Position Paper on the Reparability of High-Voltage Electric Vehicle Batteries

Introduction

Electric vehicles (EV) are becoming increasingly common on roads in Germany and other European countries. This leads to an increased potential of accidents involving at least one high-voltage vehicle. Although recent AZT studies show that only in a very small share of accidents with EVs the high-voltage (HV) battery or other HV components are damaged, those accidents can cause high costs resulting in an overall increased claims average for EVs. A recent GDV study has shown that the repair costs of electric vehicles are on average 30 to 35 percent higher than those of comparable cars with combustion engines. While this is a challenge for insurance companies, in the long run it influences insurance premiums for electric vehicles and therefore increases the cost of ownership for owners and fleets.

Our investigation of EV claims shows that there is clear room for improvement. Due to the novelty of the technology there seems to be a lack of experience and clear manufacturer's instructions and guidance resulting in high total repair cost especially when it comes to battery damages and handling of heavily damaged vehicles. To address this topic we propose the following recommendations.

Damage avoidance

In order to enhance competitiveness of BEV, measures should be taken to avoid damages of the HV system as far as possible.

1. Underbody protection

The high-voltage battery can be damaged from below, if the vehicle drives over an obstacle or hits the ground, e.g. while driving over a road bump or higher curbs. Allianz damage data show that this is the most common scenario. We also see damage to the underbody where the vehicle touches down on an embankment as a result of a collision, for example, or where the driver loses control of the vehicle and the vehicle is pushed up onto objects.

In principle, the ground clearance should be at least as good as todays ICE driven vehicles and not further reduced due to aero aspects. In order to prevent battery damage, the battery must be protected from the underside. This can for example be realized by installing a

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service part resp. an exchangeable protective plate under the battery. In case of underbody damage it would in many cases now be possible to only replace the protective plate instead of the whole battery pack.

2. Positioning of high-voltage components

High-voltage components can be damaged in the event of an accident like any other vehicle component. Due to their mostly high replacement parts, value and labour intensive components incl. HV wiring harness these must not be placed in areas where they are likely to be damaged, especially when it comes to minor accidents.

Rear-end collisions for example are a common accident scenario. If the charging port is placed in the front of the EV, even a light impact can lead to the replacement of the port. It is therefore recommended to place charging ports and other high-voltage components in areas, where they cannot be damaged in light impact collisions.

Reparability

If it is not possible to avoid damages, these should be minimized by sustainable methods and optimized reparability, as well as with practical guidelines for experts and repair shops.

1. Repair manuals

Currently there are no or very generic instructions and clear requirements on whether or how high-voltage batteries can be repaired.

As an example, we still see OEM guidelines that require a battery replacement after any deployment of pyrotechnics (e.g. the airbag/seatbelt tensioner). In view of the frequency with which airbags and belt tensioners are deployed in collisions and the cost of replacing batteries in the range of approx. 10,000 to over 40,000 euros, this will result in costs that will significantly increase the cost of damage to vehicles. The actual mechanical load on the battery depends on the crash constellation and, in our view, cannot be accurately derived from the triggering of the safety systems.

For some OEMs, there are even no clear mechanical and electronical criteria to evaluate the status of a concerned battery or HV components. Additionally the external dimension data is required to determine the status. 3D design data would enable a clear surface evaluation and would determine the mechanical set value/contour vs. actual value/contour.

In addition, the lack of repair instructions and service parts is leading to an inevitable replacement of the battery pack and components in any type of damage. In other cases, there were no guidelines on the repair of components related to the battery (e.g. a cooling inlet), again leading to a replacement of the whole battery pack.

To avoid the high costs, times and expensive logistic resulting in negative ecologic impact of a battery or component replacement there must be clear OEM directives regarding the HV-system/battery repair. Damage patterns must be defined and possible smart repair solutions described, replacement parts must be made available at reasonable costs and labour times.

2. Battery data

In order to determine the status of the high-voltage battery after an accident, it is necessary for the insurer or the repair shop to have access to the battery data.

The state of health (SOH) is of great importance for the insurance, respectively the vehicle owner when it comes to the calculation of the residual value of the vehicle. Here the OEM should supply continuously exact data on the lifetime consumption of the battery. A battery diagnosis system's statement like OK/nOK is not sufficient.

AZT recommends a standardized approach/interface to allow repairers, claims adjusters and other parties of interest, e.g. the owner, to access the data without hurdles.

3. Battery design

Besides the definition of repair guidelines and the access to battery data, the battery itself must be designed in a way that allows efficient repairs.

Clear manufacturer's statements about scratches and deformations evaluation helps to determine an appropriate and safe repair effort.

The battery housing components should be replaceable and offered as common replacement parts in cases of deep scratches or dents. With more severe damages, it should further be possible to replace certain parts (e.g. modules) of the battery instead of having to replace the whole battery pack. If this is not offered, the OEM should at least provide refurbished spare parts in order to reduce the costs for the vehicle owner. In addition, the OEMs should take clear statements in their service manual and common calculation software tools (e.g. Audatex, DAT, GT Motive) about residual value and exchange cost of the damaged battery into account when invoicing the new battery.

This is also required for other high-voltage components like high-voltage wiring harness, where repair solutions or partial replacements should be provided. Again, for electronic controllers, heaters or chargers, the OEM should offer refurbished spare parts. It would also support the green food print efforts and expectations of the community.

Repair options for batteries create significant benefits for the customer both in terms of repair cost reduction and improved type class ratings as well as for the sustainability of the products over their life cycle. Every battery replacement entails considerable costs and can quickly lead to an economic total loss, and thus also to a shortening of the service life of used vehicles. The environmental advantage of the electric vehicle only arises when they achieve a corresponding mileage.

Based on the increasing population of battery electric vehicles a significant increase in the volume of claims in liability and comprehensive insurance is to be expected – hence we expect 6,000 to 11,000 claims with battery damage in 2030 in the German market. In addition, associated with this, a worse type class rating for those vehicle models that do not provide an appropriate design protection and repair solutions, which would increase the cost of ownership. It is important to understand that insurance makes up a significantly portion of the cost of ownership and thus increased repair costs must be prevented.

4. Workshop regulations

To repair EVs, personnel with special qualifications and equipment is needed. In Germany, the DGUV 209-093 defines four different levels of expertise for staff working with high-voltage components. Following the DGUV guidelines, OEMs should define which specific tasks can be carried out by which qualification level and which equipment is needed.

Specifically when it comes to the deactivation of the high-voltage system, we currently see a huge variation on when a deactivation is carried out and how long it should take. A reduction to essential requirements together with standardization could create clarity and reduce repair costs.

Summary

Most recent studies unveil increased repair costs for EVs and therefore the affordability of such vehicles is negatively affected today. Increased repair costs directly and indirectly, via higher premiums, raise cost of ownership. The industry should address both, claims frequency and claims costs in order to make electric drives sustainable and affordable. Looking at the ecological challenge of climate change, the fact that we as a society will no longer power our vehicles with fossil fuels in the future is and remains the only right way forward. The insurers want to accompany this change and play a positive role in shaping it, which is why we are warning of this development at an early stage. If the stated recommendations are followed by the OEMs, repair costs for electric vehicles will be reduced, resulting in an overall improvement of competitiveness, better cost of ownership and higher residual value.

Document Version: 14/12/2023

This document reflects the current view of the EV expert group mentioned below. Content is subject to change and will be updated on a regular basis as both technology and society are changing rapidly.

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