passenger compartment for electric safety assessment shall enter the passenger compartment during or after the impact test.

UN R100:

M and N class vehicles with a maximum speed > 25 km/h must also comply with UN R100.

UN R100, 04 Series

the SafeBattery experience

The forum to discuss and experience the latest technologies and findings for automotive battery safety and its testing and simulation.

It focusses on the objective evaluation and validation of battery safety, testing and simulation procedures and the enabling technologies. Automotive safety has been traditionally an area for very stringent legislation and consumer testing. Battery safety is no exception. The SafeBattery Experience will address current and future legal requirements, NCAP assessments and development standards. Furthermore, the SafeBattery Experience is showcasing the latest testing technologies at real laboratories.

Keeping up with the pace of battery development

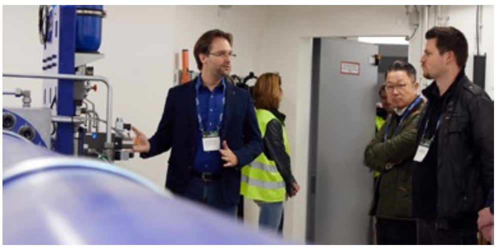
Batteries are the most influencing factor for performance, safety and reliability of electric vehicles. The development of batteries is rapidly progressing. New technologies for battery materials, packaging, integration, swapping, battery management, mass production etc. are being developed, tested and brought to market on a continuous basis. Maintaining the safety of batteries during operation but also during and after a damage or misuse is critical and requires thorough verification and validation by testing and simulation.

Topics

- Battery Basics (chemistry, types etc.)
- Rescue & Extrication
- Requirements (legal, NCAP)
- Electrical Safety
- Simulation (multi-physics, micro-macro)
- Testing (cell, module, battery, vehicle)
- Abuse Testing
- Structural Integration
- Standards (ISO, DIN etc.)
- and many more

Highlights

- **The SafeBattery Experience** is the forum to discuss and experience the latest technologies and findings for automotive battery safety and its testing and simulation.
- **The SafeBattery Experience** is showcasing the latest testing technologies at real laboratories.
- **The SafeBattery Experience** is supported by an international Editorial Advisory Board.



Facts

23.-24.09.2026

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English

C-EVFI China Electric Vehicle Fire Safety Index 2026

Overall Scoring System

Item	Score	Weight	Score Calculation
Thermal propagation protection performance	s_1	55 %	$\sum_{1}^{5}(s_i \times w_i)$
Underbody protection performance	s_2	25 %	
Charging safety performance	s_3	10 %	
Material flame retardancy	s_4	8 %	
Vehicle sealing performance	s_5	2 %	

Thermal Propagation Protection Performance

	Item	Assessment	Score	Σ	Weight
Safety Warning	Battery pack high temperature warning	Visual warning	10	20	20 %
		Auditory warning duration > 10 s	10		
	TR alarm inside the vehicle	Optical warning	15	40	
		Auditory warning duration > 20 s	15		
		Signal alarm	10		
	TR alarm time t_1	$t_1 \leq 60$ s	30	30	
		60 s < $t_1 \leq$ 300 s	15		
		$t_1 > 300$ s	0		
	TR alarm outside the vehicle	Warning is given	10	10	
Emergency Rescue	Safe evacuation	Doors can be opened normally from inside after TR	30	100	30 %
		Doors can be opened normally from outside after TR	30		
		Driver's door equipped with emergency switch	10		
		Emergency switch is clearly marked or has distinct color	10		
		Emergency switch is not obstructed by interior components	10		
		All emergency switches are located in front of seat's R-point	10		
Fire Protection	Safety egress time t_2	$t_2 > 30$ min	25	25	40 %
		20 min < $t_2 \leq$ 30 min	20		
		10 min <≤ $t_2 \leq$ 20 min	10		
		5 min < $t_2 \leq$ 10 min	5		
		$t_2 \leq 5$ min	0		
	Thermal propagation protection	no thermal propagation	20	20	
		thermal propagation to 1 cell	15		
		thermal propagation to 2 cells	10		
		thermal propagation to > 2 cells	0		
	Fire safety	No explosion in battery pack	15	50	
		No flames outside the vehicle	10		
		No flames inside the vehicle	10		
		Interior monitoring point temperature rise ≤ 10 K	15		
		10 K < Interior monitoring point temperature rise ≤ 35 K	5		
		Interior monitoring point temperature rise > 35 K	0		
	Explosion debris splash distance L_{sd}(m)	$L_{sd} \leq 1$	2	2	
		$1 < L_{sd} \leq 4$	1		
		$L_{sd} > 4$	0		
	Radiant heat flux density H (kW/m^2)	$H \leq 10$	3	3	
		$10 < H \leq 15$	2		
		$15 < H \leq 50$	1		
		$H > 50$	0		

C-EVFI China Electric Vehicle Fire Safety Index 2026

Flue Gas Control	Carbon monoxide concentration within 5 min. of TR occurrence C_{CO}(ppm)	$C_{CO} \leq 100$	40	40	5 %
		$100 < C_{CO} \leq 600$	25		
		$C_{CO} > 600$	0		
	Oxygen concentration within 5 min. of TR occurrence C_{O2}(%)	$C_{O2} > 19.5$ %	30	30	
		$C_{O2} \leq 19.5$ %	0		
	Smoke concentration within 5 min. of TR occurrence	No visible smoke inside the vehicle	30	30	
Data Linkage	Emergency response time t_3	$t_3 \leq 3$ min	100	100	5 %
		3 min $< t_3 \leq 5$ min	50		
		$t_3 > 5$ min	0		

Underbody Protection Performance

	Item	Assessment		Score	Σ	Weight
Electrical Safety	Protection against electrical shock	During and after underbody scraping test, at least one of the four criteria shall be met: Absence of high voltage, Low electrical energy, Physical protection, Isolation resistance.		70	100	30 %
	Fault warning	No smoke, fire, or explosion occurred after underbody scraping test; or smoke, fire, or explosion occurred after test, and the vehicle displayed a battery fault warning (regardless of the warning method).		30		
Structural Strength	Protection strength of connection position	The mounting points of the power battery show no signs of failure or fracture.		25	50	70 %
		The high-voltage wiring harness shows no physical damage or disconnection (such as connector terminals pulling out or loosening, failure of wire harness clips, cable ties, brackets, or other mounting points), and no mechanical locking mechanism failure (such as connector loosening or separation).		25		
	Protection strength of underbody	No liquid leakage		20	50	
		No abnormalities in cell voltage or temperature.		20		
		Evaluation of the maximum deformation depth at the bottom of the battery pack.: Set the gap between the lower surface of the battery pack casing and the lower surface of the cells/modules as *a* Set the maximum deformation depth at the bottom as *b*	b ≥ a	0		
			0.2*a < b < a	[(a-b)/a] *10		
			b ≤ 0.2*a	10		

C-EVFI China Electric Vehicle Fire Safety Index 2026

Charging Safety Performance

	Item	Assessment	Score	Σ	Weight
Virtual Simulation Charging Safety	Current fault	The vehicle has stopped charging and the charging function is intact.	20	100	55 %
	Communication fault	Before charging, S+ was short-circuited to PE, causing the vehicle to be unable to charge. After testing, no faults were generated and the charging function was intact	5		
		During charging, S+ short-circuited to PE, causing the vehicle to stop charging. After testing, no faults were found and the charging function remained intact.	5		
		Before charging, S+/S- were disconnected separately, rendering the vehicle unable to charge. No faults were detected after testing, and the charging function remained intact	5		
		During charging, S+/S- were disconnected separately, causing the vehicle to stop charging. No faults were detected after testing, and the charging function remained intact	5		
	Overcharge fault	The vehicle stops charging after reaching the full-charge condition during DC charging. No faults were detected after testing, and the charging function remained intact	20		
		The vehicle stops charging after reaching the full-charge condition during AC charging. No faults were detected after testing, and the charging function remained intact	20		
	Thermal fault	The vehicle stops charging or reduces the charging power. No faults were detected after testing, and the charging function remained intact	20		
Charging Compatib.	Internal vehicle operations during charging	The vehicle is charged normally & the charging current and voltage are stable.	50	100	10 %
	Emergency stop of charging station	The vehicle is able to stop charging. No faults were detected after testing, and the charging function remained intact	50		
Charging Safety under Extreme Conditions	High temperature charging safety	Vehicle charging normally and charging compatibility passed during charging process.	25	100	25 %
	Low temperature charging safety	Vehicle charging normally and charging compatibility passed during charging process.	25		
	Safety of charging in the rain	The DC rain charging process is normal. After the test, the insulation resistance of the vehicle charging interface is greater than 500Ω/V and the charging function is intact.	25		
		The AC rain charging process is normal. After the test, the insulation resistance of the vehicle charging interface is greater than 500Ω/V and the charging function is intact.	25		
Charging Information Security	Unauthorized access	The vehicle DC charging interface does not respond to the following messages: Diagnostic Session Control Response [50 01], Tester Present Response [7E 00], Negative Response [7F xx xx xx]	10	100	10 %
		The vehicle OBD interface does not receive and respond to the following messages: Diagnostic Session Control [10 01], Tester Present [3E00], Diagnostic Session Control Response [50 01], Tester Present Response [7E00], Negative Response [7F xx xx xx]	10		
	Message tampering	The vehicle stops charging and the charging function is intact	30		
	Replay attack	The vehicle does not display the charging status and sends a corresponding prompt message	50		
		The vehicle does not display the charging status and does not send the corresponding prompt information	30		
		The vehicle displays the charging status and stops displaying within 1 min	10		
		Vehicle charging status display for more than 2 min	0		

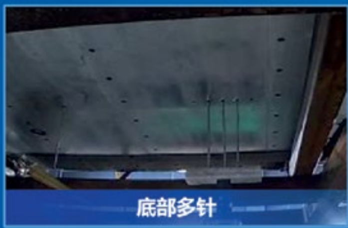
Thermal Abuse


加热触发单电芯热失控


加热触发多电芯热失控

Mechanical Abuse


底部单针


底部多针

Electrical Abuse


电芯过充

Electrical Fault


线束短路

Environmental Factor


车内火源


车外火源

www.cmvr.com.cn

CONTACTS:

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Tel: 18008379330

WeChat Official Account: 招商车研

C-EVFI

中国电动汽车火灾安全指数

CHINA ELECTRIC VEHICLE FIRE SAFETY INDEX

C-EVFI China Electric Vehicle Fire Safety Index 2026

Flame Retardant Properties of Materials

<table>
<tr><th></th><th>Item</th><th>Assessment</th><th>Score</th><th>Σ</th><th>Weight</th></tr>
<tr><td rowspan="12">Combustion Characteristics</td><td rowspan="3">Floor carpet (including underlying foam) burning rate V_1</td><td>$V_1 \leq 60$ mm/min</td><td>25</td><td rowspan="3">25</td><td rowspan="12">40 %</td></tr>
<tr><td>$60 < V_1 < 80$ mm/min</td><td>17.5</td></tr>
<tr><td>$V_1 \geq 80$ mm/min</td><td>12.5</td></tr>
<tr><td rowspan="3">Luggage compartment carpet burning rate V_2</td><td>$V_2 \leq 60$ mm/min</td><td>25</td><td rowspan="3">25</td></tr>
<tr><td>$60 < V_2 < 80$ mm/min</td><td>17.5</td></tr>
<tr><td>$V_2 \geq 80$ mm/min</td><td>12.5</td></tr>
<tr><td rowspan="3">Underbody shield burning rate V_3</td><td>$V_3 \leq 60$ mm/min</td><td>25</td><td rowspan="3">25</td></tr>
<tr><td>$60 < V_3 < 80$ mm/min</td><td>17.5</td></tr>
<tr><td>$V_3 \geq 80$ mm/min</td><td>12.5</td></tr>
<tr><td rowspan="3">Driver's seat cushion fabric burning rate V_4</td><td>$V_4 \leq 60$ mm/min</td><td>25</td><td rowspan="3">25</td></tr>
<tr><td>$60 < V_4 < 80$ mm/min</td><td>17.5</td></tr>
<tr><td>$V_4 \geq 80$ mm/min</td><td>12.5</td></tr>
<tr><td rowspan="8">Ignition Characteristics</td><td rowspan="4">Floor carpet (including underlying foam) open flame ignition temperature T_1</td><td>$T_1 \geq 750$ °C</td><td>50</td><td rowspan="4">50</td><td rowspan="8">20 %</td></tr>
<tr><td>750 °C $> T_1 \geq 650$ °C</td><td>30</td></tr>
<tr><td>650 °C $> T_1 \geq 550$ °C</td><td>15</td></tr>
<tr><td>$T_1 < 550$ °C</td><td>0</td></tr>
<tr><td rowspan="4">Underbody shield open flame ignition temperature T_2</td><td>$T_2 \geq 750$ °C</td><td>50</td><td rowspan="4">50</td></tr>
<tr><td>750 °C $> T_2 \geq 650$ °C</td><td>30</td></tr>
<tr><td>650 °C $> T_2 \geq 550$ °C</td><td>15</td></tr>
<tr><td>$T_2 < 550$ °C</td><td>0</td></tr>
<tr><td rowspan="12">Smoke Generation Characteristics</td><td rowspan="3">Floor carpet (including underlying foam) SDR_1</td><td>$SDR_1 \leq 60$</td><td>25</td><td rowspan="3">25</td><td rowspan="12">40 %</td></tr>
<tr><td>$60 < SDR_1 < 70$</td><td>12.5</td></tr>
<tr><td>$SDR_1 \geq 70$</td><td>0</td></tr>
<tr><td rowspan="3">Luggage compartment carpet SDR_2</td><td>$SDR_2 \leq 60$</td><td>25</td><td rowspan="3">25</td></tr>
<tr><td>$60 < SDR_2 < 70$</td><td>12.5</td></tr>
<tr><td>$SDR_2 \geq 70$</td><td>0</td></tr>
<tr><td rowspan="3">Underbody shield SDR_3</td><td>$SDR_3 \leq 60$</td><td>25</td><td rowspan="3">25</td></tr>
<tr><td>$60 < SDR_3 < 70$</td><td>12.5</td></tr>
<tr><td>$SDR_3 \geq 70$</td><td>0</td></tr>
<tr><td rowspan="3">Driver's seat cushion fabric SDR_4</td><td>$SDR_4 \leq 60$</td><td>25</td><td rowspan="3">25</td></tr>
<tr><td>$60 < SDR_4 < 70$</td><td>12.5</td></tr>
<tr><td>$SDR_4 \geq 70$</td><td>0</td></tr>
</table>

C-EVFI China Electric Vehicle Fire Safety Index 2026

Vehicle Sealing Performance

	Item	Assessment	Score	Σ	Weight
Vehicle Sealing Performance	Time t_1 to exceed the particulate matter concentration threshold (min)	$t_1 \geq 30$	100	100	40 %
		$20 \leq t_1 < 30$	75		
		$10 \leq t_1 < 20$	50		
		$5 \leq t_1 < 10$	25		
		$0 \leq t_1 < 5$	0		
	half-hour max. ingress particulate matter concentration $C_{30min,max}$ (µg/m³)	$C_{30min,max} \leq 100$	100	100	30 %
		$100 < C_{30min,max} \leq 200$	80		
		$200 < C_{30min,max} \leq 400$	60		
		$400 < C_{30min,max} \leq 600$	40		
		$600 < C_{30min,max} \leq 800$	20		
		$800 < C_{30min,max} \leq 1000$	10		
		$C_{30min,max} > 1000$	0		
	half-hour average ingress particulate matter concentration $C_{30min,avg}$ (µg/m³)	$C_{30min,avg} \leq 100$	100	100	30 %
		$100 < C_{30min,avg} \leq 200$	80		
		$200 < C_{30min,avg} \leq 300$	60		
		$300 < C_{30min,avg} \leq 400$	40		
		$400 < C_{30min,avg} \leq 500$	20		
		$C_{30min,avg} > 500$	0		

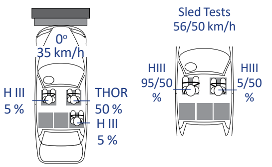
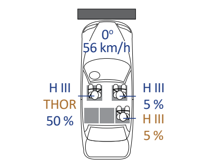
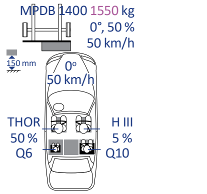
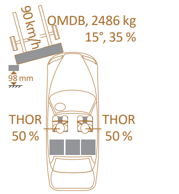
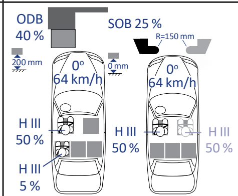
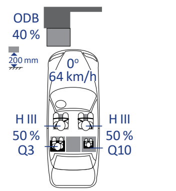
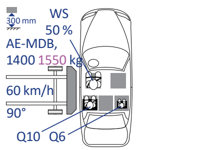
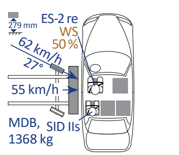
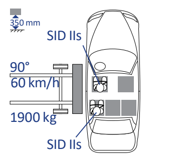
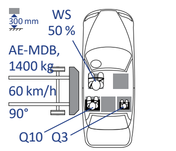
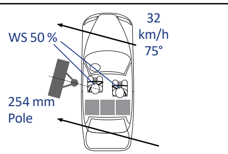
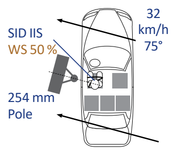
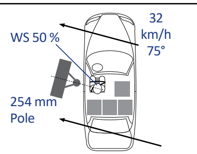
C-EVFI Star Rating

Star rating	Total score S
★★★★★	$S \geq 90$
★★★★	$80 \leq S < 90$
★★★	$70 \leq S < 80$
★★	$60 \leq S < 70$
★	$S < 60$

where $S = \Sigma (s_i \times w_i)$
with
s_i = component scores
w_i = weighting factor of the component

NCAP-Tests in Europe, America and Australia

Items written in italics are not part of the overall rating 2026 2027 2029 date of implementation unknown

	Euro NCAP / ANCAP	U.S. NCAP	IIHS	Latin NCAP
Full-width			Get familiar with NCAP tests in just 2 days with our seminar: **NCAP - New Car Assessment Programs: Tests, Assessment Methods, Ratings** learn more on ➲ page 42	
ODB / SOB				
MDB	 ■ Far Side Occupant Protection			 struck side chosen randomly
Pole	 ■ Far Side Occupant Protection			 struck side chosen randomly
Rollover		■ SSF		
VRU	■ aPLI ■ Upper Legfom ■ Headforms ■ AEB/AES Ped., Cyclist, PTW ■ AEB Reverse Pedestrian	■ *Flex PLI* ■ *Upper Legform* ■ *Headforms* ■ AEB Ped, Cyclist, PTW ■ Rear Automatic Braking	■ AEB Pedestrian	■ Flex PLI ■ Upper Legform ■ Headforms ■ AEB VRU
Child Safety	■ Frontal MPDB ■ Side MDB ■ CRS - Installation ■ Veh. Based Assessment, CPD	■ *CPD*	■ *LATCH (Lower Anchors and Tethers for Children)*	■ Frontal ODB ■ Side MDB ■ CRS - Installation ■ Veh. Based Assessment
Whiplash	■ Static Front / Rear ■ Dynamic (2 Pulses)		■ Virtual Testing + Validation Test ■ Dynamic (2 Pulses)	■ Static ■ Dynamic (1 Pulse) ■ AEB City
Other	■ SBR, SAS, AEB, LSS, AEB, Occupant Status, AES, Rescue, Pedal Misapplication, Vision, *AD*	■ *FCW, LDW, AEB, DBS, LKA, BSW, BSI*, Headlights	■ AEB, FCW, *SBR* ■ Headlights ■ *Direct vision*	■ SBR, ESC, SAS, BSD, LSS, AEB, e-Call, Rescue Sheet, Rear Impact: UN R32

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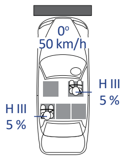
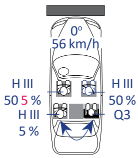
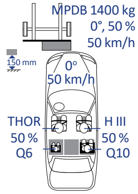
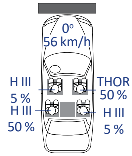
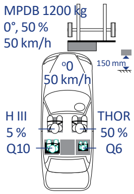
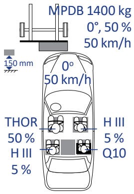
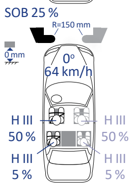
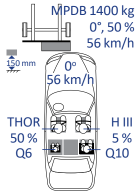
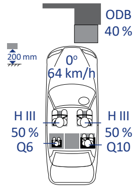
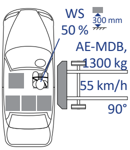
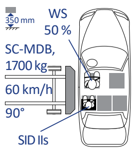
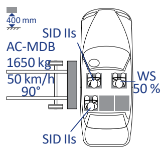
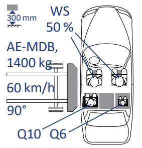
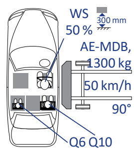
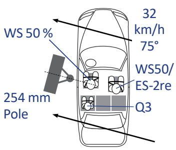
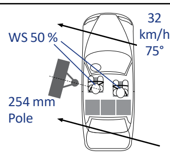
NCAP-Tests in Asia

Items written in italics are not part of the overall rating **2026 2027**

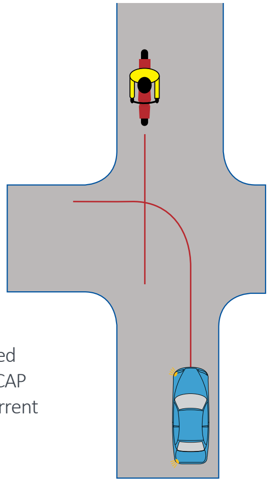
	JNCAP	C-NCAP	C-IASI	KNCAP	ASEAN NCAP
Full-width	 0° 50 km/h H III 5 % H III 5 %	 0° 56 km/h H III 50 5 % H III 5 % H III 50 % Q3	 MPDB 1400 kg 0°, 50 % 50 km/h 150 mm 0° 50 km/h THOR 50 % Q6 H III 50 % Q10	 0° 56 km/h H III 5 % H III 50 % THOR 50 % H III 5 %	
ODB / SOB	 MPDB 1200 kg 0°, 50 % 50 km/h 150 mm 0 50 km/h H III 5 % Q10 THOR 50 % Q6	 MPDB 1400 kg 0°, 50 % 50 km/h 150 mm 0° 50 km/h THOR 50 % H III 5 % H III 5 % Q10	 SOB 25 % R=150 mm 0 mm 0° 64 km/h H III 50 % H III 5 % H III 50 % H III 5 %	 MPDB 1400 kg 0°, 50 % 56 km/h 150 mm 0° 56 km/h THOR 50 % Q6 H III 5 % Q10	 ODB 40 % 200 mm 0° 64 km/h H III 50 % Q6 H III 50 % Q10
MDB	 WS 50 % 300 mm AE-MDB, 1300 kg 55 km/h 90°	 350 mm WS 50 % SC-MDB, 1700 kg 60 km/h 90° SID IIs	 400 mm SID IIs AC-MDB 1650 kg 50 km/h 90° WS 50 % SID IIs	 300 mm WS 50 % AE-MDB, 1400 kg 60 km/h 90° Q10 Q6 ■ Far Side Occ. Prot.	 WS 50 % 300 mm AE-MDB, 1300 kg 50 km/h 90° Q6 Q10
Pole		 WS 50 % 32 km/h 75° WS50/ ES-2re 254 mm Pole Q3		 WS 50 % 32 km/h 75° 254 mm Pole ■ Far Side Occ. Prot.	
Rollover		■ Curtain Airbag	■ Roof Crush		
Pedestrian	■ aPLI ■ Headforms ■ AEB Pedestrian ■ AEB Cyclist ■ AEB PTW	■ aPLI ■ Headforms ■ AEB Ped., Electric Bicyclist, Scooter, 3-wheeler, Cyclist	■ aPLI ■ Upper Legfom ■ Headforms ■ AEB Ped, Cyc, PTW	■ aPLI ■ Headforms ■ AEB Pedestrian ■ AEB Cyclist	■ Flex PLI ■ Headforms
Child Safety	■ *CRS Rating* ■ *Support Device to Prevent leaving Child in the Car*	■ Q3 in FW Frtl. / Pole ■ Q10 in MPDB ■ CRS - Installation ■ CPD	■ *LATCH (Lower Anchors and Tethers for Children)*	■ Frontal MPDB ■ Side MDB	■ Frontal ODB ■ Side MDB ■ CRS - Installation ■ Veh. Based Assmt. ■ CPD
Whiplash	■ Dynamic (1 Pulse)	■ Dynamic (1 Pulse) ■ Rear Seats Dynamic	■ Static ■ Dynamic (1 Pulse)	■ Static ■ Dynamic (1 Pulse) ■ Rear Seats Static	
Other	■ SBR, AEB, LSS, Headlights, e-Call, Pedal Misapplication, *TSR*	■ ESC, SBR, AEB/FCW BSD, SAS, LKA, LDW, ASB e-Call, V2X, Headlights, *Underbody Scraping*	■ AEB C2C/C2T, FCW, LSS, e-Call, Headlights, Low Speed Bumper, NEV Safety	■ SBR, FCW, LDW, AEB, BSD, LKAS, RCCA, ISA, Adv. Airbag, ESF, *BMS, Batt. Imp.*, e-Call, V2X	■ BST, Rear View, AHB, HPT, Safety Assist Technologies, LSS, AEB Motorcyc., ADB

➲ page 80 ➲ page 75 ➲ page 83 ➲ page 74

Euro NCAP UpDate 2026

Get ready for Euro NCAP‘s latest rating revision! ★★★★★

Image: Thatcham Research



2026 marked a milestone for Euro NCAP with the introduction of the new Haddon Matrix based rating system. But the next upgrade of the rating is already scheduled for 2029. At the Euro NCAP UpDate, experts from the relevant working groups will provide detailed information on the current status of the upcoming Euro NCAP requirements.

- Find out the current state of discussion on the upcoming protocols and roadmaps.
- Take advantage of the discussion with the experts active in the Euro NCAP working groups.

Contents

- Latest protocol versions
- Roadmap 2030
- Updates for 2029
- Assessment of automated driving functions
- Commercial Vehicle Ratings (Trucks, vans, busses)
- Virtual Testing

Who should attend?

The Euro NCAP UpDate is suited for everyone who wants to be prepared for Euro NCAP's upcoming requirements.

Safe Driving | Crash Avoidance | Crash Protection | Post-Crash Safety

Facts

02.-03.12.2026

Frankfurt/Hanau, GERMANY & ONLINE

www.carhs.de/euroncap

NCAP - New Car Assessment Programs Tests, Assessment Methods, Ratings

Course Description

In 1979 the first New Car Assessment Program (NCAP) was established by NHTSA in the United States. The goal was to motivate competing car manufacturers to enhance the safety level of their cars beyond the minimum safety standards defined by regulations. The same approach has been followed globally by other organizations (e.g. by Euro NCAP, IIHS, ANCAP, JNCAP, KNCAP, C-NCAP, ...). Euro NCAP which has been established in 1997 has taken a leading role and has significantly influenced other countries and regions. The NCAP programs in many cases are highly dynamic, especially in comparison with rulemaking activities. In order to reach the goal to continuously improve the safety level of cars, the requirements need to be permanently adapted to the state of technology. Developers in the automotive industry need to know about upcoming changes at an early stage in order to be able to design or equip their vehicles accordingly.
In this seminar attendees get an overview of the organizations in charge of the NCAP programs and become familiar with the various test and assessment methods.

The seminar is conducted several times a year with changing focuses:

- **Focus passive safety:** Here the focus is on test and assessment methods for passive safety. Frontal and side impact, whiplash, child protection and pedestrian protection are discussed in detail. Tests for active safety are only mentioned in as far as they are relevant for the overall rating.
- **Focus active safety:** Here the focus is on active safety systems such as AEB or lane assistance. The tests and assessments for these systems are explained in detail. Tests for passive safety are only mentioned in as far as they are relevant for the overall rating.

In both focusses the current overall rating methods are described and explained. In addition to that an outlook is given on the roadmaps and future developments of the NCAP programs.

Who should attend?

The seminar addresses design, simulation, testing and project engineers as well as managers who want to get a current overview on the global range of NCAP programs with an outlook on upcoming topics and trends from an insider. Depending on the focus of their work attendees should chose the appropriate focus of the seminar.

Course Contents

- Basics of New Car Assessment Programs
- Euro NCAP
  - Background, Principles and Organisation
  - Products, Rating and Rules
  - Adult Occupant Protection (AOP)
  - Child Occupant Protection (COP)
  - Vulnerable Road User Protection (PP / VRU)
  - Safety Assist (SA)
  - Automated Driving
  - Commercial Van Safety
  - Roadmap 2030
- U.S. NCAP
- IIHS
- C-NCAP

Instructor

Direktor & Professor Andre Seeck (BASt - German Federal Highway Research Institute)
has been Vice President of the Federal Highway Research Institute (BASt) since April 2022, where he heads the Vehicle Technology division. In this position he is responsible for the preparation of European Safety Regulations. Furthermore he represents the German Federal Ministry for Digital and Transport in the Board of Directors of Euro NCAP and he is the chairman of the strategy group on automated driving and of the rating system. These positions enable him to gain deep insight into current and future developments in vehicle safety. In 2017 NHTSA awarded him the U. S. Government Special Award of Appreciation.

Facts

21.-22.01.2026	164/4474	Alzenau	2 Days	1.450,- EUR till 24.12.2025, thereafter 1.750,- EUR	
21.-24.04.2026	164/4661	Online	4 x 4 Hrs.	1.450,- EUR till 24.03.2026, thereafter 1.750,- EUR	
16.-17.06.2026	164/4662	Alzenau	2 Days	1.450,- EUR till 19.05.2026, thereafter 1.750,- EUR	
15.-16.09.2026	164/4663	Alzenau	2 Days	1.450,- EUR till 18.08.2026, thereafter 1.750,- EUR	
02.-05.11.2026	164/4664	Online	4 x 4 Hrs.	1.450,- EUR till 05.10.2026, thereafter 1.750,- EUR	

Euro NCAP Passive Safety Workshop

with Praxis Session

Course Description

A top rating in Euro NCAP is part of the specs for almost all newly developed passenger cars for the European market. Hardly anything is more unpleasant for a developer than a surprising downgrade in the rating. Typical reasons for results that turn out worse than expected are often marginal differences in the execution and evaluation of the tests or modifiers assigned by Euro NCAP. To avoid this, it is important to know and understand the Euro NCAP procedure in detail. This is exactly where the Euro NCAP Passive Safety Workshop comes in: In the workshop, the latest test and assessment procedures in the area of passive safety (adult occupant protection, child protection and VRU protection) are presented specifically and illustrated as far as possible with concrete practical examples. Due to the workshop character of the event, participants will have the opportunity to present their specific problems and questions, of course also regarding the tests that have been established for some time. The course instructor Volker Sandner and his team have been conducting Euro NCAP tests as an accredited Euro NCAP laboratory for many years and, as a contributor to or a leader of various Euro NCAP working groups, he has played a significant role in the new and further development of the rating. For example, the trend-setting MPDB frontal crash was developed under his leadership.

Course Objectives

The course is designed to help vehicle developers understand the Euro NCAP approach in detail. It offers a lot of room for questions from the participants' practice and addresses the problems that the testers encounter in their practice.

Who should attend?

The workshop is aimed at development and test engineers of vehicles who have the goal to achieve a good Euro NCAP rating. Basic knowledge in the field of passive vehicle safety and Euro NCAP rating should already be available. If necessary, prior participation in the seminar Introduction to Passive Safety or the seminar Euro NCAP Compact is recommended.

Course Contents

- Overview of the test and evaluation procedures in passive safety
- Current topics
  - MPDB frontal crash
  - Knee Mapping
  - Far Side assessment
  - Rescue, Extrication & Safety evaluation
  - Introduction of aPLI and extended head impact area
  - Child Presence Detection
  - CRS installation/warning labels/vehicle equipment
  - Post crash inspection

Image: ADAC

Instructor

Volker Sandner (ADAC Technik Zentrum Landsberg) has been head of the Vehicle Safety Department of ADAC, which includes active safety, passive safety and accident research, since 2010. Before that, from 1999-2007 he was in charge of the construction of ADAC's crash test lab as a team manager. From 2007-2010 he led the Passive Safety Department of ADAC. At Euro NCAP he is a member of the Board of Directors and chairman of the frontal impact working group. In addition to that he is member of the side impact working group, the technical working group and the ratings group of Euro NCAP. He is also lecturer for vehicle safety at the University of Applied Sciences in Munich.

Facts

Date	#	Location	Duration	Price	Language
23.-24.06.2026	196/4731	Landsberg am Lech	2 Days	1.450,- EUR till 26.05.2026, thereafter 1.750,- EUR	English
14.-15.10.2026	196/4732	Landsberg am Lech	2 Days	1.450,- EUR till 16.09.2026, thereafter 1.750,- EUR	German

Euro NCAP - Compact

Course Description

An overview of the current requirements, criteria, and evaluation rules at Euro NCAP in two days.
Reading the NCAP protocols takes longer than this course—there's no more efficient way to familiarize yourself with this complex topic!
The aim of this course is to impart the latest safety knowledge with maximum efficiency. We summarize the current Euro NCAP test and evaluation protocols for you and present them in a clear and understandable way. In contrast to our other seminars, we consistently refrain from providing background information and limit ourselves to looking ahead at the future changes to the rating that have already been decided. For customers who need precisely these facts, the compact seminar is the ideal way to acquire or refresh their knowledge. For those who want to know more, understand the background, and take a valuable look behind the scenes of consumer protection, we recommend our detailed seminar on consumer protection tests or our seminars that deal with individual topics of the rating.
The Euro NCAP compact seminar summarizes the test configurations, evaluation criteria, and modifiers for all Euro NCAP evaluation categories (Safe Driving, Crash Avoidance, Crash Protection, Post-Crash Safety) and shows how the overall rating is calculated from the individual evaluations.
The course focuses on the requirements that will apply from 2026.
The seminar materials are a practical and clearly structured handbook for everyday work.

Who should attend?

The compact course is aimed at anyone who wants to gain an overview of the current Euro NCAP requirements in order to be able to develop products in line with these requirements in their everyday work.

Course Contents

- Overview Euro NCAP
  - Organization
  - Current protocols
  - Vehicle selection
  - Dual rating
  - Sliding scale
  - Modifiers
- The Euro NCAP assessment stages
  - Safe driving
    - Occupant monitoring
    - Driver engagement
    - Vehicle assistance
  - Crash avoidance
    - Frontal collisions
    - Lane departure collisions
    - Low speed collisions
  - Crash protection
    - Frontal impact
    - Side impact
    - Rear impact
    - VRU impact
  - Post-crash safety
    - Rescue information
    - Post-crash intervention
    - Vehicle extrication
  - Links between stages
- Overall rating: The star rating
  - Balancing
  - Compensation between stages
  - Weighting / Best-in-class
  - Examples

Safe Driving

Crash Avoidance

Crash Protection

Post-Crash Safety

Instructor

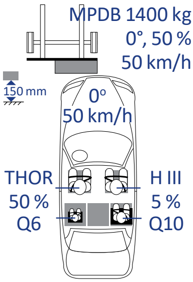
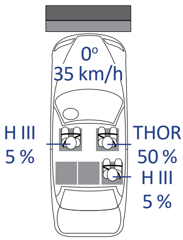
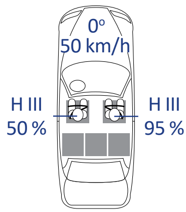
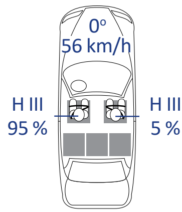
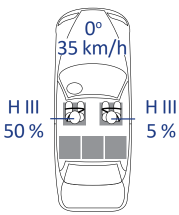
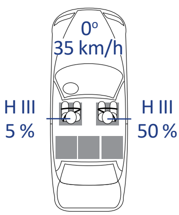
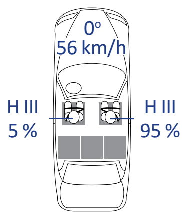
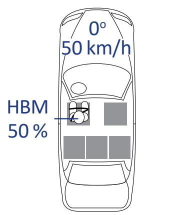
Ralf Reuter (carhs.training gmbh) studied mechanical engineering and business administration at the technical universities of Darmstadt and Eindhoven. Since 1997 he has worked for carhs in various management positions. He deals with vehicle safety issues intensively, in particular with the latest developments in rules and regulations as well as consumer testing. As he is in charge of the SafetyWissen which has been published by carhs for many years, he keeps his knowledge up-to-date and profits from the inputs of carhs' trainer and expert network.

Facts

11.-12.02.2026	111/4653	Alzenau	2 Days	1.450,- EUR till 14.01.2026, thereafter 1.750,- EUR	
12.-15.10.2026	111/4654	Online	4 x 4 Hrs.	1.450,- EUR till 14.09.2026, thereafter 1.750,- EUR	

Euro NCAP / ANCAP Frontal Impact Test Matrix

Frontal Impact Protocol Version 1.1

	Hardware Testing			
	Full Scale Tests		Sled Tests	
Test	MPDB	FWDB	Robustness 1	Robustness 2
Scenario				
Test Speed	50 km/h	35 km/h	50 km/h	56 km/h
Pulse Source	n/a	n/a	UN R137 test	Full Width rigid wall test / Generic pulse
1st Row Driver	THOR 50 % M	Hybrid III 5 % F	Hybrid III 50 % M	Hybrid III 95 % M
1st Row Passenger	Hybrid III 5 % F	THOR 50 % M	Hybrid III 95 % M	Hybrid III 5 % F
2nd Row Driver Side	Q6	-	-	-
2nd Row Pass. Side	Q10	Hybrid III 5 % F	-	-
	Virtual Testing			
Test	Robustness 1	Robustness 2	Robustness 3	HBM
Scenario				
Test Speed	35 km/h	35 km/h	56 km/h	50 km/h
Pulse Source	FWDB	FWDB	Full scale test / Simulation / Generic pulse	UN R137 test
1st Row Driver	Hybrid III 50 % M	Hybrid III 5 % F	Hybrid III 5 % F	Mid-size HBM
1st Row Passenger	Hybrid III 5 % F	Hybrid III 50 % M	Hybrid III 95 % M	-

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64293 Darmstadt
www.instron.com
sales_da@instron.com

Euro NCAP / ANCAP Frontal Impact

Frontal Impact Protocol Version 1.1

Dummy-specific Limits in Frontal Impacts

Dummy	Region	Criteria	Higher perf. limit	Lower perf. limit	Capping limit
Hybrid III 5 %	Head	HIC_{15}	< 500	> 700	> 700
		a_{3ms} (g)	< 72	> 80	> 80
	Neck	$M_{y,extension}$ (Nm)	< 36	> 49	> 57 (driver only)
		$F_{z,tension}$ (kN)	< 1.7	> 2.6	> 2.9 (driver only)
		$F_{x,shear}$ (kN)	< 1.2	> 2.0	> 2.7 (driver only)
	Chest	Deflection (mm)	< 18 (35/50 km/h) < 22 (56 km/h)	> 34 (35/50 km/h) > 42 (56 km/h)	> 34 (35/50 km/h) > 42 (56 km/h)
		VC (m/s)	< 0.5	> 1.0	> 1.0
	Femur	Axial Force(kN)	< 2.6	> 6.2	-
	Knee[1]	Displacement (mm)	< 6	> 15	-
	Tibia[1]	Tibia Index	-	> 1.3	-
		Axial Force(kN)	-	> 8.0	-
Hybrid III 50 %	Head	HIC_{15}	< 500	> 700	> 700
		a_{3ms} (g)	< 72	> 80	> 80
	Neck	$M_{y,extension}$ (Nm)	< 42	> 57	> 57
		$F_{z,tension}$ (kN)	< 2.7	> 3.3	> 3.3
		$F_{x,shear}$ (kN)	< 1.9	> 3.1	> 3.1
	Chest	Deflection (mm)	20	42	42
		VC (m/s)	< 0.5	> 1.0	> 1.0
	Femur	Axial Force(kN)	< 3.8	> 9.1	-
	Knee[1]	Displacement (mm)	< 6	> 15	-
	Tibia[1]	Tibia Index	< 0.4	> 1.3	-
		Axial Force(kN)	< 2.0	> 8.0	-
Hybrid III 95 % (Build level D)	Head	HIC_{15}	< 500	> 700	-
		a_{3ms} (g)	< 72	> 80	-
	Neck	$M_{y,extension}$ (Nm)	< 56	> 76	-
		$F_{z,tension}$ (kN)	< 3.3	> 4.0	-
		$F_{x,shear}$ (kN)	< 2.3	> 3.8	-
	Chest	Deflection (mm)	< 28	> 55	-
		VC (m/s)	< 0.5	> 1.0	-
	Femur	Axial Force(kN)	< 4.8	> 11.5	-
	Knee[1]	Displacement (mm)	< 6	> 17	-
	Tibia[1]	Tibia Index (F_{krit} = 44.1 kN, M_{krit} = 306 Nm)	< [0.4]	> 1.3	-
		Axial Force(kN)	< [4.0]	≥ 10.0	-

1 Not applicable to virtual tests.
Limits in [square brackets] are to be implemented once a lower leg certification procedure is adopted.

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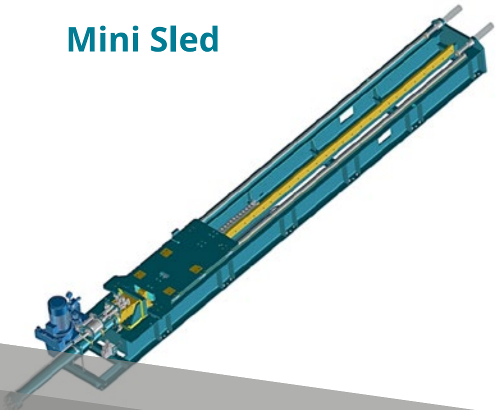

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Euro NCAP / ANCAP Frontal Impact

Frontal Impact Protocol Version 1.1

Dummy	Region	Criteria	Higher perf. limit	Lower perf. limit	Capping limit
THOR 50 %	Head	HIC_{15}	< 500	> 700	> 700
		a_{3ms} (g)	< 72	> 80	> 80
	Neck	$M_{y,extension}$ (Nm)	< 42	> 57	> 57
		$F_{z,tension}$ (kN)	< 2.7	> 3.3	> 3.3
		$F_{x,shear}$ (kN)	< 1.9	> 3.1	> 3.1
	Chest	Deflection R_{max} (mm)	< 29 (35 km/h) < 35 (50 km/h)	> 54 (35 km/h) > 60 (50 km/h)	> 54 (35 km/h) > 60 (50 km/h)
	Abdomen	Deflection (mm)	-	> 88	-
	Pelvis	$Acetabulum_{Compression}$ (kN)	< 3.3	> 4.1	-
	Femur	Axial Force (kN)	< 3.8	> 9.1	-
	Knee[1]	Displacement (mm)	< 6	> 15	-
	Tibia[1]	Tibia Index	< 0.4	> 1.3	-
		Axial Force (kN)	< 2.0	> 8.0	-
Q6/Q10[2]	Head[3]	HIC_{15}	< 500	> 700	> 700
		a_{3ms} (g)	< 60	> 80	> 80
	Neck	$F_{z,tension}$ (kN)	< 1.7	> 2.62	-
		$M_{y,extension}$ (Nm)[4]	-	> 36 (Q6) / 49 (Q10)	-
	Chest	Deflection (mm)	< 30 (Q6) / - (Q10)	> 42 (Q6) / 56 (Q10)	> 56
		a_{3ms} (g)[5]	- (Q6) / < 41 (Q10)	- (Q6) / > 55 (Q10)	> 55

1 Not applicable to virtual tests.
2 Injury parameter assessments will not be evaluated during the rebound phase of the dummy.
3 If no hard contact between the head and vehicle is observed on the high speed film, the head assessment is based on the Resultant 3ms acceleration only.
4 Neck extension M_y is evaluated where there is a head to interior contact only.
5 Chest acceleration peaks caused by the firing of seatbelt pretensioners early in the loading event will be ignored.

Dummy Scoring for Occupants in Frontal Impacts (Maximum Body Region Scores)

Loadcase	Occupant	Head & Neck	Chest & Abdomen	Pelvis & Femur & Knee	Tibia & Foot	Total
MPDB	Driver	1.25	1.25	1.25	1.25	5.0
	Front passenger	1.25	1.25	1.25	1.25	5.0
	Q6	Head 2.5 Neck 1.25	1.25			5.0
	Q10	Head 2.5 Neck 1.25	1.25			5.0
FWDB	Driver	1.25	1.25	1.25	1.25	5.0
	Front passenger	0.625	0.625	0.625	0.625	2.5
	Rear passengers	0.625	1.25	0.625		2.5
Sled (2 tests)	Driver	0.625 / 2	0.625 / 2	0.625 / 2	0.625 / 2	2.5
	Front passenger	0.625 / 2	0.625 / 2	0.625 / 2	0.625 / 2	2.5
Virtual (3 tests)	Driver	0.625 / 3	0.625 / 3	0.625 / 3	[0.625 / 3][1]	2.5
	Front passenger	0.625 / 3	0.625 / 3	0.625 / 3	[0.625 / 3][1]	2.5

1 Points awarded by default unless in any physical test (including full-scale) any dummy exceeds the lower performance limit for Tibia index or Tibia force. [To be implemented once lower leg certification procedure is adopted and virtual models qualify]

Euro NCAP / ANCAP Frontal Impact

TB CP 007 Version 1.1 | Frontal Impact Protocol Version 1.1

Frontal Impact Modifiers

Region	Modifier	Modifier score
Head & Neck[1]	Airbag contact - head bottoming out[4]	-20 %
	Airbag contact - unstable airbag contact[4]	-20 %
	Hazardous airbag deployment[4]	-20 %
	Brain Injury - DAMAGE 0.42 ... 0.47	-20 %
	Brain Injury - DAMAGE ≥ 0.47	-40 %
	Incorrect airbag deployment[4]	-20 %
	Adult rear occupant head excursion (rear seats) ≥ 450 mm	-50 %
	Adult rear occupant head excursion (rear seats) ≥ 550 mm	-100 %
Chest[1]	Steering wheel contact[4]	-20 %
	Shoulder belt load ≥ 6 kN (5th- & 50th-%ile only)[4]	-40 %
	Incorrect airbag deployment[4]	-20 %
Knee, Femur & Pelvis[1]	Submarining[4]	-100 %
	Knee loading - variable (≥ 3.8 kN or 6 mm)[4]	-20 %
	Knee loading - concentrated loads	-20 %
	Incorrect airbag deployment[4]	-20 %
Lower leg, Foot & Ankle[1]	Pedal displacement rearward ≥ 100 mm	-50 %
	Pedal displacement rearward ≥ 200 mm	-100 %
	Pedal displacement vertical ≥ 72 mm	-20 %
	Pedal blocking 50 mm	-20 %
Child Occupants	Q6 Head Excursion[1] ≥ 550 mm	-100 %
	Q10 Head Excursion[1] ≥ 450 mm	-50 %
	Q10 Head Excursion[1] ≥ 450 mm	-100 %
	Full belt slippage[2]	-100 %
	Partial belt slippage[2]	-50 %
	Lack of restraint[2]	-100 %
	Submarining[2]	-100 %
	Ejection[2]	-100 %
	CRS attachment[2]	-100 %
Modifiers applied to the overall test score[3]	A-pillar rearward displacement ≥ 100 mm	-2.5 %
	Steering column displacement (rearward ≥ 90 mm / vertical ≥ 72 mm / lateral ≥ 90 mm)	-1.25 %
	Bodyshell integrity	-1.25 %
	Footwell rupture	-1.25 %
	MPDB compatibility: OLC, standard deviation, bottoming out	0 to -50 %
	Restraint failure	-100 %
	Door opening (per door)	-5 %
	Door detachment	-100 %

1 Modifier penalties are defined as a percentage of the maximum body region score for each dummy, in each loadcase and are applied to that body region.
2 Modifier penalties are defined as a percentage of the maximum test score for each Q dummy.
3 Modifier penalties are defined as a percentage of the maximum adult occupant test score for each loadcase.
4 Modifier also applicable to sled and virtual tests.

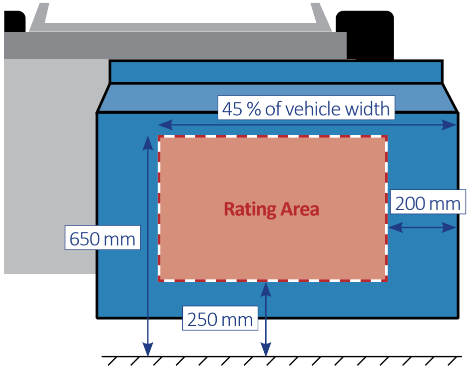
Euro NCAP / ANCAP: MPDB Frontal Impact Compatibility Assessment

TB CP 005 Version 1.1

TB CP 007 Version 1.1

Homogenity Assessment based on the Standard Deviation (SD) of the post-test Barrier Deformation within the Rating Area of the PDB Front Face

- Scanning the deformed PDB front and generating a mesh with a maximum element size of 10 mm from the resulting point cloud.
- Creation of a point grid centered on the undeformed PDB front with uniform spacings of 20 mm (1400 grid points).
- Projection of the grid points on the mesh and calculation of the intrusion at each of the points in the rating area.
- Calculation of the standard deviation SD [mm] of the intrusion (i.e. the deviation from the mean intrusion within which 68.2 % of the intrusion values fall).



Bottoming out of the PDB

Bottoming out (BO) is defined as a barrier face penetration depth of 630 mm in an area that is larger than 40 mm x 40 mm. Where bottoming out occurs, a further 25% of the penalty will be added to the barrier deformation and OLC penalty.

Calculation of the Occupant Load Criterion OLC

- Determine velocity course of the MPDB by integrating the measured X-acceleration (a_x) on the centre of gravity of the MPDB (filtered with CFC 180):

$$v_v(t) = \int a_x(t)\, dt + v_0$$

with v_0 = initial velocity of the MPDB.

- OLC, t_1 and t_2 can be calculated with solving the following equation system:

$$\int_{t=0}^{t=t_1} v_0\, dt - \int_{t=0}^{t=t_1} v_v(t)\, dt = 0.065$$

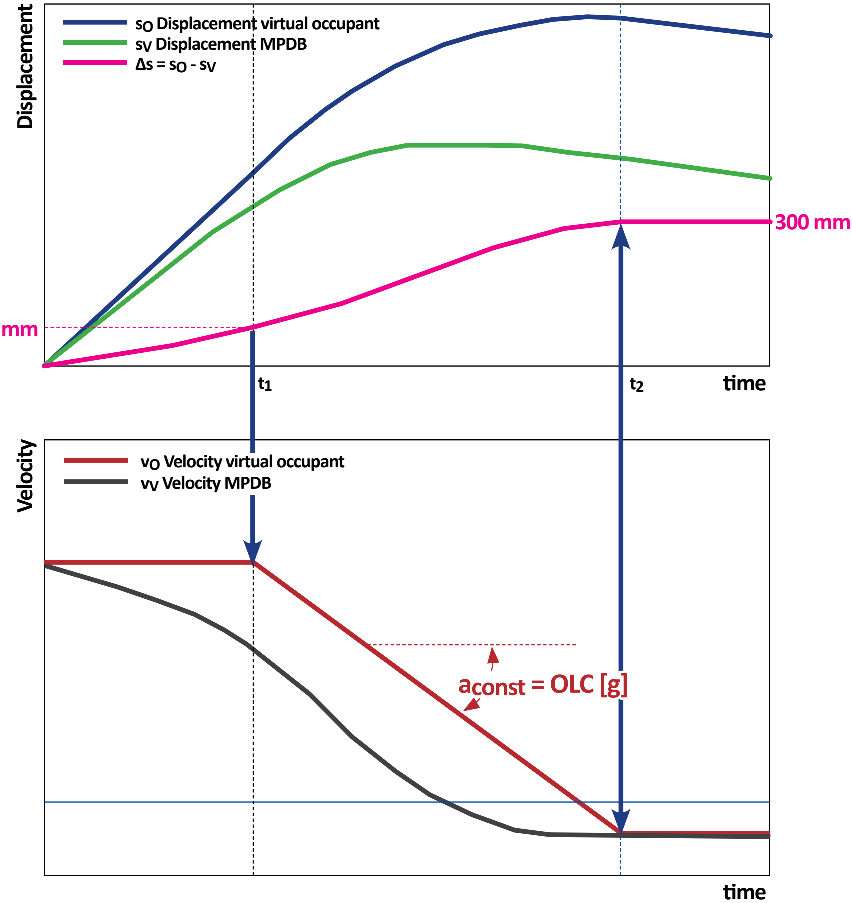
$$\int_{t=t_1}^{t=t_2} \left(v_0 - OLC \cdot (t - t_1)\right) dt - \int_{t=t_1}^{t=t_2} v_v(t)\, dt = 0.235$$

$$v_0 - OLC \cdot (t_2 - t_1) = v_v(t_2)$$

with t_1 = end of the free-flight-phase of a virtual dummy on the barrier along a displacement of 65 mm

t_2 = end of the restraining-phase of a virtual dummy on the barrier along a displacement of 235 mm after the free-flight-phase (i.e. a total displacement of 300 mm)

- For compatibility assessment **OLC** shall be converted from SI units into g.



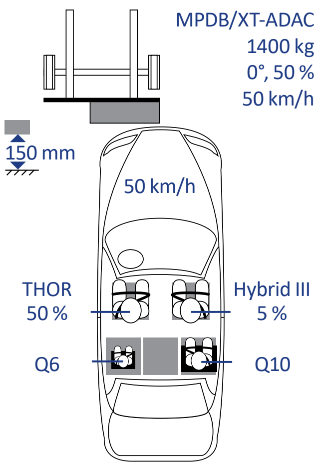
Calculation of the Compatibility Modifier

The assessment of SD and OLC are both calculated on sliding scales between their respective limits detailed in Section 3.6, the bottoming out penalty is then added to produce the final compatibility assessment.

- For SD < 50 mm, OLC < 25 g and no bottoming out there will be no penalty.
- For SD < 50 mm, OLC < 25 g with bottoming out the penalty will be -6.25 % of MPDB score.
- For SD > 150, OLC > 40 g and no bottoming out the penalty will be -25 % of MPDB score.
- For SD > 150, OLC > 40 g with bottoming out the penalty will be -25 % of MPDB score.

Where the SD and OLC are between the respective limits, the calculation is based upon the following percentages

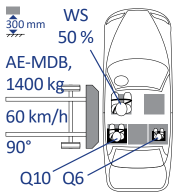
	0 %	20 %	40 %	60 %	80 %	100 %
SD	50 mm	70 mm	90 mm	110 mm	130 mm	150 mm
OLC	25 g	28 g	31 g	34 g	37 g	40 g

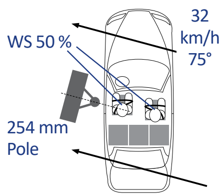


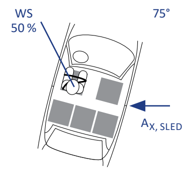
Euro NCAP / ANCAP Side Impact

Side Impact Protocol Version 1.1

Side Impact 35 points								
AE-MDB 15 points			Pole 10 points	Farside 10 points				
Front Occupant 10	Rear Occupants 5		Front Occupant 10	Main 4		Robustness 4		O2O 2
10.0	2.5	2.5	10.0	2.0	2.0	2.0	2.0	2.0
WS 50 %	Q6	Q10	WS 50 %	AE-MDB	Pole	AE-MDB	Pole	Occupant to Occupant







Dummy-specific Limits in Side Impacts

Dummy	Region	Criteria	Higher perf. limit	Lower perf. limit	Capping limit	max. score
WorldSID 50 %	Head & Neck	HIC_{15}	< 500	≥ 700	≥ 700	2.5
		a_{3ms} (g)	< 72	≥ 80	≥ 80	
		a_{res} (g)[1]			≥ 80	
	Chest	$D_{chest\ compression}$ (mm)	< 28	≥ 50	≥ 50 AE-MDB ≥ 55 Pole	2.5
	Abdomen	$D_{abdomen\ compression}$ (mm)	< 47	≥ 65	≥ 65	2.5
	Pelvis	$F_{pubic\ symphysis}$ (kN)	< 1.7	≥ 2.8	≥ 2.8	2.5
Q6	Head[2]	HIC_{15}	< 500	≥ 700	≥ 700	1.25
		a_{3ms} (g)	< 60	≥ 80	≥ 80	
	Neck	$F_{Z,\ tension}$ (kN)	< 2.4	≥ 2.4		0.625
	Chest	a_{3ms} (g)	< 67	≥ 67		0.625
Q10	Head[2]	HIC_{15}	< 500	≥ 700	≥ 700	1.25
		a_{3ms} (g)	< 60	≥ 80	≥ 80	
	Neck	$F_{Z,\ tension}$ (kN)	< 2.2	≥ 2.2		0.625
	Chest	a_{3ms} (g)	< 67	≥ 67		0.625

1 In case of direct contact to pole / occupant-to-occupant head contact.
2 In case of no hard contact of the head, the assessment is based on a_{3ms} only.

Side Impact Modifiers

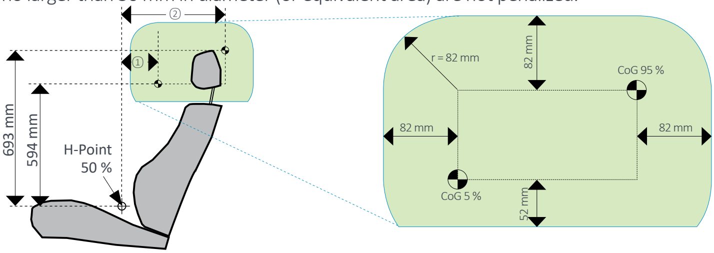
TB CP 007 Version 1.1

Region	Modifier	Modifier score
Head & Neck[1]	Direct contact with pole	capping
	Brain Injury - DAMAGE ≥ 0.47	monitoring
	Incorrect airbag deployment[4]	-20 %
Chest[1]	Shoulder load ≥ 3 kN	-100 %
	Viscous Criterion V*C ≥ 1.0 m/s	-100 %
	Incorrect airbag deployment[4]	-20 %
Abdomen[1]	Viscous Criterion V*C ≥ 1.0 m/s	-100 %
	Incorrect airbag deployment[4]	-20 %
Pelvis[1]	Incorrect airbag deployment[4]	-20 %
Child Occupants	Restraint[1]	-100 %
	CRS attachment[2]	-50 %
Modifiers applied to the overall test score[3]	HPD (Head Protection Device)	-10 % per row
	Rollover: ■ Failure in sensing rollover/triggering side curtain HPD ■ Failure in maining pressure (50%@6s or FMVSS226 complinace)	-20%
	Door opening (per door)	-5 %
	Door detachment	-100 %
	Restraint failure	-100 %
Far side occupant[4]	$F_{pubic\ symphysis}$ > 2.8 kN	-25%
	$F_{y\ lumbar}$ > 2.0 kN	
	$F_{z\ lumbar}$ > 3.5 kN	
	$M_{x\ lumbar}$ > 120 Nm	

1 Modifier penalties are defined as a percentage of the maximum body region score for each dummy, in each loadcase and are applied to that body region.
2 Modifier penalties are defined as a percentage of the maximum test score for each Q dummy.
3 Modifier penalties are defined as a percentage of the maximum adult occupant test score for each loadcase.
4 Modifier penalties are defined as a percentage of the maximum adult occupant test score for the sled test far side load cases.

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 10% point modifier is applied per seating row. Areas outside the Daylight Opening (FMVSS 201) are excluded from assessment. Seams are not penalized if the un-inflated area is no wider than 15 mm. Any other un-inflated areas that are no larger than 50 mm 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 - remaining seat travel
② = H-Point(x) + 147 mm + remaining seat travel

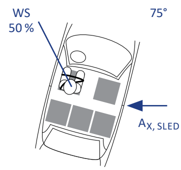
Euro NCAP / ANCAP Far Side Occupant Protection in Side Impacts

Side Impact Protocol Version 1.1

Load Cases

Type	Pulse	Angle	Driver's seat setting
Main	AE-MDB	75°	UN R135 (lowest)
	Pole	75°	UN R135 (lowest)
Robustness	AE-MDB	60°	UN R135 (lowest)
	AE-MDB	75°	highest
	AE-MDB	90°	UN R135 (lowest)
	AE-MDB	90°	highest
	Pole	75°	highest
	Pole	90°	UN R135 (lowest)

- Assessment is based on virtual tests (simulations) of the above load cases
- 2 randomly selected cases (1 AE-MDB, 1 Pole) will be physically tested for validation
- If no virtual test data is provided or validation criteria are not met, the assessment will be based on physical tests of both main load cases only
- Pulses:
  - AE-MDB 1: $A_{X,\,SLED} = A_{Y,\,VEHICLE\,(AE\text{-}MDB\ @\ 60\ km/h)} \times 1.035$
  - Pole: $A_{X,\,SLED} = A_{Y,\,VEHICLE\,(Pole\ @\ 32\ km/h)} \times 1.035$
- For the 60° dnd 90° loadcases the same pulse as for the 75° load cases will be used
- BIW mounted with centerline angled 75° towards direction of travel
- Spacers (EPP60) fitted in gaps between the struck side and the passenger seat and the passenger seat and center console
- WorldSID 50 % on driver seat



Prerequisites:

Any of the following post-test conditions identified in either the full-scale AE-MDB or Pole tests will disqualify the vehicle from any rewards in far side occupant protection:

- Structural failure of the door; its attachments to the body, the roof/cant rail and sill.
- Detachment of door latches, hinges, fully opened doors or structural failures of the roof/cant rail and sill.
- Failure of restraint system failures that are intended for far side occupant protection. For example, incorrect deployment of centre (occupant to occupant) airbags.
- Where the total score for the driver occupants in the AE-MDB and pole impacts is below 17.0 points out of 20.

Scoring

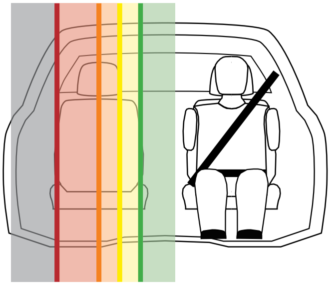
- Max points are depending on Peak Head Excursion and and the availability of far side countermeasures:

	Zone / Countermeasure	Peak Head Excursion in Zone: Capping[1]	Red[2] ≤ 125 mm	Red[2] > 125 mm	Orange	Yellow	Green
Head Excursion	with	0	0.5	1	1.5	2	2
	without	0	0		0.5	1	2

1 In case of head excursion in the capping zone both far side load cases are capped.

2 Score is depending on whether the red excursion line is > 125 mm outboard of the orange excursion line or not.

- Excursion Lines:
  - Red Line: Maximum post test intrusion of the interior door panel from AE-MDB (60 km/h) and 75° pole impacts respectively.
  - Orange Line: Seat centerline of the struck side seat
  - Yellow Line: 125 mm inboard from struck side seat centerline
  - Green Line: 250 mm inboard from struck side seat centerline
- Excursion Zones:
  - Capping Zone: Outboard from the Red Line
  - Red Zone: Between Red Line and Orange Line
  - Orange Zone: Between Orange Line and Yellow Line
  - Yellow Zone: Between Yellow Line and Green Line
  - Green Zone: Inboard from Green Line



Dummy Criteria:

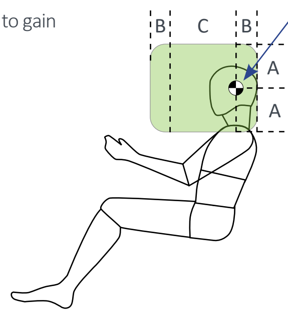
Dummy	Region	Criteria	Capping
Far Side Occupant Protection Sled Test			
World SID 50 %	Head	HIC_{15} (with direct contact only)	> 700
		a_{3ms} (g)	> 80
	Neck	Upper Neck Tension F_z (kN)	> 3.74
		Upper Neck Lateral Flexion M_xOC (Nm)	> 248
		Upper Neck Extension neg. M_yOC (Nm)	> 50
		Lower Neck Tension F_z (kN)	> 3.74
		Lower Neck Lateral Flexion M_x (Nm)	> 248
		Lower Neck Extension neg. M_y (Nm)	> 100
	Chest & Abdomen	Chest Lateral Compression (mm)	> 50
		Abdomen Lateral Compression (mm)	> 65

Occupant to Occupant Protection:

If the vehicle is equipped with a countermeasure, it must prove that the measure prevents occupant to occupant (O2O) interaction. This is verified in the full scale pole side impact. This test will be executed with an additional WS 50% dummy on the front passenger seat. Criteria for O2O head protection:

- No exceedance of the **head lower performance criteria**.
- No evidence of **direct contact** between the far side occupants head and any part of the nearside occupant.
- For an asymmetric countermeasure the OEM must provide evidence that it provides **protection in impacts from both sides**.
- Protection must be offered in a **protection zone**:

All of the above requirements must be met in order to gain **2 points** for O2O protection



CoG marking from passenger in pole test position

A = 120 mm
B = 82 mm
C = Distance between driver (mid + 20 mm) and passenger (rearmost) head CoG locations

Euro NCAP / ANCAP Post Crash Assessment

Rescue & Extrication Protocol Version 1.1	TB PC 101-3 Naming Convention 3.0
TB PC 101-1 Rescue Sheet Guidelines 2.2	Rescue Sheet Checklist 1.0
TB G 001 Application Area 2.0	TB PC 201 e-Call 1.0

Rescue Information

Rescue Sheet must ...		
... meet ISO 17840 Part 1 format.	35 points	40 points
... be provided in PDF format with filenames in accordance with TB PC 101-3.		
... be available as one PDF file per language.		
... not exceed four A4 sized pages when printed.		
... be provided in at least one of the official languages of each country covered by the Euro NCAP Application Area (EAA) as defined in TB G001, even if the vehicle is not sold in every EAA country.		
... be available for all other models, including: models not rated by Euro NCAP that are in production; models with a start of sale 2020 onwards; 2023 onwards facelifts of car models first sold before 2020.		
Emergency Response Guide must ...		
... be provided in PDF format with filenames in accordance with TB PC 101-3.	5 pts.	
... be supplied in English, German, French and Spanish languages following ISO 17840 Part 3.		
One unique ERG covering all the cars from the same brand is acceptable.		

Post Crash Intervention

Advanced eCall – 112 ...			
... provides potential number of occupants.	3	15 points[1]	25 points
... provides direction of impacts - front, side and rear (2 points per direction).	6		
... provides Delta V (1.5 points per direction).	4.5		
... provides direction of impacts - Rollover as 1st impact.	1.5		
Advanced eCall – TPS ...			
... covers all EAA countries.	3	max 15 points[1]	
... is available in multiple languages - EN, DE, FR, ES.	3		
... is available in multiple languages - 4 additional languages.	3		
... provides hazard detection after crash (e.g. fire or thermal propagation).	3		
... supports telephone pairing.	3		
... provides vehicle information (make, model, color).	3		
... provides vehicle attitude (e.g. on the wheels or on the roof).	3		
... provides any additional information, e.g. TVV (Type, Variant, Version).	3		
... supports AACN (Advanced Automatic Collision Notification) (e.g. dCall, OEM severity index).	3		
Multi-collision braking & hazard lights			
Advanced Multi-Collision Braking (MCB)	4	5 pts.	
At least rear hazard lights illuminating after MPDB and FW test. At least non-struck side hazard lights illuminating after AE-MDB and Pole test.	1		

1 Scores for advanced eCall – TPS are cumulative up to a maximum of 15 points. Maximum points available for advanced 112 eCall and advanced TPS eCall combined is 20 points.

Euro NCAP / ANCAP Post Crash Assessment

Vehicle Extrication

Criterion	Points	Sub-total	Group	Total
Energy Management[1]				35 points
Energy Isolation			20 points	
Compliance with electric safety and fuel leakage requirements in UN R94, R95, R135, R137	3	11 points		
Automatic HV deactivation	5			
First manual HV deactivation	2			
Second manual HV deactivation in a different zone of the vehicle	1			
Thermal Propagation				
No thermal propagation (90 min of lead time following UN Regulation no. 100-03 will be considered as no thermal propagation)	3	max. 9 points		
Fulfilment of UN Regulation no. 100-03 with leadtime more than 40 min	3			
Fulfilment of UN Regulation no. 100-03 with leadtime more than 20 min	3			
Thermal runaway detection communication inside the vehicle, displayed after crash, visible for rescuers, with description in Rescue Sheet	2			
Thermal runaway detection communication to the car owner (Phone App) during charging	1			
Thermal runaway detection communication for the people around the car (audio or visual) during charging	1			
Occupant Extrication			15 points	
Seat belt buckle unlatching: Seat belt buckle shall completely release under a load of no more than 60 N for frontal impact tests and 100 N for side impacts.		1		
Door opening – interior, post low voltage drop: Door opening from inside of non-crashed vehicle with 12 V disabled.		3		
Door opening – exterior, post crash: Any locked doors must automatically unlock post crash.		4		
Door opening – exterior, post crash, post low voltage drop: After a crash the doors can be opened from outside even after low voltage drop.		2		
Tailgate opening: After each of the full scale crash tests, the tailgate can be opened without the use of tools.		2		
Submergence – window opening: Electric side windows must still function when command is operated for at least 2 minutes in a replication of a vehicle entering water.	3	max. 3 pts.		
Submergence – rescue tool / emergency device: If side windows do not function when submerged, OEM must provide a method by which the occupant can open or break the front row side windows and tailgate to exit the vehicle. (Not available to vehicles with laminated side or tailgate windows)	1			

1 Vehicles with combustion engines (ICE) must fulfill UN fuel leakage requirements and will be rewarded by default with all other EV related scores.

Total Post Crash Score	**max. 100 points**

Euro NCAP / ANCAP Rating: 2026 - 2028

Overall Assessment Protocol 10.0

Safe Driving	2026 2027 2028	Crash Avoidance	2026 / 2027-2028	Crash Protection	2026-2028	Post-Crash Safety	2026-2028
Occupant Monitoring	**30**	**Frontal Collisions**	**60**	**Frontal Impact**	**40**	**Rescue Information**	**40**
Seatbelt Usage	*10*	*Car & PTW*	*40*	*Offset*	*20*	*Rescue Sheet*	*35*
Occupant Classification	*10*	*Ped. & Cyclist*	*20*	*Full Width*	*10*	*Rescue Guide*	*5*
Occupant Presence	*10*	**Lane Departure**	**20**	*VT & Sled*	*10*	**Post-Crash Intervention**	**25**
Driver Engagement	**30**	*Single Vehicle*	*10*	**Side Impact**	**35**	*Advanced eCall*	*20*
Driver Monitoring	*25*	*Car & PTW*	*10*	*Barrier*	*15*	*Multi Collision Brake*	*5*
Driving Controls	*5*	**Acceleration Prevention**	**20**	*Pole*	*10*	**Extrication**	**35**
Vehicle Assistance	**40**			*Farside*	*10*	*Energy Management*	*20*
Speed Assistance	*20*	*Car & PTW*	*10*	**Rear Impact**	**5**	*Occupant Extrication*	*15*
ACC Performance	*15*	*Ped. & Cyclist*	*10*	*Front Seats*	*4*		
Steering Assistance	*5*			*Rear Seats*	*1*		
				VRU Impact	**20**		
				Head Impact	*10*		
				Pelvis & Leg Imp.	*10*		
max. points (1)	100	max. points (1)	100	max. points (1)	100	max. points (1)	100
normalised score (2)	actual points / (1)	normalised score (2)	actual points / (1)	normalised sc. (2)	act. pts / (1)	normalised score (2)	act. pts / (1)
weighting (3)	20 %	weighting (3)	20 %	weighting (3)	50 %	weighting (3)	10 %
weighted score (4)	(2) x (3)	weighted score (4)	(2) x (3)	weighted score (4)	(2) x (3)	weighted score (4)	(2) x (3)

Balancing: minimum normalised score (2) by box for the respective star rating:

	Safe Driving 2026	2027	2028		Crash Avoidance 2026	2027-2028		Crash Protection 2026-2028		Post-Crash Safety 2026-2028
★★★★★	60 %	70 %	80 %	+	70 %	80 %	+	80 %	+	80 %
★★★★	50 %	60 %	70 %		60 %	70 %		70 %		70 %
★★★	40 %	50 %	60 %		50 %	60 %		60 %		60 %
★★	30 %	40 %	50 %		40 %	50 %		50 %		50 %
★	20 %	30 %	40 %		30 %	40 %		40 %		40 %
Compensation: Maximum shift of scores to compensate adjacent stage				← 5 % →			← 5 % →		X	

Preconditions & Links between stages

Precondition: *If the vehicle offers an Assisted Driving system, it must score at least 50 % for Driver Monitoring and for Driver Collaboration under the AD Grading protocol to be eligible for points for Driver Engagement.*

Precondition: *To be eligible for scoring points in Robustness Layers in a specific scenario, there shall be ≥ 50 % of the total available score in the Standard Range of that scenario.*

Preconditions: *Red (0 points) critical body regions prevent a 5-star rating, even if balancing threshold is reached.*

If no valid HBM data is provided the VT score will be reduced by 2.5 points.

If less than 7 (2028: 8) are scored for COP vehicle provisions, the difference between points scored and 10 will be deducted from the crash protection score.

Link: *Occupant Stature Classification points have to be awarded to allow restraint adaptivity in the Crash Protection Frontal Impact.*

Link: *Crash Occupancy Information points have to be awarded to be eligible for the potential number of occupants points under 112 eCall in Post-Crash.*

Link: *≥ 10 points need to be scored within VRU impacts in Crash Protection to be eligible of scoring points in pedestrian and cyclist scenarios in Frontal Collisions under Crash Avoidance.*

Euro NCAP Rating Composition Table

Safe

- **Occupant Monitoring 30**
  - **Seatbelt Usage 10**
    - Belt Routing 5
      - Bucke only 2.0
      - Behind back 1.0
      - Lap Belt only 2.0
    - Rear Seat 5
      - Rear Seat Occupancy Detection 5.0
  - **Occ. Classificat. 10**
    - Pass. Airb. 4
      - Passenger Airbag Deactivation 4.0
    - OoP 2
      - Close to Airbag 1.0
      - Feet on Dashb. 1.0
    - Stature 4
      - Driver 3.0
      - Frt. Passenger 1.0
  - **Occ. Presence 10**
    - Child Presence 5
      - Child Left Behind 4.0
      - Child Enters 1.0
    - Crash Occupancy 5
      - Belted Occupants 4.0
      - Children in CRS 1.0
- **Driver Engagement**
  - **Driver Monitoring 25**
    - Transient 15
      - Long Distraction 5.0
      - Short Distraction 5.0
      - Phone Use 5.0
    - Non-Trans 10
      - Impairment 4.0
      - Microsleep 2.0

Year							
2026	20 %	★	30 %	★★	40 %	★★★	50 %
2027			30 %	★	40 %	★★	50 %
2028+					40 %	★	50 %

Crash

- **Frontal Collisions 60**
  - **Car & PTW 40**
    - Longitudinal 15
      - CCRs 1.5
      - CCRm 3.0
      - CCRb 2.0
      - CCFhos 2.5
      - CCFhol 2.5
      - CMRs 1.5
      - CMRb 2.0
    - Turning 10
      - CCFtap 5.0
      - CMFtap 5.0
    - Crossing 15
      - CCCscp 7.5
      - CMCscp 7.5
  - **Pedestrian &**
    - Longitudinal 5
      - CPLA 2.5
      - CBLA 2.5
    - Turning 5
      - CPTA 2.5
      - CBTA 2.5

Year					
2026	30 %	★	40 %	★★	50 %
2027+			40 %	★	50 %

Crash

- **Frontal Impact**
  - **Offset 20**
    - Front Occupants 10
      - Driver 5.0
      - Front Passenger 5.0
    - Rear Occupants 10
      - Q6 5.0
      - Q10 5.0
  - **Full Width 10**
    - Front Occupants 7.5
      - Driver 5.0
      - Front Passenger 2.5
    - Rear 2.5
      - Rear Passenger 2.5
  - **VT & Sled 10**
    - Sled 5
      - Driver 2.5
      - Front Passenger 2.5
    - Virtual 5
      - Driver 2.5
      - Front Passenger 2.5
- **MDB**
  - Front Occupant 10
    - Driver 10.0

Year			
2026+	40 %	★	50 %

Post-Crash

- **Rescue Information 40**
  - Rescue Sheets 35
  - ERG 5
- **Post-Crash**
  - **Advanced**
    - Advanced eCall-112 and (each max. 15) are added
    - Advanced eCall 112
      - Potential number of occupants
    - Advanced eCall TPS
      - Country Coverage
      - Multiple Languages: EN|DE|FR|ES
      - Multiple Languages: 4 Additional
      - Hazard Detection after Crash
      - Phone Pairing
      - Vehicle Information

Year			
2026+	40 %	★	50 %

Scale: 10 · 20 · 30 · 40 · 50

Overall Assessment Protocol 10.0

Driving 100

Area	Group	Sub-group	Item	Points
30		ient	Sleep	2.0
30		ient	Unresponsive	2.0
30	Controls 5	Driving 2.5	Driving Controls	1.0
30	Controls 5	Driving 2.5	Vision	0.5
30	Controls 5	Driving 2.5	Lights	0.5
30	Controls 5	Driving 2.5	ADAS	0.5
30	Controls 5	Comfort 2.5	Audio Entertainment	0.5
30	Controls 5	Comfort 2.5	Calling & Dialling	0.5
30	Controls 5	Comfort 2.5	Navigation System	0.5
30	Controls 5	Comfort 2.5	Climate Controls	0.5
30	Controls 5	Comfort 2.5	Windows & Others	0.5
Vehicle Assistance 40	Speed Assistance 20	Speed Limit Information Function 12	SLIF Accuracy	4.0
Vehicle Assistance 40	Speed Assistance 20	Speed Limit Information Function 12	Advanced Speed Limits	3.0
Vehicle Assistance 40	Speed Assistance 20	Speed Limit Information Function 12	Local Hazards	3.0
Vehicle Assistance 40	Speed Assistance 20	Speed Limit Information Function 12	System Updates	2.0
Vehicle Assistance 40	Speed Assistance 20	Speed Control Function 8	ISL/iACC	8.0
Vehicle Assistance 40	ACC Performance 15	Car-to-Car 6	Longitudinal	4.0
Vehicle Assistance 40	ACC Performance 15	Car-to-Car 6	Cut-in / Cut-out	2.0
Vehicle Assistance 40	ACC Performance 15	Car-to-PTW 5	Longitudinal	4.0
Vehicle Assistance 40	ACC Performance 15	Car-to-PTW 5	Cut-in / Cut-out	1.0
Vehicle Assistance 40	ACC Performance 15	VRU 2	Longitudinal	2.0
Vehicle Assistance 40	ACC Performance 15	RF 1	Road Features	1.0
Vehicle Assistance 40	ACC Performance 15	AR 1	Auto-resume	1.0
Vehicle Assistance 40	Steer	Steer. Ass. 4	Steering Assistance S-bend	4.0
Vehicle Assistance 40	Steer	LC 1	Lane Change	1.04

★★★★ 60 % ★★★★★
★★★ 60 % ★★★★ 70 % ★★★★★
★★ 60 % ★★★ 70 % ★★★★ 80 % ★★★★★

Avoidance 100

Area	Group	Sub-group	Item	Points
	Cyclist 20	Crossing 15	CPNA + CPFA	2.5
	Cyclist 20	Crossing 15	CPNCO	2.5
	Cyclist 20	Crossing 15	CBNA + CBFA	2.5
	Cyclist 20	Crossing 15	CBNAO	2.5
Lane Departure Collisions 20	Single Vehicle 10	Driver Accept. 5	Driveability	2.0
Lane Departure Collisions 20	Single Vehicle 10	Driver Accept. 5	Driver State Link	3.0
Lane Departure Collisions 20	Single Vehicle 10	Lane Depart. 5	ELK-RE	5.0
Lane Departure Collisions 20	Car & PTW 10	ELK C2C 5	ELK-ON	2.5
Lane Departure Collisions 20	Car & PTW 10	ELK C2C 5	ELK-OV	2.5
Lane Departure Collisions 20	Car & PTW 10	ELK C2M 5	ELK-ON	2.5
Lane Departure Collisions 20	Car & PTW 10	ELK C2M 5	ELK-OV	2.5
Low Speed Collisions 20	Car & PTW 10	Turning 4	CCFtap	1.0
Low Speed Collisions 20	Car & PTW 10	Turning 4	CMFtap	3.0
Low Speed Collisions 20	Car & PTW 10	Crossing 6	CCCscp	3.0
Low Speed Collisions 20	Car & PTW 10	Crossing 6	CMCscp	3.0
Low Speed Collisions 20	Ped. & Cycl. 10	Crossing 3	CBNAO	3.0
Low Speed Collisions 20	Ped. & Cycl. 10	Manoeuvring 5	CPMRCm	1.5
Low Speed Collisions 20	Ped. & Cycl. 10	Manoeuvring 5	CPMRCs	1.5
Low Speed Collisions 20	Ped. & Cycl. 10	Manoeuvring 5	CPMFC	2.0
Low Speed Collisions 20	Ped. & Cycl. 10	Door. 2	CBDA	2.0

★★★ 60 % ★★★★ 70 % ★★★★★
★★ 60 % ★★★ 70 % ★★★★ 80 % ★★★★★

Protection 100

Area	Group	Sub-group	Item	Points
Side Impact 35	15	Rear Occupant 5	Q6	2.5
Side Impact 35	15	Rear Occupant 5	Q10	2.5
Side Impact 35	Pole 10	Front Occupant 10	Driver	10.0
Side Impact 35	Farside 10	Main 4	AE-MDB	2.0
Side Impact 35	Farside 10	Main 4	Pole	2.0
Side Impact 35	Farside 10	Robustness 4	AE-MDB	2.0
Side Impact 35	Farside 10	Robustness 4	Pole	2.0
Side Impact 35	Farside 10	O2O 2	Occupant to Occupant	2.0
Rear 5	Frt. 4	G 1	Geometry	1.0
Rear 5	Frt. 4	Dynamic 3	High Severity	1.5
Rear 5	Frt. 4	Dynamic 3	Low Severity	1.5
Rear 5	R	R 1	Rear Geometry	1.0
VRU Impact 20	Head Impact 10	Head Impact 10	Head Impact	10.0
VRU Impact 20	Pelvis & Leg 10	Pelvis 2.5	Pelvis	2.5
VRU Impact 20	Pelvis & Leg 10	Femur 2.5	Femur	2.5
VRU Impact 20	Pelvis & Leg 10	Knee & Tibia 5	Knee & Tibia	5.0

★★ 60 % ★★★ 70 % ★★★★ 80 % ★★★★★

Safety 100

Area	Group	Sub-group	Item	Points
Intervention 25	eCall 20	Advanced eCall-TPS scores up to a max. total of 20	Direction of Impacts	
Intervention 25	eCall 20	Advanced eCall-TPS scores up to a max. total of 20	Delta V	
Intervention 25	eCall 20	Advanced eCall-TPS scores up to a max. total of 20	Rollover	
Intervention 25	eCall 20	Advanced eCall-TPS scores up to a max. total of 20	Vehicle Attitude	
Intervention 25	eCall 20	Advanced eCall-TPS scores up to a max. total of 20	Additional information (e.g TVV)	
Intervention 25	eCall 20	Advanced eCall-TPS scores up to a max. total of 20	AACN	
Intervention 25	MCB 5	Adv. MCB 4	Advanced Multi Collision Brake	4.0
Intervention 25	MCB 5	HL 1	Auto Hazard Li.	1.0
Vehicle Extrication 35	Energy Management 20	UN-R 3	UN-R Compliance	3.0
Vehicle Extrication 35	Energy Management 20	Efficiency & Safety 8	Automatic HV Deactivation	5.0
Vehicle Extrication 35	Energy Management 20	Efficiency & Safety 8	1st Manual Deactivation	2.0
Vehicle Extrication 35	Energy Management 20	Efficiency & Safety 8	2nd Man. Deact.	1.0
Vehicle Extrication 35	Energy Management 20	Thermal Propagation max 9 (out of 12)	No Thermal Propagation 90 min	
Vehicle Extrication 35	Energy Management 20	Thermal Propagation max 9 (out of 12)	No Thermal Propagation 40 min	
Vehicle Extrication 35	Energy Management 20	Thermal Propagation max 9 (out of 12)	No Thermal Propagation 20 min	
Vehicle Extrication 35	Energy Management 20	Thermal Propagation max 9 (out of 12)	TR Comm. Inside Veh.	
Vehicle Extrication 35	Energy Management 20	Thermal Propagation max 9 (out of 12)	TRC Owner	
Vehicle Extrication 35	Energy Management 20	Thermal Propagation max 9 (out of 12)	TRC Around	
Vehicle Extrication 35	Occupant Extrication 15		Buckle Unlatch	1.0
Vehicle Extrication 35	Occupant Extrication 15		Door Opening Interior Post Voltage Drop	3.0
Vehicle Extrication 35	Occupant Extrication 15		Door Opening Exterior Post Crash	4.0
Vehicle Extrication 35	Occupant Extrication 15		Doorop. Ext. Post Crash + Low V	2.0
Vehicle Extrication 35	Occupant Extrication 15		Tailgate Opening	2.0
Vehicle Extrication 35	Occupant Extrication 15		Submergence Window Opening or Tool	3.0

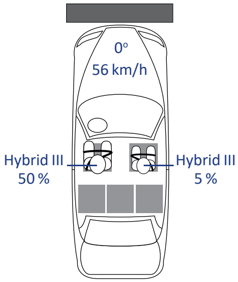
★★ 60 % ★★★ 70 % ★★★★ 80 % ★★★★★

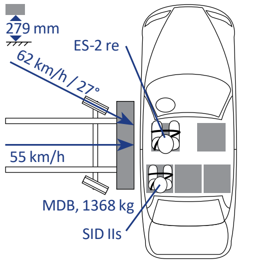
60 70 80 90 100

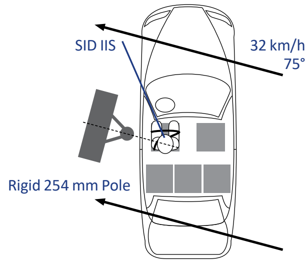
U.S. NCAP: Tests and Criteria

Docket No. NHTSA–2006–26555

Test Procedure May 2018 | **Test Procedure March 2020** | **Test Procedure March 2020**







Injury Criteria

Injury Risk Curves

Frontal-Impact against Rigid Wall with 100 % Overlap @ 56 km/h

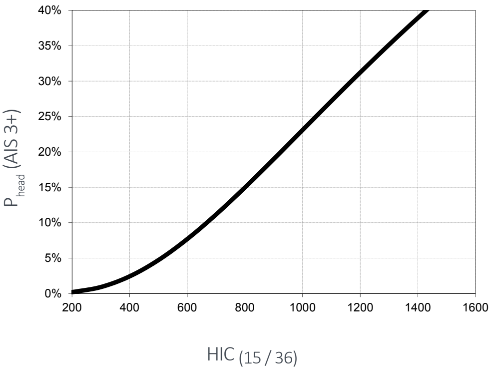
Dummy	Hybrid III 50 % (Driver)	Hybrid III 5 % (Passenger)
Head (HIC_{15})	$P_{head}(AIS3+)=\Phi\left(\frac{\ln(HIC15)-7.45231}{0.73998}\right)$ $where\ \Phi =$ cumulative normal distribution	$P_{head}(AIS3+)=\Phi\left(\frac{\ln(HIC15)-7.45231}{0.73998}\right)$ $where\ \Phi =$ cumulative normal distribution
Chest (Deflection in mm)	$P_{chest\_defl}(AIS3+)=\frac{1}{1+e^{10.5456-1.568*(ChestDefl)^{0.4612}}}$	$P_{chest\_defl}(AIS3+)=\frac{1}{1+e^{10.5456-1.7212*(ChestDefl)^{0.4612}}}$
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)	$P_{neck\_Nij}(AIS3+)=\frac{1}{1+e^{3.2269-1.9688\,Nij}}$ $P_{neck\_Tens}(AIS3+)=\frac{1}{1+e^{10.9745-2.375\,Neck\_Tension}}$ $P_{neck\_Comp}(AIS3+)=\frac{1}{1+e^{10.9745-2.375\,Neck\_Compression}}$ $P_{neck}=\max imum(P_{neck\_Nij}, P_{neck\_Tens}, P_{neck\_Comp})$	$P_{neck\_Nij}(AIS3+)=\frac{1}{1+e^{3.2269-1.9688\,Nij}}$ $P_{neck\_Tens}(AIS3+)=\frac{1}{1+e^{10.958-3.770\,Neck\_Tension}}$ $P_{neck\_Comp}(AIS3+)=\frac{1}{1+e^{10.958-3.770\,Neck\_Compression}}$ $P_{neck}=\max imum(P_{neck\_Nij}, P_{neck\_Tens}, P_{neck\_Comp})$
Overall	$P_{joint} = 1 - (1-P_{head}) \times (1-P_{neck}) \times (1-P_{chest}) \times (1-P_{femur})$	

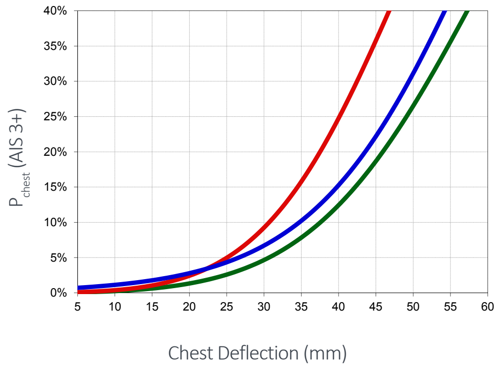
Side Impact (MDB & Pole Test)

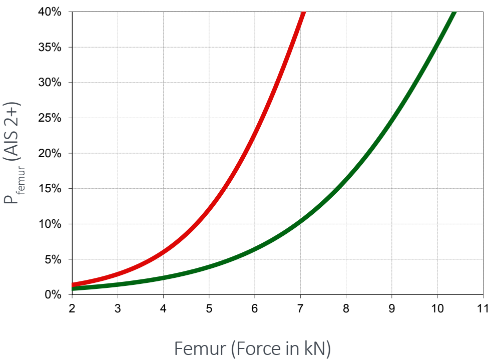
	ES-2re 50 %	SID-IIs 5 %
Head (HIC_{36})	$P_{head}(AIS3+)=\Phi\left(\frac{\ln(HIC36)-7.45231}{0.73998}\right)$ $where\ \Phi =$ cumulative normal distribution	$P_{head}(AIS3+)=\Phi\left(\frac{\ln(HIC36)-7.45231}{0.73998}\right)$ $where\ \Phi =$ cumulative normal distribution
Chest (Rib Deflection in mm)	$P_{chest}(AIS3+)=\frac{1}{1+e^{5.3895-0.0919*\max.\,rib\ deflection}}$	
Abdomen (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 in N)	$P_{pelvis}(AIS3+)=\frac{1}{1+e^{7.5969-0.0011*F}}$ *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*
Overall	$P_{joint} = 1 - (1-P_{head}) \times (1-P_{chest}) \times (1-P_{abdomen}) \times (1-P_{pelvis})$	$P_{joint} = 1 - (1-P_{head}) \times (1-P_{pelvis})$

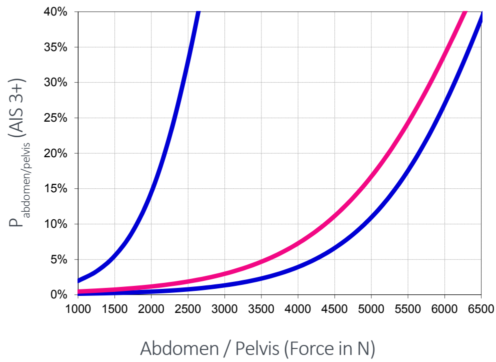
U.S. NCAP: Injury Risk Curves

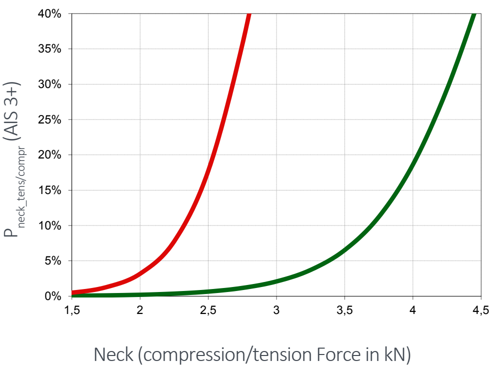
Hybrid III 50 %
Hybrid III 5 %
multiple Dummys
ES-2re 50 %
SID-IIs 5 %
SafetyWissen by carhs

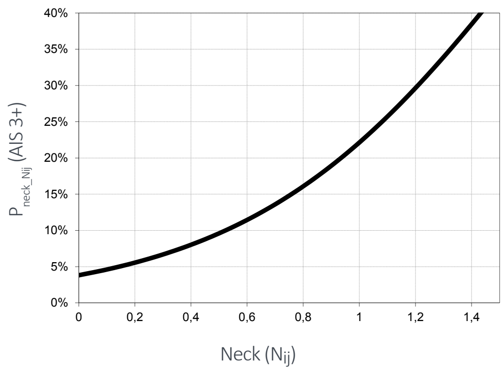












U.S. NCAP: Rating Scheme

Docket No. NHTSA–2006–26555

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

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

Rating procedure

Using the Injury Risk Curves on ➲ page 66 and page 67, 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	0.67 – 1	1 – 1.33	1.33 – 2.67	2.67 –
Stars	★★★★★	★★★★	★★★	★★	★

The rollover star rating is determined using the following table:

RR(roll)	0 – 0.67	0.67 – 1.33	1.33 – 2.0	2.0 – 2.67	2.67 –
Stars	★★★★★	★★★★	★★★	★★	★

The Vehicle Safety Score (VSS) is calculated as follows: (5/12) × RR(front) + (4/12) × RR(side) + (3/12) × RR(roll). The VSS star rating is determined using the following table:

VSS	0 – 0.67	0.67 – 1	1 – 1.33	1.33 – 2.67	2.67 –
Stars	★★★★★	★★★★	★★★	★★	★

IIHS Rating

Test Protocol Version II (May 2025)

Rating Guidelines Version II (Aug 2025)

Dummy	Region	Criteria	Good	Acceptable	Marginal	Poor
Frontal Impact against ODB with 40 % Overlap @ 64 km/h						
H III 50 % Front seat	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
		$a_{res\ peak}$ (g)	Values > 70 result in downgrading			
	Chest	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 & Hip	KTH Injury Risk (%)	≤ 5	≤ 15	≤ 25	> 25
	Legs & Feet	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
H III 5 % Rear seat	Head & Neck	HIC_{15}	≤ 560	≤ 700	≤ 840	> 840
		N_{ij}	≤ 0.80	≤ 1.00	≤ 1.20	> 1.20
		$F_{z,tension}$ (kN)	≤ 2.0	≤ 2.4	≤ 2.8	> 2.8
		$F_{z,compression}$ (kN)	≤ 2.0	≤ 2.5	≤ 3.0	> 3.0
		$a_{res\ peak}$ (g)	Values > 70 result in downgrading			
	Chest	Chest Index (-)	≤ 35	≤ 40	≤ 45	> 45
		Shoulder Belt Tension (kN)	≤ 5.9	--	< 5.9	--
	Thigh & Hip	Femur Axial Compression (kN)	≤ 4.9	≤ 6.2	≤ 7.4	> 7.4

Chest Index Calculation

The **Chest Index** provides a metric for chest protection, eliminating the influence of the belt position on the sternum.
It takes into account the dynamic belt position, i.e. the vertical distance from the sternum pot ball on the rear occupant's uncompressed thorax to the centerline of the shoulder belt at the time of maximum sternum deflection.
If *Dynamic Belt Position* ≤ 17 mm, **Chest Index** = | Max. Measured Sternum Deflection |
if *Dynamic Belt Position* > 17 mm,

$$\textbf{Chest Index} = \frac{|\ \text{Max. Measured Sternum Deflection}\ |}{(1 - 0.005 \times (\textit{Dynamic Belt Position} - 17\ \text{mm})}$$

IIHS Rating

Rating Guidelines Version IV (Apr 2024) | Test Protocol Version III (May 2025)

Dummy	Region	Criteria	Good	Acceptable	Marginal	Poor
Barrier Side Impact (IIHS MDB 2.0) @ 60 km/h						
SID-IIs 5 %	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
	Chest/ Torso	Shoulder deflection (mm)	Values > 60 or bottoming out result in downgrading by one category			
		Ø Peak rib deflection (mm)[1]	≤ 28	≤ 38	≤ 48	> 48
		Worst peak rib deflection (mm)[2]			51 - 56	> 56
		Deflection rate (m/s)	≤ 8.2	≤ 9.8	≤ 11.5	> 11.5
		VC (m/s)	≤ 1.0	≤ 1.2	≤ 1.4	> 1.4
	Pelvis	Combined acetabulum and ilium force (kN)	≤ 4.0	≤ 5.0	≤ 6.0	> 6.0
Head Protection			HPS contains head & prevents hard contact with barrier face & interior a_{res} ≤ 70 g	Head receives significat restraint but contacts interior a_{res} ≤ 70 g / a_{res} > 70 g w/o hard contacts	No head protection system or head contacts vehicle interior with Head a_{res} > 70 g	Head exposed to outside objects or contacting MDB
Structure		Intrusion: B-pillar to driver seat centerline distance (mm)	≥ 180	≥ 140	≥ 100	< 100
		Door opening	Downgrade structural rating by one category			
		Fuel spill	Downgrade structural rating according to type/severity			
		High-voltage system damage	Downgrade structural rating according to type/severity			

1 Applies when maximum rib deflection does not exceed 50 mm.
2 Applies if any of the rib deflections exceeds 50 mm.

IIHS TOP SAFETY PICK / IIHS TOP SAFETY PICK+

Year	TSP Criteria	TSP+ Criteria
2026	■ Small Overlap: Good ■ Updated ODB Crash: Good ■ Updated Side Test: Good ■ Standard Headlights: Acceptable or Good ■ Pedestrian Front Crash Prevention: Acceptable or Good	■ Small Overlap: Good ■ Updated ODB Crash: Good ■ Updated Side Test: Good ■ Standard Headlights: Acceptable or Good ■ Pedestrian Front Crash Prevention: Good ■ Vehicle-to-vehicle Front Crash Prevention: Acceptable or Good

IIHS Rating: Small Overlap

Test Protocol Version VIII (May 2025)

Rating Protocol Version VII (Apr 2024)

Dummy	Region	Criteria	Good	Acceptable	Marginal	Poor
Frontal Impact against Small Overlap Barrier with 25 % Overlap @ 64 km/h						
Structure Rating: Intrusions (mm) ❶	Lower Occupant Compartment	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	steering column (longitutinal)	≤ 50	≤ 100	≤ 150	> 150
		upper hinge pillar (resultant)	≤ 75	≤ 125	≤ 175	> 175
		upper dash (resultant)				
		left instrument panel (resultant)				
H III 50 %	Head & Neck ❷	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
	Chest/ Torso ❸	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
	Femur ❹	KTH Injury Risk (%)	≤ 5	≤ 15	≤ 25	> 25
	Leg & Foot ❺	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

Frontal Impact against Small Overlap Barrier with 25 % Overlap @ 64 km/h		
Restraints & Dummy Kinematics Rating SafetyWissen by carhs	**Demerits**	
Rating system based on a demerit system	Driver side impact	Passenger side impact
Frontal Head Protection		
Partial frontal airbag interaction	**1**	**2**
Minimal frontal airbag interaction	**2**	**4**
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**	**1**[1]
No side head protection airbag deployment	**2**	**2**[1]
Excessive head lateral movement	**1**	**1**[1]
Front Chest Protection		
Excessive vertical steering wheel movement (> 100 mm)	**1**[2]	
Excessive lateral steering wheel movement (> 150 mm)	**1**[2]	
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**

1 Passenger only 2 Driver only

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: SafetyWissen by carhs				
Overall Rating	**Good**	**Acceptable**	**Marginal**	**Poor**
Sum of demerits	**≤ 3**	**≤ 9**	**≤ 19**	**> 19**

ASEAN NCAP

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Overall Rating 2026 - 2030

Overall Assessment Protocol Version 3.1

	Adult Occupant Protection		Child Occupant Protection		Safety Assist		Motorcyclist Safety		
	Offset Frontal Impact 16		Frontal Impact 16		Seat Belt Reminder 6		Blind Spot (BST) 8		
	Side Impact (MDB) 8		Side Impact 8		EBA 6		Rear View (ARV) 3		
	HPT 8		CRS Installation 12		AEB City 2.5		Auto High Beam (AHB) 3		
			Vehicle-based Assmt. 13		AEB Inter Urban 5		Pedestrian Protection 2		
			CPD 5		Lane Support 2		AEB MC 6		
					Advanced SAT 2		Advanced MST 2		
max. points (1)	32		54		23.5		24		
normalized score (2)	actual points / (1)		actual points / (1)		actual points / (1)		actual points / (1)		Overall score (5)
weighting (3)	40 %		20 %		20 %		20 %		
weighted score (4)	(2) x (3)		(2) x (3)		(2) x (3)		(2) x (3)		∑(4)
Rating	Balancing: minimum normalized score (2) per box required for the respective star rating:								
	score	points	score	points	score	points	score	points	
★★★★★	80 %	25.60	75 %	40.50	75 %	17.63	55 %	13.20	
★★★★	70 %	22.40	60 %	32.40	60 %	14.10	45 %	10.80	
★★★	60 %	19.20	50 %	27.00	40 %	9.40	40 %	9.60	
★★	50 %	16.00	40 %	21.60	30 %	7.05	30 %	7.20	
★	40 %	12.80	30 %	16.20	20 %	4.70	20 %	4.80	

Adult Occupant Protection

AOP Assessment Protocol Version 3.0 **ODB Test Protocol Version 4.0**

Frontal Impact against ODB with 40 % Overlap @ 64 km/h

Dummy	Region	Points	Criteria	
H III 50 % front	Head, Neck	4	$HIC_{15} < 500$; $a_{3ms} < 72$ 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	max. 16 points
		0	$HIC_{15} > 700$; $a_{3ms} > 80$ 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 > 42 mm; VC > 1.0 m/s	
	Femur, Knee	4	Axial $Force_{compression} < 3.8$ kN Knee Displacement < 6 mm	
		0	Axial $Force_{compression} > 9.07$ kN @ 0 ms / > 7.56 @ 10 ms Knee Displacement > 15 mm	
	Tibia Foot	4	TI < 0.4; Axial $Force_{compression} < 2$ kN Pedal rearward displacement < 100 mm	
		0	TI > 1.3; Axial $Force_{compression} > 8$ kN Pedal rearward displacement > 200 mm	

Barrier Side Impact (MDB) @ 50 km/h

MDB Test Protocol Version 3.2

Dummy	Region	Points	Criteria	
WS-50	Head	4	$HIC_{15} < 500$; $a_{3ms} < 72$ g	max. 16 points[2]
		0	$HIC_{15} > 700$; $a_{3ms} > 80$ g	
	Chest	4	Deflection < 28 mm	
		0	Deflection > 50 mm	
	Abdomen	4	Deflection < 47 mm	
		0	Deflection > 65 mm	
	Pelvis	4	PSPF < 1.7 kN	
		0	PSPF > 2.8 kN	

[2] scaled down to 8 points in the overall rating

C-NCAP

Frontal Impact with 100 % Overlap @ 55 km/h

Dummy	Region	Points	Criteria	
H III 50 % front	Head	5	HIC_{15} ≤ 500; a_{3ms} ≤ 72 g	max. 24 points
		0	HIC_{15} ≥ 700; a_{3ms} ≥ 80 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; Knee Displacement ≤ 6 mm	
		0	Axial $Force_{compression}$ ≥ 9.07 kN @ 0 ms / ≥ 7.56 @ 10 ms; Knee 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	1.6	HIC_{15} ≤ 500; a_{3ms} ≤ 72 g	
		0	HIC_{15} ≥ 700; a_{3ms} ≥ 80 g	
	Neck	0.4	$F_{x,shear}$ ≤ 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	2	Deflection ≤ 18 mm; VC ≤ 0.5 m/s	
		0	Deflection ≥ 42 mm; VC ≥ 1.0 m/s	
Q3 rear	Head	2	HIC_{15} ≤ 500; a_{3ms} ≤ 60 g	
		0	HIC_{15} ≥ 700; a_{3ms} ≥ 80 g	
	Neck	1	$F_{z,tension}$ ≤ 1555 N	
		0	$F_{z,tension}$ ≥ 2840 N	
	Chest	1	Deflection ≤ 30 mm (forward facing CRS); a_{3ms} ≤ 41 g (rear facing CRS)	
		0	Deflection ≥ 42 mm (forward facing CRS); a_{3ms} ≥ 55 g (rear facing CRS)	

Whiplash Test @ Δv = 20 km/h

Dummy	Region	Points Front	Points Rear	Criteria	
BioRID II	NIC	2	0.8	≤ 8 m²/s²	max. 5 points / 2 points
		0	0	≥ 30 m²/s²	
	Upper Neck	1.5	0.6	F_{X+} ≤ 340 N; F_{Z+} ≤ 475 N; M_Y ≤ 12 Nm	
		0	0	F_{X+} ≥ 730 N; F_{Z+} ≥ 1130 N; M_Y ≥ 40 Nm	
	Lower Neck	1.5	0.6	F_{X+} ≤ 340 N; F_{Z+} ≤ 257 N; M_Y ≤ 12 Nm	
		0	0	F_{X+} ≥ 730 N; F_{Z+} ≥ 1480 N; M_Y ≥ 40 Nm	
Max. dyn. seatback defl.		-2	-0.8	≥ 0.04 x ΔX - 14.5°	
Dyn. seat displacement		-5	-2	≥ 20 mm	
HRMD interference		-2	-0.8	Y/N	

C-NCAP

Frontal Impact against MPDB with 50 % Overlap @ 50/50 km/h

THOR 50 % front driver	Head, Neck	4	$HIC_{15} \leq 500$; $a_{3ms} \leq 72$ g $M_{y,extension} \leq 42$ Nm; $F_{z,tension} \leq 2.7$ kN; $F_{x,shear} \leq 1.9$ kN	max. 24 points[1]
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g $M_{y,extension} \geq 57$ Nm; $F_{z,tension} \geq 3.3$ kN; $F_{x,shear} \geq 3.1$ kN	
	Chest, Abdomen	4	Chest Deflection ≤ 35 mm	
		0	Chest Deflection ≥ 60 mm; Abdomen Deflection ≥ 88 mm	
	Pelvis, Femur Knee	4	$Acetabulum_{Compression} \leq 3.28$ kN; Femur Axial $Force_{compression} \leq 3.8$ kN; Knee Displacement ≤ 6 mm	
		0	$Acetabulum_{Compression} \geq 4.1$ kN; Femur Axial $Force_{compression} \geq 9.07$ kN @ 0 ms / ≥ 7.56 @ 10 ms; Knee Displacement ≥ 15 mm	
	Tibia	4	TI ≤ 0.4; Axial $Force_{compression} \leq 2$ kN	
		0	TI ≥ 1.3; Axial $Force_{compression} \geq 8$ kN	
H III 5 % front/ rear passenger	Head, Neck	4 front / 2 rear	$HIC_{15} \leq 500$; $a_{3ms} \leq 72$ g $M_{y,extension} \leq 36$ Nm; $F_{z,tension} \leq 1.7$ kN; $F_{x,shear} \leq 1.2$ kN	
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g $M_{y,extension} \geq 49$ Nm; $F_{z,tension} \geq 2.62$ kN; $F_{x,shear} \geq 1.95$ kN	
	Chest	4 / 2	Deflection ≤ 18 mm; VC ≤ 0.5 m/s	
		0	Deflection ≥ 42 mm; VC ≥ 1.0 m/s	
	Femur	4 / -	Axial $Force_{compression} \leq 2.6$ kN	
		0	Axial $Force_{compression} \geq 6.2$ kN	
Q10 rear	Head	2	$HIC_{15} \leq 500$; $a_{3ms} \leq 60$ g	
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g	
	Neck	1	$F_{z,tension} \leq 1555$ N	
		0	$F_{z,tension} \geq 2840$ N	
	Chest	1	$a_{3ms} \leq 41$ g	
		0	$a_{3ms} \geq 55$ g	
Compatibility Assessment (➲ page 54 for more details)				max. -6 points
Homogenity		0...-2	Standard deviation of barrier deformation: 50 mm ... 150 mm	
Bottoming out		-2	Barrier penetration ≥ 630 mm in an area of ≥ 40 x 60 mm	
High intrusion		-1	For vehicles with longitudinal member above 508 mm: Intrusion of 6 consecutive 20 x 20 mm cells above the 650 mm upper boundary of the rating area ≥ 480 mm	
Occupant Load Criterion		0...-2	OLC 25 ... 40 g	

1 16 points for driver & front passenger (worst body region of either driver or passenger counts), 4 points for each rear passenger

Static Child Protection Assessment

Vehicle based assessment	0.5	Applicabilty of belt mounted child restraints	max. 3 points
	0.5	Applicabilty of ISOFIX mounted child restraints	
	0.5	Applicabilty of large child restraints	
	0.5	Communication function	
CRS Installation	0.5	Belt mounted child restraints	
	0.5	ISOFIX mounted child restraints	


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Dummy	Region	Points	Criteria	
Barrier Side Impact (SC-MDB) @ 60 km/h				
World SID 50 % front	Head	4	$HIC_{15} \leq 500$; $a_{3ms} \leq 72$ g	max. 20 points
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$g	
	Chest	4	Deflection ≤ 28 mm	
		0	Deflection ≥ 50 mm; VC ≥ 1.0 m/s; Shoulder Lateral Force ≥ 3.0 kN	
	Abdomen	4	Deflection ≤ 47 mm	
		0	Deflection ≥ 65 mm; VC ≥ 1.0 m/s	
	Pelvis	4	PSPF ≤ 1.7 kN	
		0	PSPF ≥ 2.8 kN	
SID-IIs rear	Head	1	$HIC_{15} \leq 500$	
		0	$HIC_{15} \geq 700$	
	Chest	1	Deflection ≤ 31 mm	
		0	Deflection ≥ 41 mm; VC ≥ 1.0 m/s	
	Abdomen	1	Deflection ≤ 38 mm	
		0	Deflection ≥ 48 mm; VC ≥ 1.0 m/s	
	Pelvis	1	Force ≤ 3500 N	
		0	Force ≥ 5500 N	
Pole Side Impact @ 32 km/h				
WS 50 % front	see Barrier Side Impact			max. 20 points
Q3 rear	Head	2	$HIC_{15} \leq 500$; $a_{3ms} \leq 60$ g	
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$g	
	Neck	1	$F_{res} < 2600$ N	
		0	$F_{res} \geq 2600$ N	
	Chest	1	$a_{3ms} < 67$ g	
		0	$a_{3ms} \geq 67$ g	
Far Side Assessment Single Occupant based on 8 Virtual Test Scenarios				
World SID 50 %	Head	4[1]	$HIC_{15} \leq 500$; $a_{3ms} \leq 72$ g	max. 8[1] points
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$g	
	Chest & Abdomen	4[1]	Chest Deflection ≤ 28 mm; Abdomen Deflection ≤ 47 mm	
		0	Chest Deflection ≥ 50 mm; Abdomen Deflection ≥ 65 mm	
SID-IIs	Head	4[1]	$HIC_{15} \leq 500$; $a_{3ms} \leq 72$ g	
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$g	
	Chest & Abdomen	4[1]	Chest Deflection ≤ 31 mm; Abdomen Deflection ≤ 38 mm	
		0	Chest Deflection ≥ 41 mm; Abdomen Deflection ≥ 48 mm	

1 max. score depends on head excursion and availability a far side countermeasure

Dummy	Region	Points	Criteria	
Far Side Assessment Dual Occupant in Pole Side Impact				
WS 50 % front passenger	Head	-1	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$g	max. 1.5 points penalty
	Chest Abdomen Pelvis	- 0.5	Chest Deflection ≥ 50 mm; VC ≥ 1.0 m/s	
			Abdomen Deflection ≥ 65 mm; VC ≥ 1.0 m/s	
			PSPF ≥ 2.8 kN	
ES2-re front passenger	Head	-1	$HIC_{36} \geq 1000$; $a_{3ms} \geq 88$g	
	Chest Abdomen Pelvis	- 0.5	Chest Deflection ≥ 44 mm; VC ≥ 1.0 m/s	
			Abdomen Force ≥ 2.5 kN	
			PSPF ≥ 6.0 kN	

C-NCAP

Seat Belt Reminder

SBR passenger	-1	no SBR with occupant detection available	max. -2
SBR 2nd row	-1	no SBR available	
	-0.5	only SBR without occupant detection available	

Other Items

Ejection Mitigation	3	Curtain meets FMVSS 226 or maintains 50 % of working pressure for 6 s, rollover triggering evalutaion
eCall	1	manual emergency call function
	1	automatic emergency call function
CPD	2	

Occupant Protection		VRU Protection		Active Safety		
	max. points		max. points		max. points	
MPDB Frontal	24	Head Impact	10	AEB Car-to-Car	10	
Full-width Frontal	24	Leg Impact	5	AEB false positive	3	
Side Impact MDB	20	max. points Impact (2)	15	LKA	2	
Side Impact Pole	20	AEB Car-to-Ped	12	ELK	1	
Far side	8	AEB Car-to-PTW	12	DMS	2	
Child Safety Static	3	max. points AEB (3)	24	LDW[1]	1	
Whiplash Front/Rear	7			TSR[1]	1	
Ejection Mitigation	3			BSD[1]	2	
CPD	2			ISLS[1]	1	
eCall	2			DOW[1]	1	
ASB[2]	(1)			RCTA[1]	1	
max. points (1)	113			max. points ADAS (4)	24	
				Headlights (5)	10	
normalised score (6)	actual points / (1)	normalised score (6)	60 % x act. pts. Impact / (2) + 20 % x act. pts. AEB / (3)	normalised score (6)	71.4 % x act. pts. ADAS / (4) + 28.6 % x act. pts. Headl. / (5)	Overall Score
weighting (7)	54 %	weighting (7)	25 %	weighting (7)	21 %	
weighted score (8)	(6) x (7)	weighted score (8)	(6) x (7)	weighted score (8)	(6) x (7)	∑(8)
Balancing: minimum normalised score (4) by box for the respective star rating						min. overall score
★★★★★☆	95 %	+	75 %	+	85 %	92 %
★★★★★	85 %		70 %		70 %	83 %
★★★★	75 %		65 %		60 %	74 %
★★★	65 %					65 %
★★	60 %					45 %
★	< 60 %					< 45 %

1 Optional test items. Maximal total score for all optional items = 6 points.
2 Optional test item. Does not increase max. points for the category.

JNCAP

Assessment Protocol May 2024

Full Width Protocol May 2024

MPDB Protocol May 2024

Frontal Impact against Rigid Wall with 100 % Overlap @ 50 km/h

Dummy	Region	Weight	Points	Criteria	
H III 5 %	Head[1]	0.8	4	HIC_{15} < 500	max. 12 points (after weighting)
			0	HIC_{15} > 700	
			0…-1	Modifier: steering wheel upward displacement 72 ... 88 mm (driver)	
	Neck[2]	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 < 18 mm	
			0	Deflection > 34 mm (driver) / > 42 mm (rear)	
			0…-1	Modifier: steering wheel rearward displacement 90 ... 110 mm (driver)	
			-1	Modifier: steering wheel contact (driver)	
			-2	Modifier: Shoulder belt load ≥ 6.0 kN	
	Abdomen	0.8	4	4 points awarded by default	
			-2	Modifier: Left belt strap rising (submarining)	
			-2	Modifier: Right belt strap rising (submarining)	
	Femur	0.4	4	Axial $Force_{compression}$ < 4.8 kN	
			0	Axial $Force_{compression}$ > 6.8 kN	

1 If there is no hard contact, a score of 4 points is awarded for the rear passenger.

2 The neck score is the minimum points of three criteria, Shear, Tension, Extension. If no secondary collision identified, a score of the Tension criteria shall be used for the rear passenger.

Frontal Impact against MPDB with 50 % Overlap @ 50/50 km/h

Dummy	Region	Weight	Points	Criteria	
Driver THOR 50 %	Head	0.705	4	HIC_{15} < 500	max. 12 points (after weighting)
			0	HIC_{15} > 700	
			-1 / -2	Modifier: Brain DAMAGE ≥ 0.42 / Brain DAMAGE ≥ 0.47	
			0…-1	Modifier: steering wheel upward displacement 72 ... 88 mm (driver)	
	Neck[1]	0.18	4	$F_{x,shear}$ < 2.7 kN; $F_{z,tension}$ < 1.9 kN; $M_{y,extension}$ < 42 Nm	
			0	$F_{x,shear}$ > 3.3 kN; $F_{z,tension}$ > 3.1 kN; $M_{y,extension}$ > 57 Nm	
	Chest	0.705	4	Deflection < 35 mm	
			0	Deflection > 60	
			0…-1	Modifier: steering wheel rearward displacement 90 ... 110 mm (driver)	
			-1	Modifier: steering wheel contact (driver)	
			-2	Modifier: Shoulder belt load ≥ 6.0 kN	
	Abdomen & Pelvis	0.705	4	Acetabulum Load < 3.28 kN	
			0	Acetabulum Load > 4.1 kN	
			-2	Modifier: Deflection > 88 mm	
	Femur & Tibia	0.705	2	Femur Load < 7 kN	
			0	Femur Load > 10 kN	
			2	Tibia Index < 0.4	
			0	Tibia Index > 1.3	
			-1	Modifier: Tibia Axial Force > 8 kN	
			0…-1	Modifier: brake pedal rearward displacement 100 ... 200 mm	
			0…-1	Modifier: brake pedal upward displacement 72 ... 88 mm	
Passenger H III 5 %	Head	0.8		the same points/criteria/modifiers as for Rigid Wall Frontal Impact (see above) apply. Lower performance limit Chest Deflection: 34 mm	max. 12 pt.
	Neck[1]	0.2			
	Chest	0.8			
	Abdomen	0.8			
	Femur	0.4			

1 The neck score is the minimum points of three criteria, Shear, Tension, Extension.

Side Impact Protocol May 2024

Barrier Side Impact (AE-MDB) @ 55 km/h

Dummy	Region	Weight	Points	Criteria	
World SID 50 % front	Head	1.0	4	HIC_{15} < 500	max. 12 pt.
			0	HIC_{15} > 700	
	Chest	1.0	4	Deflection < 28 mm	
			0	Deflection > 50 mm, Shoulder Lateral Force > 3.0 kN	
	Abdomen	0.5	4	Deflection < 47 mm	
			0	Deflection > 65 mm	
	Pelvis	0.5	4	PSPF < 1.7 kN	
			0	PSPF > 2.8 kN	

招商车研 CMVR

招商局检测车辆技术(合肥)有限公司

China Merchants Testing Vehicle Technology (Hefei) Co., Ltd.

Automobile Crash Test Laboratory

China Merchants Vehicle Research Hefei Company's Automobile Crash Test Laboratory is established in the core area of the Yangtze River Delta automobile industry, relying on the national-level automobile testing and certification platform. The laboratory covers an area of approximately 10,000 square meters, with an investment of about RMB 200 million.

It comprises four core testing modules: vehicle crash, simulated crash, pedestrian protection, and body strength.

The facility is equipped with independent vehicle preparation rooms, confidential vehicle storage rooms with charging capabilities, specialized firefighting systems for NEV crash tests, and a professional data storage management center. These advanced equipment and facilities, professional technical team, and strict confidentiality management system ensure the accuracy of test data.

We provide authoritative testing services, expert consulting, and tailored solutions to assist OEMs and component suppliers in enhancing product safety performance.

Additionally, we offer technical support and data support for the formulation and update of industry safety regulations, driving continuous advancements in automotive safety standards across the sector.

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JNCAP

Whiplash Test Protocol April 2023

Dummy	Criteria		Weight	Points	Limits	
Whiplash Test						
BioRID II	NIC		1	4	< 8 m²/s²	max. 12 points (after weighting)
				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	

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

Collision Safety Rating

Assessment Protocol May 2024

	max. score	weight	max. weighted score	total	total
Occupant Protection					SafetyWissen by carhs
Full-width Frontal				59	100 A-Rank ≥ 84.63[2] B-Rank ≥ 71.89 C-Rank ≥ 59.07 D-Rank ≥ 46.33 E-Rank < 46.33
Driver	12	22/24	11		
Passenger (rear)	12	22/24	11		
MPDB Frontal					
Driver	12	22/24	11		
Passenger	12	22/24	11		
Side Impact					
Driver	12	14/24	7		
Passenger[1]	12	14/24	7		
Whiplash					
Driver	12	1/24	0.5		
Passenger	12	1/24	0.5		
Pedestrian Protection (➲ page 110)					
Head Impact	4	32/4	32	37	
Leg Impact	4	5/4	5		
Seat Belt Reminder					
Front passenger	1.5	4/3.6	1.67	4	
Rear passenger	2.1	4/3.6	2.33		

1 For the passenger the same score as for the driver is assumed.
2 Downgrade to B-rank, unless at least level 4 is reached for all results.
3 eCall is a prerequisite for a 5 star rating.

Overall Rating:

Star Rating	Sum of Collision Safety score (max 100 pts.) + Preventive Safety score (max 85.8 pts.) + eCall (max 8 pts.) = max. 193.8 pts.:
★★★★★	≥ 154.07[3]
★★★★	≥ 122.09
★★★	≥ 92.27
★★	≥ 62.85
★	< 62.85

Information Category:

Not part of the overall rating.

CPD	Child Presence Detection
TSR	Traffic Sign Recognition

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Protocol 2025 Overall Rating GR-AP-1

Overall Rating

Category	Crash Safety		VRU Safety		Safety Assist[1]	
	Full Width Frontal Impact	22	VRU Impact[2]	50	AEB Car-to-Car	40
	MPDB Frontal Impact	16	AEB Pedestrian	40	LKAS	20
	MDB Side Impact	14	AEB Cyclist	10	BSD	2
	Pole Side Impact	13			RCCA (Rear Cross Collision Avoidance)	10
	Far Side Impact	6			ISA	10
	Child Protection				ESF	15
	MPDB Frontal Impact	6			PMAPS (Pedal Misapplication)	3
	MDB Side Impact	4			V2X (additional)	1
	Whiplash	6				
	SBR	3				
	Advanced Airbag[1]	1				
	Crash Compatibility	4				
	e-Call[1]	2				
	Event Data Recorder	3				
	Post-crash Rescue & Extraction	-6				
max. total points (1)	100 (-6) points		100 points		100 points	
normalized score (2)	actual points / (1)		actual points / (1)		actual points / (1)	
weighting	50 %		20 %		30 %	

Star rating per category: Minimum normalized scores (2) for the respective star rating

Category	Crash Safety	VRU Safety	Safety Assist
★★★★★	≥ 85.1 %	≥ 70.1 %	≥ 70.1 %
★★★★	≥ 79.1 %	≥ 60.1 %	≥ 60.1 %
★★★	≥ 73.1 %	≥ 50.1 %	≥ 50.1 %
★★	≥ 67.1 %	≥ 40.1 %	≥ 40.1 %
★	≤ 67.0 %	≤ 40.0 %	≤ 40.0 %

Overall classification:

1st Grade	★★★★★ in each category
2nd Grade	at least ★★★★ in each category
3rd Grade	at least ★★★ in each category
4th Grade	at least ★★ in each category
5th Grade	at least ★ in each category

1 For advanced airbag, e-Call and all items of the Safety Assist category, 100 % of the score is awarded if available as a standard equipment to the vehcle. If available as an optional equipment to the vehicle, only 50 % of the points are awarded. The total score for each category cannot exceed 100 points.

2 For VRU impact, if the score is less than 25 points, the score of the VRU impact item shall be considered as zero points.

EV Safety Rating

The EV safety rating is based on the Battery Management System (BMS) assessment with a maximum total score of 2.2 points.

Category	EV Safety
★★★★★	≥ 80.1 %
★★★★	≥ 70.1 %
★★★	≥ 60.1 %
★★	≥ 50.1 %
★	≤ 50.0 %

KNCAP

Protocol 2025 MPDB TP-CS-2

Protocol 2025 FW TP-CS-1

Frontal Impact against MPDB with 50 % Overlap @ 56/56 km/h

Dummy	Region	Points	Criteria	
Driver ❶: THOR 50 % Passenger ❷: H III 50 %	Head, Neck	5	HIC_{15} < 500; a_{3ms} < 72 g; $M_{y,ext}$ < 42 Nm; $F_{z,tens}$ < 2.7 kN; $F_{x,shear}$ < 1.9 kN	max. 16 points
		0	HIC_{15} ≥ 700 ; a_{3ms} ≥ 80 g; $M_{y,ext}$ ≥ 57 Nm; $F_{z,tens}$ ≥ 3.3 kN; $F_{x,shear}$ ≥ 3.1 kN	
		capping	HIC_{15} ≥ 700; a_{3ms} ≥ 80 g; $M_{y,ext}$ ≥ 57 Nm; $F_{z,tens}$ ≥ 3.3 kN; $F_{x,shear}$ ≥ 3.1 kN	
	Chest Abdomen	5	Chest Deflection < 35❶/ 22❷ mm; VC < 0.5 m/s ❷	
		0	Deflection ≥ 60 ❶/ 42 ❷ mm; Abd Deflection ≥ 88 mm❶; VC ≥ 1.0 m/s ❷	
		capping	Deflection ≥ 60 ❶ / 42 ❷ mm; VC ≥ 1.0 m/s ❷	
	Pelvis, Femur, Knee	2	$Acetabulum_{Compr}$ < 3.28 kN ❶; $Femur_{Compr}$ < 3.8 kN; Knee displ. < 6 mm	
		0	$Acetabulum_{Compr}$ ≥ 4.1 kN ❶ Axial $Force_{compr}$ ≥ 9.07(@ 0 ms) / 7.56 (@ 10 ms) kN; Knee displ. ≥ 15 mm	
	Tibia	4	TI < 0.4; Axial $Force_{compr}$ < 2 kN	
		0	TI ≥ 1.3; Axial $Force_{compr}$ ≥ 8 kN	
Modifiers		-1 / -2	DAMAGE ≥ 0.42 &/ DAMAGE ≥ 0.47	
		-1	Unstable airbag/incorrect airbag deployment (from head score)	
		0...-1	Steering wheel upward displacement 72 ... 88 mm (from head score)	
		0...-1	Steering wheel rearward displacement 90 ... 110 mm (from head score)	
		0...-1	Steering wheel lateral displacement 90 ... 110 mm (from head score)	
		-1	Steering wheel contact (from chest score)	
		-2	Shoulder belt load ≥ 6 kN (from chest score)	
		0...-1	A-pillar rearward displacement 100 ... 200 mm (from chest score)	
		-1	Door latch or hinge failure (from chest score)	
		-1	Incorrect airbag deployment (from femur score)	
		0...-4	Pedal upward displacement 72 ... 88 mm (from tibia score)	
		0...-4	Pedal rearward displacement 100 ... 200 mm (from tibia score)	
		-1/door	Door opening during impact	
		-1	Fuel leakage	

Frontal Impact against Rigid Wall with 100 % Overlap @ 56 km/h

Dummy	Region	Points	Criteria	
H III 5 %	Head[1]	4	HIC_{15} < 500; a_{3ms} < 72 g	max. 16 points[4] (scaled up to 22)
		0	HIC_{15} ≥ 700; a_{3ms} ≥ 80 g	
		capping	HIC_{15} ≥ 700; a_{3ms} ≥ 80 g	
	Neck[2]	4	$F_{x,shear}$ < 1.2 kN; $F_{z,tension}$ < 1.7 kN; $M_{y,extension}$ < 36 Nm	
		0	$F_{x,shear}$ ≥ 1.95 kN, $F_{z,tension}$ ≥ 2.62 kN, $M_{y,extension}$ ≥ 49 Nm	
	Chest	4	Deflection < 18 mm; VC < 0.5 m/s	
		0	Deflection ≥ 34 mm; VC ≥ 1.0 m/s	
		capping	Deflection ≥ 34 mm; VC ≥ 1.0 m/s	
	Femur	4	Axial $Force_{compr}$ < 2.6 kN	
		0	Axial $Force_{compr}$ ≥ 6.2 kN	
Modifiers		-1	Unstable airbag/incorrect airbag deployment (from head score)	
		-1	Steering wheel detachment from steering column (from driver score)	
		0...-1	Steering wheel upward displacement 72 ... 88 mm (from head score)	
		0...-1	Steering wheel rearward displacement 90 ... 110 mm (from head score)	
		-2	Rear seat: head contact with vehicle interior (from head score)	
		-1	Steering wheel contact (from chest score)	
		-2	Shoulder belt load ≥ 6 kN (from chest score)	
		-1	Incorrect airbag deployment (from femur score)	
		-4	Submarining[3] (from femur score)	
		-1/door	Door opening during impact	
		-1	Fuel leakage	

1 For the rear passenger in the rigid wall impact the score is based on a_{3ms} only, if there is no hard contact.
2 For the rear passenger, the neck score is the sum of all three criteria, with the following maximum score per criterion: Shear 1 point, Tension 1 point, Extension 2 points
3 When any of the two iliac forces drops dramatically within 1 ms and when the submarining is confirmed on the high speed film.
4 The total score is the average of the front seat score and the rear seat score.

Barrier Side Impact (AE-MDB) @ 60 km/h | Pole Side Impact @ 32 km/h

Dummy	Region	Points	Criteria	Modifiers	
World SID 50 %	Head	4	HIC$_{15}$ < 500; MDB: a_{3ms} < 72 g	Modifiers: Pole: No installation of curtain airbag or other restraint system intended for head protection during poleside impact: -1 Incorrect airbag deployment -1 (from head score) Door opening during impact -1 / door Fuel leakage -1 Head protection device assessment -4	max. 16 pts (scaled to 14[MDB]/13[Pole])
		0	HIC$_{15}$ ≥ 700; MDB: a_{3ms} ≥ 80 g		
		capping	HIC$_{15}$ ≥ 700; MDB: a_{3ms} ≥ 80 g, Pole: $a_{res\ peak}$ ≥ 80 g or head contact w/ pole		
	Chest	4	Deflection < 28 mm;		
		0	Deflection ≥ 50 mm; VC ≥ 1.0 m/s; Shoulder Force$_{Lateral}$ ≥ 3.0 kN		
		capping	Deflection MDB: ≥ 50 mm; Pole: ≥ 55 mm		
	Abdomen	4	Deflection < 47 mm;		
		0	Defl. ≥ 65 mm; VC ≥ 1.0 m/s; Lower Spine a_{res} ≥ 75 g		
		capping	Deflection ≥ 65 mm		
	Pelvis	4	PSPF < 1.7 kN		
		0	PSPF ≥ 2.8 kN		
		capping	PSPF ≥ 2.8 kN		
World SID 50 % Far side	Head	4	HIC$_{15}$ < 500; a_{3ms} < 72 g	Modifiers: Head Excursion *without center airbag* 125 mm < d < 250 mm: -8 DCL[1] < d < 125 mm: -12 DCL < d < door panel: -15 Head contact to door p.: -16 *with center airbag* DCL < d < 125 mm: -4 DCL < d < door panel: -8 Head contact to door p.: -16 Head out of protective zone of far side airbag -4 Asymmetric protection -4	max. 16 points (scaled down to 3)
		0	HIC$_{15}$ ≥ 700; a_{3ms} ≥ 80 g; Head to Head contact; $a_{res\ peak}$ ≥ 80 g		
		capping	HIC$_{15}$ ≥ 700; a_{3ms} ≥ 80 g		
	Neck	4	Upper/Lower Neck M_xOC < 162 Nm		
		0	Upper/Lower Neck F_z ≥ 3.74 kN; M_xOC ≥ 248 Nm; Upper Neck M_yOC ≥ 50 Nm		
	Chest & Abdomen	4	Deflection Chest < 28 mm / Abdomen < 47 mm		
		0	Deflection Chest ≥ 50 mm / Abdomen ≥ 65 mm		
		capping	Deflection Chest ≥ 50 mm / Abdomen ≥ 65 mm; Lower Spine a_{res} ≥ 75 g		
	Pelvis	4	PSPF ≥ 2.8 kN; Lumbar F_y < 2.0 kN, F_z < 3.5 kN, M_x < 120 Nm		
		0	PSPF ≥ 2.8 kN; Lumbar F_y ≥ 2.0 kN, F_z ≥ 3.5 kN, M_x ≥ 120 Nm		

1 DCL = Driver Center Line

Whiplash Test

Dynamic Assessment Front Seat		1.5 Points	0 Points			
BioRID IIg	NIC	11.00	24.00	max. 9 points	max. 10 points	max. 14 points (scaled down to 6)
	Nkm	0.15	0.55			
	Rebound velocity (m/s)	3.2	4.8			
	Upper Neck $F_{x,shear}$ (N)	30	190			
	Upper Neck $F_{z,tension}$ (N)	360	750			
	T1 acceleration[1] (g)	9.30	13.10			
	T-HRC[1] (ms)	57	82			
Geometry Assessment Front Seat		1 Point	-1 Point			
HRMD	Backset (mm)	40	100	max. 1 pt		
	Height (mm)	0	80			
Geometry Assessment Rear Seat		1 Point	0 Points			
Heff (mm)	in highest position in worst case position	≥ 770 ≥ 720	< 770 < 720		max. 4 points	
ΔCP X	in mid position	≤ 504.5 · sin (Torso angle-2.6) + 116	≥ 504.5 · sin (Torso angle-2.6) + 116			
ΔCP X	in worst case position	≤ 504.5 · sin (Torso angle-2.6) + 116	≥ 504.5 · sin (Torso angle-2.6) + 116			
Non-Use position acc. to KMVSS or no Non-Use position		yes	no			
Modifier: Height lock failure			-2			

1 Only the maximum score from either T1 acceleration or head restraint contact time is used in the rating.

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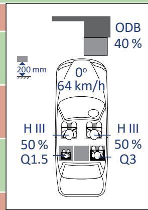
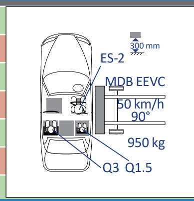
Adult Occupant Protection

AOP Assessment Protocol 2025-2028 1.1.1

Dummy	Region	Points	Criteria	
Frontal Impact against ODB with 40 % Overlap @ 64 km/h			**ODB Test Protocol Euro NCAP 7.0.1**	
H III 50 % front	Head, Neck	4	$HIC_{15} < 500$; $a_{3ms} < 72$ 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	max. 16 points
		0	$HIC_{15} > 700$; $a_{3ms} > 88$ 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 > 42 mm; VC > 1.0 m/s	
	Femur, Knee	4	Axial $Force_{compression} < 3.8$ kN Knee Displacement < 6 mm	
		0	Axial $Force_{compression} > 9.07$ kN @ 0 ms / > 7.56 @ 10 ms Knee Displacement > 15 mm	
	Tibia Foot	4	TI < 0.4; Axial $Force_{compression} < 2$ kN Pedal rearward displacement < 100 mm	
		0	TI > 1.3; Axial $Force_{compression} > 8$ kN Pedal rearward displacement > 200 mm	
Barrier Side Impact (MDB) @ 50 km/h			**MDB Test Protocol Euro NCAP 6.0**	
ES-2	Head	4	$HIC_{15} < 500$; $a_{3ms} < 72$ g	max. 16 points
		0	$HIC_{15} > 700$; $a_{3ms} > 88$ 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	
			SBR Euro NCAP Assessment SA 5.6	
Seat Belt Reminders (SBR)		0.5 0.5/n 1	SBR on driver seat SBR on front passenger seats (n = number of front passenger seats) SBR on all rear seating positions	2 pts.





AOP Star Rating	★★★★★	★★★★	★★★	★★	★
ODB+MDB Pts.	≥ 27	≥ 22	≥ 16	≥ 10	≥ 4
SBR Pts.	≥ 1			-	-
GTR8 compliant ESC	A GTR8 compliant Electronic Stability Control (ESC) must be fitted as standard across all variants of the tested model. Global NCAP will conduct at least 3 runs of a “moose test” in two different scenarios with a professional driver from the accredited crash test facility in order to evaluate the real-life robustness of the ESC system.				-
Pedestrian Protection	UN R127 or GTR 9 ompliant pedestrian rotection must be fitted as standard across all variants.			-	-
Pole Side Impact	A side head protection system must be fitted on the test model as standard. Pole Side Impact according to Euro NCAP Test Protocol 5.2, injury criteria not exceeding HIC_{15} of 700 and a_{3ms} of 80 g and the lower performance limits of all other criteria as specified for MDB side impact.			-	-

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COP Assessment Protocol 2025-2028 V. 1.1.1

Child Occupant Protection

max. 49 points	max. 24 points	Dynamic Assessment: Frontal Impact		Dummy	Q1½		Q3	
		Head		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	< 550	≥ 550	< 550	≥ 550
		Rearward Facing CRS		points	4	0	4	0
		head exposure	no compressive load on top of head, head fully restrained within CRS		no exposure	exposure	no exposure	exposure
				points	2	0	2	0
		Neck	upper Neck F_z	kN	≤ 1.7	≥ 2.62	≤ 1.7	≥ 2.62
		Chest	$a_{res\ 3ms}$	g	≤ 41	≥ 55	≤ 50	≥ 66
	max. 8 pts.	Dynamic Assessment: Side Impact		Dummy	Q1½		Q3	
		Head		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		< 80 ≤ 72	≥ 88	< 96 ≤ 87	≥ 100
	12 pts.	CRS Installation						
		CRS installation list			10			
		OEM recommended CRS			2			
	max. 13 points	Vehicle Based Assessment						
		Provision of three-point seat belts			If any passenger seat is not equipped with three-point automatic seatbelts and/or they do not meet UN or FMVSS regulations, 0 points are awarded for the vehicle based assessments.			
		Gabarit installation on all passenger seats			2			
		Three simultaneous use seating positions			2			
		ISOFIX usability			2			
		Two or more largest ISOFIX positions			1			
		Passenger airbag warning marking and disabling			4			
		Integrated CRS			2			

COP Star Rating	★★★★★	★★★★	★★★	★★	★
Total COP Points	≥ 41	≥ 35	≥ 27	≥ 18	≥ 9

TNCAP Overall Rating Scheme

Overall Rating Protocol V. 2.0

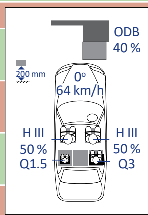
Adult Occupant Protection		Child Occupant Protection		Pedestrian Protection		Safety Assist	
	max. points		max. points		max. points		max. points
Full-width Frontal	8	Dyn. Tests	24	Head Impact	24	Occupant Status Monit.	3
Offset Frontal Impact	8	CRS Installation	12	Lower Leg Impact	6	Speed Assistance	3
Side Impact (MDB)	8	Vehicle Based	13	Upper Leg Impact	6	Lane Support	4
Side Impact (Pole)	8			AEB Pedestrian	6	AEB Inter-Urban	3
Whiplash	2			AEB Cyclist	6	Blind Spot Assist	2
AEB City	4						
max. points (1)	38	max. points (1)	49	max. points (1)	48	max. points (1)	15
normalised score (2)	actual pts. / (1)	normalised score (2)	actual pts. / (1)	normalised score (2)	actual pts. / (1)	normalised score (2)	actual pts. / (1)
Balancing: minimum normalised score (2) by box for the respective star rating:							
★★★★★	80 %	+	80 %	+	60 %	+	70 %
★★★★	70 %		70 %		50 %		60 %
★★★	60 %		60 %		40 %		50 %
★★	50 %		50 %		30 %		40 %
★	40 %		40 %		20 %		30 %

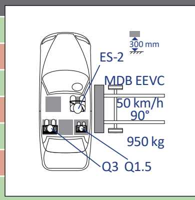
BNCAP - Bharat New Car Assessment Programme

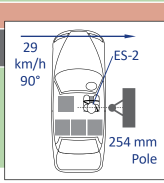
Adult Occupant Protection

AIS 197

Dummy	Region	Points	Criteria	
Frontal Impact against ODB with 40 % Overlap @ 64 km/h				
H III 50 % front	Head, Neck	4	$HIC_{15} < 500$; $a_{3ms} < 72$ 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	max. 16 points
		0	$HIC_{15} > 700$; $a_{3ms} > 88$ 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 > 42 mm; VC > 1.0 m/s	
	Femur, Knee	4	Axial Force$_{compression}$ < 3.8 kN Knee Displacement < 6 mm	
		0	Axial Force$_{compression}$ > 9.07 kN @ 0 ms / > 7.56 @ 10 ms Knee Displacement > 15 mm	
	Tibia Foot	4	TI < 0.4; Axial Force$_{compression}$ < 2 kN Pedal rearward displacement < 100 mm	
		0	TI > 1.3; Axial Force$_{compression}$ > 8 kN Pedal rearward displacement > 200 mm	
Barrier Side Impact (MDB) @ 50 km/h				
ES-2	Head	4	$HIC_{15} < 500$; $a_{3ms} < 72$ g	max. 16 points
		0	$HIC_{15} > 700$; $a_{3ms} > 88$ 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	
Pole Side Impact (MDB) @ 29 km/h				
ES-2	Head	Limiting Values	$HIC_{15} < 700$ $a_{res, peak} < 80$ g no direct contact with the pole and not exceeding lower performance limit of Barrier Side Impact (MDB)	qualifier







AOP Star Rating	★★★★★	★★★★	★★★	★★	★
ODB + MDB Pts.	≥ 27	≥ 22	≥ 16	≥ 10	≥ 4
Safety Assist Technologies					
SBR	meeting AIS-145 requirements				
Pedestrian Prot.	meeting AIS-100 requirements				
GTR 8 or AIS-133 compliant ESC	Fitment year 1 + 2 after rating : 1 variant with ESC as standard fitment and 'stand alone' option in other variants; after 2 years : 100% fitment across all variants		Fitment year 1 + 2 : Optional without any fitment rate. Same conditions as 4-star after October 2025	-	-
Pole Side Impact	Side head protection system meeting the limiting values and achieving the following fitment rates:			-	-
10/2025 - 9/2026	70 %	30 %	optional in 1 variant		
10/2026 - 9/2027	90 %	50 %	optional in 1 variant		

BNCAP - Bharat New Car Assessment Programme

Child Occupant Protection

max. 49 points; max. 16 points	Dynamic Assessment: Frontal Impact		Dummy	Q1½		Q3	
	Head		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	< 550	≥ 550	< 550	≥ 550
	Rearward Facing CRS		points	4	0	4	0
	head exposure	no compressive load on top of head, head fully restrained within CRS		no exposure	exposure	no exposure	exposure
			points	2	0	2	0
	Neck	upper Neck F_Z	kN	≤ 1.7	≥ 2.62	≤ 1.7	≥ 2.62
	Chest	$a_{res\,3ms}$	g	≤ 41	≥ 55	≤ 50	≥ 66
max. 8 pts.	Dynamic Assessment: Side Impact		Dummy	Q1½		Q3	
	Head		points	4	0	4	0
	no head contact with CRS **head contact with CRS**	no direct evidence + Head $a_{res\,peak}$ Head $a_{res\,3ms}$		< 80 ≤ 72	≥ 88	< 96 ≤ 72	≥ 88
12 pts.	CRS Installation						
	CRS installation list			10			
	OEM recommended CRS			2			
max. 13 points	Vehicle Based Assessment						
	Provision of three-point seat belts			If any passenger seat is not equipped with three-point automatic seatbelts and/or they do not meet UN or FMVSS regulations, 0 points are awarded for the vehicle based assessments.			
	Gabarit installation on all passenger seats			2			
	Three simultaneous use seating positions			2			
	ISOFIX usability			2			
	Two or more largest ISOFIX positions			1			
	Passenger airbag warning marking and disabling			4			
	Integrated CRS			2			

COP Star Rating	★★★★★	★★★★	★★★	★★	★
Total COP Points	≥ 41	≥ 35	≥ 27	≥ 18	≥ 9

Product Liability in the Automobile Industry

Course Description

In the framework of the ongoing extension of active and passive safety systems automobiles are becoming increasingly complex.

In this context the faultlessness of systems becomes more and more important, as with growing complexity, especially in the field of autonomous vehicles, not only the number but also the severity of possible faults is increasing. The use of specific sensors, software, information technology, artificial intelligence and machine learning expand the scope of liability-related topics. Even implemented equal parts strategies can quickly lead to a large number of affected vehicles in case of defects. An indicator for this is the growing number of recalls in recent years.

Each manufacturer holds the responsibility for consequential damages caused by its products when used as intended. This responsibility is defined by law in all countries and has civil and criminal penalties.

Examples include cases of damage and recalls of large numbers of vehicles that several OEMs were obliged to do during the last few years.

Obviously a safety related recall of a mass product may have severe or even existence-threatening consequences.

Consequently, manufacturers must ensure faultlessness throughout their organization. Amongst others, questions may raise like:

- Who in the company is responsible for product safety?
- Is your entire organization set up to avoid safety-related errors or to reduce the risk?
- Is compliance with product liability ensured throughout the company?
- In the case of allegations, can targeted and comprehensive evidence be quickly provided?
- How can unwarranted claims be averted?
- What can be learned from the product liability cases, which are particularly well received by the public?

Course Objectives

The aim of this course is to convey the importance of product liability for businesses and employees as well as an understanding of preventive measures.

Who should attend?

The seminar is aimed at all decision-makers in the automotive development, production and at suppliers who want to learn about the consequences of product liability and want to get familiar with preventive measures.

Course Contents

- Fundamentals of Product Liability
- Civil and criminal responsibility of the company and personal liability of employees
- Liability for Defects
- Product liability in Europe and in the U.S.
- U.S. TREAD ACT, Reporting obligation for OEMs and suppliers
- Motor Vehicle Whistleblower Act (importance to companies)
- EU-Whistleblower Directive
- Importance of norms and standards (e.g. ISO26262 Functional Safety)
- Product liability and advertisement / public relations of companies
- Quality management and its relevance from a product liability point of view
- Product liability in the supply chain
- Consequences of new technologies, liability in the area of driver assistance systems and autonomous vehicles
- Instructions, warnings
- Risk minimization within the organization, prevention
- Preventive product safety measures during product development
- Product observation and resulting consequences
- Documentation, conclusive evidence
- Insurance of product liability risk
- Recall decision and processing

Instructor

Hans-Georg Lohrmann was Manager of Reliability & Conformity of Production at ZF TRW Automotive GmbH. He has many years of experience in the field of safety, reliability and product liability in the automotive sector. Since September 2015 he has retired and is still active as a freelance consultant. He specializes in the area of restraint systems for vehicle occupant protection and supports his clients in the areas of reliability, safety planning and methods of verification and litigation support.

Facts

02.-05.02.2026	116/4649	Online	4 x 4 Hrs.	1.450,- EUR till 05.01.2026, thereafter 1.750,- EUR
20.-21.10.2026	116/4650	Alzenau	2 Days	1.450,- EUR till 22.09.2026, thereafter 1.750,- EUR

Crashworthy and Lightweight Car Body Design

Course Description

In the development of a car body different - sometimes conflicting - design requirements have to be met. Depending on the intended drive unit, the fulfilling of the crash regulations considering the lightweight principles 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.

Course Objectives

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
- Lightweight principles for the car body design
  - Lightweight design rules
  - Car body design
  - CAE conform design
- Crash simulation
  - Finite Element modeling of a car body
  - Finite Element analysis with explicit methods
  - Possibilities and limitations
- Technical implementation of safety measures
  - Energy absorbing members
  - Car bodies
  - Electric car bodies
  - Safety systems
  - Pedestrian protection
  - Post crash
- Use of mathematical optimization procedures in real world applications
  - Approximation techniques
  - Optimization software & strategies
  - Shape and topology optimization

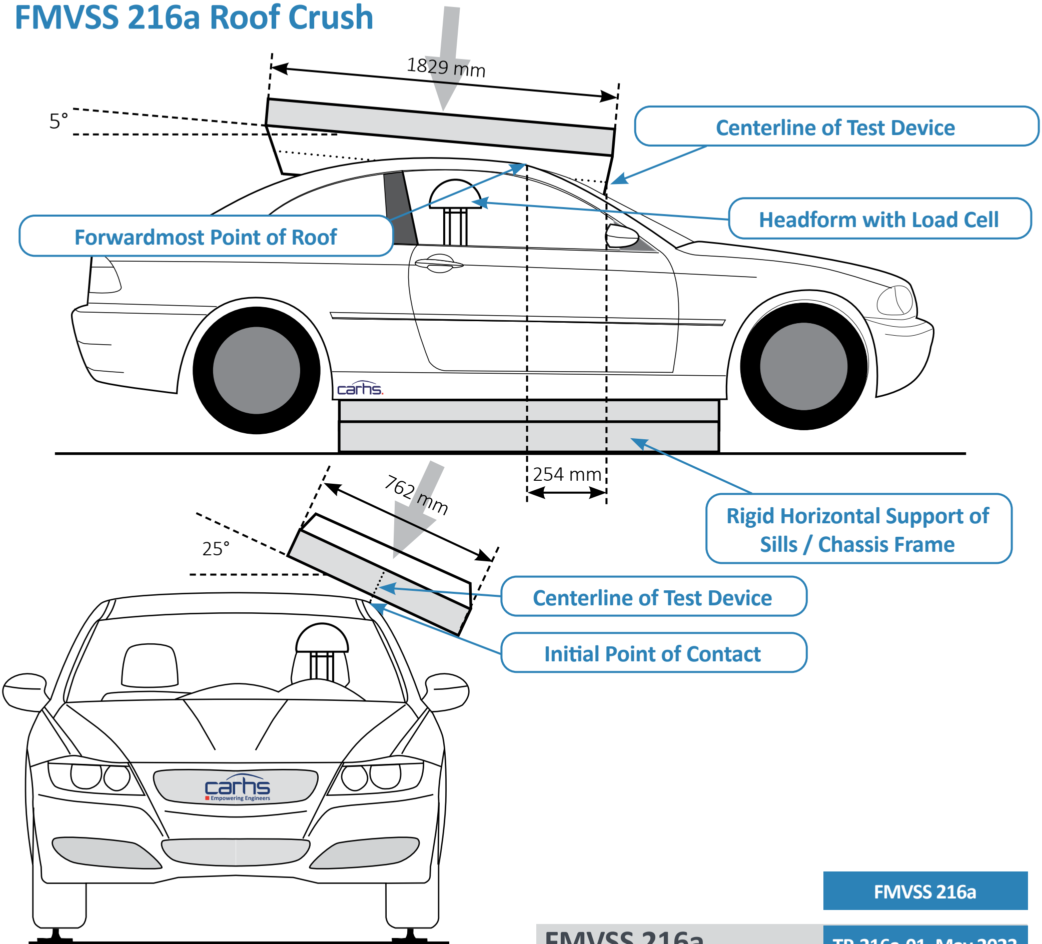
Instructor

Prof. Dr.-Ing. Axel Schumacher (University of Wuppertal) 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.

Facts

21.-22.04.2026	188/4705	Alzenau	2 Days	1.450,- EUR till 24.03.2026, thereafter 1.750,- EUR	German
09.-12.11.2026	188/4706	Online	4 x 4 Hrs.	1.450,- EUR till 12.10.2026, thereafter 1.750,- EUR	English

FMVSS 216a Roof Crush



FMVSS 216a

FMVSS 216a

TP-216a-01, May 2023

Application:
Vehicles with a GVWR ≤ 4536 kg

Applied Force:
for vehicles with a GVWR ≤ 2722 kg:
F = 3.0 x UVW x 9.8 m/s^2
for vehicles with a GVWR > 2722 kg:
F = 1.5 x UVW x 9.8 m/s^2

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

UVW = Unloaded Vehicle Weight
GVWR = Gross Vehicle Weight Rating

Protection Criteria for Frontal Impact (Legal Requirements)

Configuration		Rigid Barrier In-Position					Deformable Barrier In-Position		Out of Position			
Regulation		CMVSS 208 (old), ADR 69/00, FMVSS 208 (old)	FMVSS 208 CMVSS 208		UN R137		UN R94, ADR 73/00	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	Hybrid III	Hybrid III	CRABI
Size		50 % male	50 % male	5 % female	50 % male	5 % female	50 % male	5 % female	5 % female	6 year	3 year	1 year
Region	Criterion											
Head	HIC/HPC36 [-]	1000 (FMVSS, ADR)			1000	1000	1000					
	HIC_{15} [-]	700 (CMVSS)	700	700				700	700	700	570	390
	a_{3ms} [g]				80	80	80					
Neck	N_{ij} [-] (4 Values)		1.0	1.0				1.0	1.0	1.0	1.0	1.0
	$F_{x,shear}$ [kN]				3.1	2.7	3.1 @ 0 ms 1.5 @ 25-35 ms 1.1 @ ≥ 45 ms					
	$F_{z,tension}$ [kN]		4.17	2.62	3.3	2.9	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	57	57					
Chest	a_{3ms} [g]	60	60	60				60	60	60	55	50
	Deflection [mm]	76.2 (FMVSS, ADR) 50 (CMVSS)	63	52	42	34	42	52	52	40	34	30[1]
	VC [m/s]				1.0	1.0	1.0					
Femur	Axial Force [kN]	10	10	6.805	9.07	7	9.07 @ 0 ms 7.58 @ > 10 ms	6.805	6.8			
Knee	Displacement [mm]						15					
Tibia	TI [-]						1.3 (4 Values)					
	Axial $Force_{compr.}$ [kN]						8.0					

1 currently no measurement possible

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 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 on the design of restraint-systems for 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

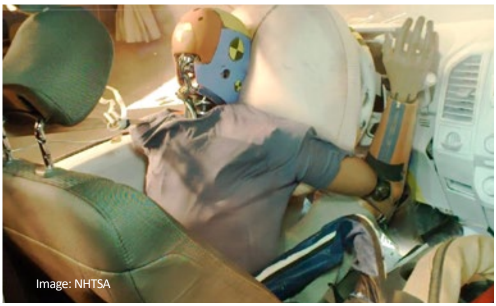


Image: NHTSA

Instructor

Kai Golowko (Bertrandt Ingenieurbüro GmbH) 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 has managed the department vehicle safety at Bertrandt in Gaimersheim. He has also been responsible for active and passive vehicle safety for the Bertrandt Group since 2017.

Facts

24.-27.02.2026	20/4714	Online	4 x 4 Hrs.	1.450,- EUR till 27.01.2026, thereafter 1.750,- EUR
15.-16.07.2026	20/4715	Gaimersheim	2 Days	1.390,- EUR till 17.06.2026, thereafter 1.690,- EUR
15.-16.10.2026	20/4716	Alzenau	2 Days	1.450,- EUR till 17.09.2026, thereafter 1.750,- EUR

Latest info about this course

Development of Frontal Restraint Systems - Advanced

Course Description

Building on the seminar 'Development of Frontal Restraint Systems meeting Legal and Consumer Protection Requirements', this seminar deals with the influence of the adjustment screws in today's highly effective restraint systems. After a short introduction to the worldwide load case mix and the available components and their parameterization, the optimization of systems and their effect on system performance will be elaborated in group work using various practical examples. The analysis of test parameters is the focus of this course. The interactions of the different load cases will be clarified once again and evaluated especially with regard to the new dummy generation around THOR-M and the new US load case Oblique Moving Deformable Barrier (OMDB). This is a workshop aiming at intensive collaboration among the participants.

Course Objectives

The course provides participants with experience in the evaluation of different load cases in frontal passenger protection using practical examples.

Who should attend?

The seminar is aimed at graduates of the course "Development of Frontal Restraint Systems - Advanced" and at developers who have already gained experience in restraint system development.

Course Contents

- Control of the energy of the restraint system
- Control of the kinematics of the occupants
- Achieving the functional objectives

Image: NHTSA

Instructor

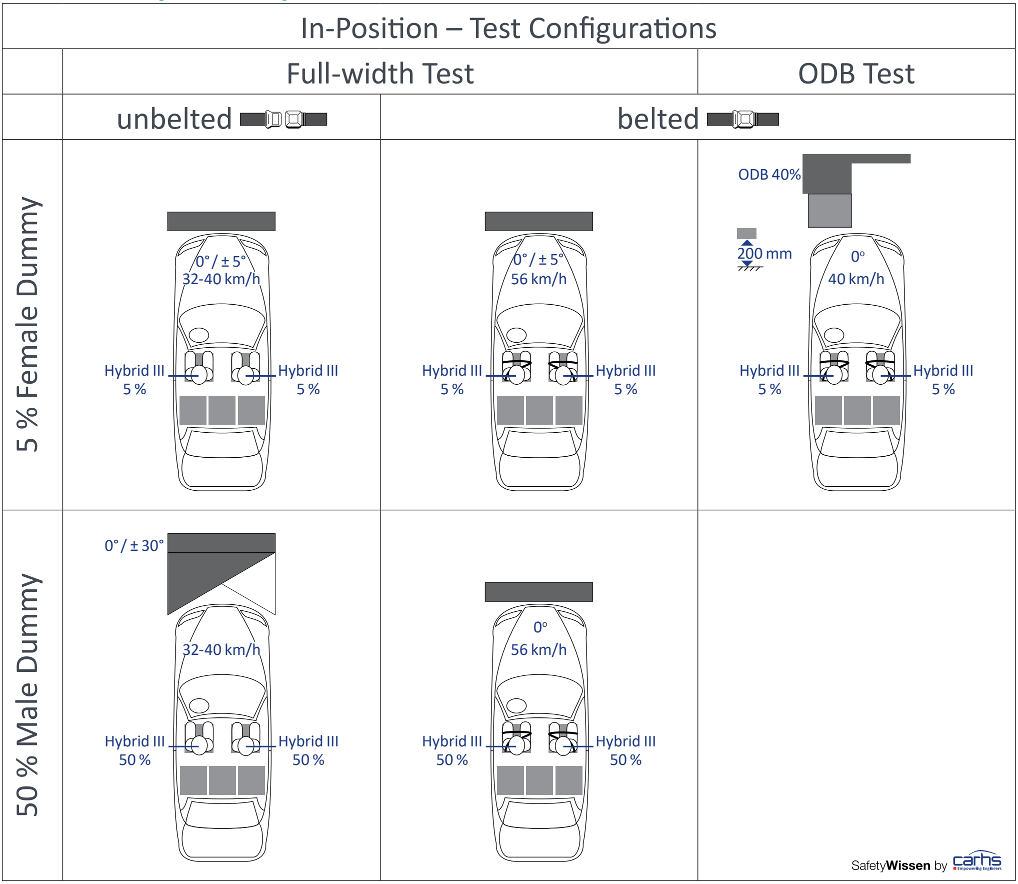
Kai Golowko (Bertrandt Ingenieurbüro GmbH) has been working in the area of vehicle safety since 1999. He started his career as a test engineer for passive safety at ACTS. Since 2003 he has been working as senior engineer for occupant safety and pedestrian protection. Since 2005 he has managed the department vehicle safety at Bertrandt in Gaimersheim. He has also been responsible for active and passive vehicle safety for the Bertrandt Group since 2017.

Dates

Date	#	Location	Duration	Price	Language
10.-11.03.2026	167/4717	Online	2 x 4 Hrs.	890,- EUR till 10.02.2026, thereafter 1.090,- EUR	English
28.10.2026	167/4718	Gaimersheim	1 Day	890,- EUR till 30.09.2026, thereafter 1.090,- EUR	German

FMVSS 208
Frontal Impact Requirements: In-Positi

FMVSS 208 | TP-208-14, April 2008



FMVSS 208: Frontal Impact Requirements: Out-of-Position

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

Early Increase of Design Maturity of Restraint System Components in the Reduced Prototype Vehicle Development Process

Course Description

The number of hardware prototypes available for the development of restraint systems and restraint system components is declining steadily due to an increasing cost pressure in automotive development. In the project schedule the availability of hardware (restraint system components and / or vehicle environments) shifts to the late vehicle development phases. As a result, ensuring the required degree of maturity of restraint system components, in addition to the sole functional development of seat belts and airbag, necessitates new strategies and development paths.

In this seminar, current risks in the development of seat belts and airbags are addressed and ideas for the early increase of maturity are elucidated. This is done by explaining the link between milestones in the development schedule, the functional requirements of restraint system components, the development duration of restraint system components and the description of approaches for the creation of substitutes of vehicle environments in the early development process. In addition the project schedules of conventional vehicle development processes and prototype-reduced development processes of base line models and derivatives are shown. Interactions of the development of seat belts and airbags with surrounding components (e.g. trim parts) are also discussed.

Course Objectives

The course provides thoughts and ideas for a successful approach in the development of restraint systems within vehicle development processes in which only a small number of prototypes are available for verification and optimization of the systems.

Who should attend?

The seminar is aimed at engineers and project managers of restraint systems and restraint system components development, as well as heads of teams or departments in the field of passive safety, which want to gain, in addition to the pure functional development of restraint systems, an overview of the requirements of the prototype-reduced restraint system development with regard to achieving and ensuring the necessary degree of maturity of belts and airbags.

Course Contents

- Overview and differences of vehicle development schedules
  - Standard project schedule
  - Prototype-reduced development of lead series
  - Prototype-reduced development of derivatives
- Safety belts
  - Examples of requirements for safety belts
  - Prerequisites and timing for functional development
  - Timing for homologation and certification
  - Ideas / possibilities for creating vehicle environments
  - Interactions with surrounding components
- Airbags
  - Examples of requirements for airbags
  - Prerequisites and timing for functional development
  - Ideas / possibilities for creating vehicle environments
  - Interactions with surrounding components

Instructor

Sandro Hübner (EDAG Engineering GmbH) studied mechanical engineering at the University of Applied Sciences Schmalkalden. After completing his studies he worked as an engineer in the FEM laboratory of Schmalkalden University of Applied Sciences. From 2003 he worked as a CAE engineer for occupant safety at EASi Engineering GmbH. In 2006, he moved to EDAG Engineering GmbH as a CAE engineer for vehicle safety and has been project manager for vehicle safety and CAE since 2013.

Facts

22.-23.04.2026	166/4733	Online	2 x 4 Hrs.	890,- EUR till 25.03.2026, thereafter 1.090,- EUR
19.11.2026	166/4734	Alzenau	1 Day	890,- EUR till 22.10.2026, thereafter 1.090,- EUR

Side Impact - Requirements and Development Strategies

Course Description

In addition to the 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, due to new pole tests (UN ECE R135 and U.S. NCAP), enhanced deformable barriers and the introduction of World-SID Dummies (5 / 50%ile) with test specific measuring methods 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 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 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 sidecrash-relevant function. Furthermore it is also 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
- Explanation of the different measuring means, in particular the different dummies
- Overview of current test procedures and side impact relevant protection criteria
  - Legal tests (FMVSS 214, UN ECE R95, UN ECE R135, ...)
  - Other tests (Euro NCAP, U.S. NCAP, further NCAPs, IIHS, manufacturer specific tests)
- Development methods and tools:
  - Crash and occupant simulation, range of application and limitations
  - Analysis of the performance of protection and restraint systems in side impact. Discussion of the boundary conditions, limits, conflicts and problems
  - Development strategy for an optimal restraint system for side impact
  - Target oriented use of CAE-simulation and hardware tests to develop optimal occupant load values
- Workshop with analysis of crash-data and discussion of the results

Instructors

Joachim Peest (BMW Group) studied Mechatronical Engineering at the Leibniz University Hannover, focussing on automation and control systems engineering. He has been working in passive safety since 2011 in different functions, starting as a test- and project-engineer, and later as a requirement- and process-developer. Since 2017, he has been working at BMW AG as a specialist in the side-crash-development of various vehicle projects.

Ralf Reuter (carhs.training gmbh) studied mechanical engineering and business administration at the technical universities of Darmstadt and Eindhoven. Since 1997 he has worked for carhs in various management positions. He deals with vehicle safety issues intensively, in particular with the latest developments in rules and regulations as well as consumer testing. As he is in charge of the SafetyWissen which has been published by carhs for many years, he keeps his knowledge up-to-date and profits from the inputs of carhs' trainer and expert network.

Facts

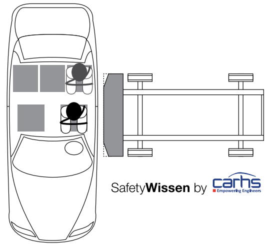
22.-23.10.2026	28/4738	Alzenau	2 Days	1.450,- EUR till 24.09.2026, thereafter 1.750,- EUR	

Protection Criteria for Side Impact (Legal Requirements)

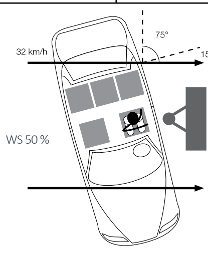
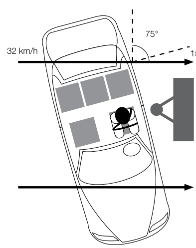
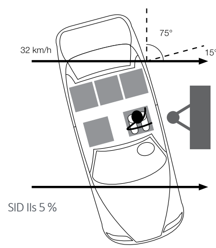
Configuration		Barrier Side Impact			Pole Side Impact		
Regulation		FMVSS 214 CMVSS 214		UN R95 ADR 72/00 ADR 72/01	FMVSS 214 CMVSS 214		UN R135 GTR 14 ADR 85/00
Dummy		ES-2 re	SID IIs	ES-2	ES-2 re	SID IIs	WorldSID
Size		50 % male	5 % female	50 % male	50 % male	5 % female	50 % male
Region	Criterion						
Head	HIC/HPC36 [-]	1000	1000	1000	1000	1000	1000
Shoulder	$F_{lateral}$ [kN]						3.0
Chest	Deflection [mm]	44		42	44		55
	VC [m/s]			1.0			
Abdomen	Peak Force [kN]	2.5		2.5	2.5		
	Deflection [mm]						65
Lower Spine	Acceleration [g]		82				75
Pelvis	PSPF [kN]	6.0	5.525	6.0	6.0	5.525	3.36

MDB Side Impact Test Procedures according to UN R95, Euro NCAP and IIHS

Requirement	UN R95	Euro NCAP	IIHS
Impact angle	lateral 90°		
MDB velocity	50 km/h	60 km/h	60 km/h
Barrier (MDB)	EEVC	AE-MDB	IIHS 2.0
Mass	950 kg	1400 kg	1900 kg
Ground clearance	300 mm	300 mm (bumper 350 mm)	350 mm (bumper 400 mm)
Upper edge height	800 mm	800 mm	950 mm
Width	1500 mm	1700 mm	1700 mm
Dummy front seat	ES-2 impact side	WS 50 % impact side, optional WS 50 % on far side (dual occupancy test)	SID IIs impact side
Dummy rear seat		Q10 impact side Q6 far side	SID IIs impact side
Protection Criteria	Head HPC < 1000 Chest VC < 1.0 m/s Rib deflection D < 42 mm Abdomen Σ APF < 2.5 kN Pelvis PSPF < 6.0 kN	➲ page 56	➲ page 70



Pole Side Impact Tests according to Euro NCAP, UN R135, GTR 14, FMVSS 214 and CMVSS 214

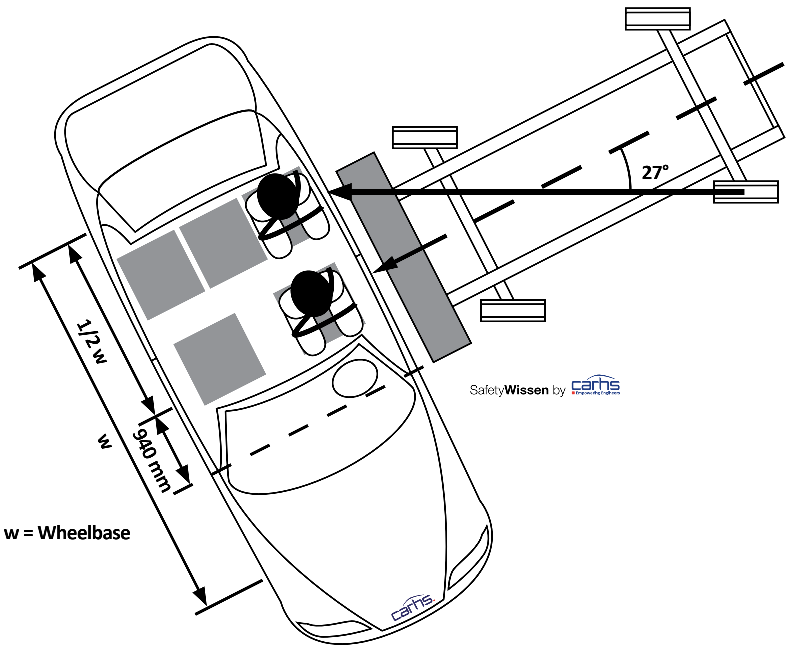
Requirement	Euro NCAP	UN R135 / GTR 14	FMVSS 214 / CMVSS 214	U.S. NCAP
Vehicle Velocity (on Flying Floor)	32 km/h	up to 32 km/h (26 km/h for vehicles up to 1.5 m width[1])	up to 32 km/h	32 km/h
Impact angle	oblique 75° on fixed pole			
Pole diameter	254 mm			
Dummy	WorldSID 50 % on impact side Euro NCAP: optional WS 50 % on far side (dual occupancy test)		ES-2 re or SID IIs (Build Level D) on impact side	SID IIs 5 % on impact side
Protection Criteria	➲ page 56	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 66
Test Configuration				

1 GTR 14 only

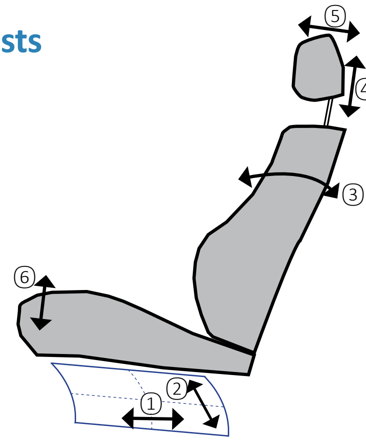
MDB Side Impact Tests according to FMVSS 214, CMVSS 214 and U.S. NCAP

Requirement	FMVSS 214 / CMVSS 214	U.S. NCAP	U.S. NCAP Upgrade[1]
Impact angle	lateral 90°, 27° crab angle		
Impact velocity	53 ±1 km/h (33.5 mph) (~47 km/h in 90° direction)	61.9 ±0.8 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 front seat	ES-2 re impact side	ES-2 re impact side	WorldSID 50 % (SBL F) impact side
Dummy rear seat	SID IIs (Build Level D) impact side	SID IIs (Build Level D) impact side	SID IIs (Build Level D) impact side
Protection Criteria	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 66	Criteria not yet defined

1 planned

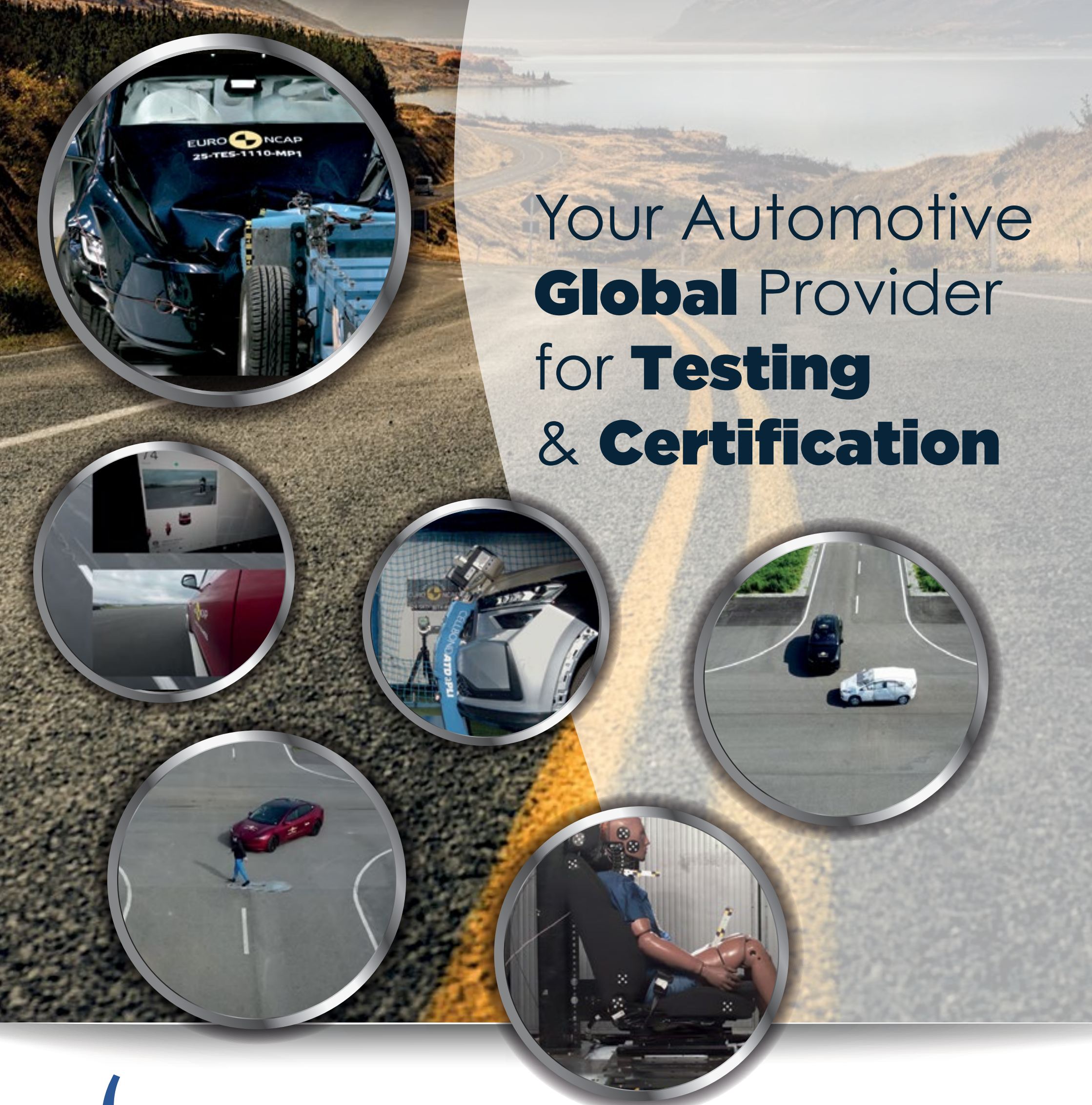


Seat Adjustments for Side Impact Tests



	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 passenger[3]: rearmost[4]	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
UN R135	mid + 20 mm	lowest	manuf. design position or 23°	uppermost or manuf. design position	most rearward	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-IIs	most forward position	mid	head at 0°	lowest	most forward	„absolute" mid[2]
U.S. NCAP / WorldSID 50	mid + 20 mm	lowest[2]	manuf. design position or 25°	uppermost	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.
3 For dual occupancy test to prove that interaction between driver and passenger in side impact is prevented.
4 The head center of gravity must be no further rearward than the pole impact line.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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 mis-use, 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

Instructor

Thomas Dittus (Dr. Ing. h. c. F. Porsche AG) has worked in passive safety for over 25 years. After studying mechanical engineering at DHBW, he began his career in automotive development at Mercedes-Benz in 2000. He worked on various projects, primarily focusing on restraint systems. Since 2006, he has been in charge of passive safety at Porsche, where he has held various engineering and management positions and been responsible for several safety functions and car projects. Since 2019, he has managed projects on rear impact, pedestrian protection, seat-, belt-, child-restraint anchorages as well as free motion headform tests (FMVSS 201u) with his team.

Facts

11.03.2026	46/4723	Alzenau	1 Day	890,- EUR till 11.02.2026, thereafter 1.090,- EUR	
16.-17.09.2026	46/4724	Online	2 x 4 Hrs.	890,- EUR till 19.08.2026, thereafter 1.090,- EUR	
26.11.2026	46/4725	Alzenau	1 Day	890,- EUR till 29.10.2026, thereafter 1.090,- EUR	

Regulations for Head Impact on Vehicle Interiors

UN R21

UN R21, 01 Series, Supplement 4

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 TP-201U-02, Jan 2016

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

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

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

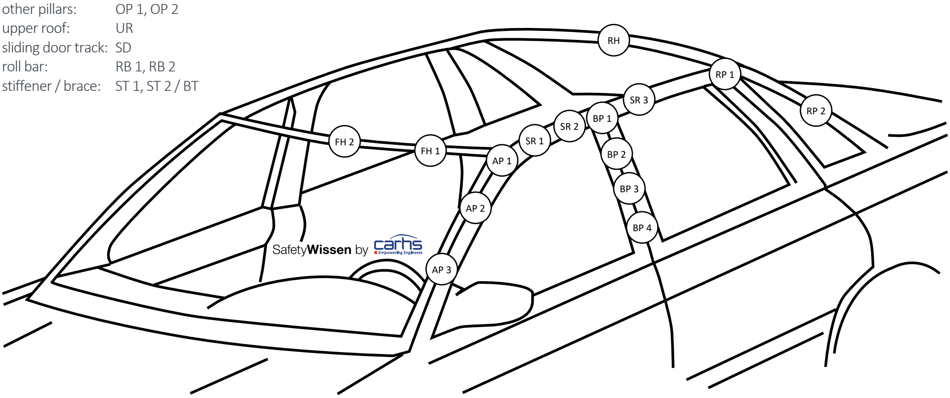
HIC value for FMH

$$HIC(d) = 0.75446\ HIC + 166.4$$

HIC(d) must not exceed 1000.

24 points defined for impact according Test Procedure TP-201U-02 (each side, left and right)

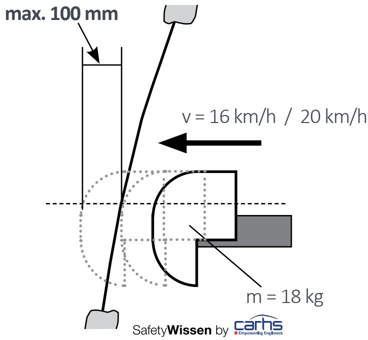
other pillars: OP 1, OP 2
upper roof: UR
sliding door track: SD
roll bar: RB 1, RB 2
stiffener / brace: ST 1, ST 2 / BT



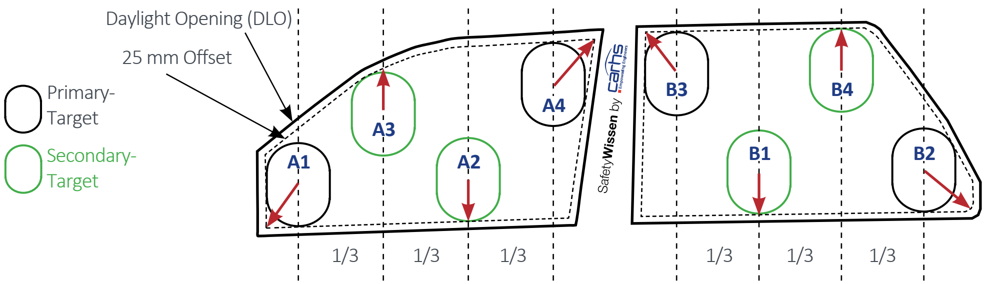
FMVSS 226, CMVSS 226 - Ejection Mitigation

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



Locating Targets:



Steps	Front Row Window	Rear Row Windows
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.	

SafetyWissen by carhs

U.S. Test Procedure TP-226-00, Mar 2011 | **CAN. Test Procedure TSD-226 Rev. 0, Nov 2016**

Pedestrian Protection - Development Strategies

Course Description

Euro NCAP annually adjusts details in its pedestrian rating protocols and even U.S. NCAP plans to introduce a pedestrian protection assessment.

Stricter injury criteria, modified testing areas and the testing of vehicles that were previously not tested, require the thorough knowledge of the requirements and a strict implementation of the requirements in the development process.

In the introduction the seminar informs 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 proof 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 (e.g. Euro NCAP, U.S. NCAP, JNCAP, KNCAP)
- Presentation and discussion of the design and application of the impactors
  - Leg impactors (Flex PLI, Upper Legform, aPLI)
  - 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
- Development strategy
  - Interaction between simulation and testing
  - Integration in the vehicle development process
- Solutions to fulfill the requirements
  - Passive solutions
  - Active solutions (active bonnets, airbags)

Instructor

Maren Finck (carhs.training gmbh) is a Project Manager at carhs.training gmbh. From 2008 - 2015 she worked at EDAG as a project manager responsible for vehicle safety.

Previously, she worked several years at carhs GmbH and TECOSIM as an analysis engineer with a focus on pedestrian safety and biomechanics.

Facts

27.-28.04.2026	152/4688	Alzenau	2 Days	1.450,- EUR till 30.03.2026, thereafter 1.750,- EUR	German
17.-19.08.2026	152/4687	Online	3 x 4 Hrs.	1.450,- EUR till 20.07.2026, thereafter 1.750,- EUR	English
16.-17.11.2026	152/4686	Alzenau	2 Days	1.450,- EUR till 19.10.2026, thereafter 1.750,- EUR	German

Test Procedures and Protection Criteria for Pedestrian Protection

Test Method	Parameter	Euro NCAP / ANCAP max. score	Euro NCAP / ANCAP zero score	U.S. NCAP (from 2027) max. score	U.S. NCAP (from 2027) zero score	JNCAP max. score	JNCAP zero score	KNCAP max. score	KNCAP zero score	C-NCAP max. score	C-NCAP zero score	UN R127.04	GTR No. 9 KMVSS 102-2
1 Adult Headform 4.5 kg Ø 165 mm	αA (°)	65 / 45[11] / 50[12]		65		65		65 / 45[11]		65 / 60[9]		65	65
	VA (km/h)	40		40		40		40		40		35	35
	WAD (mm)	1700 (1500)[1] - 2500		1700 (1500)[1] - 2100		1700 (1500)[1] - 2100[13]		1700 - 2500		1700 (1500)[1] - 2300		1700 - 2100[10]	1700 - 2100[8]
	on Windscreen	yes		yes		yes		yes		yes		yes	no
	HPC/HIC (-)	650	1700	650	1700	650	1700	650	1700	650	1700	1000 / 1700[3]	1000 / 1700[3]
2 Child Headform 3.5 kg Ø 165 mm	αC (°)	50 / 20[2]		50		50 / 20[2]		50		50		50	50
	VC (km/h)	40		40		40		40		40		35	35
	WAD (mm)	1000 - 1700 (1500)[1]		1000 - 1700 (1500)[1]		1000 - 1700 (1500)[1]		1000 - 1700		1000 - 1700 (1500)[1]		1000[7] - 1700[8]	1000 - 1700[8]
	on Windscreen	yes		yes		yes		yes		yes		yes	no
	HPC/HIC (-)	650	1700	650	1700	650	1700	650	1700	650	1700	1000 / 1700[3]	1000 / 1700[3]
3 Upper Legform | 10.5 kg	αU (°)	90 IBRL[4] - WAD 930		90 IBRL[4] - WAD 930									
	VU (km/h)	19.87 - 33.58		19.87 - 33.58									
	WAD (mm)	775		775									
	Sum of forces (kN)	5	6	5	6								
	Bending Moment (Nm)			285	350								
4 Lower Legform[6]	Legform	aPLI		Flex PLI[14]		aPLI		aPLI		aPLI		Flex PLI	Flex PLI
	VL (km/h)	40		40		40		40		40		40	40
	Ground clearance (mm)	25		75		25		25		25		75	75
	Femur Bending (Nm)	390	440			390	440	390	440	390	440		
	Tibia Bending (Nm)	275	320	282	340	275	320	275	320	275	320	340 (380)[5]	340 (380)[5]
	MCL Elongation (mm)	27	32	19	22	27	32	27	32	27	32	22	22
	ACL/PCL Elongat. (mm)			10	10							13	13
5 Upper Legform[6] | 9.5 kg	VL (km/h)											40	40
	Sum of forces (kN)											7.5	7.5
	Bending Moment (Nm)											510	510

SafetyWissen by carhs

1 Points to be tested that lie between WAD 1500 and 1700 are tested with child-/small adult headform impactor, if the points are located in front of the bonnet rear reference line (BRRL). Otherwise the adult headform is used.
2 Tests forward of the BLERL
3 The HPC shall not exceed 1000 over one half of the child headform test area and, in addition, shall not exceed 1 000 over 2/3 of the combined child and adult headform test areas. The HPC for the remaining areas shall not exceed 1700 for both headforms.
4 IBRL = Internal Bumper Reference Line
5 In an area no wider than 264 mm.
6 For vehicles with a lower bumper height < 425 mm the lower legform test 4 is applied. For vehicles with a lower bumper height ≥ 500 mm the upper legform test 5 is applied. For vehicles with a lower bumper height ≥ 425 mm and < 500 mm the impactor is at the choice of the manufacturer.
7 Minimum 82.5 mm rearward of Bonnet Leading Edge
8 Maximum 82.5 mm forward of Bonnet Rear Reference Line
9 Between WAD 2100 and WAD 2300
10 Bonnet top test area max. 82.5 mm forward of Bonnet Rear Reference Line. Windscreen test area extends from 100 mm rearward of opaque windscreen obscuration to max. 130 mm forward of rear visible edge of windscreen. Cowl area (i.e. area between bonnet top and windscreen test areas) is monitored.
11 Tests to the roof
12 Tests to heavy vehicles
13 WAD 2100 or Windshield Rear Reference Line, whichever is further forward. If the height of the selected line is >1900 mm , the position of height=1900 is the rear reference line.
14 If LBRL (Lower Bumper Reference Line) height > 500 mm zero points are awarded by default.

Co-hosted with

BGS Böhme & Gehring GmbH

PraxisConference
Pedestrian Protection

The first conference in the test lab

The unique concept of the PraxisConference, which was jointly designed and developed by BGS Böhme & Gehring GmbH and carhs.training gmbh, ideally combines the expertise of a top-class conference with the conciseness of live tests, highly instructive practical demonstrations and detailed explanations on the vehicle. The PraxisConference has been held annually since 2006 at the German Federal Highway Research Institute (BASt) and has established itself as the world's largest meeting of experts on pedestrian protection.

Top-class experts

In the lecture session of the conference, representatives from the automotive industry, authorities and institutions will speak about current developments and research projects. International experts will report on the progress of the committees working on legislation and consumer protection test procedures (NCAP). Other presentations will show practical experience in the execution of tests and present new solutions for pedestrian protection.

What is special about the PraxisConference: Hands-on pedestrian protection

As the name suggests, the PraxisConference is not a normal conference, but brings together theory and practice. On both conference days there is a detailed practical session. On the first day, the current test methods for pedestrian protection will be presented in the laboratory and on the BASt outdoor area, both for passive safety and for active safety. On the second day of the conference, automobile manufacturers will present the pedestrian protection measures of their current models directly on the exhibited vehicle and will provide deep insights into the respective solutions.

More than pedestrian protection

When the conference started in 2006, it was still all about pedestrian protection. In the meantime the scope has been broadened: All vulnerable road users (VRU) are addressed, including cyclists and motorcyclists.

Who should attend?

The PraxisConference is aimed at both experts and newcomers in the field of VRU protection. Experts receive an update on current legal and technical developments and use the conference to exchange experiences with colleagues. Beginners will get a very practice-oriented overview of the topic and can use the event to establish contacts with pedestrian protection experts.

Facts

17.-18.06.2026

Bergisch Gladbach, GERMANY & ONLINE

www.carhs.de/pkf

1.790,- EUR till 20.05.2026, thereafter 1.990,- EUR, ONLINE 1.090,- EUR

Pedestrian Protection Impact Areas

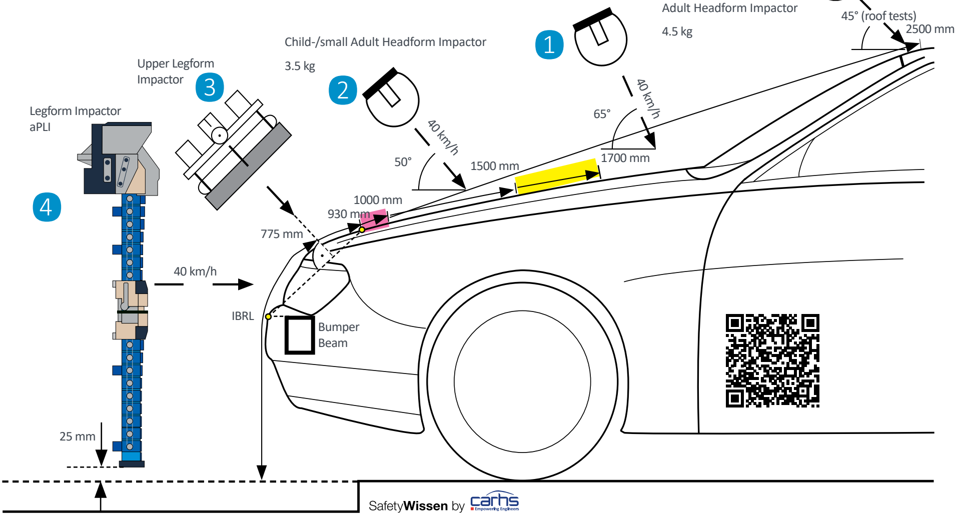
Pedestrian Protection Test Procedures in Euro NCAP / ANCAP

VRU Impact Protocol 1.1

TB CP 402 1.0

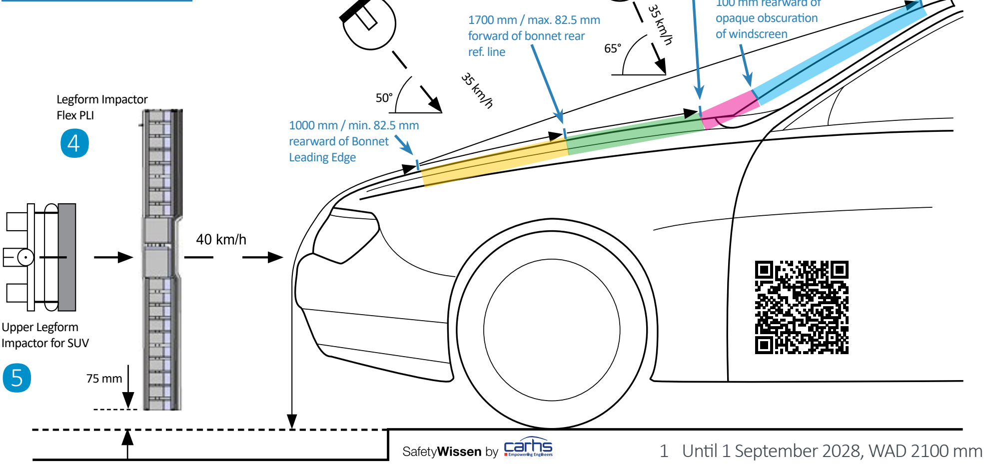
Where the bonnet leading edge reference line (BLERL) is located between WAD 930 mm and WAD 1000 mm, an additional test with the child headform will be performed on the BLERL at a speed of 40 km/h under 20°.

Points to be tested that lie between WAD 1500 und 1700 are tested with child-/small adult headform impactor, if the points are located in front of the BRRL. Otherwise the adult headform is used.



Pedestrian Protection Test Procedures according to UN R127

UN R127 04 Series



1 Until 1 September 2028, WAD 2100 mm shall be accepted.

Child headform bonnet top test area

Adult headform bonnet top test area

Cowl monitoring area

Windscreen test area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FM3643/FM3644
上下胫骨力传感器-4轴&5轴
Up/Down Tibia LoadCell 4&5
F2121/FM1914
大腿力传感器-1轴&6轴
Femur LoadCell 1&6
F20
安全带张力传感器
Seatbelt LoadCell
Range: 6kN/16kN/25kN
F1811/F1812
转向管柱力传感器-3轴
Steering Column LoadCell -Triaxial
FM3743/FM3744
左右髂骨力传感器-5轴
eft/Right ASIS LoadCell 5
H64C
单轴压阻式加速度计
Uniaxial piezoresistive accelerometer
Use for Crash Tests and Crash dummy
Range: 50~6000g
Low damping ratio
H68C
三轴压阻式加速度计
Triaxial piezoresistive accelerometer
Use for Crash dummy
Range: 500~2000g
Low damping ratio
H201/H201F
单轴压阻式加速度计
Uniaxial piezoresistive accelerometer
Use for Crash Tests
Range: 100~2000g
Low damping ratio
H30
三轴压阻式加速度计
Triaxial piezoresistive accelerometer
Use for Crash Tests
Range: 500~2000g
Low damping ratio
H40A
单轴压阻式加速度计
Uniaxial piezoresistive accelerometer
Use for Crash and Pedestrian
Protection Tests
Range: 200~2000g
High damping ratio
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www.future-tech.group
info@future-tech.group

Euro NCAP / ANCAP Pedestrian Protection: Head and Leg Impact Grid Method

VRU Impact Protocol 1.1

VRU Impact 20			
Head Impact	Pelvis	Femur	Knee & Tibia
10.0 Points	2.5 Points	2.5 Points	5.0 Points

Head Impact

Between WAD 1000 and WAD 2500 impact points are located on a fixed 100 mm grid. 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 (excluding defaulted and blue points) to obtain the final score:

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

Only data resulting in a correction factor between 0.85 and 1.15 is acceptable.

Per Grid-Point (except on A-pillar) 0 - 1 points are available according to the following scheme:

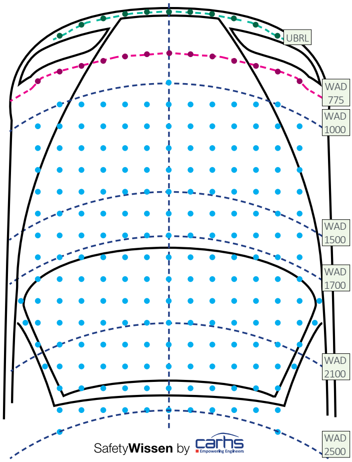
	HIC_{15}	< 650	1.00 Point
650 ≤	HIC_{15}	< 1000	0.75 Points
1000 ≤	HIC_{15}	< 1350	0.50 Points
1350 ≤	HIC_{15}	< 1700	0.25 Points
1700 ≤	HIC_{15}		0.00 Points

Points excluded from random Selection for Verification

- Grid points on A-pillars and roof are defaulted to red = 0 points. Where the vehicle manufacturer can provide evidence that shows an A-pillar or roof point is not red, those grid points will be considered in the same way as other points. Additional points are awarded for A-pillar grid points if

HIC_{15} < 1000 @ 20 km/h	1.0 point per grid point
HIC_{15} < 1700 @ 30 km/h	2.0 points per grid point
HIC_{15} < 1700 @ 40 km/h	3.0 points per grid point

- Grid points on the windscreen that are predicted green and that are entirely surrounded by green points and have distance of more than 165 mm from the solid strip around the periphery of the windscreen mounting frame and without any underlying structures within 100 mm measured in the direction of impact. At least one of the excluded points will be included in the verification tests.



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 Head-form 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
+	∑A-pillar scores
+	∑Scores from blue zones
=	Total
÷	Number of grid points
=	Percentage of max. achievable score
x	10 (Maximum achievable score)
=	Total score for headform test

more about the impactors ➲ page 140

Euro NCAP / ANCAP Pedestrian Protection: Head and Leg Impact Grid Method

VRU Impact Protocol 1.1

Leg Impact

For leg impact a 100 mm grid on WAD 775 (Upper Legform/pelvis) respectively on Upper Bumper Reference Line (aPLI) 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 tests for those points that are not tested (in advance). Per grid point up to 1 point is awarded for the Upper Legform. For the aPLI per grid point 1 point is awarded for the femur and 1 point is awarded for the knee/tibia. The knee&tibia score is based on the lowest of the 2 parameters (MCL elongation / tibia bending)

Criteria and Limit Values

Criterion	Higher Performance Limit	Lower Performance Limit
Upper Legform		
Sum of Forces	5.0 kN	6.0 kN
aPLI		
Femur Bending Moment	390 Nm	440 Nm
Tibia Bending moment	275 Nm	320 Nm
MCL Elongation	27 mm	32 mm

Total Score:

The total score for the Upper/Lower Legform tests will be calculated as follows:

$\sum$Scores of all grid points
÷ Number of grid points
= Percentage of max. achievable score
x 2.5 [5][1] (Maximum achievable score)
= Total score

The total scores for upper legform (pelvis), femur and knee&tibia are added up. The maximum total leg score is 18 points.

1 2.5 points for upper leg and femur; 5.0 points for knee&tibia

Workshop Pedestrian Protection and Low-Speed Crash

Course Description

While pedestrian protection works best when sufficient deformation space is available, for example by means of component failure, damage to the vehicle must be kept to a minimum for the UN R42, FMVSS 581 and RCAR tests. In this workshop, the aim is to extend the scope of the simulation engineers' work to include function development. This also includes the implementation of component changes and the solution of conflicting objectives. Thus, both disciplines (pedestrian protection and low-speed crash) first present their requirements and design criteria, and then search for features that enable the resolution of the target conflicts. Subsequently, the tasks of the function developers are worked out in detail, from the definition of a design strategy to the preparation of tests, including hardware acquisition, up to the final release. The focus is on method transfer instead of training design criteria, which the participants usually master very well due to their daily work.

Course Objectives

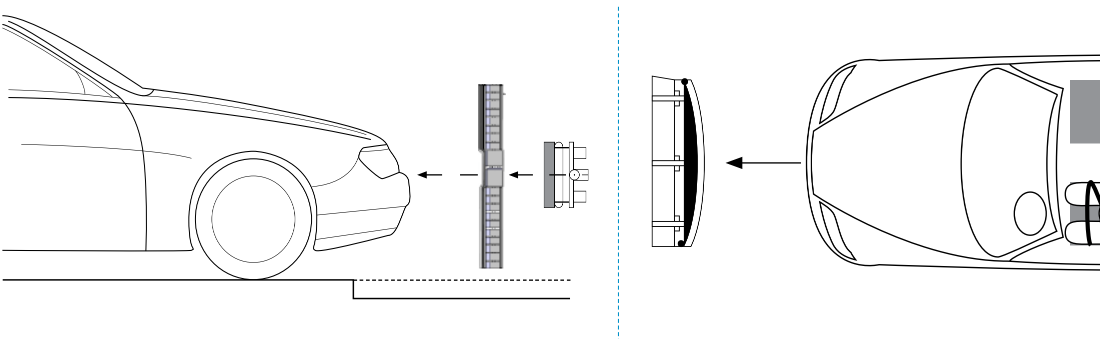
First, the involved groups (Pedestrian Protection and Low-Speed Crash) present their respective development goals and constraints to each other to provide a basis for solving the target conflicts. Then the physics of the relevant load cases are worked out in order to technically solve target conflicts. In the final part, the participants are prepared to take on the role of a function developer.

Who should attend?

The one-day workshop is aimed particularly at CAE engineers from the fields of pedestrian protection and low-speed crash. Both regularly face conflicting targets when designing the vehicle front end.

Course Contents

- Mutual presentation of legal and consumer protection requirements
  - Test areas on the vehicle
  - Load cases
  - Criteria and limit values
  - Consequences of non-compliance
  - Design criteria
- Target conflicts
  - Recognize
  - Avoid
  - Disassemble
  - Solve
- Function development
  - Dealing with time schedules
  - Determination of the design space and derivation of a development strategy
  - Pushing through of component changes
  - Test hardware: planning and logistics
  - Test execution: ensuring reproducible results
  - Homologation



Instructor

Maren Finck (carhs.training gmbh) is a Project Manager at carhs.training gmbh. From 2008 - 2015 she worked at EDAG as a project manager responsible for vehicle safety.

Previously, she worked several years at carhs GmbH and TECOSIM as an analysis engineer with a focus on pedestrian safety and biomechanics.

Facts

26.10.2026 | 192/4689 | Alzenau | 1 Day | 890,- EUR till 28.09.2026, thereafter 1.090,- EUR

Latest info about this course

Passenger Cars in Low-Speed Crashes

Course Description

In addition to the design of car structures for the protection of its occupants at high impact velocities, requirements and test procedures for collisions at low speeds, which massively influence the design of the vehicle front, were brought to the fore in recent years.

For the initial insurance classification of passenger cars classification tests of RCAR / AZT (impact speed up to 15 km/h) are used to determine standardized repair costs. To meet the insurance classification tests, many vehicles are equipped with cross member systems that feature energy absorbing elements (crash boxes), that can be connected via a detachable connection to the longitudinal members in the vehicle front.

Additional partly conflicting requirements are added through the UN R127 and the NCAP tests for pedestrian protection. Compliance with the directive in the leg impact area is usually achieved by energy absorption in conjunction with a targeted support of the impacting leg in the immediate front area of the vehicle.

In connection with the design of vehicles for the different requirements, numerous conflicts occur, which often can only be solved at the expense of a non-optimum front end package or increased weight and manufacturing costs.

Additional requirements regarding the design of the vehicle front result from legislation for vehicle protection (FMVSS581,UN R42, …) and internal testing procedures of the manufacturer for ensuring management of everyday damages for his vehicles.

Course Objectives

In this seminar, you first get an overview on the requirements and regulations which have an impact on the design of cars for the various low-speed crash constellations. This is followed by a presentation of current energy management in the front body structure and an introduction of technical solutions. Based on the state of the art approaches of integral safety are discussed.

Who should attend?

The seminar is aimed at specialists from passenger car and light commercial vehicle development, engineers and technicians from simulation and testing, project engineers and managers who want to get an overview of the requirements and technological solutions for the development of passive and integrated safety systems for passenger cars in low-speed crashes.

Course Contents

- Requirements and test procedures for low-speed crash
  - Introduction to the requirements for low-speed crash tests
  - Legal tests
  - Consumer protection tests
  - Other requirements
- Energy management and structural forces in the vehicle front
  - Load paths and structure loading
  - Connections to high-speed test
  - Influencing factors on crash sensing and structural design changes
  - Changes of structural design
  - Influence of crash sensing and restraint systems
- Design of passive systems
  - Existing solutions on the market
  - Conceptual solution approaches
  - Conflicts of objectives
  - Technological feasibility and limits
- Discussion of integral safety systems
  - Potential of integrated solutions
  - Technological feasibility and limits

Instructor

Prof. Dr. Harald Bachem (Ostfalia University of Applied Sciences) has been in charge of teaching and research in vehicle safety at the Ostfalia University of Applied Sciences since 2011. Prior to joining the university he held various management positions in industry where he was in charge of development and testing of vehicle safety functions. His last management position was head of cab body development at MAN Truck & Bus AG. Prof. Bachem is chairman of the Wolfsburg Institute for Research, Development and Technology Transfer e. V.

Facts

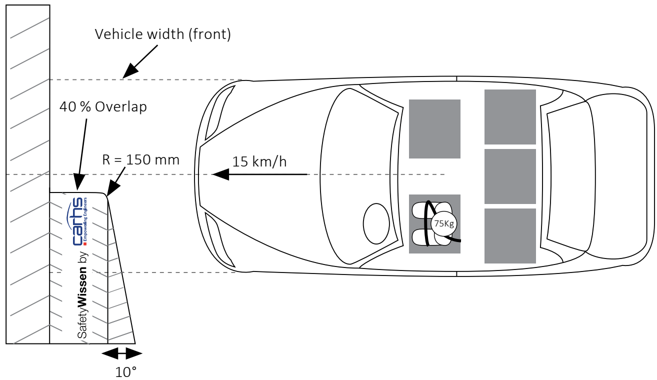
29.-30.04.2026	159/4704	Alzenau	2 Days	1.450,- EUR till 01.04.2026, thereafter 1.750,- EUR	German
19.-21.10.2026	159/4703	Online	3 x 4 Hrs.	1.450,- EUR till 21.09.2026, thereafter 1.750,- EUR	English

RCAR Insurance Tests

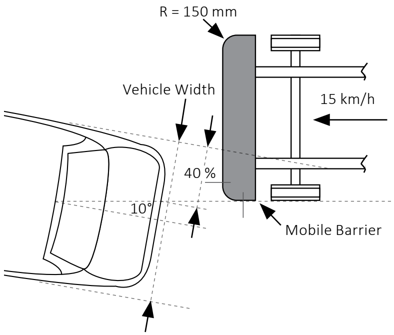
Low-Speed Structural Crash Tests

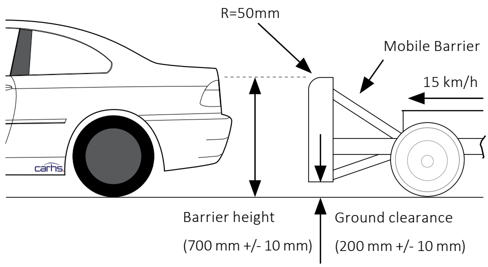
Protocol Version 2.5 (Sep 2024)

Front



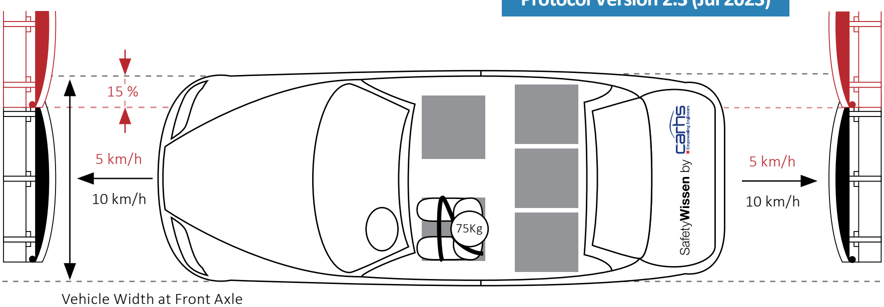
Rear





Bumper Test

Protocol Version 2.3 (Jul 2023)



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

Test	Ground Clearance
Front 100 % & 15 %	$455^{\pm 3}$ mm
Rear 100 % & 15 %	$405^{\pm 3}$ mm

Whiplash Requirements Front Seats

	Requirement	FMVSS 202a		UN R17/10		Euro NCAP	IIHS	C-IASI	JNCAP	C-NCAP	KNCAP	Latin NCAP
	Applicable in											
	Option	static	dynamic	static	dynamic							
	Virtual Testing					2029	2027					
STATIC REQUIREMENTS	Geometrical Measurements	■		■	■	■		■			■	■
	Backset	■		■		■		■			■	■
	Horizontal Load App. (Backward Displacement)	■		■								
	Vertical Load App. (Height Retention)	■		■								
	Integrated/Fixed HR, no Height Lock Modifier										■	
	Minimum Height	■		■	■							
	Minimum Width	■	■	■	■							
	Gaps	■		■	■							
	Energy Absorption (Pendulum Test)	■		■								
	Head Restraint Structure					■						
	Head Interference Space of Head Restraint									■		
DYNAMIC REQUIREMENTS	ATD		H III		BioR.	BioRID	BioRID	BioRID	BioRID	BioRID	BioRID	BioRID
	Delta Theta		■									
	HIC_{15}		■									
	Head Contact Time HCT					■[1]	■	■			■	■
	Head Rebound Velocity					■[1]					■	■
	Head-Pelvis Relative Velocity						■					
	Upper Neck Force F_{x+}				■	■		■	■	■	■	■
	Upper Neck Force F_{z+}					■	■	■	■	■	■	■
	NIC				■	■		■[2]	■	■	■	■
	Nkm					■[1]	■				■	■
	T1 Acceleration					■[1]	■	■			■	■
	Pelvis Displacement						■					
	Seatback Deflection Angle					■[1]				■		■
	Dummy Artefact Modifier					■						■
	Seat Track Dynamic Displacement									■		
	Lower Neck Force F_{x+}				■[3]	■[1]			■	■		
	Lower Neck Force F_{z+}								■	■		
	Upper Neck Momentum M_y				■	■[1]			■	■		
	Lower Neck Momentum M_y				■	■[1]			■	■		

1 Capping only 2 C-IASI only 3 Monitoring

This table is based on material generated by: LEAR Whiplash Applied Research Group

Euro NCAP / ANCAP Whiplash Assessment

Rear Impact Protocol Version 1.1

Rear Impact 5 Points						
Front Seats			Rear Seats			
Geometry	Dynamic Tests		Geometry			
Effective height / backset	High Severity Pulse	Low Severity Pulse	Effective height	ΔCP X_{mid}	ΔCP $X_{worstcase}$	Non-use pos.
1.0	1.5	1.5	0.375	0.25	0.125	0.25
1.0	3.0		1.0			

Dynamic Assessment Front Seats

Whiplash Test	Low Severity Pulse			High Severity Pulse		
	Higher Limit	Lower Limit	Capping Limit	Higher Limit	Lower Limit	Capping Limit
NIC	11.00	24.00	27.00	13.00	23.00	25.50
Nkm			0.69			0.78
Rebound velocity (m/s)			5.2			6.0
Upper Neck $F_{x,shear(+ve)}$ (N)	30	190	290	30	210	364
Upper Neck $F_{x,shear(-ve)}$ (N)			360			360
Upper Neck $F_{z,tension}$ (N)	360	750	900	470	770	1024
Upper Neck $M_{y,extension+flexion}$ (Nm)			30			30
Lower Neck $F_{x,shear(ABS)}$ (N)			360			360
Lower Neck $M_{y,extension+flexion}$ (Nm)			30			30
T1 acceleration (g)			15.55			17.80
T-HRC (ms)			92			92
Seatback Deflection (°)						32

* All parameters, except rebound velocity, are calculated until THRC-end (= End of Head Restraint Contact Time).

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). If the capping limit is exceeded by one criterion, the entire test is rated with zero points. For T1 acceleration and THRC, capping will only be applied where both parameters exceed the respective capping limits.

Modifiers

Dummy Artefact Loading — A **-1 point** modifier will be applied as a means of penalizing any seat that, by design, places unfavorable loading on other body areas or exploits a dummy artefact.

Geometric Assessment Front Seats

	Head Restraint Geometry in Test Position (mid range locking position)		Head Restraint Geometry in Worst Case Position (lowest & rearmost)
	Higher Limit	Lower Limit	Limit
Score	+0.5/n Points	0 Points	
Effective Height (mm)	825	790	> 790
Backset (mm)	< 45	≥ 45	< 70

The assessments are based on the worst performing parameter from either the height or backset.

Prerequisite for scoring points in the geometric assessment:

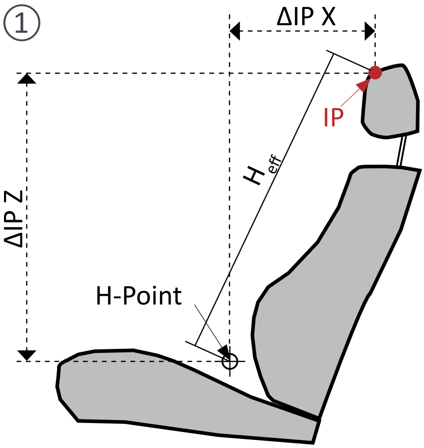
Head Restraint Structure Assessment Front Seats

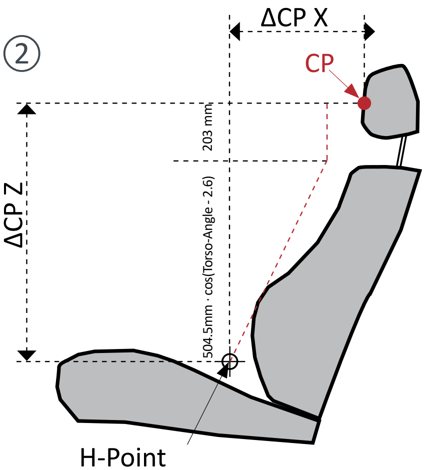
The head restraint structure shall not allow a cylinder of diameter 120 mm to pass from the front to the rear through the head restraint structure after removing restraint parts of less than 50 Shore A.

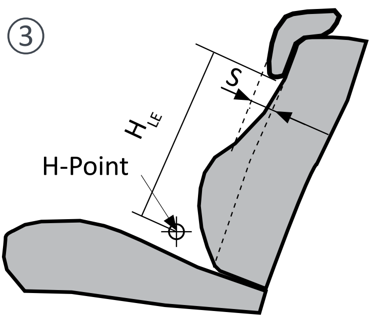
Euro NCAP / ANCAP Whiplash Assessment

Rear Impact Protocol Version 1.1

Geometric Assessment Rear Seats







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) Automatic Return Head Restraint, or
2) > 60° rotation of the headrest in non-use position, or
3) Δ Torso-Angle use / non-use > 10°, or
4) 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),
   and
   Thickness of the lower edge of the headrest S ≥ 40 mm

Score if the Requirements (see above) are met:

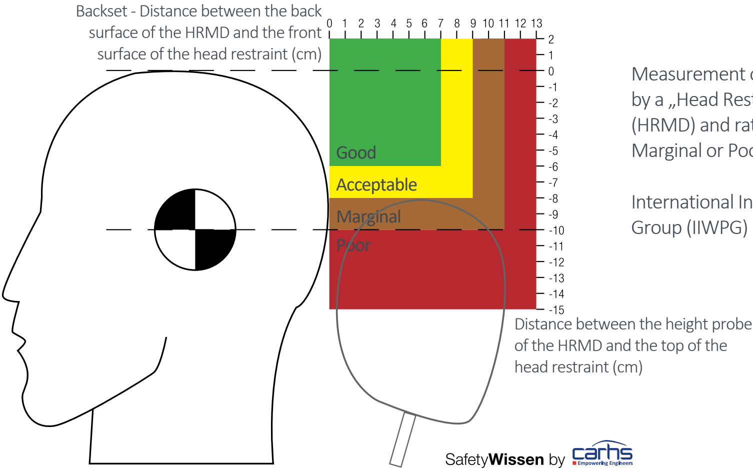
The outboard seating positions of rear seating rows are assessed. Any centre seating position needs to comply with the requirements of UN R17 (Version at the time of vehicle homologation).

Parameter	Points per seat
① H_{eff}	0.375
② ΔCP X_{mid}	0.25*
② ΔCP $X_{worstcase}$	0.125*
③ Non-Use	0.25*
max. total	1

* only if H_{eff} requirements are met

Static Geometry Assessment by IIWPG

RCAR Version 3 (Mar 2008)



Measurement of the head restraint position by a „Head Restraint Measuring Device“ (HRMD) and rating as Good, Acceptable, Marginal or Poor.

International Insurance Whiplash Prevention Group (IIWPG)

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 refers 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 static assessment for the rear seats was added. In 2020 Euro NCAP introduced a new Whiplash assessment on front seats. Where concepts and methods from the future legal requirement the Global Technical Regulation No. 7 Phase II (Head Restraints) can be recognised. 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 Global Technical Regulation No. 7 Phase I (Head Restraints, short GTR 7) was unsatisfactory from the European point of view. Therefore the United Nations published a second phase of this regulation. The content of the GTR 7 Phase II gives the legal base for the future HR development requirements. 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
- Injury criteria
- Dummy-technology for rear impacts
- Presentation of the Euro NCAP and FMVSS 202-dynamic test procedures
- Outlook on possible harmonization-tendencies
- Explanation of the possible design measures in car seats

Instructor

Thomas Frank (LEAR Corporation GmbH) 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 head restraints and 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.

Facts

24.-25.02.2026	50/4726	Online	2 x 4 Hrs.	890,- EUR till 27.01.2026, thereafter 1.090,- EUR	
23.04.2026	50/4693	Alzenau	1 Day	890,- EUR till 26.03.2026, thereafter 1.090,- EUR	
17.09.2026	50/4694	Alzenau	1 Day	890,- EUR till 20.08.2026, thereafter 1.090,- EUR	

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. Since 2013 Q dummies have been used in the dynamic assessment. In addition a CRS installation test was introduced. A significant change was the consideration of older children (Q6 and Q10) than in the previous protocol from 2015 onwards. This enables 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 proposal side impact, AMS, ADAC, others
- Child protection systems: types and classifications, standards, ISO-FIX, Top Tether, Ease of Use/Misuse

Instructor

Britta Schnottale (BASt - German Federal Highway Research Institute) 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 safety issues concerning children in vehicles. This includes participation in national research projects as well as in EU projects on child safety (CHILD, CASPER). She was a member of the informal working group of the GRSP "Child Safety" on the development of UN R129. Britta Schnottale is also a member of the Euro NCAP Child Safety Working Group.

Facts

26.03.2026	45/4674	Alzenau	1 Day	890,- EUR till 26.02.2026, thereafter 1.090,- EUR	

Latin NCAP Child Occupant Protection

Protocol Version 2.0.1

Dynamic Assessment

Manufacturers are required to provide internal test performance data for the Q1.5 dummy in full-scale ODB and AE-MDB crash tests. All points lost by the Q1.5 dummy in the ODB and AE-MDB tests will be deducted from theDynamic Score obtained by the Q3 and Q10 dummies.

	Body Region	Dummy	Points	Criteria	∑max
Frontal Impact	Head[1]	Q1.5 / Q3 CRS Contact	4	No CRS contact ($a_{res\ peak}$ < 80 g (Q1.5) / 96 g ((Q3) or $a_{res\ 3ms}$ ≤ 72 g (Q1.5) / 87 g (Q3)	4
			0	$a_{res\ 3ms}$ ≥ 88 g (Q1.5) / 100 g (Q3)	
		Q10	4	$a_{res\ 3ms}$ ≤ 60 g, HIC_{15} ≤ 500	
			0	$a_{res\ 3ms}$ ≥ 80 g, HIC_{15} ≥ 700	
			capping	HIC_{15} ≥ 800	
		Q3	4	Head Excursion ≤ 549 mm	
			0	Head Excursion ≥ 550 mm	
		Q10	4	Head Excursion ≤ 449 mm	
			2	Head Excursion ≤ 549 mm	
			0	Head Excursion ≥ 550 mm	
		Q1.5 / Q3	4	No compressive loads on top of head, full containment	
			0	compressive loads on top of head, no full containment	
	Neck	Q1.5 / Q3 / Q10	2	Fz ≤ 1.7 kN, My ≤ 49 Nm (Q10)	2
			0	Fz ≥ 2.62 kN	
	Chest	Q1.5 / Q3 / Q10	2	$a_{res\ 3ms}$ ≤ 41 g (Q1.5, Q10) / 50 g (Q6)	2
			0	$a_{res\ 3ms}$ ≥ 55 g (Q1.5, Q10) / 66 g (Q6)	
			capping	$a_{res\ 3ms}$ ≥ 55 g (Q10)	
Side Impact	Head[1]	Q1.5 / Q3 CRS Contact	4	No CRS contact ($a_{res\ peak}$ < 80 g or $a_{res\ 3ms}$ ≤ 72 g	4
			0	$a_{res\ 3ms}$ ≥ 88 g	
		Q10	2	$a_{res\ 3ms}$ ≤ 60 g, HIC_{15} ≤ 500	2
			0	$a_{res\ 3ms}$ ≥ 80 g, HIC_{15} ≥ 700	
			capping	HIC_{15} ≥ 800	
	Neck	Q10	1	F_R ≤ 2.2 kN	1
			0	F_R > 2.2 kN	
	Chest	Q10	1	$a_{res\ 3ms}$ ≤ 67 g	1
			0	$a_{res\ 3ms}$ > 67 g	

1 If there is head contact with any part of the vehicle at any time throughout the impact including rebound or through bottoming out a side airbag, the CRS containing that dummy is awarded zero points for its head performance, in that test.

ASEAN NCAP Child Occupant Protection 2026 - 2030

Protocol Version 3.2

			Dummy	Region	Points	Criteria
max. 54 points	max. 24 points	Frontal Impact (ODB)	Q6 / Q10	Head	4	HIC_{15}[1] ≤ 500; a_{3ms} ≤ 60 g
					0	HIC_{15}[1] ≥ 700, a_{3ms} ≥ 80 g
					Modifier	Head forward excursion: -2 pt. > 450 mm (Q10); -4 pt. > 550 mm (Q6 & Q10)
				Upper Neck	2	F_z ≤ 1.7 kN
					0	F_z ≥ 2.62 kN; M_y ≥ 36 (Q6) / 49 (Q10) Nm
				Chest	2	a_{3ms} ≤ 41 g (Q10); Deflection ≤ 30 mm (Q6)
					0	a_{3ms} ≥ 55 g (Q10); Deflection ≥ 42 (Q6) / 56 (Q10) mm
		Side Impact (MDB)	Q6 / Q10	Head	2	HIC_{15}[1] ≤ 500, a_{3ms} ≤ 60 g
					0	HIC_{15}[1] ≥ 700, a_{3ms} ≥ 80 g
				Upper Neck	1	F_{res} < 2.4 kN (Q6); F_{res} < 2.2 kN (Q10)
					0	F_{res} ≥ 2.4 kN (Q6); F_{res} ≥ 2.2 kN (Q10)
				Chest	1	a_{3ms} ≤ 67 g
					0	a_{3ms} > 67 g
	12	Installation of CRS				
	13	Vehicle Based Assessment				
	5	Child Presence Detection				

1 HIC15 is only applied if there is hard head contact, otherwise the score is based on a3ms only

more about ASEAN NCAP ➲ page 74

KNCAP Child Occupant Protection

Protocol 2024 COP TP-CS-6

Dummy	Region	Points	Criteria	
Frontal Impact against MPDB with 50 % Overlap @ 56/56 km/h				
Q6	Head[1]	4	$HIC_{15} < 500$; $a_{3ms} < 60$ g	max. 16 points (scaled down to 5 points)
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g	
		-4	Modifier: Head forward excursion ≥ 550 mm	
		capping	$HIC_{15} \geq 800$; $a_{3ms} \geq 80$ g	
	Neck[2]	2	$M_{y,extension} < 36$ Nm; $F_{z,tension} < 1.7$ kN	
		0	$M_{y,extension} \geq 36$ Nm; $F_{z,tension} \geq 2.62$ kN	
	Chest	2	Deflection < 30 mm	
		0	Deflection > 42 mm	
Q10	Head[1]	4	$HIC_{15} < 500$; $a_{3ms} < 60$ g	
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g	
		-2 / -4	Modifier: Head forward excursion ≥ 450 mm / 550 mm	
		capping	$HIC_{15} \geq 800$; $a_{3ms} \geq 80$ g	
	Neck[2]	2	$M_{y,extension} < 49$ Nm; $F_{z,tension} < 1.7$ kN	
		0	$M_{y,extension} \geq 49$ Nm; $F_{z,tension} \geq 2.62$ kN	
	Chest	2	$a_{3ms} < 41$ g	
		0	$a_{3ms} \geq 55$ g, Deflection ≥ 56 mm	
		capping	$a_{3ms} \geq 55$ g	
Barrier Side Impact (AE-MDB) @ 60 km/h				
Q6	Head[1]	4	$HIC_{15} < 500$; $a_{3ms} < 60$ g	max. 16 points (scaled down to 3 points)
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g	
		capping	$HIC_{15} \geq 800$; $a_{3ms} \geq 80$ g	
	Neck	2	$F_{z,tension} < 2.4$ kN	
		0	$F_{z,tension} \geq 2.4$ kN	
	Chest	2	$a_{3ms} < 67$ g	
		0	$a_{3ms} \geq 67$ g	
Q10	Head[1]	4	$HIC_{15} < 500$; $a_{3ms} < 60$ g	
		0	$HIC_{15} \geq 700$; $a_{3ms} \geq 80$ g	
		capping	$HIC_{15} \geq 800$; $a_{3ms} \geq 80$ g	
	Neck	2	$F_{z,tension} < 2.2$ kN	
		0	$F_{z,tension} \geq 2.2$ kN	
	Chest	2	$a_{3ms} < 67$ g	
		0	$a_{3ms} \geq 67$ g	
Modifier		-4	If, during the forwards movement of the dummy, the diagonal belt moves into the gap between the clavicle and upper arm with folding of the belt webbing, a modifier of -4 points will be applied to the overall dummy score of the impact in which it occurs.	

Preconditions: Where any of the following events occur, **zero points** will be awarded to the dummy.
Frontal impact: During the forwards movement of the dummy only, the diagonal belt slips off the shoulder.
Frontal impact: The pelvis of the dummy submarines beneath the lap section of the belt or the lap section does not prevent the dummy from moving upwards during rebound and is no longer restraining the pelvis.
Frontal and side impacts: The dummy pelvis does not remain in the booster seat / cushion and is not correctly restrained by the lap section of the seatbelt.
Frontal and side impacts: CRS does not remain within the same seating position or is no longer correctly restrained by the adult belt.
Frontal and side impacts: There is any breakage or fracturing of load-bearing parts of the belt system including buckles, webbing and anchorage points.
Frontal and side impacts: There is any breakage or fracturing of any seat belt lock-offs, tethers, straps, ISOFIX anchorages or any other attachments which are specifically used to anchor the CRS to the vehicle fail.

1 In the absence of hard contacts the score is based on a_{3ms} only.

2 In the absence of hard contacts the score is based on neck tension force only.

UNECE Vehicle Classification

Consolidated Resolution on the Construction of Vehicles (R.E.3), Revision 7

R.E.3 Revision 7

Category	Wheels	Engine Capacity	Maximum Design Speed	Unladen Mass	Power	Seats	Maximum Mass
L1	2	≤ 50 cm^3	≤ 50 km/h				
L2	3	≤ 50 cm^3	≤ 50 km/h				
L3	2	> 50 cm^3	> 50 km/h				
L4	3[1]	> 50 cm^3	> 50 km/h				
L5	3[2]	> 50 cm^3	> 50 km/h				
L6	4	≤ 50 cm^3	≤ 45 km/h	≤ 350 kg[3]	≤ 4 kW		
L7	4			≤ 400 kg[3, 4]	≤ 15 kW		
M	Vehicles used for the carriage of passengers						
M1	≥ 4					≤ 9	
M2	≥ 4					> 9	≤ 5 t
M3	≥ 4					> 9	> 5 t
N	Vehicles used for the carriage of goods						
N1	≥ 4						≤ 3.5 t
N2	≥ 4						3.5 t < m ≤ 12 t
N3	≥ 4						> 12 t
O	Trailers (including semi-trailers)						
O1							≤ 0.75 t
O2							0.75 t < m ≤ 3.5 t
O3							3.5 t < m ≤ 10 t
O4							> 10 t
T	Agricultural or forestry vehicles						
G	Off-road vehicles						

1 asymmetrically arranged in relation to the longitudinal median plane
2 symmetrically arranged in relation to the longitudinal median plane
3 not including the mass of the batteries in case of electric vehicles
4 ≤ 550 kg for vehicles intended for carrying goods

Applicabilty of selected UN Regulations to Vehicle Categories:

UN R	L1	L2	L3	L4	L5	L6	L7	M1	M2	M3	N1	N2	N3	O1	O2	O3	O4
11								●			●						
12								●			●						
14								●	●	●	●	●	●				
16		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
17								●	●	●	●	●	●				
21								●									
25		●		●	●	●	●	●	●	●	●	●	●				
32								●									
33								●									
42								●									
94								●			●[2]						
95								●			●						
100								●	●	●	●	●	●				
127								●			●						
135								●	●[1]		●	●[1]					
137								●			●						
145								●									

SafetyWissen by carhs

1 optional up to 4500 kg 2 with a total permissible mass not exceeding 2,500 kg

EU Vehicle Classification

Regulation (EU) 2018/858 **Regulation (EU) 168/2013**

Category	Length [mm]	Width [mm]	Height [mm]	Wheels	Engine Capacity [cm³]	Maximum Design Speed [km/h]	Mass in running order [kg]	Power [kW]	Seats	Maximum Mass [t]
L	Two- or three-wheel vehicles and quadricycles									
L1e	≤ 4000	≤ 1000	≤ 2500	2	≤ 50	≤ 45		≤ 4		
L2e	≤ 4000	≤ 2000	≤ 2500	3	≤ 50[1]/500[2]	≤ 45	≤ 270	≤ 4	≤2	
L3e	≤ 4000	≤ 2000	≤ 2500	2						
L4e	≤ 4000	≤ 2000	≤ 2500	3						
L5e	≤ 4000	≤ 2000	≤ 2500	3			≤ 1000			
L6e	≤ 4000	≤ 2000	≤ 2500	4	≤ 50[1]/500[2]	≤ 45	≤ 425			
L7e	≤ 4000	≤ 2000	≤ 2500	4			≤ 450[3]/600[4]			
M	Vehicles used for the carriage of passengers									
M1				≥ 4					≤ 9	
M2				≥ 4					> 9	≤ 5
M3				≥ 4					> 9	> 5
N	Vehicles used for the carriage of goods									
N1				≥ 4						≤ 3.5
N2				≥ 4						3.5 < m ≤ 12
N3				≥ 4						> 12
O	Trailers (including semi-trailers)									
O1										≤ 0.75
O2										0.75 < m ≤ 3.5
O3										3.5 < m ≤ 10
O4										> 10 t

1 (PI) Positive Ignition ICE 2 (CI) Compression Ignition ICE 3 for transport of passengers 4 for transport of goods

U.S. Motor Vehicle Classification

NHTSA New Manufacturers Handbook

Classification	Definition
Passenger car	A motor vehicle with motive power, except a low-speed vehicle, multipurpose passenger vehicle, motorcycle, or trailer, designed for carrying 10 persons or less.
Multipurpose passenger vehicle MPV	A motor vehicle with motive power, except a low-speed vehicle or trailer, designed to carry 10 persons or less which is constructed either on a truck chassis or with special features for occasional off-road operation.
Truck	A motor vehicle with motive power, except a trailer, designed primarily for the transportation of property or special purpose equipment.
Bus	A motor vehicle with motive power, except a trailer, designed for carrying more than 10 persons.
Motorcycle	A motor vehicle with motive power having a seat or saddle for the use of the rider and designed to travel on not more than three wheels in contact with the ground.
Trailer	A motor vehicle with or without motive power, designed for carrying persons or property and for being drawn by another motor vehicle.
Low-speed vehicle	A motor vehicle, that is 4-wheeled, whose speed attainable in 1 mile (1.6 km) is more than 20 miles per hour (32 kilometers per hour) and not more than 25 miles per hour (40 kilometers per hour) on a paved level surface, and whose GVWR is less than 3,000 pounds (1,361 kilograms).
Pole Trailer	A motor vehicle without motive power designed to be drawn by another motor vehicle and attached to the towing vehicle by means of a reach or pole, or by being boomed or otherwise secured to the towing vehicle, for transporting long or irregularly shaped loads such as poles, pipes, or structural members capable generally of sustaining themselves.

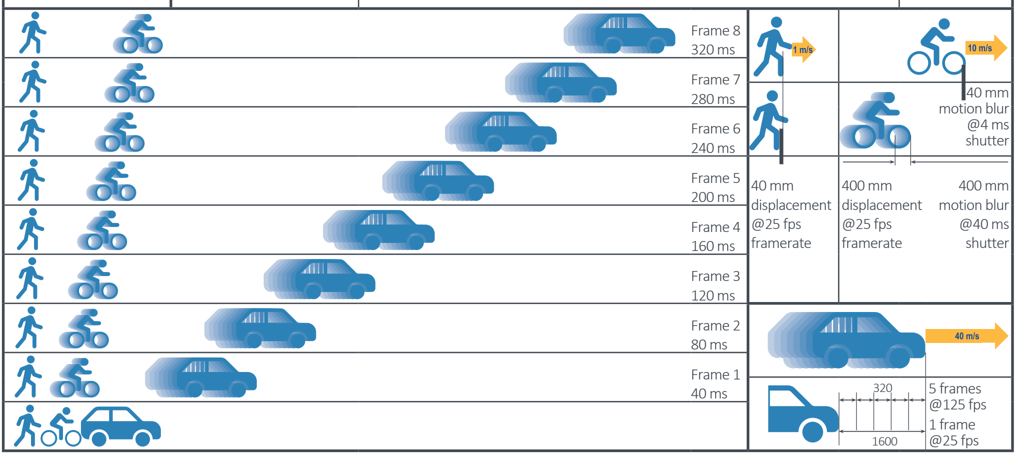
Current Dummy Landscape

	Dummies	Frontal Impact					Side Impact				Rear Impact		Child				
		HIII 50 %	HIII 5 %	HIII 95 %	THOR 50 %	THOR 5 %	ES-2	ES-2re	SID-IIs	World SID	HIII 50 %	BioRID-II	CRABI	CAMI	HIII	P Series	Q Series
Europe / UN Regulations	UN R17											●					
	UN R44															●	
	UN R94	●															
	UN R95						●										
	UN R129																●
	UN R135									●							
	UN R137	●	●														
	Euro NCAP	●	●	●	●	●				●		●					●
America	FMVSS 208	●	●										●		●		
	FMVSS 214							●	●	○							
	FMVSS 213/213a/213b												●	●	●	●	●
	FMVSS 202a										●						
	FMVSS xxx (OMDB)				○												
	U.S. NCAP	●	●		○			●	●	○							
	IIHS	●	●						●								
	Latin NCAP	●					●										●
Asia	Japan Regulations	●	●				●			●						●	
	JNCAP	●	●		●					●		●	●		●	●	●
	China Regulations	●					●	●		●							
	C-NCAP	●	●	●	●		●		●	●		●					●
	KNCAP	●	●		●	●				●		●					●
	ASEAN NCAP	●					●										●
AUS	ADR (Frontal, Side)	●					●			●							
	ANCAP	●	●	●	●	●				●		●					●
GTR	GTR 7 (Head Restr.)	●										●					
	GTR 14 (Pole Side)									●			SafetyWissen by carhs				

2026 2027 2029 ○ = planned, no date specified

Highspeed Camera Recording Settings

Variable	Derivation	Symbols	Units
Framerate	$f = \frac{v}{s} \cdot n_{frame}$	f Framerate v Velocity s Displacement n_{frame} Number of frames	fps m/s m frames
	Example - Car: v = 40 m/s s = 1.6 m	$f = \frac{40\text{ m/s}}{1.6\text{ m}} \cdot 1\,frame = 25\text{ fps}$ $f = \frac{40\text{ m/s}}{1.6\text{ m}} \cdot 5\,frame = 125\text{ fps}$	 
Exposure as derivative of the displacement	$E = \frac{B_s}{v}$	E Exposure B_s Acceptable Motion Blur as Displacement v Velocity	s m m/s
	Example - Bicycle: v = 10 m/s B_S = 0.4 m or 0.04 m	$E = \frac{0.4\text{ m}}{10\text{ m/s}} = 0.04\text{ s} = 1/25\text{ s}$ $E = \frac{0.04\text{ m}}{10\text{ m/s}} = 0.004\text{ s} = 1/250\text{ s}$	 
Exposure as derivative of the resolution	$E = \frac{B_r \cdot D_x}{(v \cdot X)}$ $E = \frac{B_r \cdot D_y}{(v \cdot Y)}$	B_r Acceptable Motion Blur as Resolution D_x Imagewidth D_y Imageheight X Horizontal Image Resolution Y Vertical Image Resolution	pixel m m pixel pixel
	$B_r = \frac{B_s}{P}$	B_s Acceptable Motion Blur as Displacement	m
	$P = \frac{D_x}{X}$ $P = \frac{D_y}{Y}$	P Pixelcalibration	m/pixel



High-Resolution - FullHD High-Speed Imaging

The Photron FASTCAM Mini W5 and Mini W2 are compact, high-performance high-speed cameras designed to deliver high image quality, light sensitivity, and versatility in demanding research and industrial environments.

FASTCAM Mini W5 / W2

- 2048 x 1152 pixels at 5,000fps (W5)
- 2048 x 1152 pixels at 2,000fps (W2)
- 1920 x 1080 pixels at 5,280fps (W5)
- 1920 x 1080 pixels at 2,750fps (W2)
- Reduced resolution to 200,000fps (W5)
- Reduced resolution to 150,000fps (W2)
- Internal memory to 64GB
- High-Speed 1/10-Gigabit Ethernet Interfac
- Standard 2-year warranty

Exceptional Image Quality - 4K-UHD Camera

Enjoy 12-bit image recording rates of up to 1,250fps at 4K resolution, with impressive shutter speeds that go as low as 2µs. For even higher frame rates, the camera offers recording rates of up to 200,000fps at lower image resolutions.

FASTCAM Mini R5-4K / R5-3K

- 4096 x 2304 pixels at 1,250fps (R5)
- 4096 x 2304 pixels at 750fps (R3)
- 3840 x 2160 pixels at 1,440fps (R5)
- 3840 x 2160 pixels at 800fps (R3)
- Reduced resolution to 200,000fps (R5)
- Reduced resolution to 150,000fps (R3)
- Internal memory to 64GB
- High-Speed 1/10-Gigabit Ethernet Interface
- Standard 2-year warranty

Photron www.photron.com | image@photron.com

Crash Test Data Acquisition Workshop

Course Description

Measurement technology is required to be able to make statements about what happens during a crash test. It reliably collects and stores all the data from the sensors installed in the vehicle in a short period of time. The associated software converts the signals into readable curves. At the same time, it digitally reproduces the test, i.e. the hierarchical structure and the sources of the individual signals are also displayed. The data is evaluated and can be used for further tests. To set up a measurement technology experiment, knowledge of how sensors work and how to parameterize them is just as important as knowledge of signal processing and possible error patterns. The workshop imparts this knowledge in an entertaining and well-founded practical way. Participants will then be able to work with measurement technology independent of the manufacturer.

Course Objectives

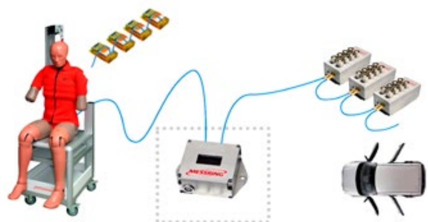
The course enables you as a participant to cover the topic of measurement technology testing from A-Z in the future. You will understand the function of all components, be able to set up and carry out tests and recognize error patterns. You will also be able to read and post-process result curves.

Who should attend?

The practical training is aimed at beginners and those switching to crash measurement technology, regardless of previous training.

Course Contents

- Concept of the measurement chain
- Getting familiar with all relevant sensors and parameters
- Creating new sensors (linking sensor and software)
- Setting up measurement technology tests and carrying out sensor tests
- Carrying out a sled system test and post-processing the signal curves



Instructors

Heiko Haupt (MESSRING GmbH) started his career in the area of system support / airbag development at Autoliv. He later took on international service and training tasks for a 3D printer manufacturer and worked as a Scrum Master in software development. Since 2021, he has been building up the Training division at MESSRING and has headed the Technical Communication group since 2023. In this role, he trains customers, sales partners and employees in the use of crash test equipment.

Franz Holzinger (MESSRING GmbH) is a master car body technician with many years of experience in prototype construction and accident repairs. Additional training as a vehicle expert followed in 2017. From 2018, his field of activity shifted towards technical training. He trains freelance for well-known OEMs in the field of accident repairs. He also teaches technical mathematics and physics at vocational schools in Munich and Stuttgart. Employed by MESSRING since 2022, he conducts user training for customers and employees.

Facts

15.-16.04.2026	205/4697	Gilching	2 Days	1.450,- EUR till 18.03.2026, thereafter 1.750,- EUR	German
14.-15.10.2026	205/4698	Gilching	2 Days	1.450,- EUR till 16.09.2026, thereafter 1.750,- EUR	English

SAFETYTESTING

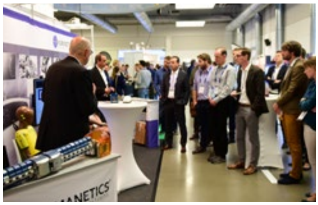
Testing is a key element in the product development cycle of any new vehicle development and its **active** and **passive safety** functions. In collaboration with the industry experts in our program committee we defined the current challenges of the safety testing landscape. Join us for a new conference format where the industry leaders challenge the test tool and testing suppliers and their hard- and software solutions. Dedicated sessions will be defined to focus on one of the challenges that will provide the platform for dialogue and discussion.
We have invited global leaders out of the full safety testing spectrum to answer these industry calls.

Challenge Topics

Expect discussions on innovations from the following fields:

Passive Safety Session

- **State of the Art Sled Testing - Yaw Pitch Roll**
- **Challenges in AV Testing**
- **Big Test Data: Modern Crash Test Evaluation**
- **Virtual Testing**



Active Safety Session

- **Swarm Testing**
- **Validation Tool Chain**
- **Next Level Proving Grounds - PG and Road Digitalization**
- **Virtual Testing**

Who should attend?

The SafetyTesting Challenge is suited for engineers and decision makers from validation departments for active and passive safety. Both experts and newcomers get an overview over the latest innovations in test equipment and software tool and find ample opportunity to share their own experiences with industry colleagues.

Facts

14.04.2026

Frankfurt/Hanau, GERMANY & ONLINE

www.carhs.de/safetyweek

Latest info about this course

High Speed Cameras Workshop

Course Description

High-speed cameras are an essential analysis and measurement tool in a wide variety of tests in passive safety. The video recording or image sequences not only provide spectacular images for all involved. They are also becoming increasingly important for downstream 2D and 3D image analysis. In addition to the direct determination of parameters such as velocities or target accuracy, the data is also frequently compared with a simulation. Due to the manifold use of video data today, the demands on the operation of the cameras are also increasing. This is accompanied by an increasing complexity of the overall system of camera, optics and lighting. Only by taking a holistic view of all components optimal results can be achieved for the various departments and customers. The seminar focuses on high-speed cameras and first provides a detailed introduction to the technology used. The special features of a high-speed sensor are explained via the structure of a pixel cell. Building on this, the essential basics, special features and optimization parameters of a high-speed camera are taught. With the well-founded basics, the essential quality criteria for the different tasks can now be explained and demonstrated. For further optimization, the possibilities of optics and illumination are then discussed in detail. It is essential to focus on the specific tasks in the automotive industry and image analysis in 2D and 3D.

Course Objectives

After attending the course, participants will have gained in-depth knowledge of the functionality and operation of a high-speed camera. They will have knowledge about the optimization of video sequences both in the area of parameterization of the cameras themselves, the tuning of the overall system with optics and light as well as the post-processing of video data.

Who should attend?

The seminar is aimed at specialists from crash-related development, engineers and technicians from test and simulation departments, as well as project engineers and managers.

Course Contents

- Structure of the sensor of a high-speed camera
- Special features and parameterization of a high-speed camera
- Requirements of the image measurement technology
- Optimization potential via optics, LED illumination and synchronization
- Optimization potential of image post-processing in software
  - Operation of different cameras in a network

Instructor

Dr.-Ing. Thomas Weber (Artho GmbH) has been working in the field of high-speed cameras for over 20 years. After studying computer science, he started at the Fraunhofer Gesellschaft in 1987, where he earned his doctorate in the area of process chain optimization and logistics. He then managed various optimization and logistics projects in full vehicle development. Via a group-wide optimization project in the area of vehicle safety, he found his home in the field of high-speed cameras more than 20 years ago. He was responsible for projects concerning the development of high-speed cameras, their accessories and control software. He designs and leads national and international projects in vehicle development with high speed cameras. A characteristic of his work is the optimization of the overall process for smooth and efficient operation of the entire system. Thus, he successfully implements projects in the safety centers of well-known suppliers and automotive manufacturers.

Facts

Date	#	Location	Duration	Price	Language
05.02.2026	200/4695	Alzenau	1 Day	890,- EUR till 08.01.2026, thereafter 1.090,- EUR	German
06.-07.10.2026	200/4696	Online	2 x 4 Hrs.	890,- EUR till 08.09.2026, thereafter 1.090,- EUR	English

THOR 50 % Male
Injury Criteria, Risk Functions and proposed Limits

Region	Criterion	Calculation[1]	Risk Function[3]	Limits for U.S. NCAP[1] Full score	Limits for U.S. NCAP[1] Zero score	Limits for Euro NCAP Full score	Limits for Euro NCAP Zero score
Head	HIC_{15} (-)	$\left\|(t_2 - t_1)\left[\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} a(t)dt\right]^{2.5}\right\|_{max}$	$p(\text{AIS } 2+) = \Phi\left[\frac{\ln HIC_{15} - 6.96362}{0.84687}\right]$ $p(\text{AIS } 3+) = \Phi\left[\frac{\ln(HIC_{15}) - 7.45231}{0.73998}\right]$	500	700	500	700
	Brain Injury Criterion BrIC (-)	$\sqrt{\left(\frac{\max(\|\omega_x\|)}{\omega_{xC}}\right)^2 + \left(\frac{\max(\|\omega_y\|)}{\omega_{yC}}\right)^2 + \left(\frac{\max(\|\omega_z\|)}{\omega_{zC}}\right)^2}$ with $\omega_{[x,y,z]}$ = Angular velocity (rad/s) ω_{xC} = 66.25 rad/s ω_{yC} = 56.45 rad/s ω_{zC} = 42.87 rad/s	$p(\text{AIS } 3+) = 1 - e^{-\left(\frac{BrIC - 0.523}{0.531}\right)^{1.8}}$ $p(\text{AIS } 4+) = 1 - e^{-\left(\frac{BrIC - 0.523}{0.647}\right)^{1.8}}$	0.71	1.05	-	-
	a3ms [g]			-	-	72	80
	DAMAGE	Euro NCAP TB 035 1.0.1		-	-	0.42 - 20 % 0.47 - 40 %	
Neck	N_{ij} (-)	$\frac{F_z}{F_{zc}} + \frac{M_y}{M_{yc}}$ with F_{zC} = 4200 N / -6400 N (tension/compression) M_{yC} = 88.1 Nm / -117 Nm (flexion/extension)	$p(\text{AIS } 2+) = \frac{1}{1 + e^{(5.819 - 5.681Nij)}}$ $p(\text{AIS } 3+) = \frac{1}{1 + e^{(6.047 - 5.44Nij)}}$	0.39	0.85	-	-
	F_{Shear} [kN]			-	-	1.9	3.1
	$F_{Tension}$ [kN]			-	-	2.7	3.3
	$M_{Extension}$ [Nm]			-	-	42	57
Chest	Multi-point Thoracic Injury Criterion R_{max} (mm)	$max(UL_{max}, UR_{max}, LL_{max}, LR_{max})$ with $[U/L\|R/L]_{max} = max\left(\sqrt{[L/R]X^2_{[U/L]S} + [L/R]Y^2_{[U/L]S} + [L/R]Z^2_{[U/L]S}}\right)$ $[L/R][X/Y/Z]^2_{[U/L]S}$: Time-History of the [left / right] chest deflection along the [x / y / z] axis relative to the [upper / lower] spine segment	$p(\text{AIS } 3+) = 1 - e^{-\left(\frac{R_{max}}{58.183}\right)^{2.977}}$	37.9	52.3	35	60
Abdomen	Compression δ_{max} (mm)	max(δL,δR): Peak X-axis deflection of the [left / right] abdomen	$p(\text{AIS } 3+) = 1 - e^{-\left(\frac{\delta_{max}}{106.222}\right)^{4.3127}}$	-	88.6	-	88
Pelvis	res. Actetabulum Load F_R (kN)	$\sqrt{F_x^2 + F_y^2 + F_z^2}$	$p(Hip\ fracture) = \Phi\left[\frac{\ln 1.429F_{AR} - 1.5751}{0.2339}\right]$	2.583	3.486	3.28	4.1
Femur	Axial Load F_Z (kN)	-	$p(\text{AIS } 2+) = \Phi\left[\frac{\ln(1.299F_{LC}) - 2.62}{0.3014}\right]$	5.331	8.588	3.8	9.07
Tibia	$F_{Z,upper}$ (kN)	-	$p(\text{AIS } 2+) = \frac{1}{1 + e^{(5.7415 - 0.8189F_{upper\ tibia})}}$	4.235	5.577	- [2]	- [2]
	$F_{Z,lower}$ (kN)	-	$p(\text{AIS } 2+) = \frac{1}{1 + e^{(3.7544 - 0.4683F_{lower\ tibia})}}$	3.573	5.861	- [2]	- [2]
	M_{res} (Nm)		$p(\text{AIS } 2+) = 1 - e^{-e^{\left(\frac{lnRTI - 0.3376}{0.3213}\right)}}$	178	240	- [2]	- [2]

1 as proposed in NHTSA's Request for Comments published in January 2017
2 Euro NCAP uses the lower leg of the Hybrid III dummy
3 Source: Craig et al.: *Injury Criteria for the THOR 50th Male ATD.*, NHTSA, September 2020

Euro NCAP Frontal Impact Protocol 1.1

Dummies: Weights, Dimensions and Calibration

Adult Dummies for Frontal / Rear Impact

	Weight (kg)	Seating Height (cm)	Instruction for Calibration
THOR 50 % Male	76.0	94	THOR 50th Percentile Male (THOR-50M) Qualification Procedures Manual, April 2023 (NHTSA)
THOR 5 % Female	49.0	81.3	
Hybrid II 50 % Male	74.4	90.7	CFR 49 Part 572, Subpart B
Hybrid III 5 % Female	49.1	78.7	SAE J2862, J2878 CFR 49 Part 572, Subpart O
Hybrid III 50 % Male	77.7	88.4	SAE J2779, J2876 CFR 49 Part 572, Subpart E 1999/98/EC
Hybrid III 95 % Male	101.2	91.9	SAE J2860
BioRID-II	78.0	88.0	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 1996/27/EC, 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	76.5	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	CFR 49 Part 572, Subpart V
WorldSID 5 % Female	48.0	76.1	User Manual
WorldSID 50 % Male	74.0	87.0	Qualification Procedure Jan. 2024

Child Dummies

	Weight (kg)	Seating Height (cm)	Instruction for Calibration
P0. P¾. P6. P10	3.4 - 32.0	34.5 - 72.5	User Manual
P3	15.0	56.0	User Manual
P1½	11.0	49.5	P1½ User Manual
Q1	9.6	47.9	Q1 User Manual
Q1½	11.1	49.9	Q1.5 User Manual
Q3	14.59	54.4	Q3 User Manual
Q3s	14.5	55.6	CFR 49 Part 572, Subpart W
Q6	22.95	60.1	Q6 User Manual
Q10	35.58	73.37	Q10 User Manual (Rev. A Draft)
CAMI Newborn	3.4	n/a	CFR 49 Part 572, Subpart K
CRABI 12 m	10.0	47.0	CFR 49 Part 572, Subpart R
VIP 3 - 3 y/o	16.1	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	16.2	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 - 6 y/o - Weighted	27.9	63.5	CFR 49 Part 572, Subpart S
Hybrid III - 10 y/o	35.3	72.4	CFR 49 Part 572, Subpart T

Dummy-Trainings

Seminars by our Partner
BGS Böhme & Gehring GmbH

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

Course Objectives

- 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

Find more dummy-related seminars on our website

- Dummy Certification
- Dummy Basics
- Dummy Measurement with Scanner/Measuring Arm

More Specific Needs?

If you need **specifc knowledge** regarding **dummies** or **pedestrian protection** testing, the experts from BGS Böhme & Gehring can offer an **indvidual coaching tailored to your needs**. Interested? Get in touch with ralf.reuter@carhs.de

Instructors

BGS

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.

Facts

DUMMY		
DUMMY	Hybrid III 5 %, 50 %, 95 %	
Dates	24.-25.02.2026	22.-23.09.2026
#	707/4754	707/4755
Price	1.850,- EUR	
DUMMY	THOR 50 %	
Dates	02.-04.03.2026	05.-07.10.2026
#	721/4758	721/4759
Price	2.940,- EUR	
DUMMY	BioRID-II	
Dates	17.-18.03.2026	03.-04.11.2026
#	708/4762	708/4763
Price	1.850,- EUR	
DUMMY	WorldSID 50 %	
Dates	14.-15.04.2026	10.-11.11.2026
#	718/4764	718/4765
Price	2.260,- EUR	
DUMMY	ES-2 / ES-2re	
Dates	10.-11.03.2026	13.-14.10.2026
#	709/4760	709/4761
Price	1.850,- EUR	
DUMMY	SID IIs	
Dates	28.-29.04.2026	17.-18.11.2026
#	710/4766	710/4767
Price	1.850,- EUR	
DUMMY	Q1.5 / Q3 / Q6	
Dates	23.03.2026	23.11.2026
#	767/4768	767/4769
Price	1.150,- EUR	
DUMMY	Q10	
Dates	25.03.2026	25.11.2026
#	720/4770	720/4771
Price	1.450,- EUR	
DUMMY	Hybrid III 3 and 6 y/o	
Dates	27.02.2026	24.09.2026
#	712/4756	712/4757
Price	1.150,- EUR	
Location	Bergisch Gladbach	

Latest info about this course

Seminars by our Partner
BGS Böhme & Gehring GmbH

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 regulation 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 in 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 regulation (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

Facts

Date	05.-07.05.2026	29.9.-1.10.2026
#	713/4788	713/4789
Location	Bergisch Gladbach	
Duration	2.520,- EUR	
Price		

Pedestrian Protection Workshop: aPLI

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

Facts

Date	23.-24.04.2026	17.-18.09.2026
#	765/4794	765/4795
Location	Bergisch Gladbach	
Duration	1.960,- EUR	
Price		

Pedestrian Protection Workshop: Vehicle Mark-Up

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
- Color scheme, manufacturers 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

Facts

Date	20.04.2026	14.09.2026
#	716/4792	716/4793
Location	Bergisch Gladbach	
Duration	1.150,- EUR	
Price		

Impactors for Pedestrian Protection

advanced Pedestrian Legform Impactor: aPLI

Instrumentation:
Upper body mass:
1 accelerometer 3-axial[1]
1 angular rate sensor 3-axial[1]

Femur:
3 strain gauges

Knee:
3 potentiometers
1 angular rate sensor 1-axial (X)[1]
1 accelerometer 1-axial (Y)[1]

Tibia:
4 strain gauges

Length	Total Mass	Upper Body Mass
1096 mm	24.7 kg	11.3 kg

1 not assessed

Flexible Pedestrian Legform Impactor: Flex PLI

Instrumentation:

Femur:
3 strain gauges[1]

Knee:
3 potentiometers
1 accelerometer 1-axial (Y)[1]

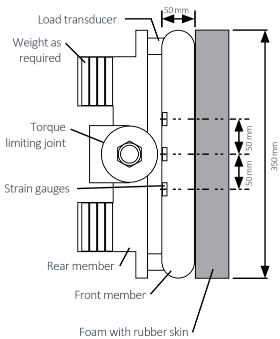
Tibia:
4 strain gauges

Injury Criteria

Criterion
Tibia Bending Moment
MCL Elongation
ACL / PCL Elongation

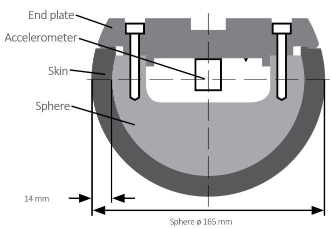
Length	Diameter	Mass
975 mm	132 - 140 mm	13.4 kg

Upper Legform



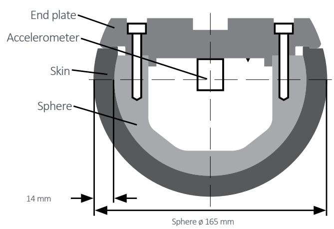
Length	Width	Mass
350 mm	~ 155 mm	11 - 18 kg

Adult Headform Impactor



	Diameter	Mass
Adult Headform	165 mm	4.5 kg

Child Headform Impactor



SafetyWissen by carhs

	Diameter	Mass
Child Headform	165 mm	3.5 kg

more on pedestrian protection ➲ page 110

Automated Driving - Safeguarding and Market Introduction

Course Description

The seminar presents the necessary and sufficient conditions for bringing automated vehicles onto the market. In addition, requirements for product monitoring and market surveillance will be derived, which can be used to ensure that the technology proves itself throughout the entire product life cycle. The question is addressed as to what forms automated driving can be expected to take in private transport, local passenger and freight transport, long-distance transport and in very special areas of application, and what opportunities connectivity and digitization of the technology open up.

Course Objectives

The course teaches the steps necessary to bring an automated vehicle to the market. In particular, it deals with how the safety of such vehicles can be proven and documented.

Who should attend?

The seminar is aimed at engineers who are faced with the task of making automated vehicles ready for the market and providing legally compliant proof of the safety of these vehicles.

Course Contents

- National and international laws and regulations
- Safety standards (functional safety, safety of the intended function, cyber security)
- Positive risk balance
- Technically unavoidable residual risks
- Proof of operational reliability
- Epidemiological and systemic approaches in safety and risk analyses
- Development of automation in
  - Customer vehicles
  - People & goods movers
  - Heavy commercial vehicles
  - Special applications
- Connectivity and digital mobility ecosystems

Instructor

Udo Steininger (TÜV SÜD Rail GmbH) is Chief Expert Automotive Safety at TÜV SÜD Rail GmbH. He has been involved in the safety of complex human-machine systems for over 35 years. After studying physics at the Technical University of Dresden, he worked for 5 years in reactor safety research. Since 1991, he has been working at TÜV SÜD on the topics of risk, reliability and safety in various fields of application - first in industry, then in railroads and, for the last 20 years, in the field of motor vehicles. For the past 15 years, he has specialized in assisted and automated driving. Initially, the focus of his work was on safety assessment during development, testing of vehicles and vehicle systems, and safety driver training. He currently supports manufacturers, suppliers and mobility service providers in the market introduction of systems for automated driving and related services. He is active in the DIN Automotive Standards Committee (ISO 26262 and ISO 21448) and is a member of the Safety - Methods and Processes - Advisory Board of the VDI Society for Vehicle and Transport Technology (FVT). Udo Steininger was a lecturer at the Munich University of Applied Sciences for many years and is a guest lecturer at the Chair of Automotive Engineering at the Technical University of Munich. His column on the current status and development of automated driving appears regularly in carhs' SafetyNews.

Facts

Date	#	Location	Duration	Price	Language
10.-11.02.2026	198/4659	Online	2 x 4 Hrs.	890,- EUR till 13.01.2026, thereafter 1.090,- EUR	English
06.05.2026	198/4660	Alzenau	1 Day	890,- EUR till 08.04.2026, thereafter 1.090,- EUR	German

Briefing on the Worldwide Status of Automated Vehicle Policies

Course Description

Regardless of the hype surrounding "self-driving cars", it is clear that automated driving systems (ADS) will fundamentally change the automotive industry. Moreover, despite widespread expectations that ADS hold the key to achieving substantial reductions in road crashes, injuries, and deaths, these systems also raise concerns among safety authorities. The validation of ADS requires long-duration testing and development to ensure correct behavior under massively variable road conditions. Conventional regulatory methods developed over the past half-century lack methods and tools to assess such performance, forcing safety authorities to look for new ways to ensure that ADS will be safe for public use.

Course Objectives

This seminar reviews current efforts to adapt regulatory systems to meet this challenge, including the vigorous debates over strategies and methods and the roles of regulators and manufacturers in ensuring the safety of automated vehicles.

Who should attend?

The briefing is aimed at employees from the development departments of vehicle manufacturers and suppliers working in the field of automated driving and vehicles equipped with automated driving systems. Given the risks of misuse, it is particularly important for all employees in product strategy and marketing departments.

Course Contents

- Safety authority expectations for automated vehicle safety
- Role and influence of manufacturers on regulatory thinking
- Pressures on current regulatory methods and tools
- Pressure on type approval for near-term framework
- Guidance versus regulation: How and when?
- Hybridization: Merging of self-certification and type approval
- Levels of automation from a regulatory perspective
- Current efforts to establish automated vehicle regulations
- Outlook: Can regulations ensure automated vehicle safety?

Instructor

John Creamer (GlobalAutoRegs.com) 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).

Facts

05.-06.05.2026	184/4670	Online	2 x 3 Hrs.	890,- EUR till 07.04.2026, thereafter 1.090,- EUR	
29.10.2026	184/4672	Alzenau	1 Day	890,- EUR till 01.10.2026, thereafter 1.090,- EUR	

Levels of Driving Automation according to BASt, SAE and NHTSA Definitions

Execution of Steering and Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability	BASt / Euro NCAP User Communica-tion	SAE Level acc. to SAE J3016	NHTSA Level
			-	-	0 No automa-tion	0 No automa-tion
			Some driving modes	Assisted	1 Driver assistance	1 Functionspe-cific automa-tion
			Some driving modes		2 Partial automation	2 Combined function automation
			Some driving modes	Automated	3 Conditional automation	3 Limited self driving auto-mation
			Some driving modes	Autonomous	4 High automation	3 / 4 Limited self driving auto-mation / Full self driving auto-mation
			All driving modes		5 Full automation	

AUTO[NOM]MOBIL

The Experts' Dialogue

Automated Driving and Safety

The hype about what is often called autonomous driving is increasingly giving way to reality. In recent years, even the greatest visionaries have realized that many questions still have to be answered, many barriers overcome and many challenges mastered in order to implement vehicle automation.

However, especially in times of the current crisis, it has become all the more clear that mobility must be regarded as one of the most fundamental basic needs, and mobility for all means that we must work on vehicle automation with full commitment.

In the Auto[nom]Mobil session of the carhs.training SafetyWeek, fundamental and cross-competitive necessities for achieving goals will be addressed and possible solutions will be presented. This expert dialogue provides the platform for an intensive exchange and is intended to accelerate the essential stronger networking of the participants.

Facts

15.-16.04.2026

Frankfurt/Hanau, GERMANY & ONLINE

www.carhs.de/safetyweek

the ADAS experience 中国

The requirements by New Car Assessment Programs regarding safety-supporting driver assistance systems for passenger cars are constantly increasing: Oncoming traffic scenarios, tests in darkness and higher expected speed reductions are some of the prerequisites for a 5-star rating in the Euro NCAP or an IIHS Top Safety Pick.

The introduction of emergency brake assistants for passenger cars is being driven forward by legislation: Since 2022 UN Regulation 152 has been applicable for passenger cars in the EU. The lane departure warning functions have also been incorporated into UN R 79.03.

At **The ADAS Experience**, the framework relevant for the development will be presented: Requirements, technical principles, development and release methods on the Theory Day in the conference hotel, followed by hands-on experience on the test track on the Demo Day. Various test scenarios will be performed and examples of how the test technology is best used, will be shown live in the different test setups.

This is what awaits you:

- The presentation of current and future requirements on emergency braking, evasion and highly automated driving functions, as well as development strategies that lead to a robust system.
- Face to face talk with the people who set the framework for the development of safety assist functions: Legislative representatives, consumer protection organizations, OEM representatives and suppliers of simulation and testing technologies.
- Practical experience with various test setups, targets, driving robots and control software on the Demo Day.

Who should attend?
The ADAS Experience addresses everyone, who works in the field of safety-related driver assistance systems. The conference is the right place to broaden and deepen your network: You will meet key players in development, system integration, regulation and verification of Safety Assist Systems.

Facts

20.-21.10.2026

tba, China

www.carhs.de/adasCN

Consumer Testing (NCAP) Assistance System Rating Matrix

	Euro NCAP ANCAP	U.S. NCAP	IIHS	Latin NCAP
SBR Seat Belt Reminder	rear seats w/ occupant detection		front seats rear seats	front seats rear seats
OSM / DSM Occupant/Driver Status Monitoring	distraction fatique unresponsiveness		impairment driver attention	DMS
ABS Anti-Lock Braking System				
ESC Electronic Stability Control				Moose test
MCB Multi Collision Brake	part of the AOP rating			
SAS Speed Assistance Systems	Speed Limit Inform. Speed Control		ISA	SLIF Manual Speed Ass. Speed Control
LSS Lane Support Systems	LDW LKA ELK ELK PTW	LDW LKA		LDW LKA RED ELK
BSM Blind Spot Monitoring	Car Motorcycle	BSW BSI		Motorcycle
AEB Car to Car	rear (stat./mov./brake.) turn across path crossing head on	rear (stat./mov./brake.) intersection head on	rear (stat.)	rear (stat./mov./brake.)
AEB Car to Truck			rear (stat.)	
AEB PSS	scenarios tbd			
AEB Pedestrian	crossing longitudinal turn across path	crossing longitudinal	crossing longitudinal	crossing longitudinal
AEB Cyclist	crossing longitudinal turn across path	tba		crossing longitudinal
AEB PTW	rear turn across path	tba	rear (stat.)	
AEB Reverse	Pedestrian (stat./mov.)	tba	Car, Bollard	
Emergency Call	part of the AOP rating			eCall
Rear View Monitor				
Rear Cross Traffic Alert			Car, Bollard	
Headlights		adaptive driving beam semiautomatic lower beam	visibility glare	
Pedal Misapplication	pedestrian rearw./forw.			
L2/L3 Assisted Driving	rewards/penalty		safeguards	
Other	dooring			alcolock

● 2026 ● 2027 ● introduction to be announced

ASEAN NCAP	C-NCAP	C-IASI	JNCAP	KNCAP
front seats rear seats	passenger w/ detection rear seats	front seats rear seats	front passenger seat rear seats	front seats rear seats
(SAT)	fatique (DFM) attention (DAM)	distraction fatique unresponsivenes		
UN R13h				
UN R13h / UN R140	ESC			
(SAT)	part of Occupant Protection rating	part of Occupant Safety rating		
(SAT)	TSR ISLS			ISA
LDW LKA ELK PTW	LKA ELK	LDW ELK	LKA LDW	LKA LDW ESF
Motorcycle	BSD	BSD		Car
rear (stat./mov./brake.)	rear (stat../cut out) turn across path crossing false positive	rear (stat./mov.) turn across path	turn across path crossing	rear (stat./mov./brake.)
		rear (stat.)		
	Pedestrian			
	crossing longitudinal turn across path	crossing longitudinal	crossing turn across path	crossing
	E-cyclist, Cyclist: crossing longitudinal	crossing longitudinal	crossing longitudinal	crossing longitudinal
rear (mov.) crossing turn across path	Scooter, Tricycle: crossing longitudinal turn across path	crossing turn across path	turn across path	
	part of the OP rating	eCall	eCall	eCall[1]
Rear View Monitor				
(SAT)	RCTA			RCCA
Auto High Beam Adaptive High Beam	Low beam High beam Bonus	Low beam High beam	Automatic antiglare Automatic switching	
	Pedal Misapplication		Pedal Misapplication	PMAPS
	dooring (DOW)	dooring	TSR	BMS[2], V2X

1 part of the Crash Safety Category
2 part of the EV Category

Simulation for Automated Vehicles - Introduction to Scenarios, ODDs and Validation

Course Description

The complexity of modern driver assistance systems and automated driving functions sometimes requires completely new methods and approaches for their development, validation and testing. In particular, the wide coverage and analysis of functions with numerical simulation over the entire operating range (the so-called Operational Design Domain) is an indispensable tool for the effective and efficient development of appropriate vehicle functions. The course is about presenting the basics of scenario-based and data-based development and putting them in a holistic context.

Course Objectives

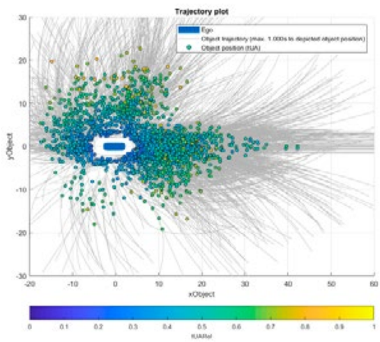
The course provides an overview and a brief introduction to the relevant scenario management methods for simulation and data-centric development and validation of automated driving functions. Some key basic principles in the development of complex systems are to be taught.

Who should attend?

The seminar addresses employees of automotive manufacturers, suppliers, engineering service providers, government agencies and research institutions, who are engaged in the development and validation of automated driving functions. In particular, method and process developers, simulation and test engineers are also addressed, who are responsible to implement corresponding processes and methods in their companies to ensure safe development and assessment of automated driving functions.

Course Contents

- Overview of the basic functions of automated driving
- Basics of Scenario and Data-based development
- Basics in Machine Learning, Data Mining and Artificial Intelligence
- Stochastic Simulation, Monte-Carlo-Simulation, Design-of-Experiments
- Optimization and automated calibration
- Robustness and complexity management
- Anomaly and fault detection
- Development processes for complex systems and software, top-down versus bottom-up
- Functional requirements management
- Validation and verification
- Definitions Operational Design Domain
- Effectiveness assessment of system functions and components
- Quality management for simulation data



Instructor

Dr. Andreas Kuhn (Andata Entwicklungstechnologie GmbH) studied Technical Mathematics and Mechanical Engineering at the Technical University of Vienna. After his dissertation on the simulation of special satellite formations for the European Space Agency, he began his professional career in crash simulation at BMW. After further years as a consultant for stochastic simulation at EASI Engineering GmbH (today carhs), he founded ANDATA in 2004, where he is responsible for development and research as managing partner. Since 2009 he has also been co-owner of Automotive Safety Technologies GmbH in Gaimersheim. His professional interests are founded in effective and efficient development, validation and assessment methods for complex, safety-critical systems. In particular, he has been working for more than 20 years on the development and combined application of methods from the fields of artificial intelligence, machine learning, advanced simulation methods, scenario-based approaches and according process models in the virtual development of vehicles and autonomous robots. His current activities are the development and implementation of cooperative, networked, automated driving strategies for effective traffic automation.

Facts

27.-30.04.2026	187/4657	Online	4 x 4 Hrs.	1.450,- EUR till 30.03.2026, thereafter 1.750,- EUR	English
13.-14.10.2026	187/4658	Alzenau	2 Days	1.450,- EUR till 15.09.2026, thereafter 1.750,- EUR	German

Artificial Intelligence and Machine Learning for ADAS and ADS - Introduction and Basics

Course Description

The functions of automated driving - no matter what degree of automation - usually require the application of modern artificial intelligence techniques in order to be able to realize the desired functionalities at all. The aim of this seminar is to present the basic methods of Artificial Intelligence and Machine Learning. The methods should be demonstrated with concrete examples from the fields of assisted and automated driving. Care is also taken about validation, verification and safeguarding of the related models and AI-based software components.

Course Objectives

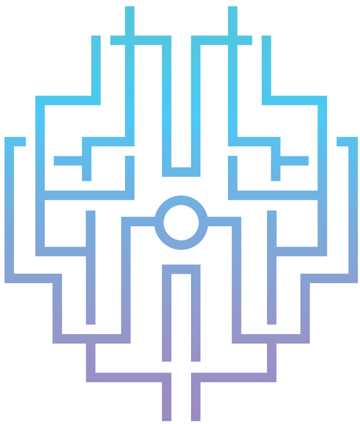
This seminar provides an overview and a brief introduction to the relevant methods of Artificial Intelligence and Machine Learning, so that both developers and managers can clearly decide which methods and procedures are relevant for their applications and which possible pitfalls they should consider in the application.

Who should attend?

Developers and (project) managers who have not yet had deep experience with the methodology and want to get a quick overview and introduction to the use of artificial intelligence.

Course Contents

- Introduction of data-based development versus analytical and rule-based approaches
- Overview of the different procedures and areas of application
- Artificial Neural Networks, Deep Learning, various variants and architectures
- Decision and regression trees
- Support Vector Machines
- Validation and safeguarding of models, sampling procedures, robustness assessment
- Data preparation and problem parameterization
- Meta modeling and model committees



Instructor

Dr. Andreas Kuhn (Andata Entwicklungstechnologie GmbH) studied Technical Mathematics and Mechanical Engineering at the Technical University of Vienna. After his dissertation on the simulation of special satellite formations for the European Space Agency, he began his professional career in crash simulation at BMW. After further years as a consultant for stochastic simulation at EASI Engineering GmbH (today carhs), he founded ANDATA in 2004, where he is responsible for development and research as managing partner. Since 2009 he has also been co-owner of Automotive Safety Technologies GmbH in Gaimersheim. His professional interests are founded in effective and efficient development, validation and assessment methods for complex, safety-critical systems. In particular, he has been working for more than 20 years on the development and combined application of methods from the fields of artificial intelligence, machine learning, advanced simulation methods, scenario-based approaches and according process models in the virtual development of vehicles and autonomous robots. His current activities are the development and implementation of cooperative, networked, automated driving strategies for effective traffic automation.

Facts

16.-19.03.2026	186/4655	Online	4 x 4 Hrs.	1.450,- EUR till 16.02.2026, thereafter 1.750,- EUR	
06.-07.10.2026	186/4656	Alzenau	2 Days	1.450,- EUR till 08.09.2026, thereafter 1.750,- EUR	

Euro NCAP Commercial Van Rating

Van Overall Assessment Protocol 1.0

Safe Driving		**Crash Avoidance**		**Crash Protection**		**Post-Crash Safety**	
	2026+		2026+		2026+		2026+
Occupant Monitoring	**25**	**Frontal Collisions**	**65**	**Frontal Impact**	**40**	**Rescue Information**	**40**
Seatbelt Usage	*25*	*Car & PTW*	*40*	*Offset*	*20*	*Rescue Sheet*	*35*
Driver Engagement	**25**	*Pedestrian & Cyclist*	*25*	*Compatibility*	*20*	*Rescue Guide*	*5*
Driver Monitoring	*20*	**Lane Departure**	**25**	**Side Impact**	**10**	**Post-Crash Intervention**	**25**
Driving Controls	*5*	*Single Vehicle*	*15*	*HPD*	*10*	*Advanced eCall*	*20*
Vehicle Assistance	**50**	*Car & PTW*	*10*	**VRU Impacts**	**50**	*Multi Collision Brake*	*5*
Speed Assistance	*30*	**Low Speed Collisions**	**10**	*Head Impact*	*25*	**Extrication**	**35**
ACC Performance	*15*	*Ped. & Cyclist*	*10*	*Pelvis & Leg Imp.*	*25*	*Energy Management*	*20*
Steering Assistance	*5*					*Occupant Extrication*	*15*
max. points (1)	100	max. points (1)	100	max. points (1)	100	max. points (1)	100
normalised score (2)	actual points / (1)	normalised score (2)	actual points / (1)	normalised sc. (2)	actual points / (1)	normalised score (2)	actual points / (1)
weighting[1] (3)	tbd	weighting (3)	tbd	weighting (3)	tbd	weighting (3)	tbd
weighted score[1] (4)	(2) x (3)	weighted score (4)	(2) x (3)	weighted score (4)	(2) x (3)	weighted score (4)	(2) x (3)
Balancing: minimum normalised score (2) by box for the respective star rating:							
★★★★★	70 %	+	70 %	+	70 %	+	70 %
★★★★	60 %		60 %		60 %		60 %
★★★	50 %		50 %		50 %		50 %
★★	40 %		40 %		40 %		40 %
★	30 %		30 %		30 %		30 %
Compensation: Maximum shift of points to compensate adjacent stage		← 10 pt. →		← 10 pt. →		X	
Preconditions & Links between stages							
				Precondition: Red (0 points) critical body regions in frontal impact and VRU impacts prevent a 5-star rating, even if balancing threshold is reached.			
		Link: A minimum of 25 points need to be scored within VRU impacts in Crash Protection to be eligible of scoring points in pedestrian and cyclist scenarios in Frontal Collisions under Crash Avoidance.					

1 For best-in-class ranking only.

SD Occupant Monitoring Protocol 1.0	**CA Frontal Collisions Protocol 1.0**	**CP Frontal Impact Protocol 1.0**	**Post-Crash Safety Protocol 1.0**
SD Driver Engagement Protocol 1.0	**CA Lane Departure Collisions Protocol 1.0**	**CP Side Impact Protocol 1.0**	
SD Vehicle Assistance Protocol 1.0	**CA Low Speed Collisions Protocol 1.0**	**CP VRU Impact Protocol 1.0**	

Euro NCAP Truck Rating Collision Avoidance

AEB HGV-to-Car

Test Protocol 1.2

HCRs: Approach to stationary Target
Impact @ 0 / 50 / 100 %
AEB

v_0 = 10 - 90 km/h v = 0 km/h

HCRm: Approach to slower Target
Impact @ 0 / 50 / 100 %
AEB

v_0 = 30 - 90 km/h v = 20 km/h

HCRb: Approach to braking Target
Impact @ 50 %
AEB

v_0 = 50 km/h d_0 = 12/40 m v_0 = 50 km/h, a = -2/-6 m/s²
v_0 = 80 km/h d_0 = 30/50 m v_0 = 80 km/h, a = -2/-6 m/s²

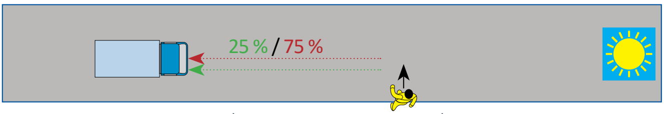
AEB HGV-to-Pedestrian

Test Protocol 1.2

Adult, Farside, Impact @ 50 % of the Vehicle Width (HPFA-50) AEB

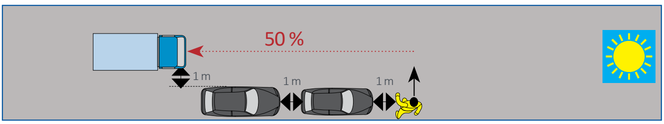
v_0 = 10 - 50 km/h v = 8 km/h

Adult, Nearside, Impact @ 25 & 75 % of the Vehicle Width (HPNA-25/75) AEB



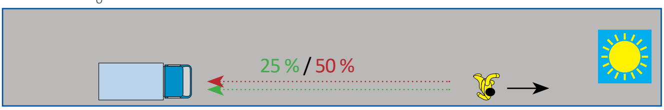
v_0 = 10 - 50 km/h v = 5 km/h

Child, Obstruction, Nearside, Impact @ 50 % of the Vehicle Width (HPNCO-50) AEB



v_0 = 10 - 50 km/h v = 5 km/h

Adult, Longitudinal, Impact @ 25 & 50 % of the Vehicle Width (HPLA-25/50) AEB FCW

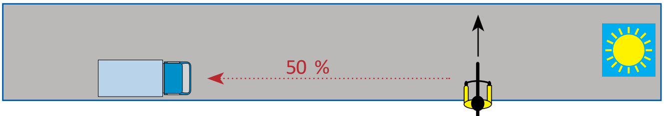


AEB	v_0 = 20 - 60 km/h	25 / 50 %	v = 5 km/h
FCW	v_0 = 50 - 90 km/h	25 %	v = 5 km/h

AEB HGV-to-Bicyclist

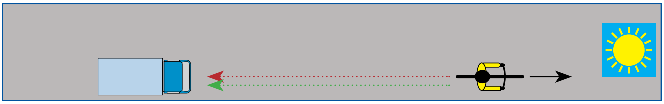
Test Protocol 1.2

Cyclist, Nearside, Impact @ 50 % of the Vehicle Width (HBNA-50) AEB



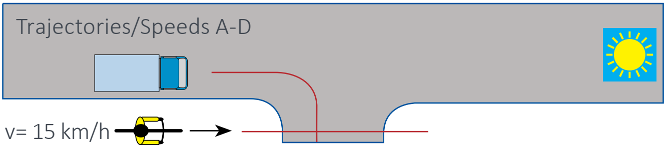
v_0 = 10 ... 50 km/h   v = 15 km/h

Cyclist, Longitudinal, Impact @ 25 & 50 % of the Vehicle Width (HBLA-25/50) AEB FCW



AEB	v_0 = 25 - 60 km/h	25 / 50 %	v = 15 km/h
FCW	v_0 = 50 - 90 km/h	25 %	v = 20 km/h

Cyclist, VUT turning across path, Nearside, Impact @ 0 m and 3 m of the Vehicle Length (HBNtap) AEB

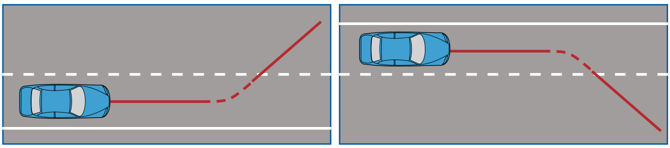


Lane Departure

Test Protocol 1.2

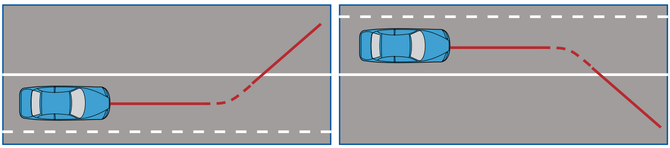
LKA

Lane Keep Assist Dashed Line: Fully Marked Lane



v_0 = 72 km/h, v_{lat} = 0.2 - 0.5 m/s in 0.1 m/s steps, R = 1200 m

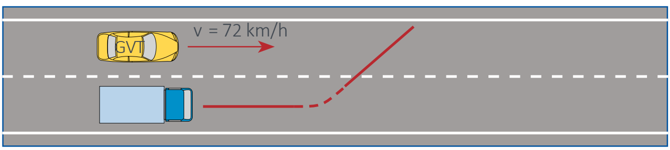
Lane Keep Assist Solid Line: Fully Marked Lane



v_0 = 72 km/h, v_{lat} = 0.2 - 0.5 m/s in 0.1 m/s steps, R = 1200 m

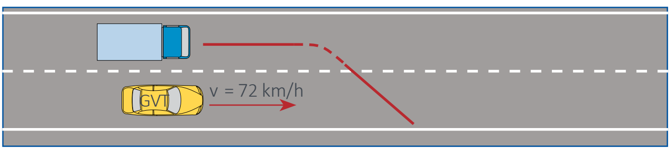
ELK

Emergency Lane Keeping Overtaking Farside: Fully Marked Lane



v_0 = 72 km/h, v_{lat} = 0.2 - 0.5 m/s in 0.1 m/s steps, R = 1200 m (unintentional)
v_0 = 72 km/h, v_{lat} = 0.5 - 0.7 m/s in 0.1 m/s steps, R = 800 m (intentional)

Emergency Lane Keeping Overtaking Nearside: Fully Marked Lane



v_0 = 72 km/h, v_{lat} = 0.2 - 0.5 m/s in 0.1 m/s steps, R = 1200 m (unintentional)
v_0 = 72 km/h, v_{lat} = 0.5 - 0.7 m/s in 0.1 m/s steps, R = 800 m (intentional)

Euro NCAP Safe Driving: Occupant Monitoring

SD Occupant Monitoring Protocol 1.1

Seatbelt Usage

The seat belt reminder must be able to detect the following misuse cases for the driver's seat to ensure correct seatbelt routing:

Correct seatbelt routing	5 points
Seatbelt buckle only	2 points
Seatbelt completely behind back	1 point
Lap belt only	2 points

Rear seats equipped with a seatbelt reminder, that come with occupancy detection will be awarded points:

Rear seat occupancy	5 points
Nr. of rear seats with occupancy detection / Nr. of rear seats x 5 points	5 points

Occupant Classification

Passenger airbag status (for rearward facing CRS)	4 points
Automatic	4 points
System advised with manual software switch	3 points
System advised with manual hardware switch	2 points
Manual (software or hardware switch)	1 point

Airbag status must be indicated with the words "Passenger AIRBAG OFF/ON":

- ON: For 60 seconds after ignition/master control is switched on and after the airbag is switched from OFF to ON.
- OFF: Permanently when the ignition/master control is on and the seat is occupied.

Technical Bulletin SD 101 AB Disabling 1.0

The vehicle must be able to detect the following Out of Position (OoP) cases for the front outboard passenger seat:

Out of Position	2 points
Close proximity to the airbag	1 point
Feet on dashboard	1 point

The vehicle must provide a warning (visual + audible) to either the driver or the passenger. Alternatively, countermeasures that adapt the strategy of the occupant restraint system are also eligible for these rewards. Warning must commence within 30 s after passenger is OoP. Warnings must be repeated after < 15 min if passenger remains OoP.

The vehicle must be able to classify occupants and adapt the restraint systems appropriately:

Occupant stature classification	4 points
Driver	3 points
Front seat passenger(s)	1 point

The restraint system must have at least two adaptivity settings.

Euro NCAP Safe Driving: Occupant Monitoring

SD Occupant Monitoring Protocol 1.1

Occupant Presence

Child presence detection using direct sensing must be able to detect children of ages up to and including 6 years old.

Child presence detection		5 points	
Scenarios	*Strategy*	*Rear Seats only*	*All pass. seats*
Child left behind	Warning	1.5 points	3.0 points
	Warning & Intervention	3.0 points	4.0 points
Child enters unlocked vehicle	Warning	0.5 points	1.0 points
	Warning & Intervention	0.5 points	1.0 points

Technical Bulletin SD 102 CPD Evaluation 2.0

The vehicle must provide occupancy information as part of the eCall message.

Crash occupancy information	5 points
Number of adult occupants (including the number of belts in use)	4 points
Number of Children in ALL CRS	1 point

MAX. TOTAL OCCUPANT MONITORING SCORE	30 points

Euro NCAP Safe Driving: Driver Engagement

SD Driver Engagement Protocol 1.1

Precondition

Where the vehicle offers an assisted driving system as option or standard, the system shall meet a minimum score of 50 % of Driving Collaboration and Driver Monitoring respectively, in accordance to the 2026 Assisted Driving Grading Protocol, to prevent overreliance.

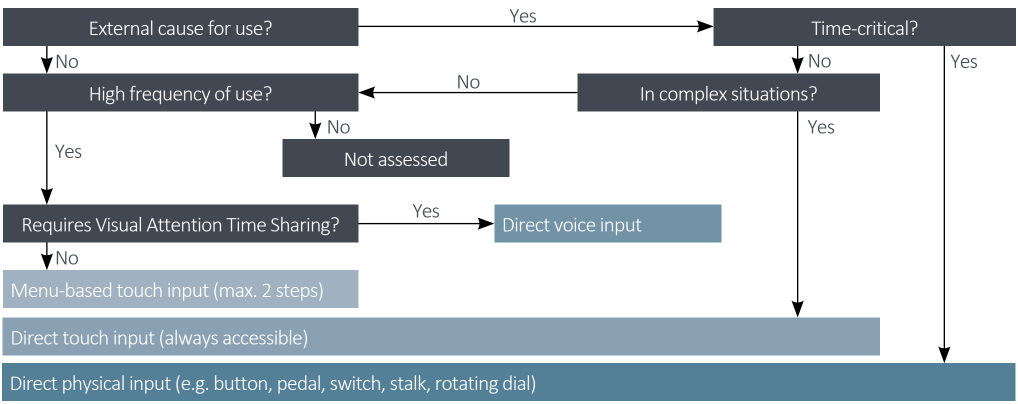
Assisted Driving Protocol 1.1

Driver Monitoring

Driver State	Distraction Type	Glance Target Type	Movement Type	Warning	Intervention			Sub Total	Total Points
					Forward Support Sensitivity	Lane Support Sensitivity	Total		
Transient	Long Distraction	Non-driving task	Owl	0.5	0.4	0.1	0.5	1	5
			Lizard	0.5	0.4	0.1	0.5	1	
			Body Lean	0.5	0.4	0.1	0.5	1	
		Driving task	Owl	-	0.8	0.2	1	1	
			Lizard	-	0.8	0.2	1	1	
	Short Distraction (VATS)	Non-driving task	Owl	0.5	0.4	0.1	0.5	1	5
			Lizard	0.5	0.4	0.1	0.5	1	
		Driving task	Owl	-	0.8	0.2	1	1	
			Lizard	-	0.8	0.2	1	1	
		Multi-target	Lizard	0.5	0.4	0.1	0.5	1	
	Phone Use	Basic	Owl + Lizard	1.25	1	0.25	1.25	2.5	5
		Advanced	Lizard	1.25	1	0.25	1.25	2.5	
Non-transient	Impairment	Drowsiness		0.5	1.5			2	4
		Non-fatique		0.5	1.5			2	
	Microsleep			0.5	1.5			2	2
	Sleep			0.5	1.5			2	2
	Unresponsive Driver			-	2			2	2
								Driver State Monitoring Total	25

Driving Controls

Assessment criteria scheme for vehicle control functions:



Euro NCAP Safe Driving: Driver Engagement

SD Driver Engagement Protocol 1.1

	Function	Category	Direct voice	Menu-based touch	Direct touch	Direct physical	Points	
Driving Controls	Direction indicator	Driving				■	1	2.5
	Gear selector					■		
	Hazard light					■		
	eCall					■		
	Horn					■		
	Wiper front	Vision				■	0.5	
	Wiper rear					■		
	Demist / Defrost			rear	■	■		
	Side Mirrors				■	■		
	Exterior Lights	Light		■	■	■	0.5	
	Full Beam					■		
	Headlight height adjustment			■	■	■		
	Front fog light				■	■		
	Rear fog light				■	■		
	Vehicle Assistance - Activation/ Deactivation &setting following distance	ADAS			■	■	0.5	
	Vehicle Assistance - setting speed					■		
Comfort & infotainment controls	Change audio source from radio to media	Audio		■	■	■	0.5	2.5
	Tune radio to a pre-determined station		■					
	Play		■					
	Skip song/station				■	■		
	Adjust volume				■	■		
	Mute audio				■	■		
	Call	Phone	■				0.5	
	Answer incoming call				■	■		
	Reject incoming call				■	■		
	Navigate to ...	Navigation	■				0.5	
	End navigation		■		■	■		
	Change temperature	Climate			■	■	0.5	
	Adjust fan speed				■	■		
	Vent control				■	■		
	Recirculation mode			■	■	■		
	Deactivate climate sys.			■	■	■		
	Seat heating/cooling			■	■	■		
	Steering wheel heating			■	■	■		
	Open close front windows	Windows			■	■	0.25	
	Open close rear windows				■	■		
	Lock/unlock doors	Other			■	■	0.25	
	Seat adjustment				■	■		
	Interior lights				■	■		
						Driving Controls Total	5	

Euro NCAP Safe Driving: Vehicle Assistance

SD Vehicle Assistance Protocol 1.1

Speed Assistance

Speed Limit Information Function					Max Total
SLIF accuracy (on-road evaluation)					
Distance based ($KPI_{Distance}$)			> 80 %	2	4
Event based (KPI_{Event})			> 80 - 10 %	2	
Advanced Speed Limits					3
Conditional Speed Limits					
Rain/wetness (including implicit)			Show correct limit	0.4	
Snow/icy			Warning only / ignore if irrelevant	0.4	
Time/season			Show correct limit	0.4	
Distance for/in			Show correct limit	0.4	
Arrows	Non lane-relevant		Show correct limit / ignore if irrelevant	0.1	
	Lane-relevant			0.2	
Vehicle categories			Show correct limit	0.2	
Implicit speed limits					
Highway / Motorway City Entry / Exit Residential zones			Show correct limit	0.5	
Dynamic speed limits					
Dynamic speed signs including roadworks	Non lane-relevant		Show correct limit	0.25	
	Lane-relevant			0.5	
Local Hazards					3
	Direct OR Cloud Communication		Direct AND Cloud Communication		
	Sending	Receiving & informing	Sending	Receiving & informing	
Construction zones	0.15	0.15	0.2	0.15	
Items on road	0.15	0.15	0.2	0.15	
Stopped vehicle	0.15	0.15	0.2	0.15	
Broken down vehicle	0.15	0.15	0.2	0.15	
Post crash	0.15	0.15	0.2	0.15	
Poor weather	0.15	0.15	0.2	0.15	
Poor road	0.15	0.15	0.2	0.15	
Wrong way driver	0.15	0.15	0.2	0.15	
Amber + Blue lights	N/A	0.15	N/A	0.15	
Traffic jam	N/A	0.15	N/A	0.15	
	Max 2.5		Max 3.0		
System Updates					2
Continuous connectivity (Streamed)				2	
Temporary connectivity (OTA updates, at least quarterly)				1	
				SLIF Total	12

Speed Control Function		Max Total
Intelligent Speed Limiter (ISL)	5	8
Intelligent Adaptive Cruise Control (iACC)	8	
	SCF Total	8

To be awarded full score, speedometer accuracy shall be -3/+0 km/h. When the speedometer accuracy is -5/+0 km/h the SCF points are halved.

Euro NCAP Safe Driving: Vehicle Assistance

SD Vehicle Assistance Protocol 1.1

ACC Performance

ACC Performance				15 points
Car-to-Car	Longitudinal	CCRs straight	1	6
		CCRs curve	1	
		CCRm	1	
		CCRb	1	
	Cut-in / Cut-out	Cut-in	1	
		Cut-out	1	
Car-to-Motorcycle	Longitudinal	CMRs straight	1	5
		CMRs curve	1	
		CMRm	1	
		CMRb	1	
	Cut-in / Cut-out	Cut-in	0.5	
		Cut-out	0.5	
Car-to-VRU	Longitudinal	CPLA	1	2
		CBLA	1	
Road Features	Curves	adjust speed ⟶ $a \leq 3.5\ m/s^2$	0.2	1
	Roundabouts	reduce speed to ≤ 50 km/h @ 20 m	0.2	
	Intersection	reduce speed to ≤ 30 km/h	0.2	
	Traffic lights	reduce speed to ≤ 30 km/h (red, orange)	0.2	
	Stop signs	reduce speed to ≤ 30 km/h	0.2	
Auto-resume	Auto resume after confirmed surrounding & eyes on-road		1	1
	Resume after driver confirmation		0.5	

KPI for ACC Scenarios

Score	Colour	Scenario	ACC Perfomance (a ≥ -5 m/s2)
Full score		Car-to-Car	Full avoidance
		Car-to-Motorcycle	Full avoidance
		Car-to-VRU	Speed reduction > 30 km/h
Half score		Car-to-Car	Speed reduction > 15 km/h
		Car-to-Motorcycle	
		Car-to-VRU	
Zero score		Car-to-Car	Speed reduction ≤ 15 km/h
		Car-to-Motorcycle	
		Car-to-VRU	

Euro NCAP Safe Driving: Vehicle Assistance

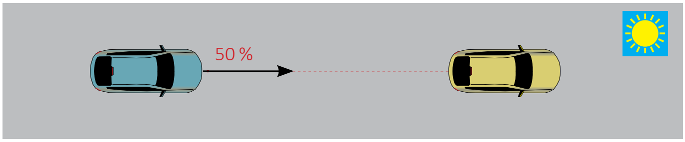
SD Vehicle Assistance Protocol 1.1

ACC Car-to-Car Scenarios

ACC CCR

CCRs: Car-to-Car Rear stationary, straight

Impact @ 50 %

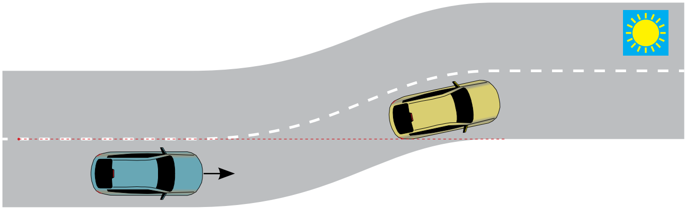


v_0 = 60 - 130 km/h   v = 0 km/h

ACC CCR

CCRs: Car-to-Car Rear stationary, curved

Impact @ 50 %

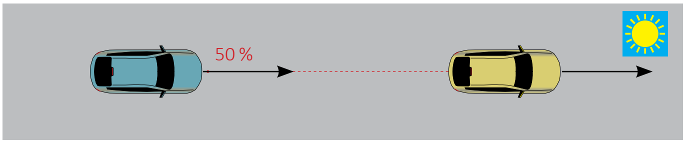


v_0 = 60 - 130 km/h   v = 0 km/h

ACC CCR

CCRm: Car-to-Car Rear moving

Impact @ 50 %

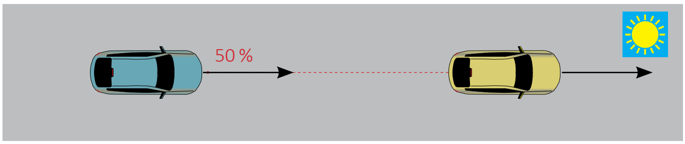


v_0 = 60 - 130 km/h   v = 20 km/h
v_0 = 70 - 130 km/h   v = 60 km/h

ACC CCR

CCRb: Car-to-Car Rear braking

Impact @ 50 %

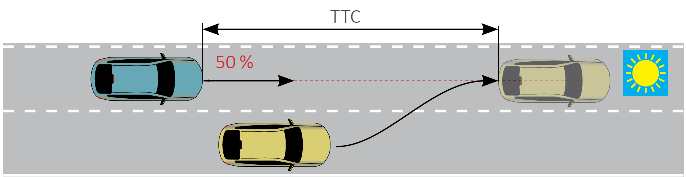


v_0 = 55 km/h   v = 50 km/h; a = -4 m/s²

ACC Cut-in

CCCut-in:

Impact @ 50 %

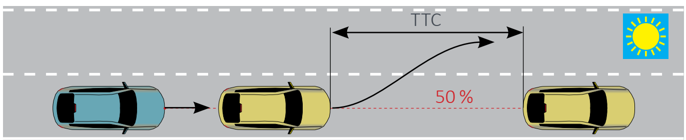


v_0 = 50 km/h   v = 10 km/h   TTC = 0.0 s
v_0 = 120 km/h   v = 70 km/h   TTC = 1.5 s

ACC Cut-out

CCCut-out:

Impact @ 50 %



v_0 = 70 km/h   v = 50 km/h   TTC = 3.0 s   v = 0 km/h
v_0 = 90 km/h   v = 70 km/h   TTC = 3.0 s   v = 0 km/h

Euro NCAP Safe Driving: Vehicle Assistance

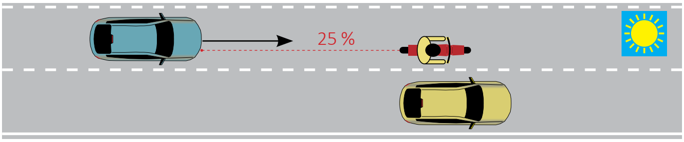
SD Vehicle Assistance Protocol 1.1

ACC Car-to-Motorcycle Scenarios

ACC CMR

CMRs: Car-to-Motorcycl. Rear stationary, straight

Impact @ 25 %

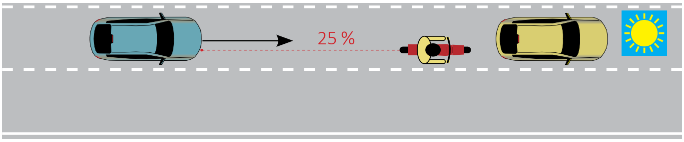


v_0 = 60 - 90 km/h v = 0 km/h

ACC CMR

CMRs: Car-to-Motorcycl. Rear stationary, straight

Impact @ 25 %

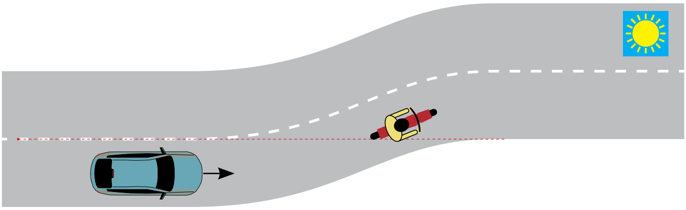


v_0 = 60 - 90 km/h v = 0 km/h

ACC CMR

CMRs: Car-to-Motorcycl. Rear stationary, curved

Impact @ 50 %

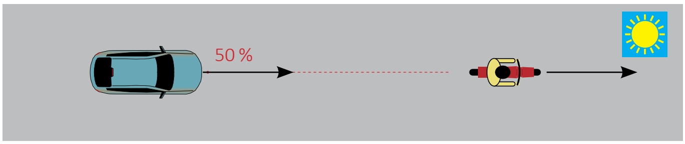


v_0 = 60 - 90 km/h v = 0 km/h

ACC CMR

CMRm: Car-to-Motorcycl. Rear moving

Impact @ 50 %

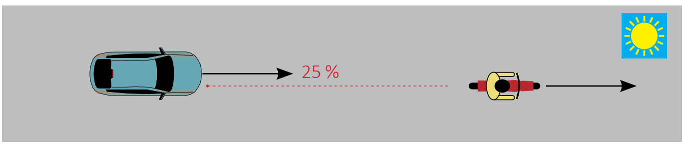


v_0 = 60 - 130 km/h v = 20 km/h
v_0 = 70 - 130 km/h v = 60 km/h

ACC CMR

CCRb: Car-to-Motorcycl. Rear braking

Impact @ 25 %

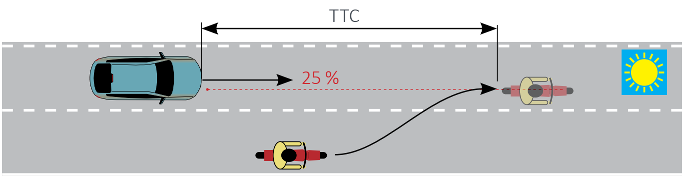


v_0 = 55 km/h v = 50 km/h; a = -4 m/s²

ACC Cut-in

CMCut-in:

Impact @ 25 %



v_0 = 50 km/h v = 10 km/h TTC = 0.0 s
v_0 = 120 km/h v = 70 km/h TTC = 1.5 s

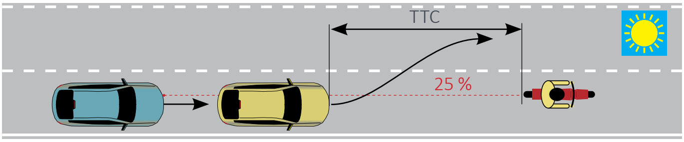
Euro NCAP Safe Driving: Vehicle Assistance

SD Vehicle Assistance Protocol 1.1

ACC Cut-out

CMCut-out:

Impact @ 25 %



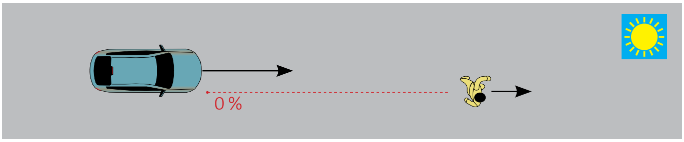
v_0 = 70 km/h	v = 50 km/h	TTC = 3.0 s	v = 0 km/h
v_0 = 90 km/h	v = 70 km/h	TTC = 3.0 s	v = 0 km/h

ACC Car-to-VRU Scenarios

ACC CPLA

CPLA: Car-to-Pedestrian Longitudinal, Adult

Impact @ 0 %

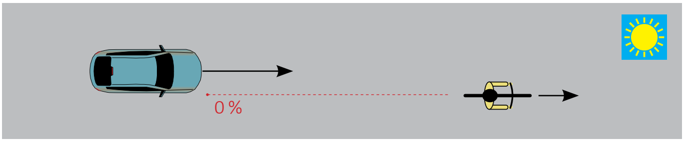


v_0 = 60 - 90 km/h   v = 5 km/h

ACC CBLA

CBLA: Car-to-Bicyclist Longitudinal, Adult

Impact @ 0 %



v_0 = 60 - 90 km/h   v = 20 km/h

Steering Assistance

Steering assistance systems are tested at ACC indicated vehicle speeds of 60, 80, 100 and 130 km/h in an S-bend (fully marked lane). The full score (1 point) for the respective test speed is awarded if the vehicle stays in lane in both turns. The half score (0.5 points) is awarded if the vehicle stays in lane in 1st turn and redirects in 2nd turn.

Steering Assistance	5 points
Steering assistance @ 60 km/h	1
Steering assistance @ 80 km/h	1
Steering assistance @ 100 km/h	1
Steering assistance @ 130 km/h	1
Lane change assist	1

Euro NCAP Safe Driving: Overview

Euro NCAP Safe Driving Stage				Points	∑	∑	∑	∑
Occupant Monitoring	Seatbelt Usage	Correct belt routing	Seatbelt buckle only	2	5	10	30	100
			Seatbelt completely behind back	1				
			Lap belt only, diagonal belt behind back	2				
		Rear seat occupancy		5				
	Occupant Classification	Passenger airbag status		4		10		
		Out of Position	Close proximity to the airbag	1	2			
			Feet on dashboard	1				
		Stature classification	Driver	3	4			
			Front seat passenger	1				
	Occupant Presence	Child presence detection	Child left behind	4	5	10		
			Child enters unlocked vehicle	1				
		Crash occupancy information	Belted occupants	4	5			
			Children in ALL CRS	1				
Driver Engagement	Driver Monitoring	Transient	Long distraction	5	15	25	30	
			Short distraction	5				
			Phone Use	5				
		Non-Transient	Impairment	4	10			
			Microsleep	2				
			Sleep	2				
			Unresponsive	2				
	Driving Controls	Driving	Driving controls	1	2.5	5		
			Vision	0.5				
			Lights	0.5				
			ADAS	0.5				
		Comfort & Infotainment	Audio	0.5	2.5			
			Phone	0.5				
			Navigation	0.5				
			Climate	0.5				
			Windows	0.25				
			Other	0.25				
Vehicle Assistance	Speed Assistance	SLIF	SLIF Accuracy	4	12	20	40	
			Advanced Speed Limits	3				
			Local Hazards	3				
			System updates	2				
		Speed Control Function	ISL	5	8			
			iACC	8				
	ACC Performance	Car-to-Car	Longitudinal	4	6	15		
			Cut-in / Cut-out	2				
		Car-to-Motorcycle	Longitudinal	4	5			
			Cut-in / Cut-out	1				
		Cart-to-VRU	Longitudinal	2				
		Road Features		1				
		Auto-resume		1				
	Steering Assistance	Steering Assistance	S-Bend	4		5		
		Lane Change Assist		1				

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

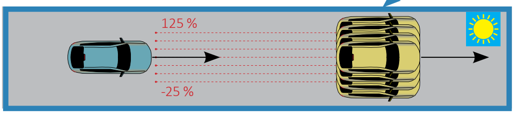
Assessment Process

Prediction of Performance in Standard & Extended Range	■ Manufacturer **predicts performance** in terms of **colour bands** for each **grid-cell** of each **scenario** using the applicable **KPI → p.83**. ■ Predictions can be submitted using the **Virtual Testing** protocol or as a **self-claim** without providing further evidence.
Claiming of Robustness Layers	■ Manufacturer **claims robustness layers** from the set of layers available for each scenario **→ p.82**, under which the system will perform as predicted.
Assessment	■ **Standard & Extended Range** score are calculated by multiplying the Total Range Score with the sum of predicted sub-scores divided by the number of grid cells. ■ The **Extended Range score is adjusted** based on the percentage of the total score **→ p.83**.
Verification	■ For each scenario Euro NCAP conducts a predefined number (3-5 in standard range, 2 in extended range) of **verification tests**. ■ 1 of the claimed **robustness layers** will be applied in the standard range verification tests. ■ A 2 km/h **tolerance** is added to the predictions. ■ If a test fails the manufacturer may request 2 **additional tests**.
Final Score	■ The **final score** depends on the outcome of the verification tests ■ Failing verification tests will result in a reduction of the score calculated in the assessment. **→ p.85** ■ The amount of reduction depends on prediction mode (Virtual Testing or self-claim).

Scenario

AEB CCR

CCRb: Car-to-Car Rear braking
Impact @ -25 ... 125 %
AEB



v_0 = 30 - 130 km/h   t = 1.0 s   v = 30 - 130 km/h; a = -4 m/s²

VUT speed	Target speed	Function	Impact Location 125 %	100 %	75 %	50 %	25 %	0 %	-25 %
30 km/h	30 km/h	AEB							
40 km/h	40 km/h	AEB							
50 km/h	50 km/h	AEB							
60 km/h	60 km/h	AEB							
70 km/h	70 km/h	AEB							
80 km/h	80 km/h	AEB							
90 km/h	90 km/h	AEB							
100 km/h	100 km/h	AEB							
110 km/h	110 km/h	AEB							
120 km/h	120 km/h	AEB							
130 km/h	130 km/h	AEB							

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCRb	1.6	0.2	0.2	2.0

# Grid Cells / Layers	30	47	9	**KPI:**
# Verification Tests	3	2	1	**Relative Imp. Speed**

Grid Cell

Standard Range

Extended Range

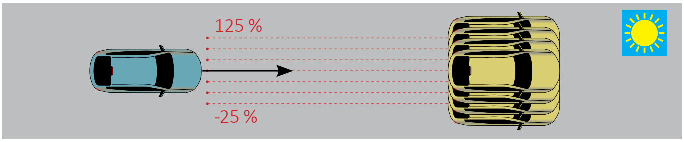
Applicable KPI

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

AEB CCR

CCRs: Car-to-Car Rear stationary
Impact @ -25 ... 125 %
AEB (≤ 50 km/h) **FCW** (> 50 km/h)



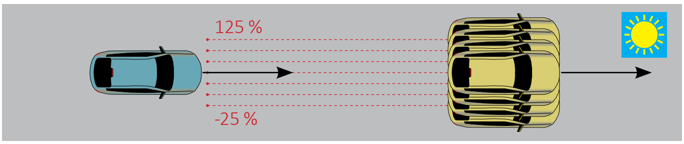
v_0 = 10 - 80 km/h   v = 0 km/h

VUT speed	Target speed	Function	Impact Location						
			125 %	100 %	75 %	50 %	25 %	0 %	-25 %
10 km/h	0 km/h	AEB							
20 km/h	0 km/h	AEB							
30 km/h	0 km/h	AEB							
40 km/h	0 km/h	AEB							
50 km/h	0 km/h	AEB							
60 km/h	0 km/h	FCW							
70 km/h	0 km/h	FCW							
80 km/h	0 km/h	FCW							

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCRs	1.2	0.15	0.15	1.5
# Grid Cells / Layers	40	16	8	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed**

AEB CCR

CCRm: Car-to-Car Rear moving
Impact @ -25 ... 125 %
AEB



v_0 = 30 - 130 km/h   v = 20 - 70 km/h

VUT speed	Target speed	Function	Impact Location						
			125 %	100 %	75 %	50 %	25 %	0 %	-25 %
30 km/h	20 km/h	AEB							
40 km/h	20 km/h	AEB							
50 km/h	20 km/h	AEB							
60 km/h	20 km/h	AEB							
70 km/h	20 km/h	AEB							
80 km/h	20 km/h	AEB							
90 km/h	30 km/h	AEB							
100 km/h	40 km/h	AEB							
110 km/h	50 km/h	AEB							
120 km/h	60 km/h	AEB							
130 km/h	70 km/h	AEB							

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCRm	2.4	0.3	0.3	3.0
# Grid Cells / Layers	55	22	7	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed**

Euro NCAP Crash Avoidance: Frontal Collisions

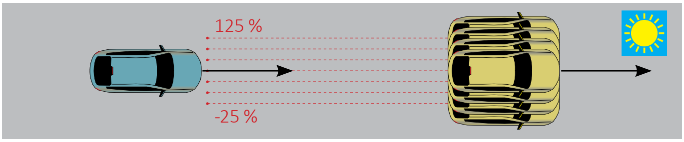
CA Frontal Collisions Protocol 1.1

AEB CCR

CCRb: Car-to-Car Rear braking

Impact @ -25 ... 125 %

AEB



v_0 = 30 - 130 km/h   t = 1.0 s   v = 30 - 130 km/h; a = -4 m/s²

VUT speed	Target speed	Function	Impact Location						
			125 %	100 %	75 %	50 %	25 %	0 %	-25 %
30 km/h	30 km/h	AEB							
40 km/h	40 km/h	AEB							
50 km/h	50 km/h	AEB							
60 km/h	60 km/h	AEB							
70 km/h	70 km/h	AEB							
80 km/h	80 km/h	AEB							
90 km/h	90 km/h	AEB							
100 km/h	100 km/h	AEB							
110 km/h	110 km/h	AEB							
120 km/h	120 km/h	AEB							
130 km/h	130 km/h	AEB							

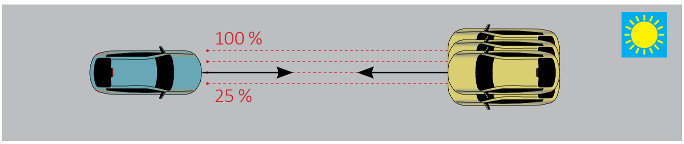
Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCRb	1.6	0.2	0.2	2.0
# Grid Cells / Layers	30	47	9	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed**

AEB CCF

CCFhos: Car-to-Car Front head-on straight

Impact @ 25 ... 100 %

AEB



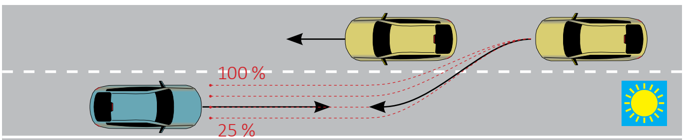
v_0 = 30 - 100 km/h   v = 50 - 100 km/h

AEB CCF

CCFhol: Car-to-Car Front head-on lane change

Impact @ 25 ... 100 %

AEB



v_0 = 30 - 100 km/h   v = 50 - 100 km/h

VUT speed	Target speed	Function	Impact Location			
			100 %	75 %	50 %	25 %
30 km/h	50 km/h	AEB				
40 km/h	50 km/h	AEB				
50 km/h	50 km/h	AEB				
60 km/h	70 km/h	AEB				
70 km/h	70 km/h	AEB				
80 km/h	70 km/h	AEB				
90 km/h	90 km/h	AEB				
100 km/h	100 km/h	AEB				

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCFhos	2.0	0.25	0.25	2.5
CCFhol	2.0	0.25	0.25	2.5

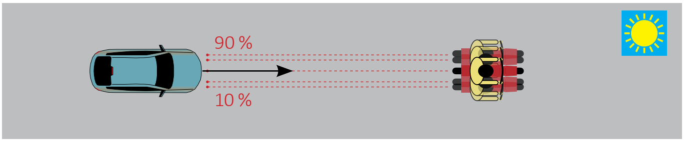
# Grid Cells / Layers	18	14	6	**KPI:**
# Verification Tests	4	2	1	**Speed Reduction**

AEB CMR

CMRs: Car-to-Motorcycl. Rear stationary

Impact @ 10 ... 90 %

AEB (≤ 50 km/h) **FCW** (> 50 km/h)



v_0 = 10 - 80 km/h v = 0 km/h

VUT speed	Target speed	Function	Impact Location 90 %	75 %	50 %	25 %	10 %
10 km/h	0 km/h	AEB					
20 km/h	0 km/h	AEB					
30 km/h	0 km/h	AEB					
40 km/h	0 km/h	AEB					
50 km/h	0 km/h	AEB					
60 km/h	0 km/h	FCW					
70 km/h	0 km/h	FCW					
80 km/h	0 km/h	FCW					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CMRs	1.2	0.15	0.15	1.5

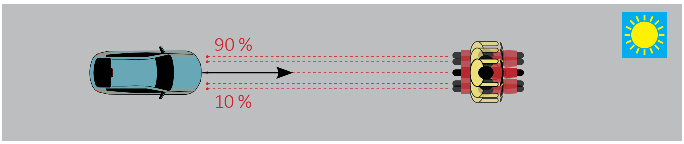
# Grid Cells / Layers	24	16	8	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed**

AEB CMR

CMRb: Car-to-Motorcycl. Rear braking

Impact @ 10 ... 90 %

AEB



v_0 = 30 - 130 km/h t = 1.0 s v = 30 - 130 km/h; a = -4 m/s²

VUT speed	Target speed	Function	Impact Location 90 %	75 %	50 %	25 %	10 %
30 km/h	30 km/h	AEB					
40 km/h	40 km/h	AEB					
50 km/h	50 km/h	AEB					
60 km/h	60 km/h	AEB					
70 km/h	70 km/h	AEB					
80 km/h	80 km/h	AEB					
90 km/h	90 km/h	AEB					
100 km/h	100 km/h	AEB					
110 km/h	110 km/h	AEB					
120 km/h	120 km/h	AEB					
130 km/h	130 km/h	AEB					

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CMRb	1.6	0.2	0.2	2.0

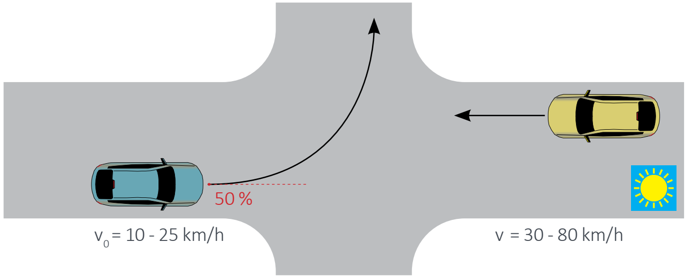
# Grid Cells / Layers	18	37	9	KPI:
# Verification Tests	3	2	1	Relat. Imp. Speed

AEB CCF

CCFtap: Car-to-Car Front turn across path

Impact @ 50 %

AEB

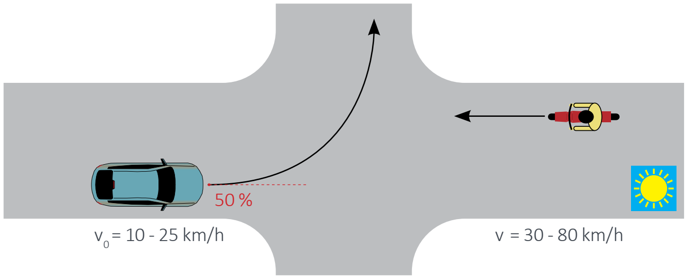


AEB CMF

CMFtap: Car-to-Motorcycl. Frt. turn across path

Impact @ 50 %

AEB



VUT speed	Target speed 30 km/h	45 km/h	60 km/h	80 km/h
10 km/h				
15 km/h				
20 km/h				
25 km/h				

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCFtap	4.0	0.5	0.5	5.0
CMFtap	4.0	0.5	0.5	5.0

# Grid Cells / Layers	9	7	8	KPI:
# Verification Tests	3	2	1	Avoidance

Euro NCAP Crash Avoidance: Frontal Collisions

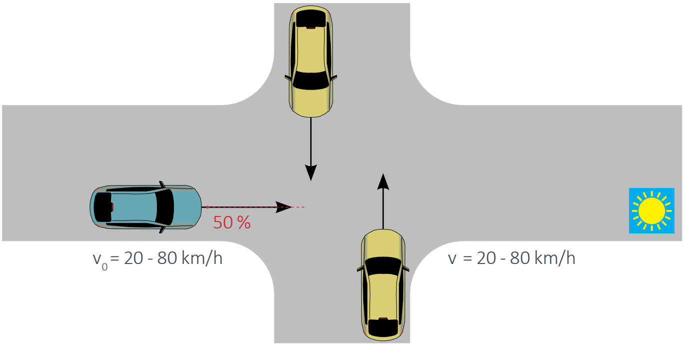
CA Frontal Collisions Protocol 1.1

AEB CCC

CCCscp: Car-to-Car Crossing straight crossing path

Impact @ 50 %, obscured

AEB

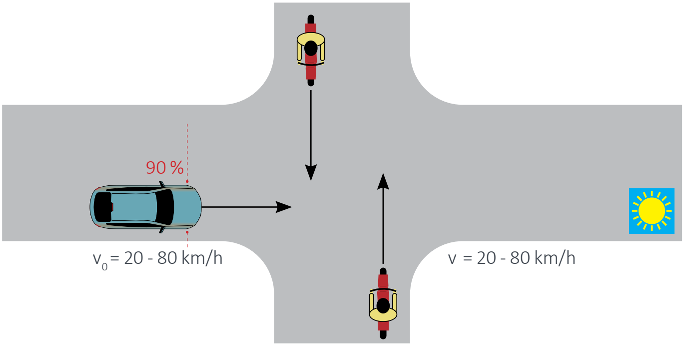


AEB CMC

CMCscp: Car-to-Motorcycl. Cross. straight crossing path

Impact @ 90 % (side)**, obscured**

AEB



VUT speed	Function	Target speed						
		20 km/h	30 km/h	40 km/h	50 km/h	60 km/h	70 km/h	80 km/h
20 km/h	AEB							
30 km/h	AEB							
40 km/h	AEB						-	-
50 km/h	AEB						-	-
60 km/h	AEB						-	-
70 km/h	AEB			-	-	-	-	-
80 km/h	AEB			-	-	-	-	-

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCCscp	6.0	0.75	0.75	7.5
CMCscp	6.0	0.75	0.75	7.5

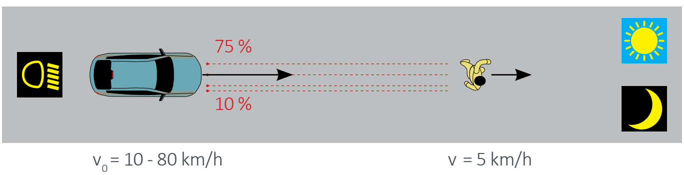
# Grid Cells / Layers	25	8	8	**KPI: Avoidance**
# Verification Tests	5	2	1	

AEB CPLA

CPLA: Car-to-Pedestrian Longitudinal, Adult

Impact @ 10 ... 75 %

AEB (≤ 60 km/h) **FCW** (≥ 50 km/h)



Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

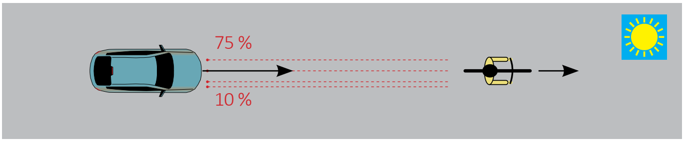
VUT speed	Target speed	Function		Impact Location 10 %	25 %	50 %	75 %
10 km/h	5 km/h	AEB	/				
20 km/h	5 km/h	AEB	/				
30 km/h	5 km/h	AEB	/				
40 km/h	5 km/h	AEB	/				
50 km/h	5 km/h	AEB	/				
60 km/h	5 km/h	AEB	/				
50 km/h	5 km/h	FCW	/				
60 km/h	5 km/h	FCW	/				
70 km/h	5 km/h	FCW	/				
80 km/h	5 km/h	FCW	/				

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
$CPLA_{day}$	1.0	0.125	0.25	2.5
$CPLA_{night}$	1.0	0.125		

# Grid Cells / Layers	10	30	7	**KPI:**
# Verification Tests	3 day / 3 night	2	1	**Relat. Imp. Speed/TTC**

AEB CBLA

CBLA: Car-to-Bicyclist Longitudinal, Adult
Impact @ 10 ... 75 %
AEB (≤ 60 km/h) **FCW** (≥ 50 km/h)



v_0 = 20 - 80 km/h v = 15 - 20 km/h

VUT speed	Target speed	Function	Impact Location 10 %	25 %	50 %	75 %
20 km/h	15 km/h	AEB				
30 km/h	15 km/h	AEB				
40 km/h	15 km/h	AEB				
50 km/h	15 km/h	AEB				
60 km/h	15 km/h	AEB				
50 km/h	20 km/h	FCW				
60 km/h	20 km/h	FCW				
70 km/h	20 km/h	FCW				
80 km/h	20 km/h	FCW				

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CBLA	2.0	0.25	0.25	2.5

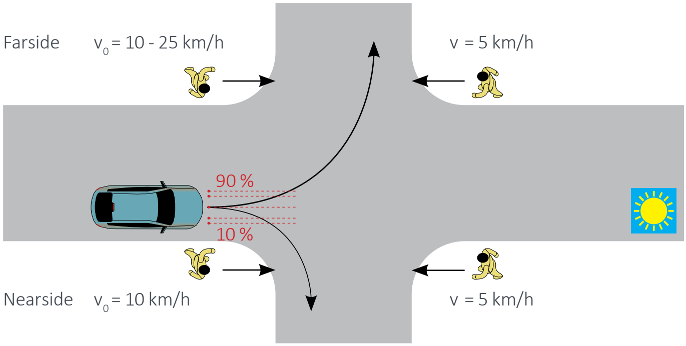
# Grid Cells / Layers	9	27	7	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed/TTC**

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

AEB CPTA

CPTA: Car-to-Pedestrian Turn across path, Adult
Impact @ 10 ... 90 %
AEB



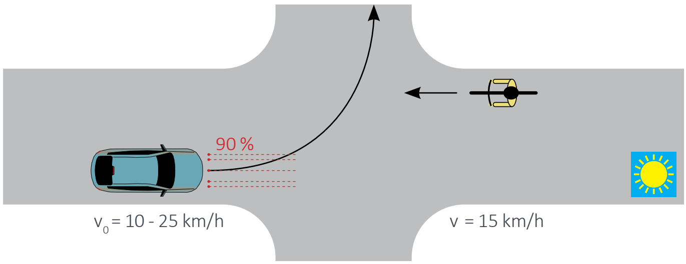
VUT speed	Turn	Target direction	Target speed	Impact Location				
				10 %	25 %	50 %	75 %	90 %
10 km/h	farside	same/opp.	5 km/h					
15 km/h	farside	same/opp.	5 km/h					
20 km/h	farside	same/opp.	5 km/h					
25 km/h	farside	same/opp.	5 km/h					
10 km/h	nearside	same/opp.	5 km/h					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CPTAfs & CPTAns	1.0	0.125	0.125	1.25
CPTAfo & CPTAno	1.0	0.125	0.125	1.25

# Grid Cells / Layers	3 / 1	17 / 4	9	**KPI:**
# Verification Tests	3	2	1	**Avoidance**

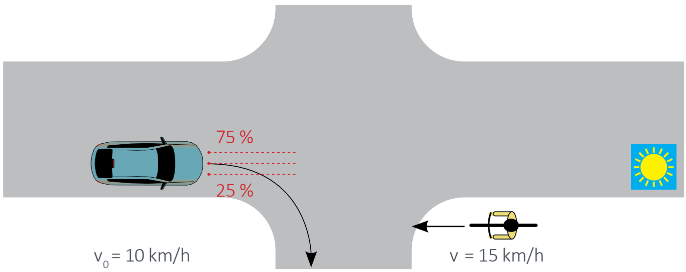
AEB CBTA

CBTAfo: Car-to-Bicyclist Turn across path, Adult farside, opposite direction
Impact @ 10 ... 90 %
AEB



AEB CBTA

CBTAno: Car-to-Bicyclist Turn across path, Adult nearside, opposite direction
Impact @ 25 ... 75 %
AEB

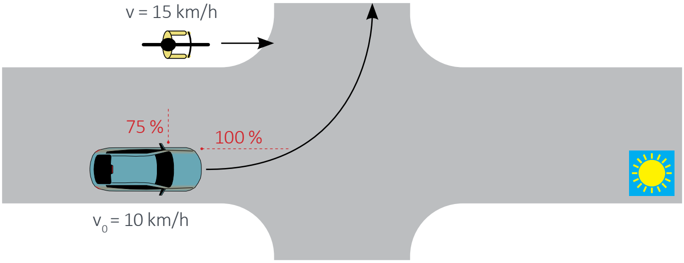


Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

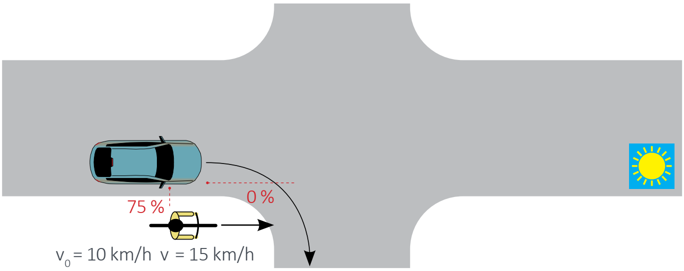
AEB CBTA

CBTAfs: Car-to-Bicyclist Turn across path, Adult farside, same direction Impact @ 100 % / 75 % (side) AEB



AEB CBTA

CBTAns: Car-to-Bicyclist Turn across path, Adult nearside, same direction Impact @ 0 % / 75 % (side) AEB



VUT speed	Turn	Target direction	Target speed	Impact Location				
				10 %	25 %	50 %	75 %	90 %
10 km/h	farside	opposite	15 km/h					
15 km/h	farside	opposite	15 km/h					
20 km/h	farside	opposite	15 km/h					
25 km/h	farside	opposite	15 km/h					

VUT speed	Turn	Target direction	Target speed	Impact Location		
				25 %	50 %	75 %
10 km/h	nearside	opposite	15 km/h			

VUT speed	Turn	Target direction	Target speed	Impact Location	
				100 %	75 % (side)
10 km/h	farside	same	15 km/h		
15 km/h	farside	same	15 km/h		
20 km/h	farside	same	15 km/h		
25 km/h	farside	same	15 km/h		

VUT speed	Turn	Target direction	Target speed	Impact Location	
				0 %	75 % (side)
10 km/h	nearside	same	15 km/h		

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CBTAfs & CBTAns	1.0	0.125	0.125	1.25
CBTAfo & CBTAno	1.0	0.125	0.125	1.25

# Grid Cells / Layers	3 / 1 / 3 / 1	17 / 2 / 5 / 1	9	**KPI: Avoidance**
# Verification Tests	3	2	1	

Euro NCAP Crash Avoidance: Frontal Collisions

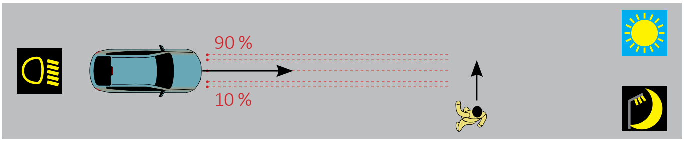
CA Frontal Collisions Protocol 1.1

AEB CPNA

CPNA: Car-to-Pedestrian Nearside, Adult

Impact @ 10 ... 90 %

AEB



v_0 = 10 - 60 km/h v = 5 km/h

VUT speed	Target speed	Function		Impact Location 10 %	25 %	50 %	75 %	90 %
10 km/h	5 km/h	AEB	/					
20 km/h	5 km/h	AEB	/					
30 km/h	5 km/h	AEB	/					
40 km/h	5 km/h	AEB	/					
50 km/h	5 km/h	AEB	/					
60 km/h	5 km/h	AEB	/					

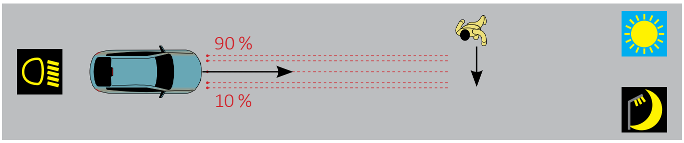
Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
$CPNA_{day}$	0.5	0.0625	0.125	1.25
$CPNA_{night}$	0.5	0.0625		
# Grid Cells / Layers	18	12	10	**KPI: Relat. Imp. Speed**
# Verification Tests	3	2	1	

AEB CPFA

CPFA: Car-to-Pedestrian Farside, Adult

Impact @ 10 ... 90 %

AEB



v_0 = 10 - 60 km/h v = 8 km/h

VUT speed	Target speed	Function		Impact Location 10 %	25 %	50 %	75 %	90 %
10 km/h	8 km/h	AEB	/					
20 km/h	8 km/h	AEB	/					
30 km/h	8 km/h	AEB	/					
40 km/h	8 km/h	AEB	/					
50 km/h	8 km/h	AEB	/					
60 km/h	8 km/h	AEB	/					

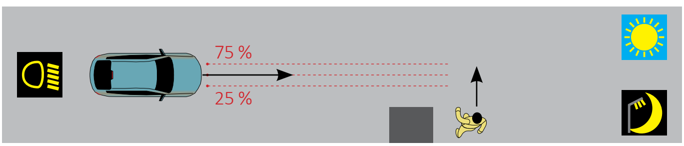
Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
$CPFA_{day}$	0.5	0.0625	0.125	1.25
$CPFA_{night}$	0.5	0.0625		
# Grid Cells / Layers	6	24	10	**KPI: Relat. Imp. Speed**
# Verification Tests	3	2	1	

AEB CPNCO

CPNCO: Car-to-Pedestrian Nearside, Child, Obstructed

Impact @ 25 ... 75 %

AEB



v_0 = 10 - 60 km/h v = 5 km/h

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

VUT speed	Target speed	Function		25 %	50 %	75 %
10 km/h	8 km/h	AEB	/			
20 km/h	8 km/h	AEB	/			
30 km/h	8 km/h	AEB	/			
40 km/h	8 km/h	AEB	/			
50 km/h	8 km/h	AEB	/			
60 km/h	8 km/h	AEB	/			

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
$CPNCO_{day}$	1.0	0.125	0.25	2.5
$CPNCO_{night}$	1.0	0.125		

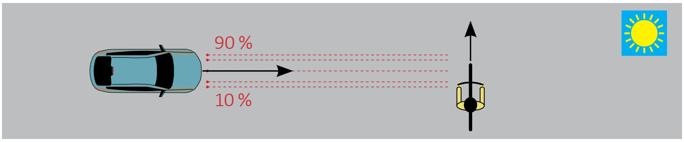
# Grid Cells / Layers	6	12	10	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed**

AEB CBNA

CBNA: Car-to-Bicyclist Nearside, Adult

Impact @ 10 ... 90 %

AEB



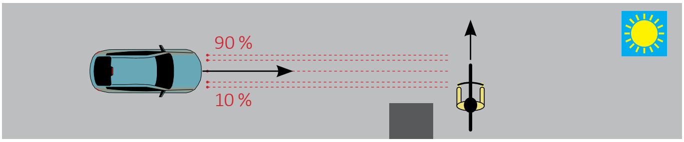
v_0 = 10 - 60 km/h   v = 15 km/h

AEB CBNAO

CBNAO: Car-to-Bicyclist Nearside, Adult, Obstructed

Impact @ 10 ... 90 %

AEB



v_0 = 10 - 60 km/h   v = 10 km/h

VUT speed	Target speed	Function	Impact Location 10 %	25 %	50 %	75 %	90 %
10 km/h	10/15 km/h	AEB					
20 km/h	10/15 km/h	AEB					
30 km/h	10/15 km/h	AEB					
40 km/h	10/15 km/h	AEB					
50 km/h	10/15 km/h	AEB					
60 km/h	10/15 km/h	AEB					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CBNA	1.0	0.125	0.125	1.25
CBNA0	2.0	0.25	0.25	2.5

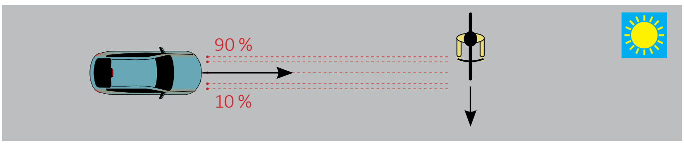
# Grid Cells / Layers	12	18	10	**KPI:**
# Verification Tests	3	2	1	**Relat. Imp. Speed**

AEB CBFA

CBFA: Car-to-Bicyclist Farside, Adult

Impact @ 10 ... 90 %

AEB



v_0 = 10 - 60 km/h   v = 20 km/h

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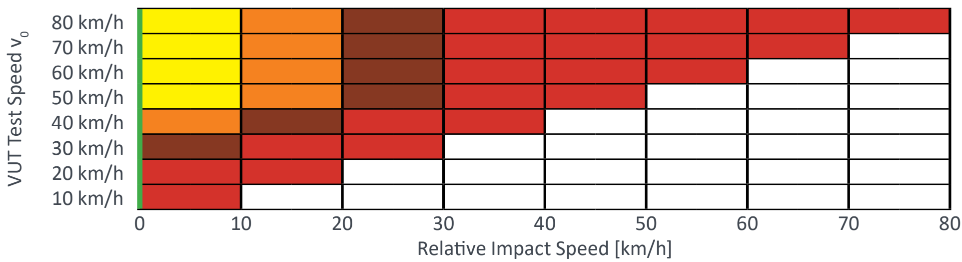
VUT speed	Target speed	Function	Impact Location 10 %	25 %	50 %	75 %	90 %
10 km/h	20 km/h	AEB					
20 km/h	20 km/h	AEB					
30 km/h	20 km/h	AEB					
40 km/h	20 km/h	AEB					
50 km/h	20 km/h	AEB					
60 km/h	20 km/h	AEB					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CBFA	1.0	0.125	0.125	1.25
# Grid Cells / Layers	12	18	10	KPI:
# Verification Tests	3	2	1	Relat. Imp. Speed

Applicability of Robustness Layers

		Car-to-	Car							PTW				Pedestrian					Bicyclist				
Type	Robustness Layer	Assess-ment	CCRs	CCRm	CCRb	CCFhos	CCFhol	CCFtap	CCCscp	CMRs	CMRb	CMFtap	CMCscp	CPLA	CPTA	CPNA	CPFA	CPNCO	CBLA	CBTA	CBNA	CBFA	CBNAO
VUT	Driver input pre-crash	Verif. Test	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Target	Speed	Verif. Test				●	●	●	●			●	●		●	●	●	●		●	●	●	●
Target	Acceleration	Verif. Test			●						●												
Target	Initial position offset	Verif. Test			●			●			●	●			●	●	●	●		●	●	●	●
Target	Trajectory/Heading	Verif. Test	●							●						●	●	●			●	●	●
Target	Type	Field data	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Target	Appearance	Field data	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Environment	Adverse Weather Cond.	Field data	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Environment	Illumination (Night)	Field data	●	●	●	●	●	●	●	●	●	●	●		●				●	●	●	●	●
Environment	Illumination (Sun Glare)	Field data	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Environment	Illumination (Head-lamp Glare)	Field data												●		●	●	●					
Environment	Infrastructure/Clutter	Field data	●	●	●				●	●	●		●	●	●	●	●		●	●	●	●	
Environment	Obscuration/Obstruct.	Field data																●					●
Number of applicable robustness layers			8	7	9	6	6	8	8	8	9	8	8	7	9	10	10	10	7	9	10	10	10

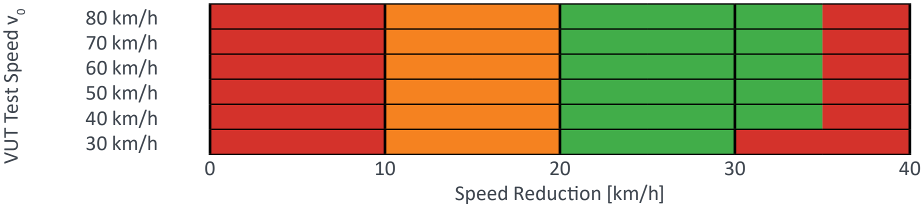
Colour Band Criteria - KPI Relative Impact Speed



Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

Colour Band Criteria - KPI Speed Reduction



Colour Band Criteria - KPI Avoidance: Impact Speed

Green	Red
0	> 0
V_{impact} [km/h]	

Colour Band Criteria - KPI FCW TTC

Green	Red
≥ 1.7	< 1.7
FCW TTC [s]	

KPI Application by Scenario

	CCRs	CCRm	CCRb	CMRs	CMRb	CCFhos	CCFhol	CCFtap	CMFtap	CCCscp	CMSscp	CPLA	CBLA (< 50 km/h)	CPNA	CPFA	CPNCO	CNBA	CBFA	CBNAO	CPTA	CBTA	CPLA	CBLA (≥ 50 km/h)
Rel. Impact Speed	●	●	●	●	●							●	●	●	●	●	●	●	●				
Speed Reduction						●	●																
Impact Speed								●	●	●	●									●	●		
FCW TTC																						●	●

Grid Cell Sub-scores

Predicted Colour	Standard Range Sub-score	Extended Range Sub-score
Green	1.00	1.00
Yellow	0.75	
Orange	0.50	
Brown	0.25	
Red	0.00	0.00

Standard Range Scoring

$$Score\ \ Standard\ \ Range\ = \frac{\sum Sub\!-\!scores\ \ in\ \ Standard\ \ Range\ \ x\ \ Total\ \ Standard\ \ Range\ \ Score}{Number\ \ of\ \ grid\ \ cells\ \ in\ \ Standard\ \ Range}$$

Extended Range Scoring

$$Score\ \ Extended\ \ Range\ = \frac{\sum Sub\!-\!scores\ \ in\ \ Extended\ \ Range\ \ x\ \ Total\ \ Extended\ \ Range\ \ Score}{Number\ \ of\ \ grid\ \ cells\ \ in\ \ Extended\ \ Range}$$

Score Extended Range Transformation Table	
% of Score Extended Range	Final Score Extended Range
50 ≤ Score Extended Range < 75	50 %
75 ≤ Score Extended Range < 100	75 %
Score Extended Range = 100	100 %

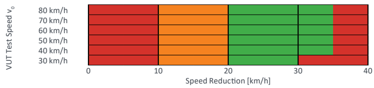
Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

Assessment Procedure

1. Predict Colors for Grid Points in Standard and Extended Ranges using the applicable KPI

Example Scenario: CCFhol → KPI: Speed Reduction

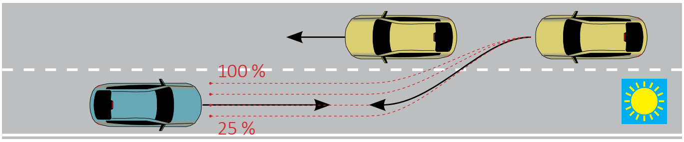


AEB CCF

CCFhol: Car-to-Car Front head-on lane change

Impact @ 25 ... 100 %

AEB



v_0 = 30 - 100 km/h　　v = 50 - 100 km/h

VUT speed	Target speed	Function	Impact Location			
			100 %	75 %	50 %	25 %
30 km/h	50 km/h	AEB	0.00	**0.00**	**0.50**	**0.00**
40 km/h	50 km/h	AEB	0.00	**0.00**	**1.00**	**0.00**
50 km/h	50 km/h	AEB	0.00	**0.50**	**1.00**	**0.50**
60 km/h	70 km/h	AEB	0.00	**0.50**	**1.00**	**0.50**
70 km/h	70 km/h	AEB	0.00	**0.50**	**1.00**	**0.50**
80 km/h	70 km/h	AEB	0.00	**0.50**	**1.00**	**0.50**
90 km/h	90 km/h	AEB	0.00	1.00	1.00	1.00
100 km/h	100 km/h	AEB	0.00	1.00	1.00	1.00

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCFhol	2.0	0.25	0.25	2.5

ΣSub-scores in Standard Range = 9.5, 18 Grid Cells in the Standard Range
Score Standard Range = 9.5 x 2.0 / 18 = 1.06

ΣSub-scores in Extended Range = 6.0, 14 Grid Cells in the Extended Range
Score Extended Range = 6.0 x 0.25 / 14 = 0.11 → < 50 % of max. Extended Range Score (0.25) → 0

Score Extended Range Transformation Table	
% of Score Extended Range	Final Score Extended Range
50 ≤ Score Extended Range < 75	50 %
75 ≤ Score Extended Range < 100	75 %
Score Extended Range = 100	100 %

2. Claim Robustness Layers

Type	Robustness Layer	Assess-ment	CCFhol	Claim
VUT	Driver input pre-crash	Verif. Test		
Target	Speed	Verif. Test	●	✓
	Acceleration	Verif. Test		
	Initial position offset	Verif. Test		
	Trajectory/Heading	Verif. Test		
	Type	Field Data	●	✓
	Appearance	Field Data	●	✓
Environ-ment	AWC	Field Data	●	-
	Illumination (Night)	Field Data	●	-
	Illumination (Glare)	Field Data	●	-
	Infrastructure/Clutter	Field Data		
	Obscuration/Obstruct.	Field Data		
Number of applicable/claimed robustness layers			6	3

Score Robustness Layer = 0.25 x 3 / 6 = 0.13

Euro NCAP Crash Avoidance: Frontal Collisions

CA Frontal Collisions Protocol 1.1

Final Score

The final score of a given scenario depends on the outcome of the verification tests. If all verification tests confirm the prediction, the calculated score remains unchanged. If some of the verification tests fail, the calculated score will be reduced according to the following table.

# of tests → passed tests↓	Score % from verification tests outcome							
	Standard Range						Extended Range	
	Virtual Testing predictions			Self-claim predictions			Virtual Testing predictions	Self-claim predictions
	5	4	3	5	4	3	2	2
5	100 %			100 %				
4	80 %	100 %		80 %	100 %			
3	60 %	75 %	100 %	0 %	75 %	100 %		
2	40 %	50 %	67 %	0 %	0 %	67 %	100 %	100 %
1	20 %	25 %	33 %	0 %	0 %	0 %	50 %	0 %
0	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %

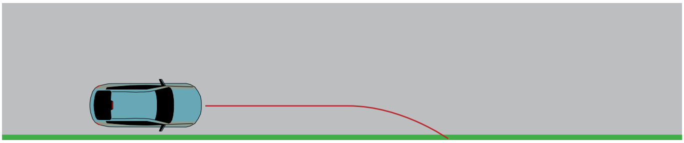
Euro NCAP Crash Avoidance: Lane Departure Collisions

CA Lane Departure Collisions Protocol 1.1

Single Vehicle Scenarios

ELK

ELK-RE: Emergency Lane Keeping Road Edge



v_0 = 50 - 100 km/h v_{lat} = 0.2 - 0.6 m/s

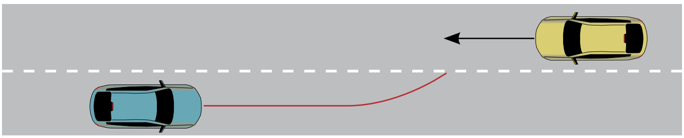
VUT speed	vlat					
	0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s
50 km/h						
60 km/h						
70 km/h						
80 km/h						
90 km/h						
100 km/h						

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
ELK-RE	4.0	0.5	0.5	5.0
# Grid Cells / Layers	15	21	4	**KPI:**
# Verification Tests	3	2	1	**DTLE**

Car-to-Car/PTW Scenarios

ELK

ELK-ON: Emergency Lane Keeping ONcoming Car

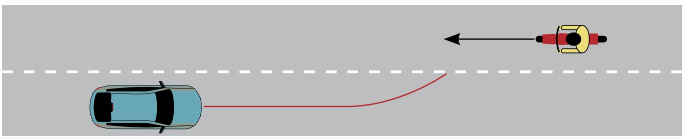


v_0 = 50 - 100 km/h v_{lat} = 0.3 - 0.6 m/s v = 50 - 100 km/h

ELK

ELK-ON: Emergency Lane Keeping ONcoming Motorcyclist

Impact @ 110 %



v_0 = 50 - 100 km/h v_{lat} = 0.3 - 0.6 m/s v = 50 - 100 km/h

VUT speed	Target speed	vlat			
		0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s
50 km/h	50 km/h				
60 km/h	60 km/h				
70 km/h	70 km/h				
80 km/h	80 km/h				
90 km/h	90 km/h				
100 km/h	100 km/h				

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
ELK-ON C2C	2.0	0.25	0.25	2.5
ELK-ON C2PTW	2.0	0.25	0.25	2.5
# Grid Cells / Layers	4	20	8	**KPI:**
# Verification Tests	3	2	1	**Avoidance**

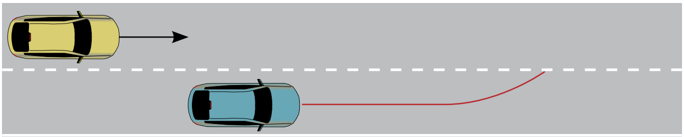
Euro NCAP Crash Avoidance: Lane Departure Collisions

CA Lane Departure Collisions Protocol 1.1

ELK

ELK-OV: Emergency Lane Keeping OVertaking Motorcyclist

Impact @ 110 %



① v = 60 - 140 km/h v_0 = 50 - 130 km/h v_{lat} = 0.2 - 0.7 m/s (unintentional)

② v = 60 - 100 km/h v_0 = 50 - 90 km/h v_{lat} = 0.4 - 0.8 m/s (intentional)

VUT speed	Target speed	Vlat unintentional ①					
		0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s
50 km/h	60 km/h						
60 km/h	70 km/h						
70 km/h	80 km/h						
80 km/h	90 km/h						
90 km/h	100 km/h						
100 km/h	110 km/h						
110 km/h	120 km/h						
120 km/h	130 km/h						
130 km/h	140 km/h						

VUT speed	Target speed	Vlat intentional ②				
		0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s	0.8 m/s
50 km/h	60 km/h					
60 km/h	70 km/h					
70 km/h	80 km/h					
80 km/h	90 km/h					
90 km/h	100 km/h					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
ELK-OV C2C ①	1.0	0.125	0.125	1.25
ELK-OV C2C ②	1.0	0.125	0.125	1.25

# Grid Cells / Layers ①	4	50	8	**KPI: Avoidance (BSM)**
# Grid Cells / Layers ②	3	22	8	
# Verification Tests	3	2	1	

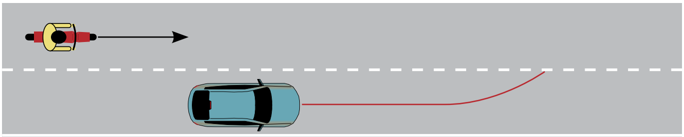
Euro NCAP Crash Avoidance: Lane Departure Collisions

CA Lane Departure Collisions Protocol 1.1

ELK

ELK-OV: Emergency Lane Keeping OVertaking Motorcyclist

Impact @ 110 %



v = 60 - 140 km/h v_0 = 50 - 130 km/h v_{lat} = 0.2 - 0.7 m/s (unintentional)

v = 60 - 100 km/h v_0 = 50 - 90 km/h v_{lat} = 0.4 - 0.8 m/s (intentional)

VUT speed	Target speed	Vlat unintentional 1					
		0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s
50 km/h	60 km/h						
60 km/h	70 km/h						
70 km/h	80 km/h						
80 km/h	90 km/h						
90 km/h	100 km/h						
100 km/h	110 km/h						
110 km/h	120 km/h						
120 km/h	130 km/h						
130 km/h	140 km/h						

VUT speed	Target speed	Vlat intentional 2				
		0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s	0.8 m/s
50 km/h	60 km/h					
60 km/h	70 km/h					
70 km/h	80 km/h					
80 km/h	90 km/h					
90 km/h	100 km/h					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
ELK-OV C2PTW 1	1.0	0.125	0.125	1.25
ELK-OV C2PTW 2	1.0	0.125	0.125	1.25

# Grid Cells / Layers 1	12	42	8	**KPI: Avoidance (BSM)**
# Grid Cells / Layers 2	9	16	8	
# Verification Tests	3	2	1	

Applicability of Robustness Layers

Type	Robustness Layer	Assessment	ELK-RE	ELK-ON Car	ELK-ON PTW	ELK-OV Car	ELK-OV PTW
VUT	Impact Location	Verification Test		•	•	•	•
Target	Initial position offset	Verification Test		•	•	•	•
	Type	Field Data		•	•	•	•
	Appearance	Field Data	•	•	•	•	•
Lane Bdry.	Appearance	Field Data	•	•	•	•	•
Environment	Adverse Weather Conditions	Field Data	•	•	•	•	•
	Illumination (Night)	Field Data	•	•	•	•	•
	Illumination (Glare)	Field Data	•	•	•	•	•
Number of applicable robustness layers			5	8	8	8	8

Euro NCAP Crash Avoidance: Lane Departure Collisions

CA Lane Departure Collisions Protocol 1.1

Criteria (KPI)

Single Vehicle							
	Driver Acceptance						
		Driveability					
			Overriding torque				≤ 3.0 Nm
			Continuous intervention				≤ 1.0 s
			Steering wheel velocity (tests @ ≥ 70 km/h)				
			v_{lat}	0.2 m/s	0.3. m/s	0.4 m/s	0.5 m/s	0.6 m/s
			$v_{steering\ wheel}$	±20°/s	±25°/s	±30°/s	±35°/s	±40°/s
			Returning v_{lat}				
				for test with approaching $v_{lat} > 0.3$ m/s			≤ v_{lat}
				for test with approaching $v_{lat} \leq 0.3$ m/s			≤ 0.3 m/s
		Driver State Link (= Adaptation of Lane Support sensitivity based on driver status)					
	Lane Departure						
		DTLE Distance To Lane Edge					> 0.1 m
		LDW (haptic) in extended range before DTLE of -0.1 m is reached					
Car-to-Car/PTW							
	No impact (PTW: Lateral separation > 0.3 m)						
	Blind Spot Monitoring in extended range: visual blind spot information						

Final Score

The final score of a given scenario depends on the outcome of the verification tests. If all verification tests confirm the prediction, the calculated score remains unchanged. If some of the verification tests fail, the calculated score will be reduced according to the following table.

# of tests → passed tests↓	Score % from verification tests outcome			
	Standard Range		Extended Range	
	Virtual Testing predictions	Self-claim predictions	Virtual Testing predictions	Self-claim predictions
	3	3	2	2
3	100 %	100 %		
2	67 %	67 %	100 %	100 %
1	33 %	0 %	50 %	0 %
0	0 %	0 %	0 %	0 %

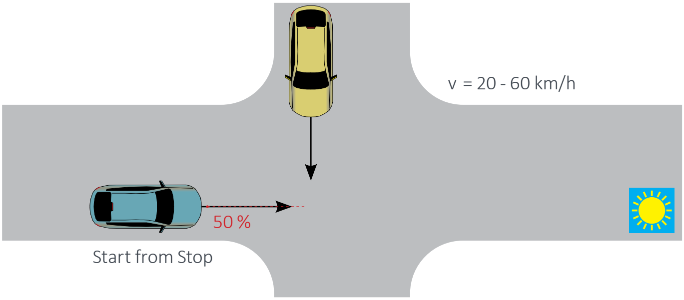
Euro NCAP Crash Avoidance: Low Speed Collisions

CA Low Speed Collisions Protocol 1.1

Car & PTW Scenarios

AEB CCC

CCCscp: Car-to-Car Crossing straight crossing path
Impact @ 50 %,
AEB

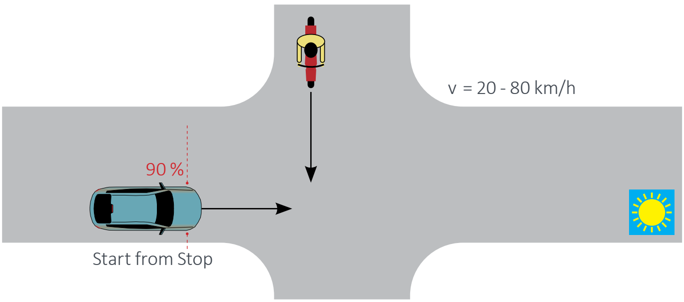


VUT speed	Function	Target speed				
		20 km/h	30 km/h	40 km/h	50 km/h	60 km/h
Start from Stop	AEB					

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCCscp	3.0	-	-	3
# Grid Cells / Layers	5	-	-	**KPI: Avoidance**
# Verification Tests	3	-	-	

AEB CMC

CMCscp: Car-to-Motorcycl. Cross. straight crossing path
Impact @ 90 % (side)
AEB



VUT speed	Function	Target speed						
		20 km/h	30 km/h	40 km/h	50 km/h	60 km/h	70 km/h	80 km/h
Start from Stop	AEB							

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCCscp	3.0	-	-	3
# Grid Cells / Layers	7	-	-	**KPI: Avoidance**
# Verification Tests	3	-	-	

Euro NCAP Crash Avoidance: Low Speed Collisions

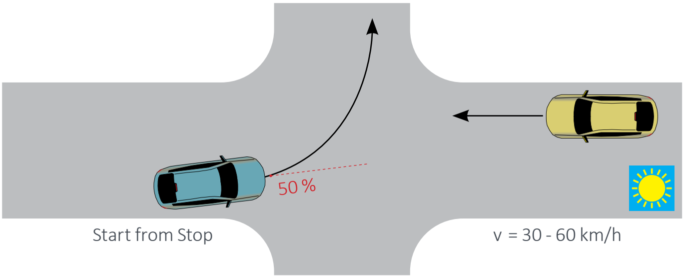
CA Low Speed Collisions Protocol 1.1

AEB CCF

CCFtap: Car-to-Car Front turn across path

Impact @ 50 %

AEB



VUT speed	Function	Target speed		
		30 km/h	45 km/h	60 km/h
Start from Stop	AEB			

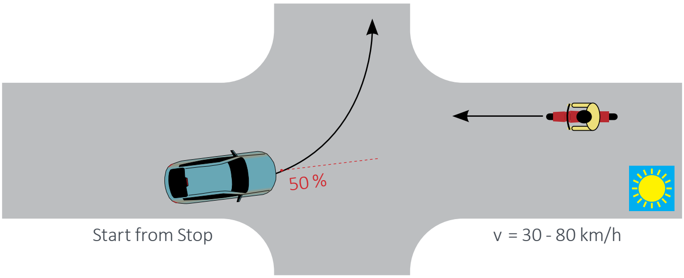
Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CCFtap	1.0	-	-	1
# Grid Cells / Layers	3	-	-	**KPI: Avoidance**
# Verification Tests	3	-	-	

AEB CMF

CMFtap: Car-to-Motorcycl. Frt. turn across path

Impact @ 50 %

AEB



VUT speed	Function	Target speed			
		30 km/h	45 km/h	60 km/h	80 km/h
Start from Stop	AEB				

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CMFtap	3.0	-	-	3
# Grid Cells / Layers	4	-	-	**KPI: Avoidance**
# Verification Tests	3	-	-	

Euro NCAP Crash Avoidance: Low Speed Collisions

CA Low Speed Collisions Protocol 1.1

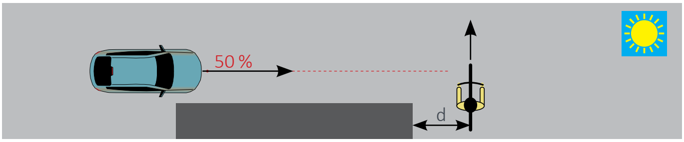
Pedestrian & Cyclist Scenarios

AEB CBNAO

CBNAO: Car-to-Bicyclist Nearside, Adult, Obstructed

Impact @ 50 %

AEB



Start from Stop   d = 1.5/2.5 m; v = 10 - 20 km/h

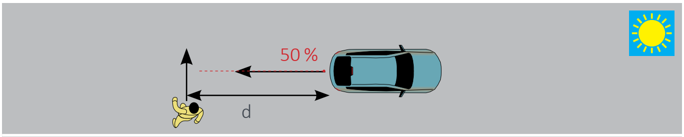
d	Function	Target speed		
		10 km/h	15 km/h	20 km/h
1.50 m	AEB			
2.50 m	AEB			

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CBNAO	3.0	-	-	3
# Grid Cells / Layers	3	-	-	KPI: Avoidance
# Verification Tests	4-6	-	-	

CPMR

CPMRCm: Car-to-Pedestrian Manoeuvring Reverse Child moving

Impact @ 50 %



v = 5 / 8 km/h   d = 1 - 2 m   Start from Stop

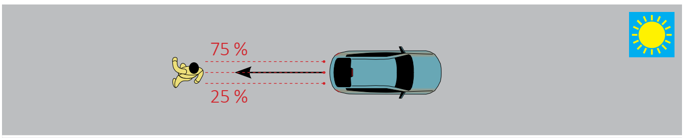
d	Function	Target speed	
		5 km/h	8 km/h
1.00 m	AEB		
1.50 m	AEB		
2.00 m	AEB		

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CPMRCm	1.5	-	-	1.5
# Grid Cells / Layers	6	-	-	KPI: Avoidance
# Verification Tests	4-6	-	-	

CPMR

CPMRCs: Car-to-Pedestrian Manoeuvring Reverse Child stationary

Impact @ 25 ... 75 %



v = 0 km/h v_0 = -4 / -8 km/h

VUT speed	Function	Impact Location		
		25 %	50 %	75 %
4 km/h	AEB			
8 km/h	AEB			

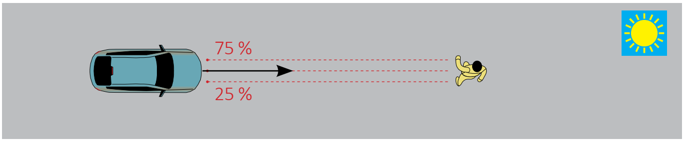
Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CPMRCs	1.5	-	-	1.5
# Grid Cells / Layers	6	-	-	KPI: Avoidance
# Verification Tests	4-6	-	-	

Euro NCAP Crash Avoidance: Low Speed Collisions

CA Low Speed Collisions Protocol 1.1

CPMFC

CPMFC: Car-to-Pedestrian Manoeuvring Front Child (stationary)
Impact @ 25 ... 75 %



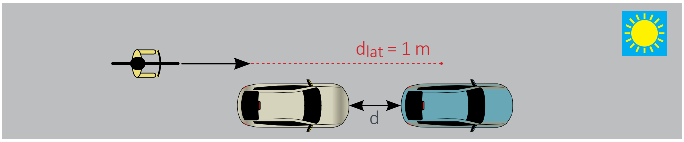
Accelerate from Creeping v = 0 km/h

d from pedal application point	Function	Impact Location		
		25 %	50 %	75 %
d_1: dist. to reach max. creeping speed until T_{ACC}	AEB			
d_2: creeping for 1 s	AEB			

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CPMFC	2	-	-	2
# Grid Cells / Layers	6	-	-	**KPI: Torque Suppression**
# Verification Tests	4-6	-	-	

CBDA

CBDA: Car-to-Bicyclist Dooring, Adult



v = 10 - 20 km/h d = 0.5 - 2.0 m

d	Target speed		
	10 km/h	15 km/h	20 km/h
0.50 m			
1.00 m			
1.50 m			
2.00 m			

Total Scenario Scores	Standard Range	Extended Range	Robustness Layers	Total
CBDA	2	-	-	2
# Grid Cells / Layers	12	-	-	**KPI: TTC**
# Verification Tests	4-12	-	-	

Key Performance Indicators

1.0	0
0	> 0
Avoidance: V_{impact} [km/h]	

1.0	0
Yes	No
Drivetrain Torque Suppression	

Response	1.0	0.75	0.5	0.25	0
Retention	Start @ **TTC** ≥ 1.7 s AND End @ **TTC** ≤ -0.4 s		-	-	Start @ **TTC** < 1.7 s OR
	All Doors	Driver's Door	-	-	End @ **TTC** > -0.4 s
Warning	-	**TTC** ≥ 1.7 s		-	**TTC** < 1.7 s
	-	All Doors	Driver's Door	-	
Information	-	-	-	**TTC** ≥ 2.3 s	**TTC** < 2.3 s
	-	-	-	Driver's Door	

Euro NCAP Crash Avoidance: Overview

Euro NCAP Crash Avoidance Stage				Scenario	Standard Range	Extended Range	Robust-ness	Total	∑	∑	∑	∑
Frontal Collisions	Car & PTW Scenarios	Longitudinal	CCR Car to Car Rear	CCRs	1.2	0.15	0.15	1.5	6.5	15.0	40.0	60
				CCRm	2.4	0.3	0.3	3.0				
				CCRb	1.6	0.2	0.2	2.0				
			CCF Car to Car Front	CCFhos	2.0	0.25	0.25	2.5	5.0			
				CCFhol	2.0	0.25	0.25	2.5				
			CMR Car to Motorcycle Rear	CMRs	1.2	0.15	0.15	1.5	3.5			
				CMRb	1.6	0.2	0.2	2.0				
		Turn.	CCF Car to Car Front	CCFtap	4.0	0.5	0.5	5.0		10.0		
			CMF Car to Motorcycle Front	CMFtap	4.0	0.5	0.5	5.0				
		Cross.	CCC Car to Car Crossing	CCCscp	6.0	0.75	0.75	7.5		15.0		
			CCC Car to Motorcycle Crossing	CMCscp	6.0	0.75	0.75	7.5				
	Pedestrian & Cyclist Scenarios	Long.	CP Car to Pedestrian	CPLA	2.0	0.25	0.25	2.5		5.0	20.0	
			CB Car to Bicyclist	CBLA	2.0	0.25	0.25	2.5				
		Turning	CP Car to Pedestrian	CPTAfs & CPTAns	1.0	0.125	0.125	1.25	2.5	5.0		
				CPTAfo & CPTAno	1.0	0.125	0.125	1.25				
			CB Car to Bicyclist	CBTAfs & CBTAns	1.0	0.125	0.125	1.25	2.5			
				CBTAfo & CBTAno	1.0	0.125	0.125	1.25				
		Crossing	CP Car to Pedestrian	CPNA	1.0	0.125	0.125	1.25	5.0	10.0		
				CPFA	1.0	0.125	0.125	1.25				
				CPNCO	2.0	0.25	0.25	2.5				
			CB Car to Bicyclist	CBNA	1.0	0.125	0.125	1.25	5.0			
				CBFA	1.0	0.125	0.125	1.25				
				CBNAO	2.0	0.25	0.25	2.5				
Lane Departure Collisions	Single Veh.	Driver Acceptance		Driveability	2.0	-	-	2.0		5.0	10.0	20.0
				Driver State Link	3.0	-	-	3.0				
		Lane Departure		ELK-RE	4.0	0.5	0.5	5.0		5		
	Car & PTW	Car-to-Car		ELK-ON	2.0	0.25	0.25	2.5		5.0	10	
				ELK-OV unintent.	1.0	0.125	0.125	1.25				
				ELK-OV intentional	1.0	0.125	0.125	1.25				
		Car-to-Motorcyclist		ELK-ON	2.0	0.25	0.25	2.5		5.0		
				ELK-OV unintent.	1.0	0.125	0.125	1.25				
				ELK-OV intentional	1.0	0.125	0.125	1.25				
Low Speed Collisions	Car & PTW	Turn.	CCF Car to Car Front	CCFtap	1.0	-	-	1.0		4.0	10.0	20.0
			CMF Car to Motorcycle Front	CMFtap	3.0	-	-	3.0				
		Cross.	CCC Car to Car Crossing	CCCscp	3.0	-	-	3.0		6.0		
			CCC Car to Motorcycle Crossing	CMCscp	3.0	-	-	3.0				
	Ped. & Cyclist	CB Car to Bicyclist Crossing		CBNAO	3.0	-	-	3.0		3	10.0	
		Manoeuv.	CPMR Car to Pedestrian Manoeuvring Reverse	CPMRCm	1.5	-	-	1.5	3.0	5.0		
				CPMRCs	1.5	-	-	1.5				
			CPMF Manoeuvring Forward	CPMFC	2.0	-	-	2.0	2			
		CBD Car to Bicyclist Dooring		CBDA	2.0	-	-	2.0		2		

Latest info about this course

Introduction to ADAS and Active Safety

Course Description

Increasing demands on the protection of vehicle occupants have led to a continuous reduction in the number of injured and killed persons. While more than 20,000 persons have been killed on German roads in the early 1970s, this number is now about 2,800. Passive safety, i.e. measures which are designed to minimize the consequences of an accident, has made a significant contribution to this achievement. While the potential of passive safety is considered to be largely exhausted and huge efforts are required to achieve further progress in occupant protection, active safety has become increasingly important in recent years. Active Safety means measures which prevent an accident or at least reduce the collision speed and thus the energy input. While technologies such as ABS or ESC have been established years ago and have proven their effectiveness, new techniques such as the emergency brake, the lane keeping assist, evasive steering support and numerous other driver assistance systems are just entering the market. It can be assumed that these systems will be widely used in the next few years and will lead to a further decrease in the number of traffic victims. Automated driving can be seen as the next step of active safety. Although there is still a lot of development needed in this area, vehicles which can drive automated in certain traffic scenarios, are already available.

In the seminar first a brief introduction to active safety, in contrast to passive safety is given. This is followed by a presentation of current active safety systems and an overview of the requirements of legislation and consumer protection organizations. In addition, current and upcoming developments in the area of driver assistance systems and automated driving are presented.

Who should attend?

The seminar is aimed at new and experienced engineers working in the field of active vehicle safety in research and development departments of automotive OEMs or suppliers, as well as for all other interested parties, which want to receive an overview of current and future developments in the areas of active vehicle safety, driver assistance and automated driving.

Course Contents

- Fundamentals of active safety
  - Basic principles of action
  - Legal requirements
  - Euro NCAP requirements
- Current active safety systems
  - ABS, ESC, Evasive Steering Support, AEBS
  - Pre-crash systems
  - Sensor technologies
- Driver assistance systems
  - Basic requirements and design strategies
  - Current and future driver assistance systems
  - General Safety Regulation
- Automated driving
  - State of the art
  - Opportunities and risks
  - Human machine interface
  - Legal framework

Instructor

Dr.-Ing. Gerd Müller (Technical University Berlin) has been working at the department automotive technology of the Technical University of Berlin since 2007. From 2007 to 2015 he was a research assistant. Since 2015 he has been a senior engineer of the same department. His research focuses on vehicle safety and friction coefficient estimation. Dr. Müller gives the lecture "Fundamentals of Automotive Engineering" and conducts parts of the integrated course "Driver Assistance Systems and Active Safety".

Facts

05.-06.05.2026	51/4665	Online	2 x 4 Hrs.	890,- EUR till 07.04.2026, thereafter 1.090,- EUR
12.11.2026	51/4666	Alzenau	1 Day	890,- EUR till 15.10.2026, thereafter 1.090,- EUR

Application of ASAM OpenX® Standards

Course Description

With increasing levels of vehicle automation, the complexity of testing grows rapidly, making traditional road testing alone impractical. New safety requirements and consumer tests, such as future virtual NCAP assessments, demand reproducible and scalable simulation-based validation. To achieve this, diverse simulation tools and models must work together seamlessly across domains like traffic, environment, and sensor simulation. ASAM OpenX standards provide the common language and interfaces needed for this interoperability. This training equips participants with the knowledge to apply these standards effectively in (co-)simulation workflows for credible automated driving validation.

Course Objectives

By the end of this one-day course, participants will: Understand the scope, purpose, and relationships of ASAM OpenX standards for (co-)simulation / Gain hands-on practical insight into Open Simulation Interface (OSI), OpenSCENARIO XML, OpenDRIVE, and OpenMATERIAL 3D in the context of multi-domain simulation by building a minimal co-simulation setup with OpenX-based interfaces / Learn best practices for integrating simulation components from different vendors into a unified test environment / Explore workflows for credible simulation in automated driving development / Identify how OpenX standards support interoperability, repeatability, credibility, and safety argumentation.

Who should attend?

This training is designed for simulation engineers, sensor (model) developers and integrators, ADAS/AD validation specialists, test automation engineers, software architects, and project managers involved in virtual validation of automated driving systems. It is equally relevant for researchers, tool vendors, and anyone integrating heterogeneous simulation tools using ASAM OpenX standards.

Course Contents

- Introduction to ASAM OpenX® Standards Ecosystem
  - Overview of the ASAM organization and standardization process.
  - OpenX family overview: OpenDRIVE, OpenSCENARIO, OSI, OpenCRG, OpenODD, OpenLABEL, OpenMATERIAL 3D, etc.
- Co-Simulation Concepts
  - Definition and benefits of co-simulation.
  - Role of standards in heterogeneous simulation environments.
- OSI – The Backbone for Sensor & Environment Exchange
  - Data model, message structure, and use cases.
  - Interfaces between perception, environment, and traffic simulation.
- Integrating OpenX Standards in Practice
  - Combining OpenSCENARIO XML, OpenDRIVE, and OSI for automated driving simulation.
  - Material modeling with OpenMATERIAL 3D for sensor realism.
- Toolchain Interoperability
  - Connecting simulators and test frameworks from different vendors.
  - Real-world examples and lessons learned.
- Discussion & Outlook
  - How OpenX standards support Credible Simulation.
  - Current developments in ASAM OpenX.
  - Roadmap and opportunities for participants' projects.

Instructor

Dr.-Ing. Philipp Rosenberger (Persival GmbH) is co-founder and CEO of Persival GmbH, which supports sensor manufacturers and OEMs in the specification, development and validation of perception sensor models. He finished his PhD thesis on "Metrics for Specification, Validation, and Uncertainty Prediction for Credibility in Simulation of Active Perception Sensor Systems" at the Institute of Automotive Engineering at the Technical University of Darmstadt. In the European project "ENABLE-S3" he led the work package for simulation and stimulation and in the German project "PEGASUS" he was responsible for the development and validation of sensor models. Recently, he was involved in the German projects "SET Level" and "Verification & Validation Methods" to continue his work on model development and validation. He is a founding member and part of the Change Control Board of the ASAM OSI standard. Together with his research group at TUDa FZD, he founded the PerCollECT initiative to collect and provide perception sensor cause-effect chains in a tree-like ontology. Furthermore, he is an active contributor to the open source perception sensor models of the asc(s e.V. - ENVITED Open Source Model & Simulation Library.

Facts

Date	#	Location	Duration	Price	Language
07.-08.05.2026	209/4681	Online	2 x 4 Hrs.	890,- EUR till 09.04.2026, thereafter 1.090,- EUR	English
15.10.2026	209/4680	Alzenau	1 Day	890,- EUR till 17.09.2026, thereafter 1.090,- EUR	German

Model Validation for Credible Simulation

Course Description

As simulation becomes a cornerstone of virtual testing and validation in automotive and other industries, ensuring the credibility of simulation models is paramount. Credible simulation requires validated models that accurately represent real-world behavior across domains such as vehicle dynamics, sensors, traffic, and environment. This training provides participants with knowledge about the methodology, the metrics, and the important aspects during data collection and re-simulation to validate simulation models on the example of perception sensor models. The goal is to support safety argumentation and regulatory compliance in virtual validation workflows.

Course Objectives

By the end of this one-day course, participants will: Understand the principles and requirements for credible simulation / Learn ways to derive requirements and relevant effects for simulation models / Learn the importance of reference data accuracy and re-simulation of measurements / Learn methods and metrics for validating simulation models / Gain practical insight into sensor model verification, validation, and uncertainty quantification / Explore workflows and tools that support model credibility and traceability / Identify best practices for documentation and evidence generation in model validation.

Who should attend?

This training is intended for simulation engineers, model developers, validation specialists, software architects, test engineers, and project managers involved in virtual validation. It is also relevant for researchers, tool vendors, and anyone responsible for ensuring the credibility of simulation models used in safety-critical applications.

Course Contents

- Introduction to Credible Simulation
  - Definition and importance of Credible Simulation.
  - Regulatory and safety requirements for model validation.
- Co-Simulation Concepts
  - Definition and benefits of co-simulation for credible simulation.
  - Benefits of standards in heterogeneous simulation environments.
- Model Validation Methodology
  - Verification vs. validation: concepts and differences.
  - Uncertainty quantification and sensitivity analysis.
  - Metrics for model validation.
- Domain-Specific Validation
  - Validation of vehicle dynamics models.
  - Traffic behavior model validation.
  - Environment and 3D asset quality.
  - Sensor model validation.
- Case Studies and Best Practices
  - Real-world example of sensor model validation.
    - Requirements / analysis of relevant effects.
    - Measurement conduction.
    - Re-simulation of measurements.
    - Validation with qualified metrics.
  - Lessons learned and common pitfalls.
- Discussion & Outlook
  - Virtual proving grounds.
  - Continuous validation.
  - Opportunities for participants' projects.

Instructor

Dr.-Ing. Philipp Rosenberger (Persival GmbH) is co-founder and CEO of Persival GmbH, which supports sensor manufacturers and OEMs in the specification, development and validation of perception sensor models. He finished his PhD thesis on "Metrics for Specification, Validation, and Uncertainty Prediction for Credibility in Simulation of Active Perception Sensor Systems" at the Institute of Automotive Engineering at the Technical University of Darmstadt. In the European project "ENABLE-S3" he led the work package for simulation and stimulation and in the German project "PEGASUS" he was responsible for the development and validation of sensor models. Recently, he was involved in the German projects "SET Level" and "Verification & Validation Methods" to continue his work on model development and validation. He is a founding member and part of the Change Control Board of the ASAM OSI standard. Together with his research group at TUDa FZD, he founded the PerCollECT initiative to collect and provide perception sensor cause-effect chains in a tree-like ontology. Furthermore, he is an active contributor to the open source perception sensor models of the asc(s e.V. - ENVITED Open Source Model & Simulation Library.

Facts

12.-13.05.2026	210/4684	Online	2 x 4 Hrs.	890,- EUR till 14.04.2026, thereafter 1.090,- EUR	
08.10.2026	210/4683	Alzenau	1 Day	890,- EUR till 10.09.2026, thereafter 1.090,- EUR	

U.S. NCAP Crash Imminent Braking & Dynamic Brake Support

Test Procedure Nov. 2024 | **Docket No. NHTSA-2024-0077**

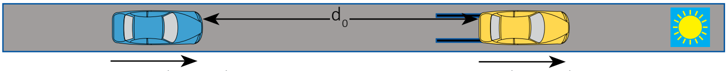
LVS (Lead Vehicle Stopped)
Approach to stationary target

CIB v_0 = 40 - 80 km/h | v = 0 km/h
DBS v_0 = 70 - 100 km/h | v = 0 km/h

LVM (Lead Vehicle Moving)
Approach to slower target

CIB v_0 = 40 - 80 km/h | v = 20 km/h
DBS v_0 = 70 - 100 km/h | v = 20 km/h

LVD (Lead Vehicle Decelerating)
Approach to braking target



CIB&DBS v_0 = 50/80 km/h | 50/80 km/h
d_0 = 40 / 12 m | a = -0.3/-0.5 g

False Positive Test
Approach to steel trench plate

CIB&DBS v_0 = 80 km/h | 8 ft x 12 ft x 1 in (2.4 m x 3.7 m x 25 mm)

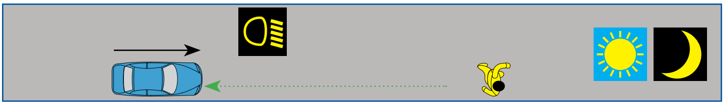
Requirements

Scenario	LVS	LVM	LVD	False Positive
Requirement	no impact			deceleration ≤ 0.25 g

U.S. NCAP Pedestrian AEB

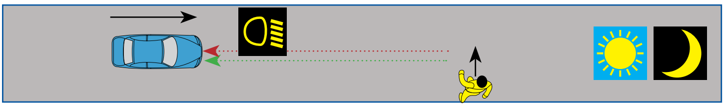
Test Procedure Nov. 2024 | **Docket No. NHTSA-2024-0077**

Adult, Longitudinal, Impact at 25 % of the Vehicle Width (S4c, S4a)
AEB



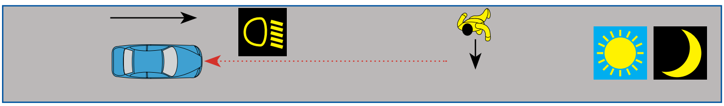
v_0 = 10 - 60 km/h | v = 0 / 5 km/h

Adult, Nearside, Impact at 25/50 % of the Vehicle Width (S1a, S1b)
AEB



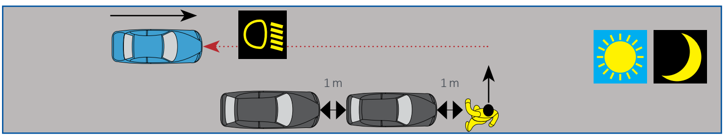
v_0 = 10 - 60 km/h | v = 5 km/h

Adult, Farside, Impact at 50 % of the Vehicle Width (S1e)
AEB



v_0 = 10 - 60 km/h | v = 8 km/h

Child, Obstruction, Nearside, Impact at 50 % of the Vehicle Width (S1d)
AEB



Day v_0 = 10 - 60 km/h | v = 5 km/h
Night v_0 = 10 - 40 km/h | v = 5 km/h

Requirements

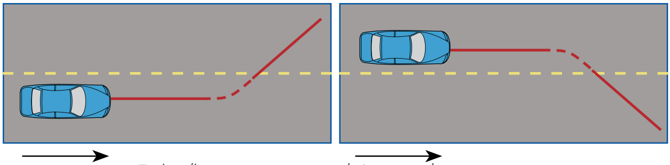
Scenario	S4c	S4a	S1a	S1b	S1e	S1d
Requirement	no impact					

U.S. NCAP LKA and LDW System Confirmation Test Procedure

LKA & LDW System Confirmation Test Procedure, Nov 2024

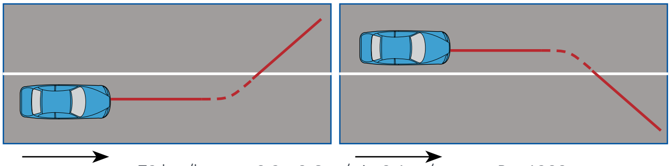
LKA & LDW

Single Lane Line: Dashed Yellow Line



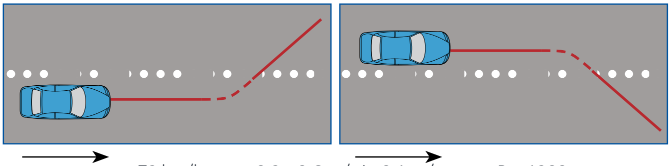
v_0 = 72 km/h, v_{lat} = 0.2 - 0.6 m/s in 0.1 m/s steps, R = 1200 m

Single Lane Line: Solid Line



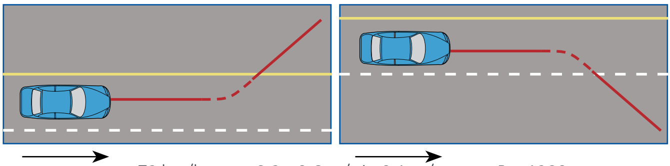
v_0 = 72 km/h, v_{lat} = 0.2 - 0.6 m/s in 0.1 m/s steps, R = 1200 m

Single Lane Line: Botts' Dots Line



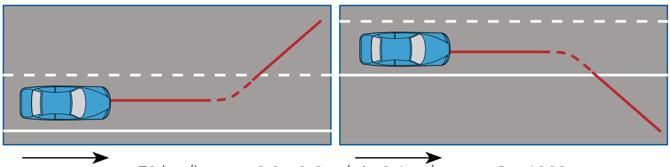
v_0 = 72 km/h, v_{lat} = 0.2 - 0.6 m/s in 0.1 m/s steps, R = 1200 m

Double Lane Line: Solid Yellow Line / Dashed White Line



v_0 = 72 km/h, v_{lat} = 0.2 - 0.6 m/s in 0.1 m/s steps, R = 1200 m

Double Lane Line: Solid White Line / Dashed White Line



v_0 = 72 km/h, v_{lat} = 0.2 - 0.6 m/s in 0.1 m/s steps, R = 1200 m

Initial Offset from Lane Marking

v_{lat} [m/s]	Initial lateral offset from lane marking [m]
0.2	0.42
0.3	0.76
0.4	1.04
0.5	1.04
0.6	1.13

Evaluation Criteria

- LDW and LKA systems must be “Default On”.
- Vehicle must present, at a minimum, visual and haptic components of an LDW alert when the lateral position of the vehicle is ≤ 0.75 m (2.5 ft.) of the inboard edge of the lane line and before the lane departure > 0.3 m (1 ft.).
- No visual LDW alert or LKA intervention if the vehicle has not departed its lane and is > 0.75 m (2.5 ft.) from the inboard edge of the lane line.
- Visual LDW alert and LKA intervention must be issued before the vehicle has departed its lane by > 0.3 m (1 ft.), measured from the inboard edge of the lane boundary.
- Visual LDW alert must be issued prior to, or concurrent with, the start of the LKA intervention.

IIHS Vehicle-to-Vehicle Front Crash Prevention Tests

V2V Front Crash Prevention Test Protocol, V. II (April 2025)

Car, stationary, Target with ± 25 % / 100 % Overlap (CCRs)
AEB + FCW

v_0 = 50 / 60 / 70 km/h   v = 0 km/h

Motorcycle, stationary, Unobstructed, Longitudinal, Target with ± 25 % / 100 % Overlap (CMRs)
AEB + FCW

v_0 = 50 / 60 / 70 km/h   v = 0 km/h

Dry Van Trailer, stationary, Target with 100 % overlap
FCW

v_0 = 50 / 60 / 70 km/h   v = 0 km/h

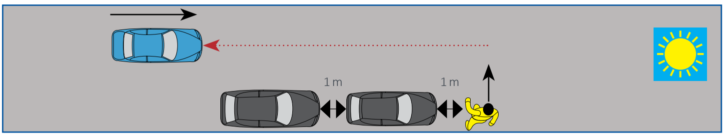
IIHS Test Scenarios for AEB Pedestrian

Pedestrian AEB Test Protocol, V. IV (January 2024)

Adult, Nearside, Impact at 25 % of the Vehicle Width (CPNA-25) night
AEB

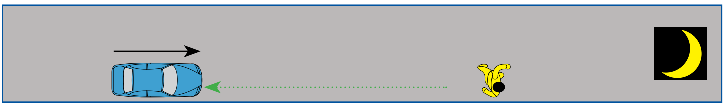
v_0 = 20 / 40 km/h   v = 5 km/h

Child, Obstruction, Nearside, Impact at 50 % of the Vehicle Width (CPNC-50) day
AEB



v_0 = 20 / 40 km/h   v = 5 km/h

Adult, Longitudinal, Impact at 25 % of the Vehicle Width (CPLA-25) night
AEB FCW (@ 60 km/h only)



v_0 = 40 / 60 km/h   v = 0 km/h

Scoring

Speed reduction [km/h]	0 ... 8	9 ... 18	19 ... 28	29 ... 38	39 ... 48	49 ... 58	59 ... 61
Points	0.0	0.5	1.0	1.5	2.0	2.5	3.0

1.0 points are awarded if a FCW is given ≥ 2.1 s time to collision in the CPLA-25$_{60\ km/h}$ scenario.
Points are awarded for the daytime child scenario at both test speeds and the nighttime adult scenarios at all the test speeds with low and high beams. Points are then weighted by multiplying the crossing-child and crossing-adult points by 2. Specific crossing- and stationary-adult points are further weighted based on the availability and speed range of high beam assist. For vehicles with high beam assist, individual scores are multiplied by 2 based on the activation speed of the high beam assist.
A maximum score of 42 is possible. The final weighted score is divided by 7 to get the overal score for the rating:

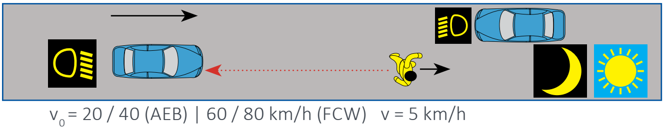
Overall score	< 1	< 3	< 5	≥ 5
Rating scale	Poor	Marginal	Acceptable	Good

C-NCAP Active VRU Safety Rating

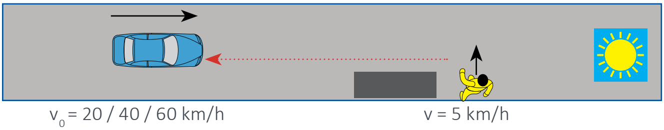
Management Regulation 2024 Revision

AEB VRU

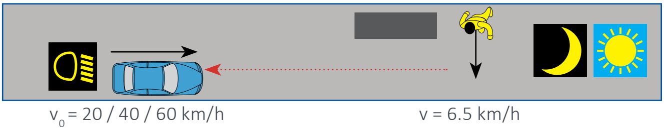
Adult, Longitudinal, Impact at 25 % of the Vehicle Width (CPLA-25)
AEB + FCW



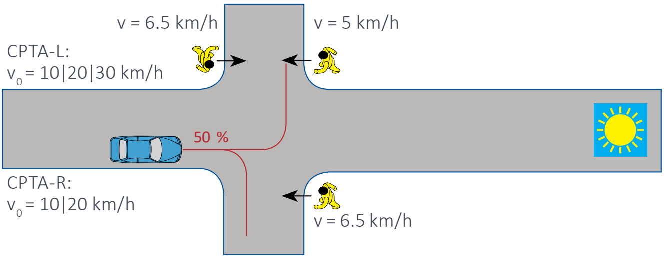
Child, Nearside, Obstruction, Impact at 25 % of the Vehicle Width (CPNCO-25)
AEB



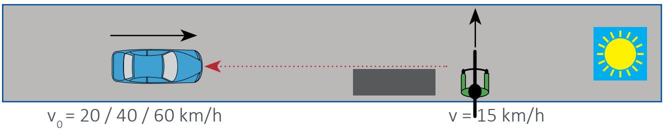
Adult, Farside, Obstruction, Impact at 25 % of the Vehicle Width (CPFAO-25)
AEB



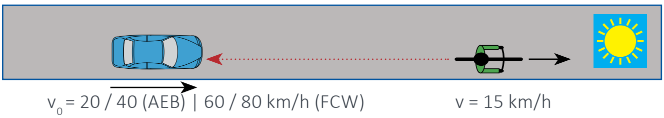
Adult, VUT Turning, Farside / Nearside, Same / Opposite Direction, Impact at 50 % of the Vehicle Width (CPTA-LN / LF / RF)
AEB



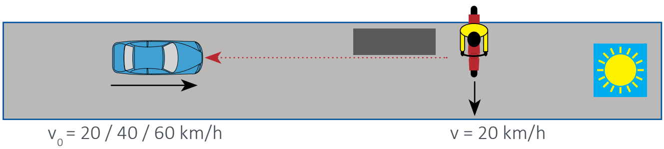
E-Bike, Nearside, Obstruction Impact at 50 % of the Vehicle Width (CBNAO-50)
AEB



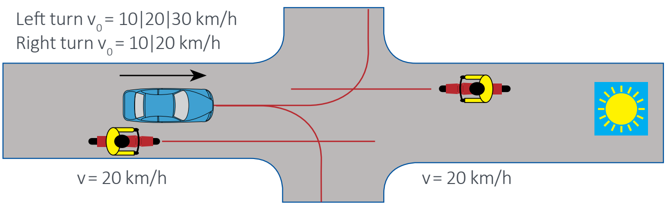
E-Bike, Longitudinal, Impact at 25 % of the Vehicle Width (CBLA-25)
AEB + FCW



Scooter, Farside, Obstruction Impact at 50 % of the Vehicle Width (CSFAO-50)
AEB



Scooter, Turn across path (CSTA-LN-50, CSTA-RN)
AEB



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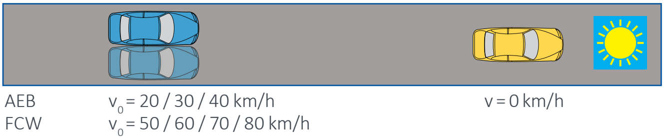
C-NCAP Active Safety Rating

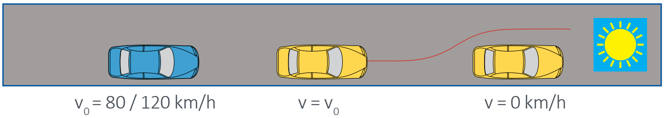
Management Regulation 2024 Revision

AEB Car to Car

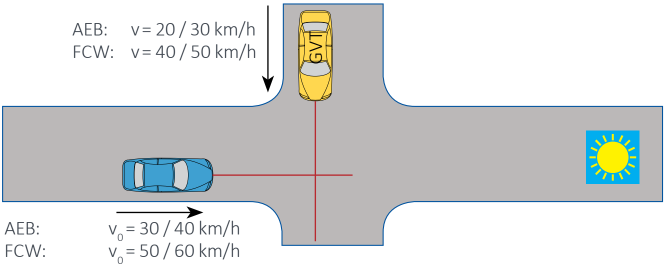
CCRs: Approach to stationary target with ± 50 % overlap
AEB + FCW



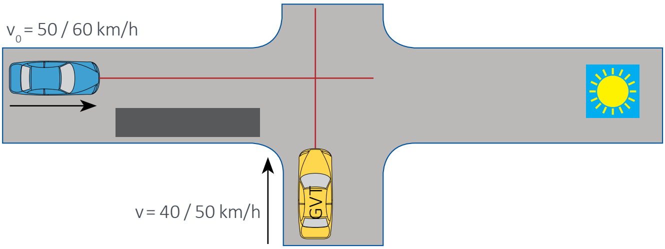
CCRH: High speed cut-out with 100 % overlap
FCW



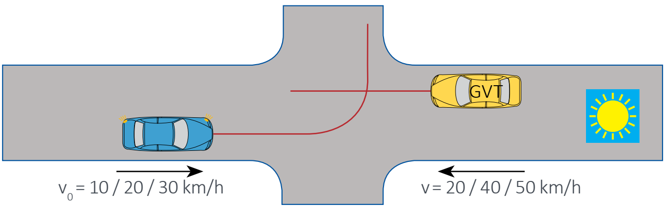
C2C SCP: Crossing straight crossing path
Impact at 25 % of GVT lenght
AEB + FCW



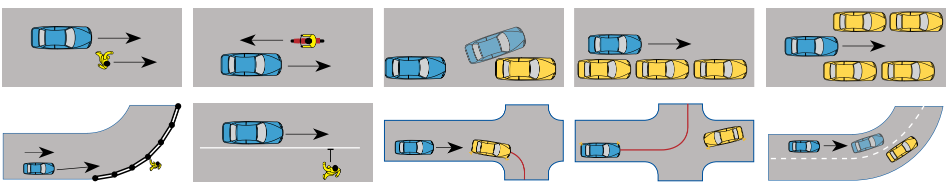
C2C SCPO: Crossing straight crossing path, Obstruction
Impact at 25 % of GVT lenght
FCW



CCFT: Front turn across path
Impact at 50 % Overlap
AEB



10 False Positive Scenarios

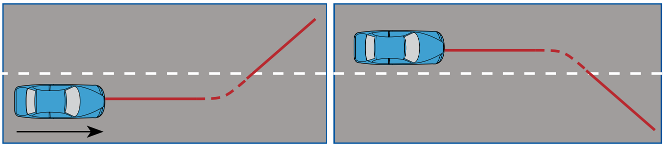


C-NCAP Active Safety Rating

Management Regulation 2024 Revision

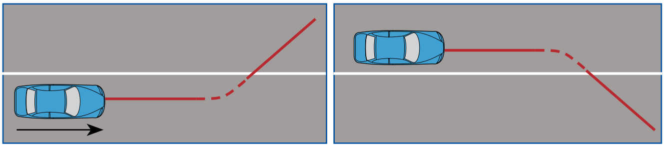
LSS

Lane Keep Assist Dashed Line: Single Line



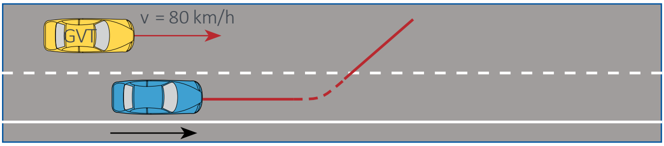
v_0 = 80 km/h, v_{lat} = 0.3 / 0.5 m/s, R = 1200 m

Lane Keep Assist Solid Line: Single Line



v_0 = 80 km/h, v_{lat} = 0.3 / 0.5 m/s, R = 1200 m

Emergency Lane Keeping Overtaking Vehicle: Fully Marked Lane



v_0 = 70 km/h, v_{lat} = 0.6 m/s, R = 800 m

AEB	Test Type	VUT Speed (km/h)	Offset	v_{Target}	Item Weight		Scenario Score
CCRs	AEB	20	- 50 %	0	1	11	3
		30	+ 50 %	0	2		
		40	- 50 %	0	2		
	FCW	50	+ 50 %	0	2		
		60	- 50 %	0	2		
		70	+ 50 %	0	1		
		80	- 50 %	0	1		
CCRH	FCW	80	100 %	0	1	2	1
		120	100 %	0	1		
C2C SCP	AEB	30		20	1	5	2
		40		30	2		
	FCW	50		40	1		
		60		50	1		
C2C SCPO	FCW	50		40	1	2	1
		60		50	1		
CCFT	AEB	10		20	1	3	2
		20		40	1		
		30		50	1		
HMI	Shutdown				2	4	1
	Alarm				1		
	Active seat belt				1		
LSS	**Direction**	**VUT Speed (km/h)**	**v_{Lat}**	**v_{Target}**	**Item Weight**		**Scenario Score**
LKA solid	Left	80	0.3		1	4	2
		80	0.5		1		
	Right	80	0.3		1		
		80	0.5		1		
LKA dotted	Left	80	0.3		1	4	
		80	0.5		1		
	Right	80	0.3		1		
		80	0.5		1		
ELK dotted	Left	70	0.6	80	1	1	1

C-IASI AEB Test Scenarios

AEB Car to Car Rating Protocol 2023	AEB Car to Car Test Protocol 2023

AEB Car to Car

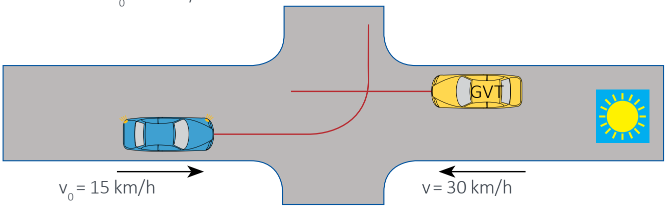
CCRs*: Approach to stationary target with ± 50 % (30 / 50 km/h) / 100 % (40 km/h) overlap
AEB + FCW

AEB v_0 = 30 / 40 / 50 km/h v = 0 km/h
FCW v_0 = 72 km/h (100 % overlap only)

CCRm*: Approach to slower target with 100 % overlap
AEB + FCW

AEB v_0 = 60 / 70 / 80 km/h v = 20 km/h
FCW v_0 = 80 km/h

CCFtap: Front turn across path Impact at 50 % overlap
AEB



v_0 = 15 km/h v = 30 km/h

Car to Truck

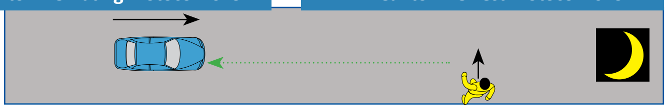
Car to Truck: Approach to stationary target with ± 50 %* / 100 % overlap
AEB *** monitoring only**

AEB v_0 = 45 / 55 km/h (day) & 50 / 60 km/h (night) v = 0 km/h
FCW v_0 = 72 km/h (100 % overlap only)

AEB Car to VRU Rating Protocol 2023	AEB Car to VRU Test Protocol 2023

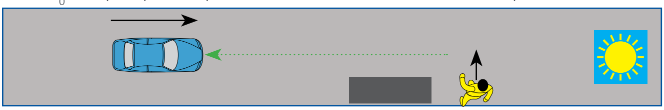
AEB Pedestrian

Adult, Nearside, Impact at 25 % of the Vehicle Width (CPNA-25)
AEB



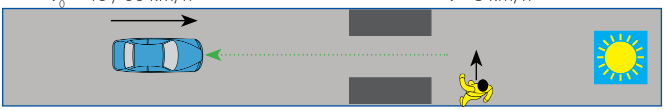
v_0 = 20 / 40 / 60 km/h v = 5 km/h

Child, Nearside, Single Obstruction Impact at 50 % of the Vehicle Width (CPNSOC-50)
AEB



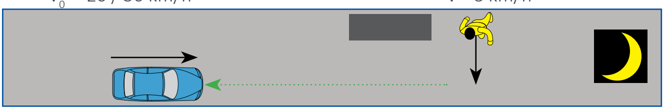
v_0 = 40 / 60 km/h v = 5 km/h

Child, Nearside, Double Obstruction Impact at 50 % of the Vehicle Width (CPNDOC-50)
AEB



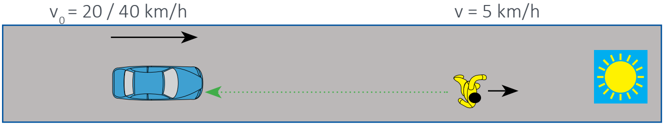
v_0 = 20 / 30 km/h v = 5 km/h

Adult, Farside, Obstruction, Impact at 50 % of the Vehicle Width (CPFOA-50)
AEB



v_0 = 20 / 40 km/h v = 5 km/h

Adult, Longitudinal, Impact at 25 % of the Vehicle Width (CPLA-25)
AEB



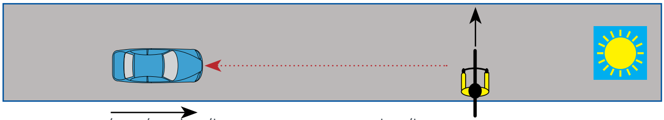
v_0 = 35 / 55 km/h v = 5 km/h

C-IASI AEB Test Scenarios

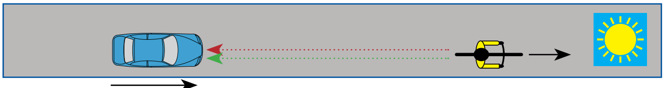
AEB Car to VRU Rating Protocol 2023 | **AEB Car to VRU Test Protocol 2023**

AEB Cyclist

Cyclist, Nearside, Impact at 50 % of the Vehicle Width (CBNA-50)
AEB

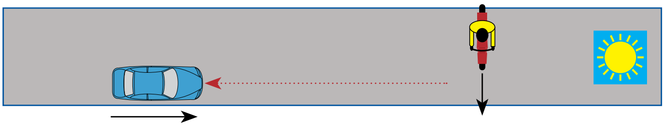


Cyclist, Longitudinal, Impact at 50 % of the Vehicle Width (CBLA-50)
AEB + FCW

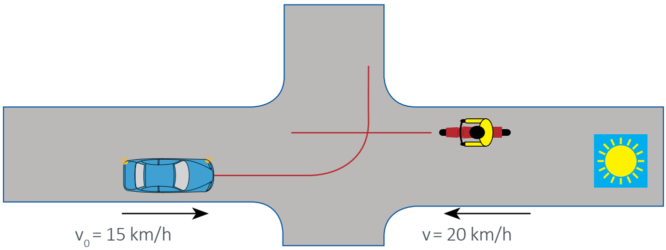


AEB Scooter (PTW)

Scooter, Farside, Impact at 50 % of the Vehicle Width (CSFA-50)
AEB



Scooter, Front turn across path, Impact at 50 % of the Vehicle Width (CSFtap-50)
AEB



IVISTA China Intelligent Vehicle Index

IVISTA Protocol 2027

IVISTA China Intelligent Vehicle Index

Intelligent Cruise		Intelligent Parking		Intelligent Interaction		Intelligent Safety	
Cruise Assist		**Parking Assist**		**Voice and Touch-Screen**		**Active Safety**	
Stationary target	9	Parking ability	85	Voice interaction	23	AEB Car to Car	40
Target cut-out	6	Remote control parking	10	Touch screen interaction	17	AEB Car to VRU	53
Straight into bend	7	Safety reminder review	5	Terminal interconnection	6	AEB system robustness	4
Lane change ass.	3	Total points	100	Head-up display	4	LDP	9
Speed limit sign	2	**Memory Parking**		Panoramic surround view	6	LDW	6
Related fct. & manual	3	Enclosed ground	60	Total points	59	ELK	6
Total points	30	Proving ground	40	**Occupant Status Monitoring**		BSD	8
		Total points	100	Distraction monitoring	12	DOW	3
				Fatigue monitoring	4	Advanced	1
Navigation on Autopilot				Child presence (bonus)	4	Total points	151
Closed field	100			Total points	16	**Passive Safety (optional)**	
Simulation	10					**Electrical Safety (EV only)**	
Open road	100						
Total points[1]	110						

1 Navigation Pilot Score= min {Closed field score, Open road score} + Simulation score

JNCAP Preventive Safety Performance Evaluation

Test Protocol Cyc 2024

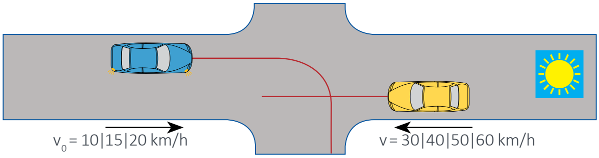
Test Prot. AEB C2C Junction 2024 | Test Prot. AEB Ped Junction 2024 | Test Prot. Ped Day 2023 | Test Prot. Ped Night 2023

Evaluation Item		Max. Score	Max. Total Score	Ranking
AEB	VUT Turning (Car & Pedestrian)	7.8 points	85.8 points	A Rank ≥ 69.44 points[1] B Rank ≥ 50.20 points C Rank ≥ 33.20 points D Rank ≥ 16.52 points E Rank < 16.52 points
	Pedestrian daytime	15 points		
	Pedestrian night	38 points		
	Cyclist	9 points		
Lane Support		11 points		
Headlights		4 points		
Pedal Misapplication		1 point		

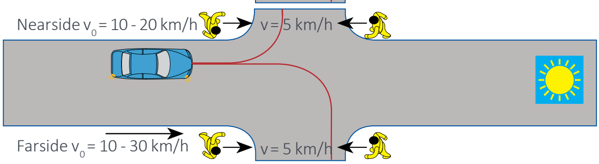
1 To earn the highest Ranking (A Rank), all of the test results except for AEB for cyclist must be rated 4 or higher. In addition, AEB for cyclist shall be equipped.

AEB VUT Turning

CCFtap: Front turn across path Impact at 50 % or 100 % overlap
AEB + FCW

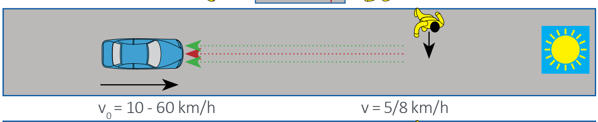


Adult, VUT Turning, Farside / Nearside, Same / Opposite Direction, Impact at 50 % of the Vehicle Width (CPTA-Farside / Nearside) AEB + FCW

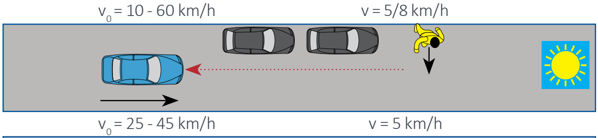


AEB VRU

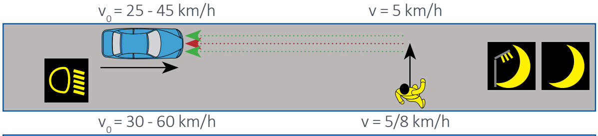
Adult/Child, Nearside, Impact at 25, 50 & 75 % of the Vehicle Width (CPN-25/50/75)
AEB + FCW



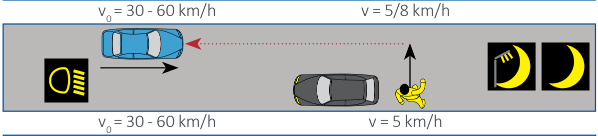
Adult/Child, Nearside, Obstruction, Impact at 50 % of the Vehicle Width (CPNO-50)
AEB + FCW



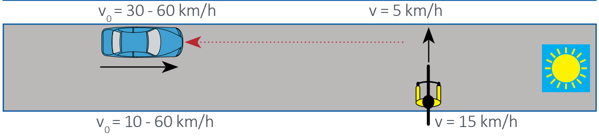
Adult, Farside, Impact at 25, 50 & 75 % of the Vehicle Width (CPF-25/50/75 Night)
AEB + FCW



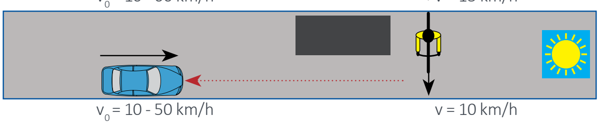
Adult, Farside, Obstruction Impact at 50 % of the Vehicle Width (CPFO-50 Night)
AEB + FCW



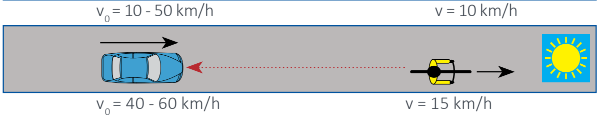
Cyclist, Farside, Impact at 50 % of the Vehicle Width (CBF-50)
AEB + FCW



Cyclist, Nearside, Obstruction, Impact at 50 % of the Vehicle Width (CBNO-50)
AEB + FCW



Cyclist, Longitudinal, Impact at 50 % of the Vehicle Width (CBL-50)
AEB + FCW



KNCAP AEB Tests

daylight testing · nighttime testing with streetlights · low beam headlights

AEB Car-to-Car

Protocol 2025 AEB Inter-Urban TP-SS-01 | Protocol 2025 AEB City TP-SS-02

CCRs: Approach to stationary Target with ± 50 / ± 75 / 100 % Overlap
AEB + FCW

v_0 = 10 - 50 km/h   v = 0 km/h

CCRm: Approach to slower Target with ± 50 / ± 75 / 100 % Overlap
AEB + FCW

v_0 = 30 - 70 km/h   v = 20 km/h

CCRb: Approach to braking Target with 100 % Overlap
AEB + FCW

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

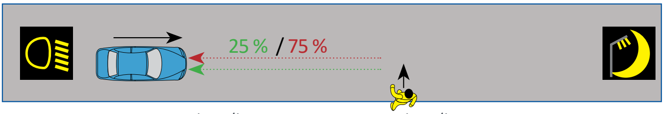
AEB Pedestrian

Protocol 2025 AEB Ped TP-VS-02

Adult, Farside, Impact at 50 % of the Vehicle Width (CPFA-50)

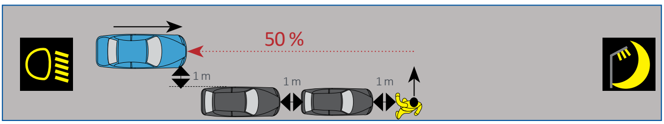
v_0 = 20 - 60 km/h   v = 8 km/h

Adult, Nearside, Impact at 25 & 75 % of the Vehicle Width (CPNA-25/75)



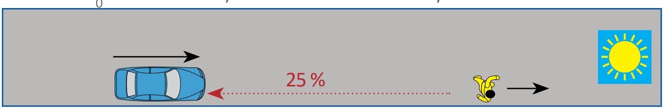
v_0 = 20 - 60 km/h   v = 5 km/h

Child, Obstruction, Nearside, Impact at 50 % of the Vehicle Width (CPNCO-50)



v_0 = 20 - 60 km/h   v = 5 km/h

Adult, Longitudinal, Impact at 25 % of the Vehicle Width (CPLA-25)

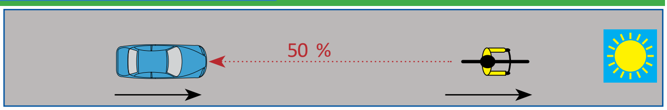


v_0 = 20 - 60 km/h   v = 5 km/h

AEB Cyclist

Protocol 2025 AEB Cyclist TP-VS-03

Cyclist, Longitudinal Impact at 50 % of the Vehicle Width (CBLA-50)



v_0 = 25 ... 60 km/h   v = 15 km/h

Cyclist, Nearside, Ostructed, Impact at 50 % of the Vehicle Width (CBNAO-50)

v_0 = 20 ... 60 km/h   v = 15 km/h

Introduction to Impact Biomechanics and Human Body Models

Course Description

To prevent human injury in traffic it is necessary to understand the biomechanics of impact. This can be done through experimental studies with human subjects, volunteers, or post-mortem human subjects (PMHS), after ethical approval. The individual variation is large in experiments with human subjects, due to the wide spread of anthropometry and material properties that depend on factors such as gender, age, and health status. Mechanical anthropometric crash test dummies were developed to provide repetitive tools for development and assessment of safety systems for specific loading scenarios, representing mid-size males, large males, small females and children of different ages. With the development of advanced safety systems, the need for repetitive tools with increased biofidelity and anatomical details, initiated development of numerical human body models. With increasing computer capacity, human body models have become popular tools for traffic safety research, crash simulations, safety evaluations and to study the effects of population diversity on traffic safety. This course covers the basic topics of impact biomechanics, such as human anatomy, population variance, mechanical properties of human tissues, and injury criteria. Finally, it focuses on computational models of the human body and their use to develop and evaluate safety systems.

Course Objectives

The objective of this course is to introduce impact biomechanics, injury biomechanics, and to provide an overview of computational models of the human body. You will learn about the most important topics and get a chance to understand how it relates to your work and traffic safety in general.

Who should attend?

This seminar addresses everyone who wants to obtain an up-to-date overview or who needs a deepened understanding of the field of impact biomechanics, such as university graduates, career changers, management, project assistants, internal service providers, qualified technicians from the crash-test lab or anyone basing product development or decision-making on simulation results with human body models.

Course Contents

- Introduction to impact biomechanics
  - Human anatomy & physiology
  - Medical terminology
  - Injury scaling scores
  - Epidemiology
  - Human substitutes
- Material properties
  - Soft tissues
  - Hard tissues
- Injury mechanisms, tolerances & criteria
  - Head and neck
  - Thorax
  - Upper and lower extremities
- Population variability
  - Biomechanics of children
  - The aging population
  - Gender differences
- Human body models
  - Introduction to numerical methods
  - Methodology for model development
  - Validation of models
  - State of the art models
  - Strengths and limitations

Instructor

Dr. Karin Brolin (Lightness by Design AB) has worked in the field of impact biomechanics throughout her career. Brolin earned her Ph.D. in 2002 at the Royal Institute of Technology, and since then she has worked in both academia and industry on the topic of human body injury mechanisms and tolerances. For ten years she led a research group focusing on human body simulations for traffic safety and injury prevention, as Professor in Computational Impact Biomechanics at Chalmers University of Technology. Since, 2019 Dr. Brolin works as an independent consultant and researcher.

Facts

20.-29.01.2026	193/4488	Online	4 x 4 Hrs.	1.450,- EUR till 23.12.2025, thereafter 1.750,- EUR
22.-25.09.2026	193/4673	Online	4 x 4 Hrs.	1.450,- EUR till 25.08.2026, thereafter 1.750,- EUR

HUMAN MODELING AND SIMULATION
IN AUTOMOTIVE ENGINEERING

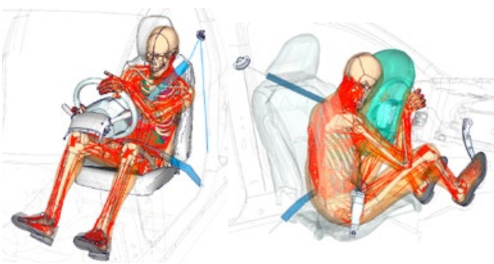
Human Modeling and Simulation in Automotive Engineering

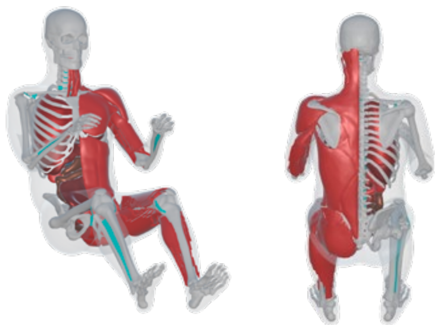
The application of numerical simulation with digital human models offers exciting new opportunities in automotive engineering. The use of human models in the areas of safety, comfort, and ergonomics can overcome the limitations imposed by the use of real humans or their mechanical surrogates, thus enabling further optimization of automotive designs. In addition, human modeling and simulation is opening the new era of virtual testing for safety assessment and homologation.

Focus Topic 2026

Autonomous vehicles will bring significant comfort benefits to passengers. However, safety cannot be compromised for alternative seating positions. Human Modeling and Simulation is currently the only technology that will allow assessment of occupant protection for new car interior architectures with flexible seat arrangements.

In 2026 the **12th International Symposium Human Modeling and Simulation in Automotive Engineering** will be held in Germany. The symposium aims to continue and advance the dialog between researchers, software developers and industrial users of human models. Presentations by renowned researchers, software developers and industrial users from around the world on biomechanical research, digital human models and their application in automotive engineering will guarantee a unique and highly relevant conference.





Facts

11.-12.11.2026

tba & ONLINE

www.carhs.de/humo

automotive CAE GRAND CHALLENGE

May 19 – 20, 2026
Congress Park Hanau
Germany

Computer simulation has become an indispensable tool in automotive development. Tremendous progress in software and computer technology makes it possible today to assess product and process performance before physical prototypes have been built. Despite of significant progress in simulation technology and impressive results in industrial application there remains a number of challenges which prevent a "100 % digital prototyping". We at carhs.training call these Grand Challenges.

Automotive CAE Grand Challenge offers a Platform for Dialogue

The automotive CAE Grand Challenge stimulates the exchange between users, scientists and software developers in order to solve these challenges. Annually the current, critical challenges in automotive CAE are being identified through a survey among the simulation experts of the international automotive industry. In the conference one session is dedicated to each of the most critical challenges, the so-called Grand Challenges. In each session CAE experts from industry, research and software development will explain the importance of the individual challenge for the virtual development process and talk about their efforts to solve the challenge.

Automotive CAE Grand Challenges 2026

The most important current challenges of automotive CAE - the so-called "Grand Challenges" - were determined through the expert survey described above. These "Grand Challenges" will form the topics of the sessions of our automotive CAE Grand Challenge 2026 conference:

- Artificial Intelligence, Machine Learning, Big Data: **How can AI Actually Help Designing a Vehicle**?
- CAE Process & Quality Assurance: **Automated CAE Model Quality Checks for Certification Readiness**
- Durability / Fatigue: **Fatigue Simulation of HV-Batteries (Vibration Fatigue)**
- Full Vehicle Simulation: **Virtual Verification and Certification**
- Material Modeling - Focus Structural Analysis: **Advanced Modelling of Material Damage and Failure**
- Occupant Safety: **Meta Models for Occupant Injury Prediction**
- Optimization & Robustness: **Challenges of Multidisciplinary Design Optimization**

Who should attend?

The conference intends bringing together industrial users, researchers and software developers to discuss these current, critical challenges of automotive CAE and to initiate collaboration between these groups to help overcoming these Grand Challenges. The presentation program of the conference provides both experts and beginners valuable information for their daily work. The possibility to meet and exchange with all stakeholders of automotive CAE is a great opportunity. In the accompanying exhibition participants can receive additional information from leading companies of CAE.

Facts

19.-20.05.2026

Hanau, GERMANY & ONLINE

www.carhs.de/grandchallenge

1.190,- EUR till 21.04.2026, thereafter 1.490,- EUR, ONLINE 1.090,- EUR

Introduction to the Python Programming Language

Course Description

Python is a modern programming language that is increasingly used in the field of Scientific Computing. Together with the environment scipy Python is an open source alternative to the commercial software MATLAB. A series of CAE software products, including the Pre-Processor ANSA, the solvers ABAQUS and PAM-CRASH and the Post-Processor META, are already using Python as an integrated scripting language. Python puts the emphasis on well-readable code, so beginners can learn the language very quickly. Nevertheless, Python is a powerful programming language and can also be used for larger projects. Further advantages of Python are the platform independence and the very extensive standard library supplied.

Course Objectives

The seminar provides a comprehensive introduction to the basics of the Python programming language. It also includes an introduction to object-oriented programming. Practical exercises, such as processing text-based files from the CAE world, will be treated. After the seminar, participants will be able to acquaint themselves with the Python interfaces of CAE software products.

Who should attend?

The seminar is aimed at newcomers to the Python language. Experience in other scripting or programming languages would be an advantage but is not a requirement.

Course Contents

- Basic concepts of the Python programming language
  - Introduction to the language
  - Data and control structures, functions
- Advanced topics
  - Processing of data
  - Important modules of the Python standard library
  - Examples from scientific computing
  - Modularization in bigger Python projects
- Practical exercises

Facts

30.06.-01.07.2026	161/4710	Alzenau	2 Days	1.450,- EUR till 02.06.2026, thereafter 1.750,- EUR	
07.-12.12.2026	161/4711	Online	6 x 2 Hrs.	1.450,- EUR till 09.11.2026, thereafter 1.750,- EUR	

Python based Machine Learning with Automotive Applications

Course Description

Especially in the automotive environment, extensive data are generated in the context of simulation or testing, for which an automated analysis is often sought. In addition to the classical interpretation of individual simulation or testing results, the methods of machine learning allow a new view at models and results. Based on the analysis of numerous results (big data), e.g. from parameter studies, it is possible to derive Artificial Intelligence using methods of machine learning, which is then used to evaluate further simulations or tests.

Course Objectives

The seminar gives an introduction to machine learning based on the programming language Python. After the seminar participants will be able to tackle the implementation of their own tasks.

Course Contents

- Basics of data analysis with Python
- Machine Learning with Python
- Applications motivated by CAE or testing background

Facts

08.-11.06.2026	185/4712	Online	4 x 2 Hrs.	1.450,- EUR till 11.05.2026, thereafter 1.750,- EUR	
17.-18.11.2026	185/4713	Alzenau	2 Days	1.450,- EUR till 20.10.2026, thereafter 1.750,- EUR	

Instructor

Dr. André Backes (TECOSIM GmbH) studied Mathematics at the University of Duisburg. From 2000 to 2006 he was a researcher at the Institute for Mathematics at the Humboldt University in Berlin. His PhD studies at the chair for Numerical Mathematics introduced him to the field of CAE. Since 2006 he works at TECOSIM GmbH in Ruesselsheim and among other topics specialized in NVH. In the area of Virtual Benchmarking he helped developing the TECOSIM-owned process TEC|BENCH where also the Python language was used. In current research projects he investigates the use of Python-based methods for data analysis and machine learning in the CAE process. Since 2020 he has been working at TECOSIM Stuttgart.

Latest info about this course

Structural Optimization in Automotive Design Theory and Application

Course Description

In recent years numerical simulation has gained importance in all engineering disciplines. In the automotive industry the development process evolved from an experiment based to a virtual development process. Through this move towards simulation, mathematical optimization also gained importance and new opportunities for its application have been opened within the development process. Only a few years ago it would have been unthinkable to find the optimal cross section and the number and location of ribs for a cast part through mathematical optimization, which is now common practice.

As there exists no single optimization method that is suited for all problems, it is important to gain an overview over various optimization methods and their characteristics. In the seminar the most popular and reliable optimization methods will be presented. The focus will be on the explanation of the basic concepts and ideas rather than on the detailed mathematical derivations and formulations.

Emphasis will be on practical applications. Possibilities for using optimization methods will be demonstrated through many industrial examples.

The following questions will be answered in the seminar:

- Which optimization methods are suited for which problems and which are not?
- How big is the optimization effort?
- How can the optimization effort be minimized?
- Which possibilities exist for the formulation of different optimization problems?
- What can lead to failure of an optimization?

Course Objectives

At the end of the seminar participants will have gained an overview over different optimization disciplines and procedures, the areas of application and their individual limitations.

Who should attend?

The seminar is suited for engineers and technicians from research and development departments, users that intend to enlarge or fresh up their background knowledge and newcomers that want to get an overview of the subject.

Course Contents

- Local and global optimization methods and coupled strategies
- Approximation methods
- Lagrange function, dual method
- Optimality criteria methods
- Bionic optimization procedures (CAO, SKO, evolutionary algorithms, optimization with particle swarms)
- Coupling with FEM
- Formulation of optimization problems
- Sensitivity analysis
- Determination of important variables and variable reduction
- Sizing
- Shape optimization, use of morphing techniques, topology optimization
- Robustness optimization
- Multi disciplinary and multi objective optimization
- Numerous application examples

Instructor

Prof. Dr. Lothar Harzheim (Opel Automobile GmbH) worked in the Group of Professor Mattheck on the development of the optimization programs CAO and SKO, before joining the simulation department of Opel. At Opel he is responsible for optimization, bio engineering and robustness. In this position he not only introduced and applied optimization methods but has also developed software for topology optimization. Prof. Dr. Harzheim regularly holds seminars for applied structural optimization and teaches at the Technical University of Darmstadt. He is the author of the book "Strukturoptimierung: Grundlagen und Anwendungen".

Facts

02.-03.03.2026	112/4630	Alzenau	2 Days	1.450,- EUR till 02.02.2026, thereafter 1.750,- EUR	German
23.-26.11.2026	112/4699	Online	4 x 4 Hrs.	1.450,- EUR till 26.10.2026, thereafter 1.750,- EUR	English

Latest info about this course

Simulation | Engineering
Seminar

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:

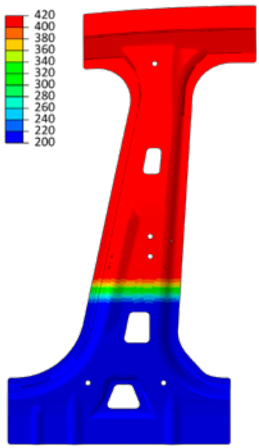
- mild and high strength steels,
- cold formable AHSS and UHSS steels,
- hot formable and quenchable boron steels,
- wrought Al and Mg alloys,
- cast Al and Mg alloys,
- metalic material produced by additive manufacturing.

The objective of this 1-day course is to give the participants an overview of material models of metals used in crash simulation. Within the first chapter the deformation behavior and the failure mechanisms of each material class are explained based on the material structure. In the second chapter phenomenological models for crash simulation of metals are introduced. This includes elasticity, viscoplasticity and failure due to localized necking, ductile normal fracture and ductile shear fracture. In case of crashworthiness simulation the influence of strain rate on the aforementioned properties is of high interest. In the third chapter the tests needed for the characterization of materials are described and the parameter identification for the material models is discussed. The manufacturing process can have a significant impact on the material properties (pre-straining of sheets, paint bake heat treatment,local heating in joining processes etc.). Within the fourth chapter simulation examples are discussed which show the sensitivity of simulation results regarding the identified material parameters. In the final chapter the influence of the discretization on the predictive quality of a crashworthiness model is discussed. This includes both the element size and the type of element (shell vs. solid).

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 behavior
- Phenomenological material models for metals
- Overview of experimental methods for material characterization
- Identification of material parameters from experiments
- Discussion of the sensitivity material parameters



> *The seminar was extremely well received in our company! Even our colleagues, who had already worked a lot in this area, were able to learn many new things.“*
>
> **Fabian Wolf - *P+Z Engineering GmbH***

Instructor

Dr.-Ing. Helmut Gese (MATFEM Ingenieurgesellschaft mbH) founded the engineering consultancy MATFEM in 1993 (from 1999 the company has been named MATFEM partnership Dr. Gese & Oberhofer; in 2022 the legal status has changed to MATFEM Ingenieurgesellschaft mbH). 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.

Facts

10.03.2026	70/4635	Alzenau	1 Day	890,- EUR till 10.02.2026, thereafter 1.090,- EUR	German
22.-23.09.2026	70/4708	Online	2 x 4 Hrs.	890,- EUR till 25.08.2026, thereafter 1.090,- EUR	English

Latest info about this course

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.

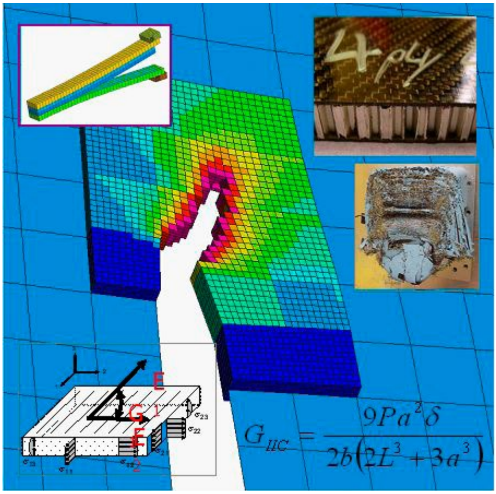
In this one day seminar Prof. Thomas Karall presents the foundations of structural impact and crash analysis of composites with the Finite Element Method. At the beginning of the seminar an overview of current and upcoming industrial applications of composite materials is given. Thereafter concepts for 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
- Modeling methods for plies and laminates
- FEM modeling of composites
- Failure mechanisms and their representation
- PAM-CRASH ply and delamination models
- Necessary material tests
- Examples



Instructor

Prof. Dr. Thomas Karall (Hof University of Applied Sciences) 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. From 2010 to 2015 he worked as Lead Researcher for lightweight design at Virtual Vehicle Research Center in Graz. He was also a lecturer at the Technical University of Graz and lecturer at the FH Joanneum Graz. Since 2015 he has been Professor at the Engineering Department of the Hof University. His areas of work include lightweight design, fibre-reinforced composites and the finite element method.

Facts

19.03.2026	68/4702	Alzenau	1 Day	890,- EUR till 19.02.2026, thereafter 1.090,- EUR	
03.-04.12.2026	68/4701	Online	2 x 4 Hrs.	890,- EUR till 05.11.2026, thereafter 1.090,- EUR	

Modeling of Joints in Crash Simulation

Course Description

For the efficient assembly of components and complete structures many different joining techniques are available. Joints have to ensure that the assembly will fulfill crashworthiness, durability and other requirements. Therefore the best joining technique has to be selected for each application. Modern lightweight design often uses a material mix. Using different materials, like various steel grades, lightweight alloys, plastics or composites for applications for which the individual material is best suited allows for weight savings. The efficient and reliable joining of different materials is even more challenging. Failure of joints can be a reason for collapse of vehicle structures during crash testing. Therefore failure of joints must be precisely predicted in numerical crash simulation applied in the virtual design process of vehicle development.

Course Objectives

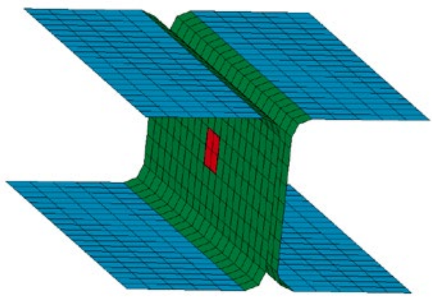
The objective of this one day course is to give the participants an overview of failure modelling of different joints (punctiform, linear, planar joints) for crash simulation and also of the characterization tests and methods that are necessary for calibrating the model parameters. Also recommendation for validation tests and simulations of calibrated joint models are given. Examples of typical and used models are shown in all common crash codes.

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 modelling of joints including failure.

Course Contents

- Overview of modeling techniques for different joining techniques
- Tests and methods for characterization of joints
- Local loading conditions at joints during testing under shear, tension and bending load
- Characteristics of failure behavior
- Failure modeling of
  - Spot welded joints including spot welds in press hardened steels
  - Self-piercing riveted joints
  - Laser welded joints
  - Adhesive joints
- Calibration methods for determination of model parameters
- Validation of calibrated models through testing and simulation



Instructor

Dr.-Ing. Silke Sommer (Fraunhofer Institute for Mechanics of Materials IWM) studied Physics at the RWTH Aachen University and obtained her PhD degree at the Karlsruhe Institute of Technology about modeling of the deformation and failure behaviour of spot welds. She has been working at the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg since 2000 in the field of damage and failure modeling of materials and joints for crash simulation. Since 2013 she has been a group leader for joining and joints.

Facts

18.03.2026	155/4633	Alzenau	1 Day	890,- EUR till 18.02.2026, thereafter 1.090,- EUR	German
27.-28.10.2026	155/4707	Online	2 x 4 Hrs.	890,- EUR till 29.09.2026, thereafter 1.090,- EUR	English

Important Abbreviations

A

AAA	American / Australian Automobile Association
AAAM	Association for the Advancement of Automotive Medicine
AACN	Advanced Automatic Collision Notification
AAM	Alliance of Auto Manufacturers
aBAS	Advanced Brake Assist System
ACC	Adaptive Cruise Control
ACEA	Association of European Automobile Manufacturers
ACL	Anterior Cruciate Ligament
AC-MDB	Advanced Chinese Mobile Deformable Barrier
ACN	Automatic Collision Notification
ACSF	Automatically Commanded Steering Function
ACU	Airbag Control Unit
AD	Automated Driving
ADAC	Allgemeiner Deutscher Automobil Club (German Automobile Association)
ADAS	Advanced Driver Assistance Systems
ADB	Adaptive Driving Beam
ADL	Automatic Door Locking
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
AES	Autonomous Emergency Steering
AHB	Auto High Beam
AHOD	Average Height of Deformation
AHOF	Average Height of Force
AHR	Active Head Rest
AIS (1)	Abbreviated Injury Scale
AIS (2)	Automotive Industry Standards (India)
AISC	Automotive Industry Standards Committee
ANCAP	Australasian New Car Assessment Program
AOP	Adult Occupant Protection
APF	Abdominal Peak Force
APROSYS	Advanced PROtection SYStems
APSS	Active Pedestrian Safety System
ARAI	Automotive Research Association of India
ARV	Advanced Rear Visualization
ASB	Active Seat Belts
ASCC	Adaptive Speed Cruise Control
ASIC	Application-Specific Integrated Circuit
ASIL	Automotive Safety Integrity Level (Functional Safety)
ASIS	Advanced Side Impact System
ASL	Applicable Speed Limit
ASLD	Adjustable Speed Limitation Device
ATD	Anthropomorphic Test Device
AWC	Adverse Weather Conditions
AZT	Allianz Zentrum Technik

B

BAS	Brake Assist
BASt	Federal Highway and Transport Research Institute
BDA	Bonnet Deployment Actuator
BEV	Battery Electric Vehicle
BIS	Bureau of Indian Standards
BLE	Bonnet Leading Edge
BMDV	German Federal Ministry for Digital and Transport
BMS	Battery Management System
BoD	Board of Directors (Euro NCAP)
BOS	Beginning of Steer
BRIC	Brain Injury Criterion
BSD	Blind Spot Detection
BST	Blind Spot Technology
BSV	Blind Spot Visualization
BTA	Bumper Test Area

C

C-AHI	China Automotive Health Index
C-IASI	China Insurance Automotive Safety Index
C-ICAP	China Intelligent Connected Car Assessemnt Programme
C-NCAP	China New Car Assessment Programme
C2C	Car-to-Car
CA	Crash Avoidance
CAE	Computer Aided Engineering
CAN	Controller Area Network
CAT	Computer Aided Testing
CATARC	China Automotive Technology and Research Center
CCD	Charge Coupled Device
CCR	Car to Car-Rear
CDC	Collision Deformation Classification
CEA	Comité Européen des Assurances
CFD	Computational Fluid Dynamics
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
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)
COPD	Child Occupant Presence Detection
COS	Completion of Steer
CP	Contact Point
CPD	Child Presence Detection
CRABI	Child Restraint Airbag Interaction (Child Dummy)
CRS	Child Restraint System
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

DAM	Driver Attention Management
DAS	Data Acquisition System
DBS	Dynamic Brake Support
DCU	Domain Control Unit
DFM	Driver Fatique Management
DGPS	Differential Global Positioning System
DMS	Driver Monitoring System
DLO	Daylight Opening
DOW	Door Opening Warning
DPPS	Deployable Pedestrian Protection Systems
DSM	Driver State Monitoring
DT	Deployment Time

E

EAA	Euro NCAP Application Area
EBA	Emergency Brake Assist
EBA	Effective Braking & Avoidance (ASEAN NCAP)
EBD	Electronic Brake Force Distribution
EBT	Euro NCAP Bicyclist Target
ECE	Economic Commision for Europe (United Nations)
ECOSOC	United Nations Economic and Social Council
EDM	Engineering Data Management
EES	Energy Equivalent Speed
EEVC	European Enhanced Vehicle-Safety Committee
EIF	Entry Into Force
ELK	Emergency Lane Keeping

Important Abbreviations

ELSA	ELectric SAfety (UNECE/ WP.29 Working Group)
EMC	Electromagnetic Compatibility
EOU	Ease of Use
EPB	Electrical Protection Barrier
EPT	Euro NCAP Pedestrian Target
ERG	Emergency Response Guide
ES-2 re	Euro SID 2 Rib Extension
ESA	Emergency Steering Assist
ESC	Electronic Stability Control
ESS	Emergency Steering Support
ESV	Enhanced Experimental Vehicles Safety Program / Enhanced Safety of Vehicles Program
ETC	European Test Consortium
ETSC	European Transport Safety Council
Euro NCAP	European New Car Assessment Programme
EVPC	Electric Vehicles Post Crash
EVS	Electric Vehicle Safety
EVT	Euro NCAP Vehicle Target

F

FARS	Fatality Analysis Reporting System
FCEV	Fuel Cell Electric Vehicle
FCW	Forward Collision Warning
FCWS	Forward Collision Warning System
FEM	Finite Element Method
FFC	Femur Force Criterion
FIWG	Frontal Impact Working Group (Euro NCAP)
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
FRS	Fitment Rating System (ASEAN NCAP)
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 (WP.29 - General Safety Provisions)
GRSP	Groupe de Rapporteurs sur la Sécurité Passive (WP.29 - Passive Safety)
GSR	General Safety Regulation
GTR	Global Technical Regulation
GVM	Gross Vehicle Mass
GVT	Global Vehicle Target
GVWR	Gross Vehicle Weight Rating

H

HAD	Highly Automated Driving
HAV	Highly Automated Vehicle
HBM	Human Body Model
HGV	Heavy Goods Vehicle
HIC	Head Injury Criterion
HIT	Head Impact Time
HLDI	Highway Loss Data Institute
HLLC	High Level Liaison Committee
HMI	Human Machine Interface
HNI	Head Neck Impactor
HOF	Height of Force
HPC	Head Performance Criterion
HPM	H-Point Manikin
HPS	Head Protection System
HPT	Head Protection 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
ISLS	Intelligent Speed Limit System
ISM	Intelligent Speed Management
ISO	International Organization for Standardization
ISS	Injury Severity Score
ITC	Inland Transport Committee (UNECE)
IVISTA	Intelligent Vehicle Integrated Systems Test Area
IWVTA	International Whole Vehicle Type Approval

J

J-MLIT	Japan: Ministry of Land, Infrastructure and Transport
JA	Junction Assist
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
LSS	Lane Support System
LTR	Land Transport Rules (New Zeeland)

M

MAIS	Maximum AIS (Abbreviated Injury Scale)
MCB	Multi Collision Brake
MCL	Medial Collateral Ligament
MDB	Mobile Deformable Barrier
MoD	Motor own Damage (Insurance)
MOST	Media Oriented Systems Transport
MPDB	Moving Progressive Deformable Barrier
MRM	Minimum Risk Maneuver
MSA	Manual Speed Assist
MST	Motorcyclist Safety Technology
MTBI	Mild Traumatic Brain Injury
MVWG	Motor Vehicle Working Group (EU)

Important Abbreviations

N

NASS	National Automotive Sampling 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)
NIC	Neck Injury Criterion
NISS	New Injury Severity Score
NNT	Number Needed to Treat
NPACS	New Programme for the Assessment of Child-restraint Systems
NPRM	Notice of Proposed Rule Making (USA)
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
OMDB	Oblique Moving Deformable Barrier
OoP	Out of Position
OSM	Occupant Status Monitoring

P

PADI	Procedures for the Assembly Disassembly and Inspection
PAEB	Pedestrian Automatic Emergency Braking
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
PMA	Parking and Maneuvering Assistant
PMAPS	Pedal Misapplication Prevention System
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
PPA	Pedestrian Protection Airbag
PPAD	Partner Protection Assessment Deformation
PSPF	Pubic Symphysis Peak Force
PSS	Powered Standing Scooter
PSV	Passenger Service Vehicles
PTS	Poly Trauma Score
PTW	Powered Two Wheeler

R

Radar	Radio Detection and Ranging
RCAR	Research Council for Automobile Repairs
RCCA	Rear Cross Collision Avoidance System
RCTA	Rear Cross Traffic Alert
RFCRS	Rearward Facing Child Restraint System
RHD	Right Hand Drive
RID	Rear Impact Dummy
RR	Repeatability & Reproducibility
RVW	Relevant Vehicle Width

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
SD	Standard Deviation
SEAS	Secondary Energy Absorbing Structure
SgRP	Seating Reference Point
SID	Side Impact Dummy
SLD	Speed Limitation Device
SLIF	Speed Limit Information Function
SOB	Small Overlap Barrier (IIHS)
SRA	Swedish Road Administration
SRP	Seat Reference Point
SRS	Supplementary Restraint System
SSF	Static Stability Factor
SSR	Speed Sign Recognition
SSS	Side Support Systems
ST	Sensing Time
STNI	Soft Tissue Neck Injury
SUFEHM	Strasbourg University Finite Element Head Model
SUV	Sports Utility Vehicle
SWR	Strength-to-Weight Ratio (Roof Crush)

T

TNCAP	Taiwan New Car Assessment Programme
TA	Type Approval
TCMV	Technical Committee - Motor Vehicles (EU)
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
TIPT	Thorax Injury Prediction Tool
ToPI	Time of Pedestrian Identification
TOR	Takeover Request
TP	Thermal Propagation
TPL	Third Party Liability (Insurance)
TR	Thermal Runaway
TREAD	Transportation Recall, Enhancement, Accountability and Documentation
TRL	Transport Research Laboratory (UK)
TRT	Total Reaction/Response Time
TSP	Top Safety Pick (IIHS)
TSR	Traffic Sign Recognition
TT	Top Tether
TTB	Time to Brake
TTC	Time to Collision
TTD	Time to Decision
TTI	Thoracic Trauma Index
TTS	Time to Steer

U

U.S. NCAP	United States New Car Assessment Program
UBM	Upper Body Mass
UL	Upper Leg
UMTRI	University of Michigan Transportation Research Institute
UN	United Nations
USCAR	The United States Council for Automotive Research
UUT	Unit Under Test

V

VAN	Vehicle Area Network
VATS	Visual Attention Time Sharing
VC	Viscous Criterion
VDC	Vehicle Dynamics Control
VSA	Voluntary Safety Assessment
VR	Virtual Reality
VRTC	Vehicle Research & Test Center (NHTSA)
VRU	Vulnerable Road User
VSS	Vehicle Safety Score (U.S. NCAP)
VTA	Virtual Testing ADAS
VTC	Virtual Testing Crashworthiness

W

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

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