



**RCAR**

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# January NEWSLETTER

*From the Secretary General*



Hello RCAR members.

I am very pleased to see that we have contributions from 13 RCAR research centres to the January 2021 newsletter.

Despite many centres continuing to be at least partially closed over the past 12 months, with many staff working from home, the January 2021 newsletter includes a good mixture of articles on a wide range of technical topics that should be of great interest to RCAR members.

This month, it was my sad duty to pass on the news of the passing of former RCAR Secretary General (2000-2008) Michael Smith, after a long battle with Leukaemia. I passed on your many condolences to his wife Patricia.

As usual, my contact for any feedback or questions is [rmcdonald@rcar.org](mailto:rmcdonald@rcar.org)

Stay safe.

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## **Protection Potential of Vehicle Seats in Rear Impacts**

For many years now, Allianz Center for Technology (AZT), has been investigating the protection potential of vehicle seats in rear impacts. For this purpose, it has conducted and analysed RCAR standard crash tests alongside with car-to-car tests, in order to determine the physical effects on vehicle occupants with the aid of a BioRid II dummy placed on the driver's seat. It was examined whether and to what extent state-of-the-art vehicle structure elements play a role in the physical effects on vehicle occupants in rear-end collisions today. This investigation focused on the claim made by third parties that vehicle structures become stiffer over time for better self-protection in car-to-car collisions and thus lead to increased neck loadings for occupants in rear endings.

AZT's investigation into this topic is based on the assessment of 58 RCAR crash repair tests and 14 RCAR standard bumper tests performed from 2006 to 2019 as well as four car-to-car crash tests conducted with vehicles built in 2012 and known for increased stiffness of their crash management systems. The purpose of this investigation was to observe the influence of the maximum and mean vehicle acceleration, the impact-induced change of speed  $\Delta v$  and the vehicle model year on the data captured using the dummy. The observed change of speed ranged from 5 km/h to 12 km/h.

This allows

- to make general statements about the protection potential of vehicle seats
- to assess the behavior of individual seats in a range of impact-induced changes of speed, and
- to verify the findings from the standard crash tests regarding their limitations in relation to the non-deformable fixed barrier, using car-to-car crash tests as the basis.

The results show that there is not a higher risk of suffering a distortion of the cervical spine in a low severity rear impact in today's vehicles than was the case previously. On the contrary, the strict consumer protection criteria in the Euro NCAP are demonstrably reducing the physical loads on the cervical spine in volume car models.

The measured maximum acceleration values of the vehicles tested by the AZT have not increased in the RCAR standard crash tests. Therefore, contrary to what is frequently claimed, the vehicles are not being made increasingly more rigid in the bumper crossbeam or crash box areas. The individual and very brief acceleration peaks of the vehicle do not impact on the occupant.

It was found that the mean vehicle acceleration is not a reliable indicator for the physical effects on vehicle occupants at this g value. Still the impact-induced change of velocity is currently the most likely relevant, and also often the only determinable variable after a real world accident, for assessing the physical effects on the vehicle occupants.

The results have been published in a German trade journal for lawyers and experts and a translation was made available to the RCAR IIWPG working group.

See **Protection Potential of Vehicle Seats in Rear Impacts** published in VKU 05/2020 pg. 186-194 (part 1) & VKU06/2020 pg. 224-233 (part 2), <https://www.vkuonline.de/>

## **8th Allianz Motor Day: “Cyber Risks in the Connected Car Eco System”**

Hacker attacks on connected ecosystems are anything but an unrealistic possibility. “Alongside the logistics and energy sector, connected cars may become one of the main targets of IT crime,” said Klaus-Peter Röhler, a member of the Management Board of Allianz SE and CEO of Allianz Deutschland AG.

At the 8th edition of the Allianz Motor Day on September 22, 2020, experts from the automotive industry, science, public authorities and Allianz discussed cyber risks of connected vehicles.

Due to the current situation around COVID-19, the Allianz Motor Day was held for the first time as a Europe-wide digital press event and the expert panel was broadcasted via online stream. The audience consisting of international press and industry representatives followed the event digitally and there was the possibility to ask questions to the panelists via online form.

In the context of the event Allianz also published its positions on IT security in connected vehicles, which are summarised below:

- To confront cyberchallenges effectively, Allianz is calling for a European solution for a multi-industry Automotive Security Information Center. The center’s primary purpose would be to ensure by pooling of competencies that the mobility ecosystem is able to prepare for, and respond to, security threats, vulnerabilities and incidents, so that everyone involved can best manage their business risks and the risks to customers and third parties.
- Vehicle insurance will cover the consequences of accidents after hacker attacks. But if a vehicle malfunctions and an accident results, the car owner has a right to know whether that was the result of a hacker attack. In addition to the measures called for at the 7th Allianz Motor Day for using vehicle data to investigate accidents in connected and smart cars, future cyberattacks should also be recorded by an independent data trustee. Such records could be kept in compliance with the data protection laws without transmitting personal information. Recording cyberattacks could also serve to develop protective mechanism and avert future damage.
- Vehicle manufacturers are responsible for preventing hacker attacks on their digital platforms that communicate with the vehicle. It’s up to the vehicle manufacturers to ensure that vehicles, and especially their automated systems, work without disruption, and to cover the costs of remedying defects. But Allianz will provide benefits for the consequences of accidents, and also for mere disruptions of function in the event of attacks on an individual vehicle.

These positions and further details are included in an [Allianz press release](#). A short film to the event can be accessed via the following link: [https://www.youtube.com/watch?v=VWH\\_jweiNwU&feature=emb\\_logo](https://www.youtube.com/watch?v=VWH_jweiNwU&feature=emb_logo)



*Panel discussion at Allianz Motor Day in compliance with COVID-19 restrictions (left to right): Professor Dr. Rudi Hackenberg (OTH Regensburg), online participant Professor Dr. Christoph Krauss (Fraunhofer Institute for Secure Information Technology SIT), Fero Andersen (moderator of the event), Hans Adlkofer (Infineon) and Dr. Christoph Lauterwasser (Allianz Center for Technology)*



## **Influence of drying temperature on HVs and EVs in high tension batteries**

After repair, an electrified vehicle - electric or hybrid - can be painted, but the question remains as to whether high tension batteries should be dismantled before drying the vehicle in the booth.

Certain manufacturers indicate in the technical specifications of their electrified vehicles that the lithium-ion battery must be dismantled before going into the paintwork booth, along with high tension elements, to avoid deterioration. CESVIMAP, which has been analysing electric vehicles since 2011, presents various tests performed.



Dismounting a battery involves risks, such as damage to some element. The financial cost is also higher: specialised repair shop personnel are needed, with authorisation to work with electrical risk, and repair time increases.

CESVIMAP has established what temperature the battery modules reach during the drying process. After registering the battery temperature at its different stages of function - charging, driving and parked - this has been compared with the temperature in the paintwork booth - for diesel and with endothermic panels.

The temperatures reached by the batteries in certain parking situation outdoors, while driving or while charging, are much higher than those reached in the paintwork cabins.

CESVIMAP does not recommend dismantling the batteries for drying after repainting, as long as the temperature does not go above 60° C and the time does not exceed 60 minutes.

[www.revistacesvimap.com](http://www.revistacesvimap.com)

## **MAPFRE and CESVIMAP, committed to sustainability and the circular economy.**

MAPFRE, whose mission is in line with the principles of sustainability of the United Nations, is one of the 15 Spanish companies comprising the Dow Jones Sustainability Index. It is also the first insurance company and the first on the Ibex 35 to sign up to the Pact for a Circular Economy, driven by the Ministry for Ecological Transition and Demographic Challenge.

The goal of this agreement is to "*involve the main economic and social agents in Spain in the transition towards a new economic model*" related to the process of decarbonisation.

To join this initiative, MAPFRE has set 10 commitments, such as the reduction in use of non-renewable natural resources, the incorporation of ecological criteria in the development of its products and services, the promotion of innovation guidelines and the minimisation in waste generation, among others.



Therefore, CESVIMAP's mission is also to contribute, from a multidisciplinary approach, to palliating the effects of the automotive industry on society, proposing innovative solutions which will increase vehicle safety, efficiency in repair and the reduction of environmental effects deriving from the industry.

For over 37 years, CESVIMAP has been working to encourage vehicle body repair, instead of replacing components, training thousands of technicians in repair processes which they apply every day in their work. The bumpers repaired by MAPFRE collaborating repair shops in Spain mean a saving of more than 1200 tons per year in plastic production, equivalent to 278 million bottle tops recovered for recycling. It also advocates windscreen repair – making it unnecessary to produce glass to replace the windscreens - in a unique exercise of circular economy applied in its own business and not as a collateral activity.

This leads to the reduction of volumes of discarded parts, to reducing CO<sub>2</sub>, since new parts do not need to be transported, to reducing their packaging, etc. More employment is generated and of higher qualified personnel, investing time and effort in training technicians in novel repair methods.

CESVIMAP studies new mobility forms: the connected, autonomous shared and electric car. Since 2004, It has shown its preference for online training; in this way, CESVIMAP has saved its students from having to travel to attend in-person courses at CESVIMAP (around 13,000 online students, between 2004 and 2019, would have circled the world more than 130 times). And by means of the treatment of end-of-life vehicles carried out at CesviRecambios, the CESVIMAP Authorised End-of-Life Treatment Centre, the environmental impact of MAPFRE total write-off vehicles is neutralised, offering a second life for their parts, with guarantee. MAPFRE has published this video, about sustainability and circular economy <https://youtu.be/UYaC5KXFLrc>

### **24<sup>th</sup> CESVIMAP University Course in Appraisal**

The CESVIMAP Chair at the *Universidad Católica de Ávila*, in conjunction with APCAS, the *Asociación de Peritos de España* (Spanish Association of Appraisers), has presented its 24<sup>th</sup> Higher University Course in Automotive Appraisal.

This training course will take place from February to September 2021. Direct employment rate after the training is 48%, and this year's course includes the new "you choose!" option: 100% on-line training, or 80% on-line training + 20% in-person.

Appraisal bureaux, insurance companies and repair shops need to have an automobile appraiser or a receptionist with capacity to carry out delegated valuations. These professionals have to have mastery of the methodology of appraisals, computerised valuation systems, the preparation of appraisal reports, repair techniques and methods for vehicles and other damage which may arise in an accident: pre-tensioners, airbags, fires, and so on.

The CESVIMAP Higher University Course in Automotive Appraisal provides, with no need for prior specific qualifications, the technical and theoretical valuation methods.

*As a former course graduate states "CESVIMAP training brings together the need for qualification with the theoretical and practical content called for nowadays: learning alongside repair shop, dealership and engineering staff is enormously valuable. The wide range of experts involved in delivering the training implies we have practical sessions with the different points of view of the people involved in an appraisal, which gives us a head start and prepares us for the reality of our working sphere".*





## Cesvi México improves its VINPlus application

- Reduces typing errors

To optimize registration times and avoid capture errors, Cesvi México's Vehicle Identification team has developed the version for mobile devices of its automotive identification platform, VINPlus.

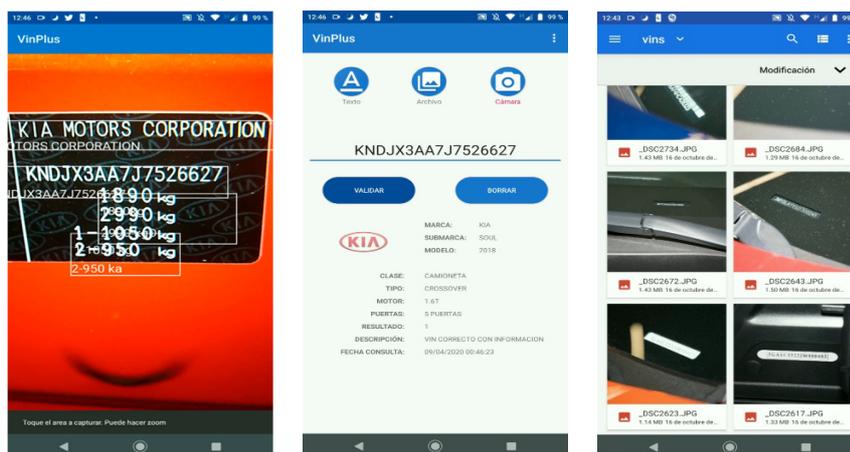
One of the improvements that the application has on the web platform is the ability to capture the VIN series using the device's camera and the text recognition that the smartphone or tablet operating system has. With this technology, human error is reduced.

"Over the years, we have been realizing that users made mistakes with some frequency when entering the characters of the VIN, so it was very frequent that we received calls for help to validate the information. Once the team received the report, the capture was compared with a legal document and we noticed that the user had misspelled, had changed a character, or had read a number for a letter or vice versa; so we set about finding a simple, inexpensive and easy-to-implement solution. Which we obtained with the image recognition technology that today is increasingly familiar to us", explained Osiel Velázquez, Director of Operations for Cesvi México.



With images from a VIN sticker or the car registration, the VINPlus App can read the 17 characters of the identification series. By innovating with text recognition technologies through images, the work of VINPlus users is easier than ever.

The VINPlus application is available in the Google PlayStore. However, only paid subscribers have access to all the features of the VINPlus system.



## **Cesvi trains nearly a thousand delivery drivers**

Cesvi México gave a master training program to delivery truck drivers and instructors from the largest Coca-Cola bottling company in the country, on preventive management and didactic techniques.

The training period lasted five months, beginning on August 3 and ending on December 28, equivalent to more than 4,000 hours of theoretical-practical training.



Two types of services were provided, certifications and change agents. The certification consisted of 4 processes: initial theoretical exam, final theoretical exam, practice in the yard, and road evaluation.

As for “Change Agents”, they participated in the Certification process and received an additional instructor training session. Regarding the instructors, the staff was made up of 24 instructors, 17 belonging to Cesvi plus 7 temporary ones due to the size of the project.

Oscar Enriquez, Coordinator of the Training Program said: “training about a thousand people without affecting the logistics operation of the bottler was a challenge, we had weeks in which we taught up to 17 courses simultaneously in several cities of the Mexican Republic. In addition, the situation of the pandemic led us to be even more rigorous in the organization of the courses, since they were all in person at each of the 17 centers in the center and south of the country ”.

Fortunately, Enriquez explained, “the Program was developed successfully and the goals established with the Bottler and in parallel with the Company that owns the brand were achieved. For 2021, the negotiations and the evaluation of the results continue their course to extend the training service for another year ”.



## Cesvi México engineers analyze two electric motorcycles

Since 2004, the vehicle fleet of motorcycles in Mexico has been increasing considerably. This is because the roads in large cities and their metropolitan areas have become congested, in addition to the fact that delivery and delivery services have increased the demand for such vehicles.

As explained, in just 16 years, with some 300,000 units, the latest census indicates that more than 3 million motorcycles circulate in Mexico, although it was until a couple of years ago that electric options have been a real option in the market.



Aware of this situation, Cesvi México analyzed two motorcycles with this propulsion system: the Super Soco TS, designed by Vmoto Australia Pty Ltd., and the NUUV scooter, manufactured by Niu, the fastest growing Chinese company of intelligent motorcycles in Asia and Europe.

In the studies of both vehicles, the protocol established by Cesvi México was followed and it was discovered that electric motorcycles in their structure are practically identical to those powered by gasoline engines.

One of the basic components of this type of vehicle is the battery that has an approximate life of 2500 charge cycles, which could be estimated at 7 years of useful life time considering constant use.

To handle the batteries, basic electrical protection is required and all the recommendations indicated by the manufacturer are followed to avoid damage to people and the vehicle.

It was identified that the electric motorcycles analyzed require less maintenance, since they have fewer moving parts and if the maintenance of this type of vehicle is carried out on time, the maintenance costs are lower than those required by a vehicle of this type powered by an internal combustion engine.

Finally, it should be said that motorcycle rental companies in Mexico City prefer this type of vehicle on their platforms.



**CENTRO ZARAGOZA analyzes the influence of battery degradation and cells arrangement in a fire of an electric vehicle.**

Due to their high energy density and excellent working performance, lithium ion batteries are widely used in most portable electrical and energy storage devices. However, the safety of fire batteries remains a major concern. In the past 30 years there have been numerous fire accidents involving lithium ion batteries, including recent fire accidents in vehicles, some of them while driving and others during the battery charging and discharging process.

In general, lithium ion batteries will become more vulnerable if they subjected to high temperatures, electrical failure, or mechanical impact. In order to characterise the behavior of cells in a fire, Centro Zaragoza is conducting controlled fire tests: on a complete electric vehicle with the high voltage battery installed, and scale tests with different batteries and different arrangement of their cells. It is expected to achieve a methodology for testing and analyzing how the arrangement of the cells and their state of charge could influence, on the one hand, the evolution of a potential fire, due to an accident or failure and, on the other hand, the High Voltage battery degradation. On the way in which a battery dissipates heat will also be analyzed, based on the number and arrangement of its cells. This study also intends to establish which cell arrangement and which location of the battery pack is safer.



Fig. 1.- Fire blanket to extinguish fire on the tested electric vehicle.

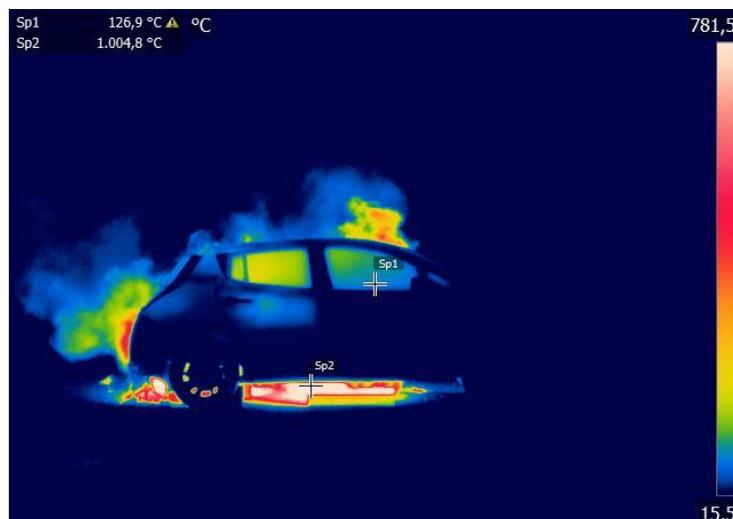


Fig. 2.- Temperature monitoring during the test.

A controlled fire test on a complete electric vehicle has already been carried out, in which the evolution of the temperature and the behavior of the battery have been analyzed. The fire was started with the positioning of a fuel burner at the bottom of the vehicle battery. Time from the start of the test and the temperature of the battery were monitored, with the help of a thermal camera. The fire was put out with a fire blanket. After the explosions stopped, and when it was confirmed that the temperature has dropped, the fire blanket was removed. After a small period of time, the battery temperature rose again and the fire restarted. The vehicle was covered again and the same process was performed, monitoring the temperature evolution over time. Once the test was successfully finished, and after a quarantine period, the cells were dismantled to see how they had behaved and their state depending on their position. It was also analyzed how the battery case had been deteriorated, the position of each cell within the battery case and the type of deformation that each cell had suffered.



*Fig. 3. - Battery disassembly process after the test.*

The next step will be to carry out controlled scale fire tests with different cells arrangement, to see how the evolution of the fire and the temperature gradient that it experiences could influence. In these tests the cells will be instrumented in such a way that maximum information of the behavior of the cells could be obtained, using thermocouples and strain gauges with measurement capacity above 1000°C.

## **Study shows front crash prevention works for large trucks too**



Equipping large trucks with forward collision warning and automatic emergency braking (AEB) systems could eliminate more than 2 out of 5 crashes in which a large truck rear-ends another vehicle, a new study from the Insurance Institute for Highway Safety (IIHS) suggests.

IIHS Director of Statistical Services Eric Teoh examined data on crashes per vehicle mile traveled from 62 carriers operating tractor-trailers and other trucks weighing at least 33,000 pounds. He found that trucks equipped with forward collision warning had 22 percent

fewer crashes and trucks with AEB had 12 percent fewer crashes than those without either technology. Forward collision warning and AEB reduced rear-end crashes — the specific type of collision they’re designed to prevent — by 44 and 41 percent, respectively.

Teoh’s study covered some 2,000 crashes that occurred over more than 2 billion vehicle miles traveled during 2017-19. The analysis excluded incidents that weren’t serious enough to result in injury or significant property damage.

Teoh compared trucks from the same carriers that were equipped with forward collision warning alone, AEB, and no front crash prevention at all. AEB systems generally include forward collision warning too.

The study drew on data compiled by SmartDrive Systems, a video-based safety program for commercial fleets.

“The potential benefits are great enough that these crash avoidance systems should be standard equipment on all new large trucks,” says IIHS President David Harkey.

For more information, visit <https://www.iihs.org/news>.

## **Drivers let their focus slip as they get used to partial automation**

Drivers fidget with electronics and take both hands off the wheel more often as they develop trust in automated systems, new research from IIHS and the Massachusetts Institute of Technology’s AgeLab shows.

To investigate how experience with automation affects driver disengagement, the researchers studied the driving behavior of 20 Massachusetts-based volunteers over a month’s time as they gained familiarity with advanced driver assistance features, examining how often they removed both hands from the steering wheel or took their attention away from the road to do things like use their cell phone or adjust the controls on the vehicle’s console.

One group of 10 drove a Land Rover Range Rover Evoque equipped with adaptive cruise control (ACC). Another 10 drove a Volvo S90 with both ACC and Pilot Assist, a partially automated (Level 2) system that combines ACC with lane-centering technology that keeps the vehicle positioned laterally in the travel lane.



When the drivers first received the vehicles, there was little or no difference in how frequently they showed signs of disengagement, whether they were driving manually, using ACC or using Pilot Assist. After a month, however, they were substantially more likely to let their focus slip or take their hands off the wheel when using automation, and the impact of Volvo's Level 2 system was more dramatic than that of ACC alone, says IIHS Senior Research Scientist Ian Reagan, the lead author of the study.

"Drivers were more than twice as likely to show signs of disengagement after a month of using Pilot Assist compared with the beginning of the study," Reagan says. "Compared with driving manually, they were more than 12 times as likely to take both hands off the wheel after they'd gotten used to how the lane centering worked."

Pilot Assist and similar systems like Tesla's Autopilot, Cadillac's Super Cruise and Mercedes-Benz's Intelligent Drive are not designed to replace the driver. They have trouble negotiating many common road features, so the driver must be in control at all times. However, with the automation managing steering and speed — quite well in some cases — it's easy for the driver to lose focus.

"This study supports our call for more robust ways of ensuring the driver is looking at the road and ready to take the wheel when using Level 2 systems," says Reagan. "It shows some drivers may be getting lulled into a false sense of security over time."

For more information, visit <https://www.iihs.org/news>.

### **IIHS award criteria push manufacturers to scrap inferior headlights**

At least 10 manufacturers have improved their 2021 headlight offerings by eliminating or modifying inferior choices.

The IIHS *TOP SAFETY PICK+* award is driving the improvements. Beginning in 2020, vehicles have only been able to qualify for the higher of the Institute's two awards if they come equipped with good or acceptable headlights across all trims. The new headlight requirement will remain in place for the 2021 awards.

Many 2020 models fell short of the Institute's highest award as a result of the new headlight requirement. But manufacturers have reacted swiftly. In many cases, they simply stopped offering the systems that didn't perform well enough in IIHS tests.

For model year 2020, 85 out of 185 models tested could be purchased with good-rated headlights. In eight of those models, the good headlights were standard. A total of 42 model year 2020 vehicles came exclusively with good- or acceptable-rated headlights.

Model year 2021 appears slated for further improvement.

So far, manufacturers have boosted 10 models to *TOP SAFETY PICK+* from *TOP SAFETY PICK* by eliminating or changing poor or marginal headlight packages. These include the Audi A7, Honda Accord, Hyundai Palisade, Mazda CX-30, Nissan Altima, Subaru Ascent, Toyota Highlander, Volvo S60, Volvo XC40 and Volvo XC60.

The 2021 Honda Odyssey also earns a *TOP SAFETY PICK+* award after Honda eliminated the inferior headlight options available on the previous year's model.

Automakers also improved the headlights on four more vehicles that had earned *TOP SAFETY PICK+* awards for their 2020 models — the Acura RDX, Subaru Forester, Subaru Legacy and Subaru Outback. Previously, these vehicles were available with different headlights that earned both good and acceptable ratings. For 2021, good-rated headlights are standard.

For more information, visit <https://www.iihs.org/news>.



## **Dialogue with Automakers**

Last November, JKC hosted the annual meeting called “D & R Dialogue” inviting engineers and service & repair staffs from Japanese automakers, and discussed the notable points of collision repair processes of latest models. Here, we would like to introduce some of the features of this meeting.

Every year, JKC purchases newly introduced car models and conduct crash tests at our facility to study reasonable and efficient repair methods for car users and auto insurance companies.

We normally discuss our test results with automakers at our facility. In 2020, we purchased and tested six new models.

Due to Covid-2019, however, the November meeting was held virtually replacing previous face-to-face format.

Although the participants from automakers could not actually observe the damaged models at our testing facility, they welcomed this online format because they were able not only to reduce the risk of Covid-19 infection but also to save the precious time and use it for other productive purposes.

Two major topics were discussed at this meeting. The first topic was the contents of the repair manuals for the new car models. New car model tends to require special repair method due to its new body design and mechanical structure. The second topic was the body design and structure of component parts. As we mentioned in the latest RCAR newsletter, the costs of assembly parts of new models, such as head lamps and sensors for advanced electric devices, are becoming very expensive and average repair costs are becoming much higher than before.

Automakers have welcomed our suggestions, such as not only supplying the expensive parts in an assembly but also providing smaller pieces so that only the specified parts can be replaced without incurring extra costs for purchasing the undamaged ones.

Through our discussions, we were able to gain useful information on various matters and it was a great opportunity for both automakers and JKC to discuss the important common issue of “Improving the damageability and reparability of passenger cars.”

We are sure that this meeting would lead to beneficial results for car users and auto insurers.



## **“Hybrid model” of JKC Training**

JKC has been a provider of on-site training programs for the participants, such as insurance adjusters, claims representatives and lawyers, who come to our facility with overnight stays. Unfortunately, however, we had to halt providing all training programs from April through October of 2020 due to Covid-19. In November 2020, however, we started so-called “Hybrid model” of training as a counter-measure against the current difficult situation and we would like to introduce its overview in this article.

“Hybrid model” is a type of training program with a mix of online and face-to-face instruction.

Originally, JKC training programs provided the participants with on-site experience, from which they could learn many things from checking the damaged cars, observing actual car repairs and crash-tests. In order to reduce the risk of COVID-19 infection and to enjoy the merits of on-site training, we started this hybrid training program.

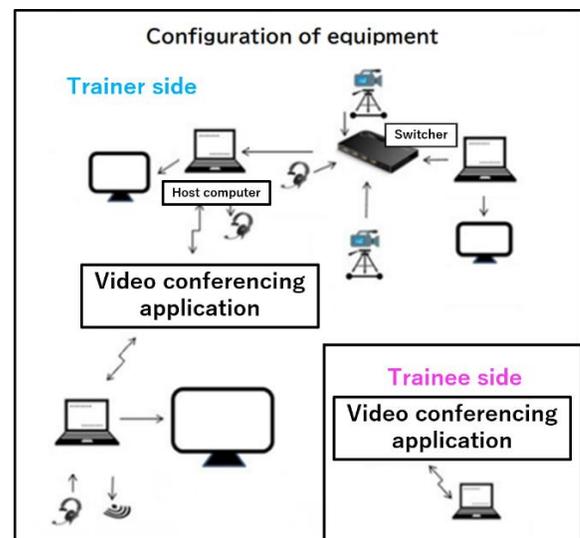
In this program, trainees are firstly required to take online classes at their homes or offices on Thursday and Friday. Then they will come to the JKC facility to take on-site classes on Monday through Wednesday and stay at a nearby hotel that provides high standards of hygiene, sanitization and cleaning procedures.

JKC has taken preventive measures to reduce the risk of spreading Covid-19, such as installing clear plastic barriers between each trainee, preparing hand sanitizers in every classroom, and supplying face shields so that all attendees can wear in addition to masks.

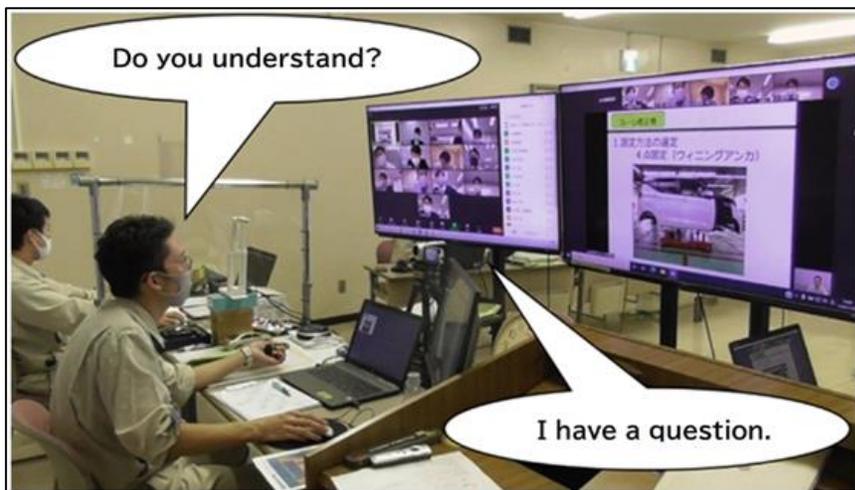
To avoid infection between trainees and JKC employees, we separated their activity areas and requested all trainees to take and report their body temperatures every morning.

We were also faced with many challenges in conducting remote classes and retained video & sound experts for professional advice, such as implementing effective and user-friendly interface for question & answer sessions and observing various online materials.

The image below shows the configuration of equipment used for our remote classes.



We have been receiving many positive and favorable responses from the trainees who attended the hybrid training programs. We feel that hybrid model will remain to be an effective training method even in a post-coronavirus world and we are planning to increase the number of training programs using this model.



## Test of different systems for static calibration of driver assistance systems

Currently, a market penetration of all vehicle classes with environment monitoring advanced driver assistance systems (ADAS) can be observed. According to the DAT report every 6th car is equipped with a radar-based ADAS and every 5th car with a camera-based ADAS. One consequence is that after damage or repair of a component equipped with ADAS sensors (e.g. windshield), the calibration of the affected advanced driver assistance system is usually unavoidable. Against this background, the Institute of Automotive Engineering (KTI) has taken a closer look at systems from various manufacturers for the static calibration of driver assistance systems. It became clear that, in addition to a suitable calibration tool, the procedure of calibration according to manufacturer specifications as well as a qualified measurement environment are of great importance.

The application tests of the calibration systems were performed as standard on a VW Tiguan 2.0 TDI 4Motion (type AD1; 140 kW) from model year 2019. On this vehicle, the test included calibration of the multifunction camera on the windshield as well as the front radar in the radiator grille (Figure 1). Both brand and multi-brand solutions were tested (Figure 2).

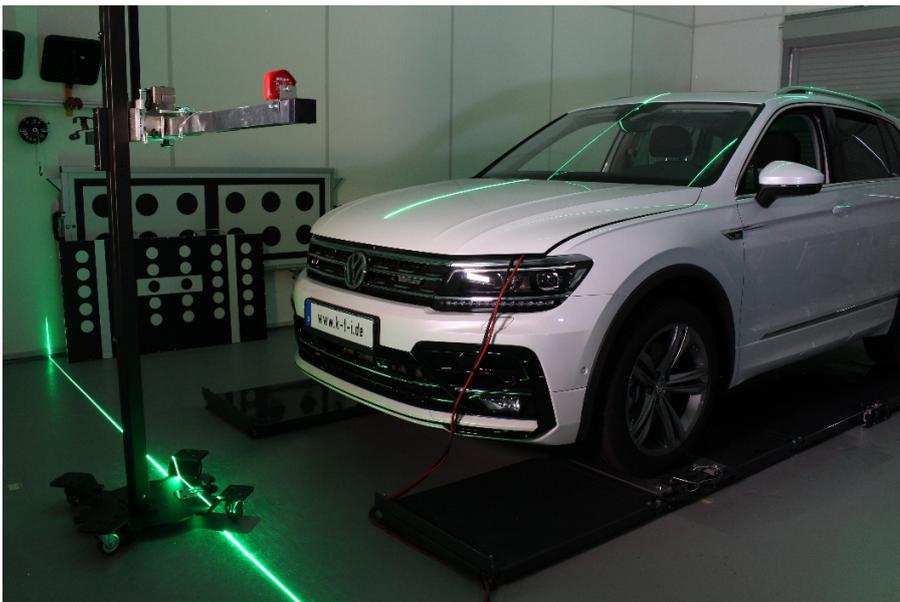


Fig. 1. Calibration tool test on a VW Tiguan 2.0 TDI model year 2019

### Start-up

Before the calibration tools are put into operation, some conditions must be observed. The manufacturers of the devices make various requirements on flatness and inclination of the measuring place. In addition, it must be large enough, the lighting conditions should not have a negative influence on the calibration process and the difference in height between the vehicle footprint and the floor level must be compensated.

Depending on the manufacturer's specifications, the ADAS are oriented to the symmetry axis of the body or to the geometric drive axis of the vehicle.

In the first case it is absolutely necessary to measure and adjust the suspension geometry, in the wheel run out compensation specified by the manufacturer must be carried out when aligning with the geometrical axis of vehicle (e.g. Volkswagen). Nevertheless, the information on this from the calibration system is often missing in the corresponding place.

### **Conspicuities in the test**

During the tests it became clear that the software navigation through the calibration process or the stored guidelines for the brand-specific tools mostly correspond to the manufacturer's specifications. This is usually not the case with multi-brand solutions. In addition, due to possible secured diagnostic interfaces (keyword: "security gateway"), it must be ensured that the universal devices offer the possibility of authentication with the OEM.

Two calibration systems stood out with special functions during the test series. One manufacturer relies on a dual-camera system for the alignment and distance measurement of the tool in contrast to the usual measuring tapes or lasers. Another manufacturer displays the targets digitally on a 65" flat screen TV. On the one hand, this solution provides the advantage of not having to purchase and store a large number of OEM-specific target boards, and on the other hand, distortion of the digital representation can compensate a not exactly parallel alignment of the calibration tool. Furthermore, differences in handling, speed and quality of the calibration tools could be noticed. Also the compatibility with other devices, especially diagnostic devices and wheel aligner was questioned. However, it was found out that this is usually not the given case.

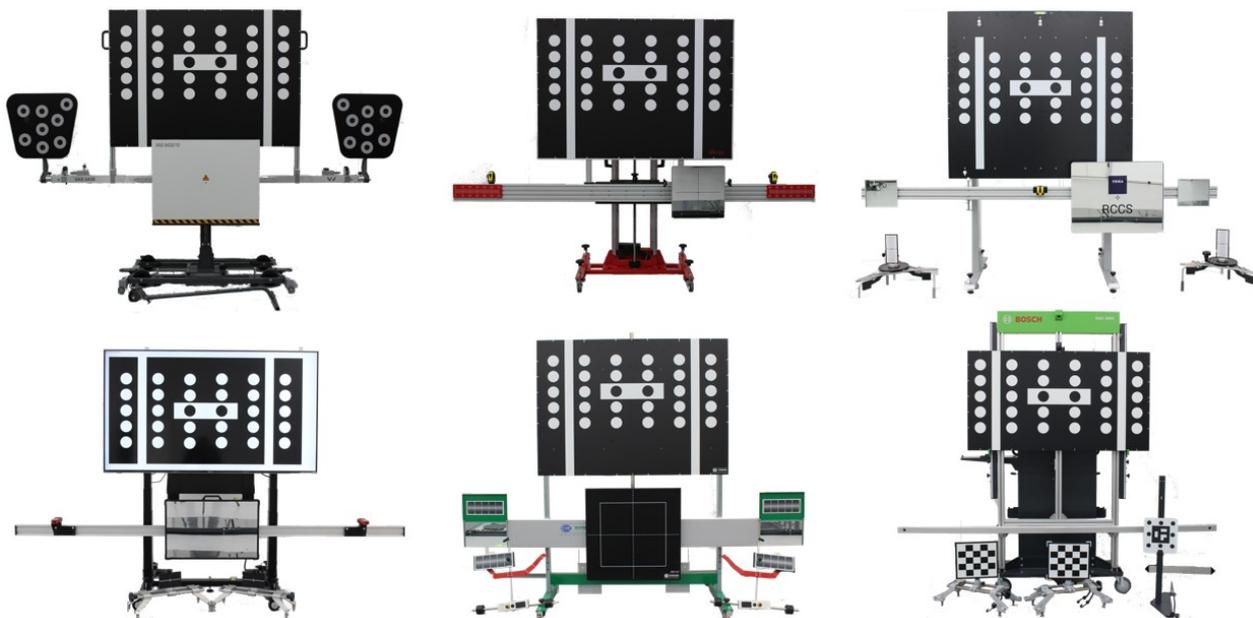


Fig. 2. Selection of tested calibration tools

### **Conclusion and outlook**

With all tested systems the calibration can be carried out professionally, if the manufacturer's specifications are taken into account. The usability during start-up and application turned out differently. Possible weaknesses or disadvantages of the calibration systems were discussed with the respective manufacturers with the result that some have optimized their tools in the meantime or have announced further improvements.

The accuracy of the calibration tools as well as the function of the calibrated driver assistance systems were not determined and considered in the conducted tests. In a planned further series of tests these aspects will also be included and evaluated.

### **Contact**

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34253 Lohfelden

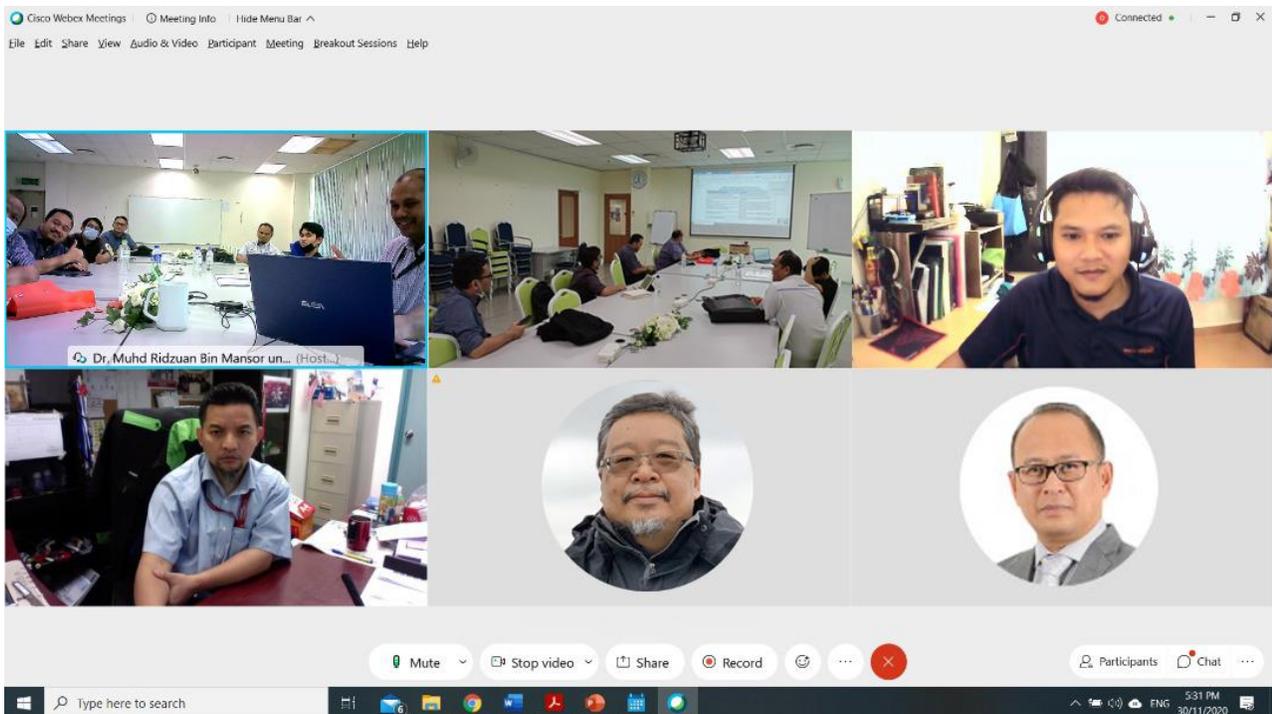
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## **MRC Malaysia continues Collaborative Research in ANCHOR III project with ASEAN NCAP and ASEAN universities**

After the successful collaboration in the ASEAN NCAP Collaborative Holistic Research (ANCHOR II) projects in 2019/2020, MRC Malaysia's research team continues to participate in ANCHOR III 2020/2021 projects. The MRC team, represented by Head of Research, Hairul Abdul Majid and Research Analyst, Akmal Hakeem Maamor, has continued the collaboration with Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka (*UTeM*) and Faculty of Engineering Technology, Universiti Malaysia Pahang (*UMP*).

Three new proposals have been submitted to SAE Malaysia, the secretariat on behalf of ASEAN NCAP on April 2020. The proposals were also presented and defended to the secretariat via video conference in June 2020. All proposals has been accepted and awarded in August 2020 followed by the ANCHOR III official kick-off meetings. These proposals will help to enhance MRC's image and increase credibility and institution of know-how.

The project title for the collaboration with Universiti Teknikal Malaysia Melaka is *"Experimental Evaluation on Autonomous Emergency Braking (AEB) System for ASEAN Passenger Vehicles subjected to Varying Environment Conditions"*.



*Virtual online kick-off meetings of ANCHOR III project with ASEAN NCAP and researchers from Universiti Teknikal Malaysia Melaka on November 30, 2020*

The objective of the project is to systematically evaluate AEB performance for ASEAN passenger vehicles subjected to varying environment conditions through experimental method (on road test) according to EuroNCAP AEB car to car test protocol v 3.0.2 2019 and to compare the AEB system performance for two types of car models sold in ASEAN, representing passenger vehicle with low cost AEB version, and high end passenger vehicle with AEB

Meanwhile, the project titles for collaboration with Universiti Malaysia Pahang and together with Faculty of Engineering, Universitas Andalas, Indonesia are “*Pattern of Occupant Injury and Vehicle Impact in Real Frontal Crashes*” and “*Rear Impact Crash Characteristics in ASEAN Countries*”.



*Kick-off meetings of ANCHOR III projects with researchers from Universiti Malaysia Pahang and Universitas Andalas, Indonesia on August 19, 2020*

The objectives of these projects are to determine the distribution of occupant injury categories based on police reported frontal and rear crashes and the distribution of damaged claims based on frontal and rear crash configuration. Also, to compare the distribution of occupant injury and damaged claims among the frontal and rear crash configuration.

**ALKS**

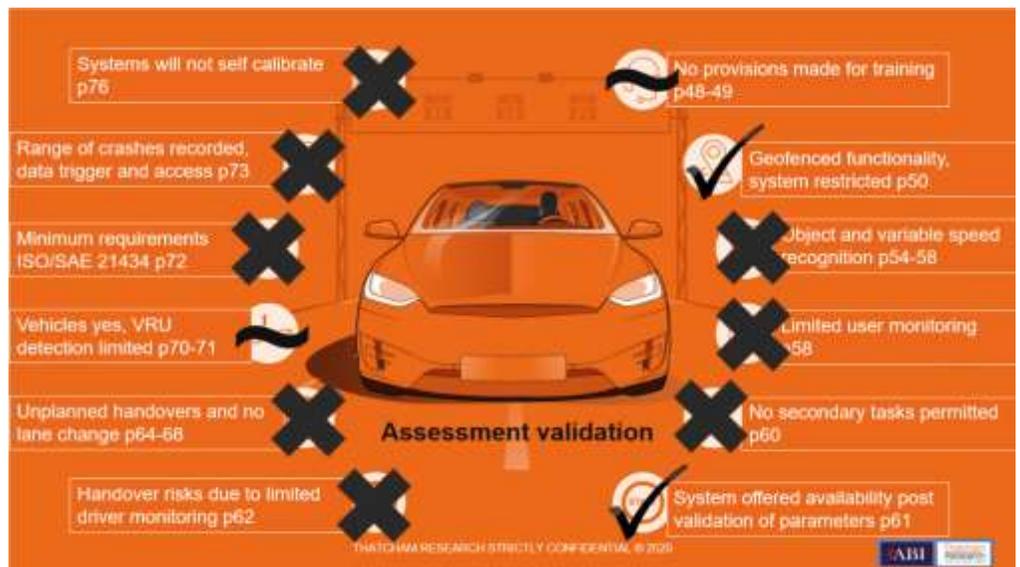
Automated Driving is a key part of the Global Transport Strategy, instrumental in reducing emissions, congestion and road casualties. The first iteration of Automated Driving (SAE Level 3 is Automated Lane Keeping Systems (ALKS) which was approved at the UNECE in June 2020. ALKS controls the lateral and longitudinal movement of the vehicle for extended periods without further driver command, a system whereby automation is in primary control of the vehicle and becomes the first regulated automated driving function globally.



ALKS is designed to operate only on divided highways under certain conditions at speeds of up to 60 km/h. However, suggested amendments at the UN are already proposing 130 km/h running. These systems also only allow the car to be guided in-lane and cannot automatically steer out of lane. ALKS allows the driver to undertake secondary tasks through the on-board infotainment system. E.g. emails or movies.

The UK Government issued a recent consultation to understand safety and liability concerns, although they have made clear that they intend to allow ALKS on UK roads as early as April 2021. Whilst a minor technological change from today's Assisted Driving systems ALKS represents a huge change for UK Insurers as liability shifts from the driver to the car.

There are also safety concerns and whilst these systems will undoubtedly have state-of-the-art collision avoidance systems, they may not be capable of undertaking all the functions of a competent human driver - potentially creating new collisions. Should ALKS be regarded as Automated or just another step in the Assisted Driving Journey? The UK Insurers' minimum requirements for safe automation have been set out in the document



“Safe Automated Driving” which highlights 12 key criteria for safe adoption. At the minimum standard, ALKS only fully meets 2 of these 12 criteria. Therefore the UK insurers do not regard ALKS as Automated.

Finally, there are issues around consumer acceptance. Thattham has undertaken customer surveys regarding their expectations for automated driving. The two key advantages of automation are seen as allowing sleep and the use of mobile phones. Neither of these will be allowed with ALKS and driver monitoring systems will be mandated that control this behaviour.

## **New Ratings Driving Van Safety**

Vans cause more fatal injuries to road users per mile travelled than any other type of vehicle on the UK's roads\*. With the surge in demand for home delivery (especially since COVID!) coupled with legislative changes favouring van rather than small truck operations, there are more vans on the roads than ever before. However in 2019 only 13% of new vans were fitted with Autonomous Emergency Braking (AEB) technology as standard in the UK, compared to 62% of new cars.



*Van Safety in Focus*

\* 'What kills most on the roads' – PACTS, November 2020

## **Vans Fall Between Regulation and Rating**

The Euro NCAP five-star safety rating has massively accelerated fitment of ADAS on passenger cars, and in Europe ADAS is mandated on trucks by regulation. However, vans fall between with neither consumer pressure nor regulation driving fitment. Van procurement is a commercially driven decision dominated by upfront cost of ownership, so they are built to a price, hence technology adoption is limited.

Thatcham Research engaged initially with Highways England (the body responsible for operating the trunk road network) to develop the concept of an ADAS focused van safety rating scheme to help protect other road users as well as van occupants. Euro NCAP adopted the concept and initiated a commercial vehicle working group, the first output being van safety ratings published in December 2020. Tests are based on those used for assessing passenger car ADAS, albeit modified to encompass typical van operation. Results will be updated annually to reflect manufacturer developments.



*Nineteen Vans tested and Rated*

## **Failing to Deliver Safety**

Of the nineteen vans tested (representing 98% of new van sales in 2019), only the Volkswagen Crafter, Mercedes-Benz Vito and Ford Transit were awarded a 'gold' rating, five achieved 'silver' and six 'bronze'. Five others emerged with a disappointing 'not recommended' rating, highlighting the glaring disparity between the levels of collision avoidance technology fitted on vans and modern cars. It is apparent that brands are making a clear decision not to fit these important technologies as standard and van operators are not buying it as a cost option either.

Longer term, the vision is a commercial vehicle safety roadmap to influence manufacturers and operators alike. It will demand standard fit collision avoidance technology on all new vehicles, to protect all road users, just like we have for cars.

For further information see:

- Thatcham Research launch video <https://www.youtube.com/watch?v=BOvNuXgL9mQ&t=6s>
- Euro NCAP van safety ratings <https://www.euroncap.com/en/vehicle-safety/safety-campaigns/2021-commercial-van-safety/>

## COMMERCIAL VAN SAFETY RATING 2020

MAKE & MODEL	TOTAL PERCENTAGE %	RATING	
Volkswagen Transporter T6.1	65%	 <b>COMMERCIAL VAN SAFETY</b>	
Ford Transit 2T	63%		
Mercedes-Benz Vito	61%		
Ford Transit Custom	58%	 <b>COMMERCIAL VAN SAFETY</b>	
Mercedes-Benz Sprinter	52%		
Volkswagen Crafter	44%		
Peugeot Expert	44%	 <b>COMMERCIAL VAN SAFETY</b>	
Vauxhall Vivaro	42%		
Citroën Dispatch	37%		
Toyota ProAce	35%		
Peugeot Boxer	33%		
Citroën Relay	32%		
Iveco Daily	30%		
FIAT Ducato	28%		
Renault Master	16%		Not Recommended
Nissan NV400	12%		Not Recommended
Renault Trafic	11%	Not Recommended	
Vauxhall Movano	7%	Not Recommended	
FIAT Talento	5%	Not Recommended	

## Impact of Electrification and CAV Risk

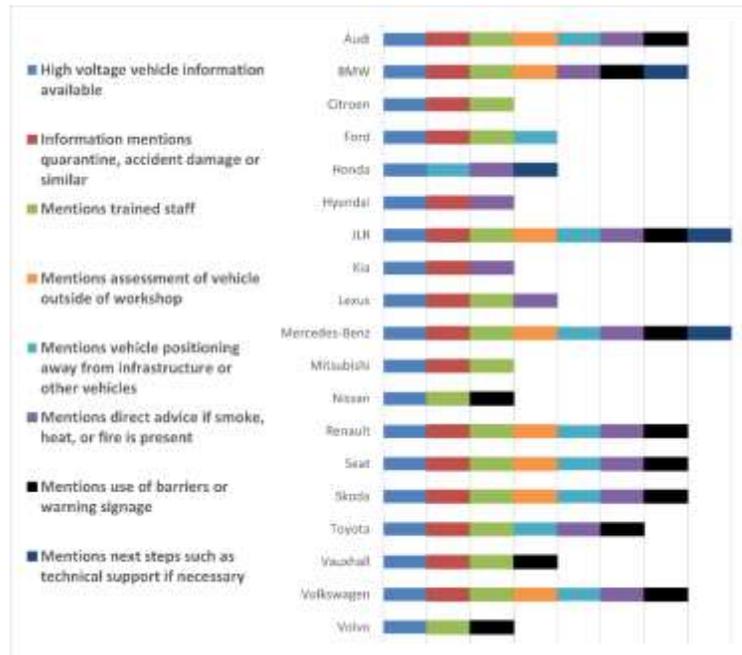
The two major changes causing concern to Thatcham Research's member organisations are the rapid uptake of Battery Electric Vehicles (BEV) and the acceleration of adoption of Connected and Autonomous Vehicles (CAV).

Having spent the last two years looking into industry safety and providing identification guidance, our focus has moved to quantification of insurability principles and associated differential risks of BEVs. Risks have been categorised into three main groups; Handling and Management in Repair; BEV Repair; Damageability.

Quarantine has been our latest research topic and had resulted in variable picture of the availability and quality of Vehicle Manufacturer information around making rapid and safe decisions post-accident.

Our methodology has evolved to:

- identify data collection points and associated differential risk score to enable better decision making information for our members' underwriting and pricing teams
- establish principles of insurability and each VM position against those principles will enable a more direct conversation with the VMs about improvements in both their information provision but also how to optimise their vehicle insurability for each topic.



*Differential analysis of available key information on safe vehicle quarantine*

Connected & Automated Vehicles (CAV) are part of the internet-of-things (IoT) and as such are at greater risk from cyber-attacks than air-gapped vehicles. Understanding and responding to the new nature, scope and scale of CAV risk and loss is crucial to the motor insurance industry. Thatcham Research are conducting a study into the safety and security aspects of Connected and Automated Vehicles (CAV). We will be examining areas such as:

- The risk landscape (vehicles, manufacturers, and 3rd party infrastructure) providing risk visibility, assessment & control beyond existing motor insurance frameworks.
- Impact (Control of vehicle, Bodily injury, 3rd party damage, nuisance and distractions and loss of personal data)
- Typical Scenarios members may be faced with
- Managing claims information such as the scale and complexity of attacks, and identification of cyber-attacks
- How Industry and regulations are preparing

The aim of the project is to provide the insurer's position on CAV risk by supporting members with:

- Policy wording and coverage
- Assessments of risk around vehicles, vehicle manufacturers and 3rd parties
- Managing claims through a mechanism to identify and process cyber claims



## Costs and replacement indications for high-voltage batteries of electric vehicles



The electric car market in Europe is growing very fast and, in particular, in Italy the battery electric vehicles (BEVs) exceeded the 100.000 units with a share of 2,3% of the national car registered in 2020.

In spite of a negative record of vehicles sold in 2020 (-27,9%) due to the pandemic crisis, **the number of battery electric cars sold in Italy in 2020 tripled compared to 2019**, increasing from 10.577 to 32.538 BEV (source: Ministry of Transports).

The diffusion of electric vehicles has pushed us to investigate on the repair procedurs of electric vehicles after a road accidens and, more precisely, on the official replacement/repair indications of the carmakers regarding the high-voltage tracion battery batteries.

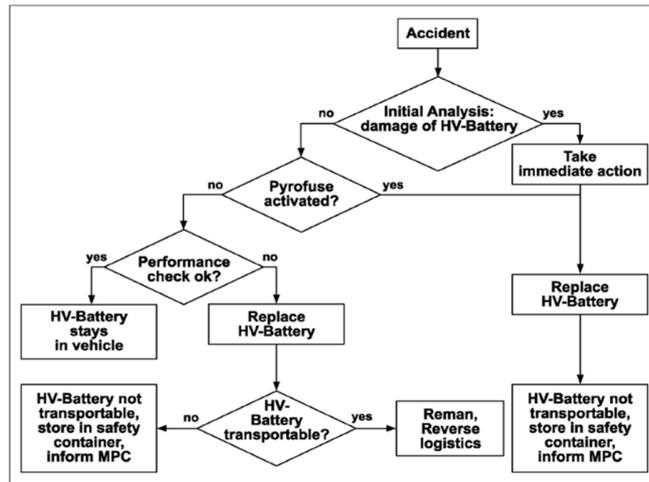
Verifying the need to replace the high voltage battery is particularly important in the insurance claims, due to **the high cost of the spare part** which can lead to a total loss. The impact of the battery spare part compared to the list price of the car is, on average, about **40%** and it seems higher in vehicles that cost less (e.g. the new Fiat 500BEV costs about 30K€ with an high voltage battery that costs more than 20K€).

Brand	Model	Car Price	Battery Price	Incidence € Battery Cost on Car Price	Charger	Converter	Electric Engine	Cable of Recharge
VW	E-Up	From € 23.750	€ 13.168,90	<b>55,40%</b>	€ 1.260,20	€ 3.574,78	€ 5.310,00	€ 685,16
Smart	ForTwo EQ	From € 25.000	€ 8.866,00	<b>35,50%</b>	€ 2.433,32	€ 2.646,45	€ 3.760,07	€ 298,95
Peugeot	208 E	From € 33.600	€ 13.629,78	<b>40,56%</b>	€ 1.794,98	€ 2.697,91	€ 5.131,05	€ 561,34
Nissan	Leaf 2° Gen.	From € 35.500	€ 14.950,84	<b>42,11%</b>	€ 3.300,86	€ 5.575,39	€ 3.604,15	€ 850,01
Bmw	i3	From € 40.600	€ 14.671,52	<b>36,13%</b>	€ 4.607,00	€ 1.890,76	€ 5.380,76	€ 655,25
Renault	Zoe	From € 34.100	€ 12.990,00	<b>38,09%</b>	€ 3.415,39	€ 2.051,64	€ 2.147,60	€ 165,11
Tesla	Model 3	From € 50.480	€ 10.899,16	<b>21,60%</b>	€ 907,56	€ 1.142,36	€ 2.151,26	€ 306,72
Tesla	Model S	From € 89.880	€ 21.505,00	<b>23,90%</b>	€ 2.096,64	€ 1.342,28	€ 2.972,80	€ 432,77
Fiat	500 BEV	From € 29.900	€ 20.208,00	<b>67,59%</b>	Not Available	Not Available	Not Available	€ 339,00

*Cost of vehicles and their spare parts for most common BEVs in Italy*

After studying the costs of the main components of BEVs, we analyzed the official indications of the car manufacturers for the repair/replacement of batteries, which we can be summarized in three groups:

- Group 1 (Mercedes, Smart): battery replacement required if pyro-fuse or airbag has been activated due to the accident
- Group 2 (Nissan, Tesla, VW, Renault): damaged battery modules can be replaced, without necessarily replacing the entire battery pack
- Group 3 (Peugeot, Citroen, BMW, FCA): the battery replacement is usually mandatory in the presence of fault codes, physical damage to the battery pack, liquid spilling from battery; however the battery replacement is not always mandatory in case of airbag deployment



*Mercedes-Smart evaluation process for high-voltage battery replacement after an accident*

After the first cases of Smart EQ accidents, we focused on the official indications of Mercedes and Smart: they declare that in the event of pyro-fuse activation or airbag deployment, the high-voltage battery replacement is mandatory (with an high impact on the repair costs).

Based on the new electric vehicles that will arrive on the market and their diffusion, we will continue to monitor the repair indications of the car manufacturers and the impacts on the **average repair cost in insurance claims**.

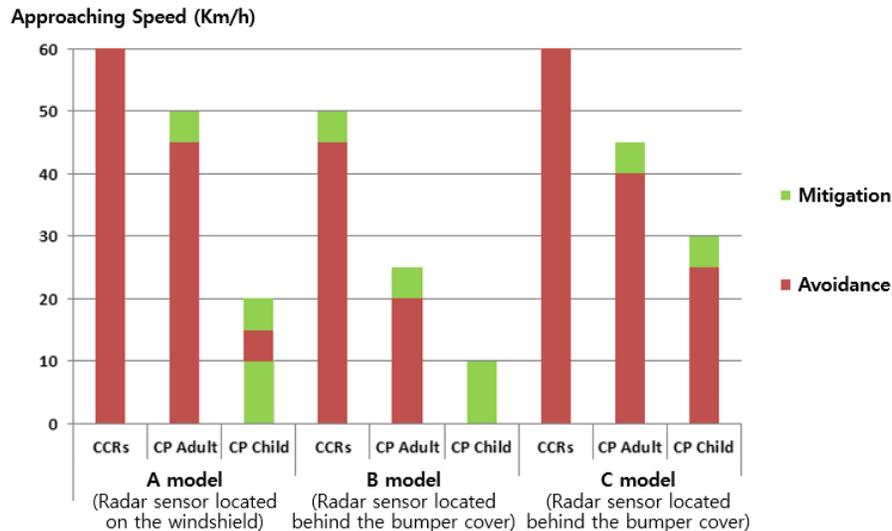


**Study on the effect of changing the position  
of the front radar sensor**

We studied the effect of reducing repair cost when the front radar sensor used for AEB (autonomous emergency braking) and ACC (adaptive cruise control) is moved to the top of the windshield. In most vehicles, the front radar sensor is installed in a location that is likely to be damaged in the event of a traffic accident (behind the radiator grill), which is causing the increase in repair costs. It was found that moving the front radar sensor to the windshield (like Volvo) could save about 10.6 billion won (about \$ 9.6 million) per year in Korea (as of 2019).

As a result of comparing the pre/post accident rate of the Volvo XC90 model in which the front radar sensor was moved from the inside of the bumper cover to the top of the windshield in 2017, it was found that the movement of the mounting location did not affect the accident rate. Collision coverage accident rate (14.5% → 14.0%) decreased by 0.5%p, and property damage liability accident rate (9.9% → 9.6%) decreased by 0.3%p.

As a result of evaluating the accident prevention performance of A model (Volvo XC90) equipped with a radar sensor on the upper part of the windshield, it showed good performance compared to other vehicles.



Remarks) CCRs : Car-to-Car Rear Stationary, CP Adult : Car-to-Pedestrian Adult, CP Child : Car-to-Pedestrian Child

The number of replacements of the front radar sensors, bumper rails and windshields in 2018 and 2019 is shown in the table below (Statistics based on the estimating program AOS developed and operated by KIDI). The number of replacement of the front bumper rail is about 79 to 88 times more than that of the windshield.

Year	Replacement (Number of cases)		
	Front radar sensor	Front bumper rail	Front windshield
2018	-	149,324	1,705
2019	7,467	131,171	1,661

As of 2019, the estimated repair cost savings were calculated using the following equation. Savings: (Difference between bumper rail and front windshield replacement x (front radar sensor average price + labor rate x replacement time)) + (difference in number of calibrations x labor rate x calibration time)

Assuming that the front radar sensor installation rate is 50%, the savings amount to about 69.9 billion Won (about \$ 63 million) per year in Korea.

It was confirmed that even if the front radar sensor was moved to the windshield and installed, the accident prevention performance did not deteriorate, and it was confirmed that the effect of reducing repair costs was great. The installation of expensive advanced safety systems is effective in preventing accidents, but when an accident occurs, it causes an increase in repair costs. Therefore, the vehicle design must be changed in a direction that can maintain accident prevention performance while minimizing repair costs.



## CHINA INSURANCE AUTOMOTIVE SAFETY INDEX

序号	品牌	生产厂家	测评车型	车辆级别	车辆型号	耐撞性与维修经济性	车内乘员	车外行人	辅助安全
1		启辰 东风汽车有限公司	启辰星	SUV	DFL6470MTN81 (2020款 260T手动星悦版)	M	G	G	G *
2		蔚来 上海蔚来汽车有限公司	EC6	SUV	HFC6483ECSEV6-W (2020款 430KM运动版...)	A	G	G	G
3		理想智动 重庆理想汽车有限公司	理想ONE	SUV	LXA6500SHEVM1 (2020款 增程6座版)	M	G	G	G
4		江淮 安徽江淮汽车集团股份有...	嘉悦A5	轿车	HFC7152B1S (2021款 1.5T+6MT 智行版精...)	P	A	A	G *
5		宝马 华晨宝马汽车有限公司	X3	SUV	BMW6475SX (2020款 xDrive 25iM运动套...)	P	G	G	G
6		丰田 四川一汽丰田汽车有限公司	RAV4荣放	SUV	CA64642XME6 (2020款 2.0L汽油版风尚版)	M	G	G	G
7		奥迪 一汽-大众汽车有限公司	Q5L	SUV	FV6481LAQDG (2020款 40TFSI 尊享进取型)	P	G	G	G
8		大众 上汽大众汽车有限公司	帕萨特 (2020)	轿车	SVW71423DT (2020款 280TSI商务版)	A	G	G	G *
9		马自达 中国第一汽车集团有限公司	阿特兹	轿车	CA7200ATE6A (2020款 2.0L 蓝天豪华版)	M	A	G	G *
10		领克 浙江吉利汽车有限公司	领克03	轿车	MR7152D09 (2019款 1.5TD-7DCT 劲)	M	G	G	G *
11		本田 广汽本田汽车有限公司	皓影	SUV	GHA6460RAC6A (2020款 240TURBO CVT...)	P	G	G	G *
12		哈弗 长城汽车股份有限公司	H6	SUV	CC6464RM08A (2020款 铂金都市版)	P	A	G	--
13		特斯拉 特斯拉 (上海) 有限公司	Model 3	轿车	TSL7000BEVAR0 (2019款 标准续航升级版)	M	G	A	G
14		别克 上汽通用汽车有限公司	君威	轿车	SGM7157EBA1 (2019款 20T 精英型)	M	G	G	G *

China is the largest auto market and insurance market in the world. CIRI mainly guides the market direction and researches the risk of vehicle insurance, and promote the upgrading of vehicle safety performance and reduce the vehicle maintenance cost. C-iasi has released the 14 models test results in 2020. Before the Chinese New Year, CIRI will complete 23 popular models C-iasi test, including new BMW X3, Audi Q5L, Tesla model 3, NIO EC6, Lixiang ONE. Compared with the low speed structure test results in 2019. The 27 tested models airbag deployment rate is 26% in 2019, but 14 tested models is 7% in 2020. In terms of vehicle safety, the side airbags rate has increased from 59% in 2019 rise to 79%, and the rate of Good results of passage protection rise from 44% to 82%, and the rate of vehicle emergency brake assist system (AEB) has increased from 26% in 2019 to 43% in 2020. After the Volkswagen Passat A-pillar broken event, china automakers attach great importance to vehicles safety.

In 2020, chinses EVs test results are better than the conventional vehicles, like Tesla model 3 (Made in Shanghai), NIO EC6, and Lixiang ONE. In additon, the NIO EC6 achieved nearly all GOOD results. With the revolution of the china vehicle insurance, it is becoming a hot topic in the insurance industry

that how to make the vehicle price rate by the crash test results.

Fang Zhongyou, Chairman of the C-IRI said "From 2016, C-iasi has become an independent, fair third-party and reliable evaluation institute in China, and has played a positive role in the improvement of automobile safety technology, damageability & repairability and the underwriting of automobile insurance risks. In the field of automobile insurance, we will further strengthen exchanges and cooperation with the international automobile industry and insurance industry. While supporting insurance companies to improve the ability of vehicle risk identification, c-iasi will continue to promote the service and digital application transformation of insurance. On the consumer side, c-iasi will continue to aim at reducing the cost of repair cars, make the C-iasi has better sever and expand the ability of risk identification for china auto industry and insurance industry."



### **Repairability can go with safety**

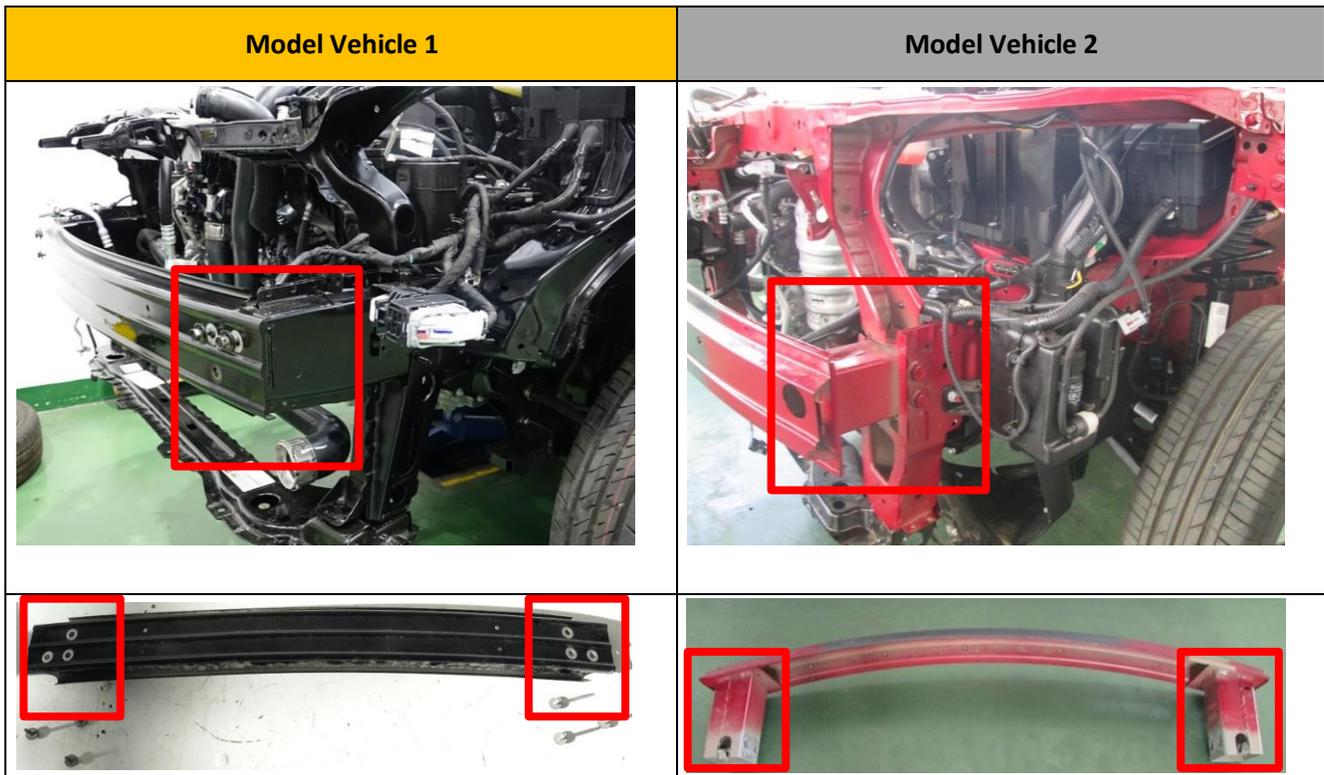
The vehicle brands are working to improve the safety of their models with the objective to preserve the lives of the occupants the event of a traffic accident. However, while it is necessary for the vehicles parts to contribute to the energy absorption of the crash, it is also necessary to reduce the damage of the structure in order to also consider the cost to repair the vehicle after the crash.

The energy absorbing elements installed in the structure of the vehicle, reduce the impact and severity of the damage in crashes with low velocity in the urban crash. These represent the most common cases experienced by insurance companies. These elements are designed with the objective to avoid the energy created in crash being transferred to the body structure and as a result reduce the damage to many parts and the cost of repair, but do not affect the safety of the occupants of the car.

CESVI Colombia's low speed crash test experience has found that in the Colombian market, imported vehicles have the most improvements to passive safety of the occupants (elements like Airbags). In contrast, those same vehicles have reduced the use of elements of energy absorption like front bumper reinforcements and front crush cans. This has resulted in an increase in the severity of damage and repair cost.



To demonstrate, we compared two models of vehicle of the same brand which is one of the most important in the Colombian market, with a representative sales of 18%. These two vehicle models are similar because the latest in the model evolution of the first, but the latest model has less elements to reduce energy of the crash, like front bumper reinforcement and front crush cans in the front structure. The table show the differences between these two models and the results.



This table show some differences between the two models in the front structure. Vehicle 1 has no bumper reinforcement with in-built crush cans.

In the next table, we will show the characteristics in respect to safety of the two models.

Aspect to compare	Criteria	Model Vehicle 1	Model Vehicle 2
<b>System of the safety</b>	Number of Airbags	6	2
	Brakes ABS	✓	✓
	Seat belt on the 5 seats	✓	✓
	System to retention ISOFIX	✓	✗
	Hill Start Assist	✓	✗
	<b>Results test LatinNcap</b>	 <span style="font-size: small;">28.90 max. 34.00</span>	 <span style="font-size: small;">0 max. 34.00</span>
	<b>Five Stars</b>	<b>Zero Stars</b>	
<b>Structural elements on the front vehicle</b>	Front bumper reinforcement	✓	✓
	Front crush cans	✗	✓
	Sub frame with beam reinforcement	✗	✗
	Sub frame with Crush cans	✗	✗
	Element in Polypropylene	✓	✗
	<b>Cost to repair front section (With Workforce)</b>	US \$ 5.900	US \$ 2.700
<b>Structural damages</b>	Damages in the Test RCAR (Low speed to 15 km/h)	Replacement on the Front chassis leg, and open Airbag	Repair on the Front Chassis leg.

With the last table we can see that the model vehicle 1, that although it has obtained the max Latin NCAP 5 star rating, this model has a higher cost to repair compared with model vehicle 2, with a difference of **45%**. These results show that while model vehicle 1 is safer, it has lost design to enable it to be repaired after the crash and also important aspects of repairability.