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Theme booklet

Special conditions for rescue in electric and hybrid cars

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Theme booklet: Special conditions for rescue in electric and hybrid cars

Cover photo: The National Emergency Management Agency

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Contents

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About the Emergency Management Agency's learning materials

Textbook
A textbook contains an in-depth professional review of a subject area in rescue preparedness. The textbook is aimed at anyone who needs a thorough knowledge of the subject.

Theme booklet
A theme booklet is a supplement to other teaching and learning materials. The focus in the book is on one or more subject areas. As a rule, a theme booklet addresses a specific subject group, e.g. technical managers or investment managers.

Method booklet
The method booklet has a current focus on, we have updated it within a subject area in rescue preparedness. The method booklet is aimed at e.g. firefighters and team leaders who need up-to-date knowledge of the current situation on a daily basis
subject.

Student
booklets Student booklets are locally based publications produced according to guidelines from the Swedish Emergency Management Agency's Center for Education. It often contains locally rooted cases. Student booklets are aimed at the firefighter level and are a supplement to other learning materials.

Teaching video Teaching
videos are shorter or longer videos that review one or more academically defined areas within the various areas of action. The videos can be viewed by all targets

groups.

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Preface

In connection with the green changeover, the Danish emergency services want the best possible handling of challenges within their own sector from an increased use of lithium-ion batteries (Li-ion) as propellant in various forms of transport, including electric and hybrid vehicles.

In December 2020, a political agreement was reached on a green transformation of road transport, which is estimated to lead to up to one million zero- and low-emission cars in 2030 in Denmark.
According to Statistics Denmark, electric and hybrid cars, measured on an annual basis, make up an increasing share of new car sales.

This development is expected to continue further in the coming years, together with an increase in the efforts of the rescue services, both in terms of passenger electric cars, but also for other means of transport, such as buses and ferries.

Against this background, the rescue services will often be faced with having to be deployed for these new types of efforts. In the spring of 2021, the Danish Emergency Management Agency published a new thematic booklet on the emergency response's efforts in the event of a fire in electric and hybrid cars.

Even before publication, however, it was clear that the theme booklet would not stand alone,
partly because the use of Li-ion batteries is constantly developing with e.g. larger battery packs, partly because firefighting only forms part of the efforts of the rescue services in connection with electric and hybrid cars.

The theme booklet has been created in collaboration with Danske Beredskaber. A special thank you must go to North Jutland Emergency Services, Hovedstadens Emergency Services and East Emergency Services for their contribution to the work.

The National Emergency Management Agency January 2023

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About the theme booklets

The development of energy-efficient Li-ion battery packs is progressing rapidly. In several areas within transport, a general increase in the use of battery packs with a high voltage, which i.a. for usability reasons are made more and more compact.

Today, e.g. several passenger electric cars with battery packs of up to 1000 V. The term electric car will most often cover both pure electric cars, hybrid electric cars and plug-in hybrid electric cars of the passenger vehicle class.

The themed booklets 'Fire response in electric and hybrid cars' and 'Special conditions for rescue in electric and hybrid cars' should be read in conjunction. The two booklets describe the safety and health conditions as well as the response tactics that should be followed in the event of road accidents or fires where an electric car is involved.

An extinguishing or rescue effort for a car accident with an electric car that touches the battery package, can be difficult for the rescue services and other actors at ska to handle instead.

This is due, among other things, to the high voltage in voltage-carrying cables and in the vehicles' Li-ion batteries, where there is a significantly higher voltage than in the cars' ordinary 12 V batteries.

In a damaged electric car, it can also be kom necessary to gain correct access to the live parts and thereby ensure that cables and wires are de-energized. A fire in the high-voltage battery or the risk of fire can further complicate the effort.

Please note that the theme booklets deal with electric cars with high-voltage batteries up to 1000 V.

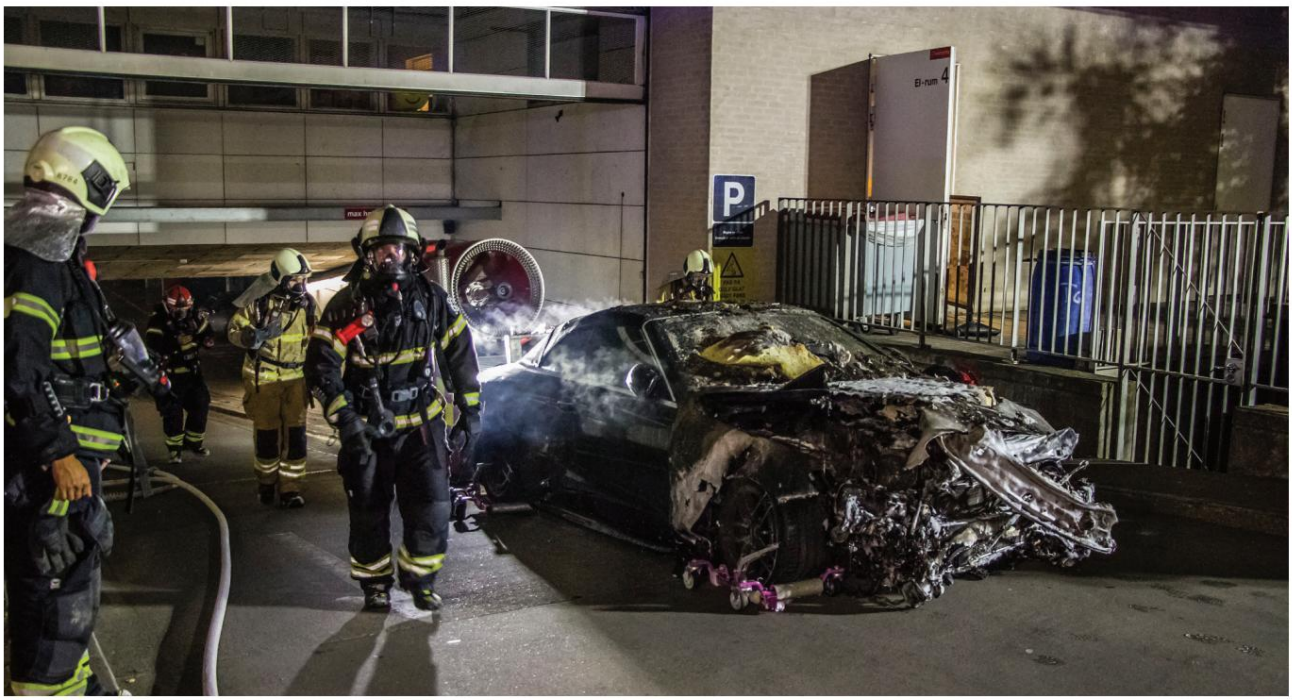

Photo: Bjørn Nielsen/ www.bpln.dk

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Structure and use of the theme booklets

The target group is primarily the technical management of the municipal rescue services, while some will be relevant for the individual firefighter. In the individual sections, there are a number of fact boxes, which are important reading for the deployed personnel.

The starting point is some general principles for response tactics and cooperation with other emergency response actors in the response area.
The descriptions of the possible tasks of other actors at the scene of the accident (the police, the emergency services and the transporter) are only input for inspiration for a task solution, which is not necessarily covered by the emergency response act.
Any implementation falls under the responsibility of the relevant authority at the site of the damage.

The structure of the theme booklets is built on the basis of an operative approach, where the sections gradually provide the rescue services with such knowledge that a proper investment in electric cars can be carried out in terms of safety, health and the working environment. The sections cannot stand alone, as they are based on some general principles for effort management, etc.

The theme booklets are based on national and international knowledge about electric cars as well as experiences from the municipal rescue services. They build on existing learning materials, but with updated knowledge of special risks and intervention tactics, as previously published material only describes conditions surrounding electric and hybrid cars to a limited extent.

The conditions described can be used in the demonstration and training of operational competences in the rescue service in order to raise awareness of the potential risks.

The themed booklets describe the response team's options for action and general considerations about the working environment and protective equipment that the technical manager should observe. In general, the theme booklets illuminate a number of points of attention on an overall level. Depending on the situation, the technical management is handled by the team leader or a task leader.

Individual sections can be used in whole or in part as a reference work in relation to operational tactical priorities during the first operation. The material is also intended as inspiration for a Celtic rescue service's own operative teams, including the content of the action cards.

Finally, there are a number of appendices with various background knowledge, such as characteristics of electric cars, use of tools and protective equipment, etc.

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Information from the alarm, security center and AMK

For the efforts of the rescue services, it is important information that the accident involves an electric car. All stages before the arrival of the rescue services - from the alarm and duty center, the Emergency Medical Coordination (AMK) and the first patrol car can contribute to this.

Relevant information can come from those first present at the scene of the accident. It can be e.g. be the police, emergency services, passengers in the electric car or other people at the scene of the accident who can contribute to an early identification of whether it is an electric car.

Alternatively, as early as possible, regive information should be given to the first units that there is an accident involving an electric car. This gives the crew the opportunity to take the right measures, including calling in additional units and special equipment.

A question guide has been drawn up, which can be used in the event of an alarm and by the first vehicles at the scene of the accident (see 'Action card – Ask eguide for the control centre, AMK and first vehicle).

There may also be a need to call the emergency services for traffic accidents, where they are not normally called because of the risk an electric car can cause. There may also be situations where the police or the emergency services are the first to arrive at the scene of the accident. Here, their safety is taken care of, as well as the need for a joint approach to handling the inmates. Separate annexes and action cards have been prepared for inspiration.

Technical help
Via the website "motorregister.skat.dk" under the "Find vehicle" tab, information about a vehicle's fuel can be obtained by entering the registration number. However, there are exceptions to this, as registration numbers for special vehicles with e.g. police, defense and emergency services are not publicly available.

There are a number of software solutions and information systems which can advantageously be obtained in advance. The systems have in common, that they can best be used via a tablet or corresponding unit. This can be done both online and offline.

The joint European organization for the safety classification of vehicles (Euro NCAP) has, in collaboration with CTIF (International Technical Committee for Fire Prevention and Extinguishing), published an App – Euro Rescue1.

It can be downloaded in the App Store and Google Play as a freeware. The program contains all approved European car brands and describes the construction of the vehicle, including what potential hazards there may be.

Other systems work with a subscription scheme, which gives access to information about the vehicle's data, location of central components, etc.

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Summary of general conditions

Increased attention When handling traffic-damaged electric cars, including freeing people and extinguishing fires, the crew should be trained in a number of special aspects of the effort. Eg. Some electric cars have high voltage batteries up to 1000 V.

Depending on the situation, the technical management is handled by the team leader or a task leader.
Often, an effort with electric cars will entail extra tasks and a number of risks, which suggests that there is a greater need for an effort leader to supervise or assist the technical management.

The manufacturer's own instructions (rescue sheets) are followed as far as possible, with the caveat that the electric car will most often be damaged.

In addition to the high-voltage battery, the electric car itself will be able to have high voltage in e.g. cables which have not been de-energized. There is also a risk of that the high-voltage battery may catch fire. Both parts should be part of the risk assessment.

- The location of the main switch is identified and it is disconnected as far as possible.
  In a damaged electric car, however, it can be complicated to gain correct access to the live parts and thereby ensure that cables and wires are de-energized.

- It is recommended that safety hoses with a total water output of min. 400 l/min – also without visible smoke from high
  volt battery.

- Wind direction and the safety of persons outside the danger zone are taken into account due to the risk of fire and the development of smoke and dangerous gases from the high-voltage battery.

A fire in an electric car can quickly develop violently Photo: Bjørn Nielsen/ www.bpln.dk

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Tools and equipment
Tools used when cutting or touching the electric car's parts should be approved for 1000 V. Safety mats or safety covers can be used.

The technical manager should set aside a mark for cuts in the bodywork based on an assessment of the placement of cables (mostly orange-coloured) with high voltage, if cuts are made in the electric car.

Thermal cameras can be used to monitor the battery's temperature, which can indicate the development of a fire in the Li-ion battery.

Personal safety Protective
clothing and protective equipment (PPE – Personal Protective Equipment) should be well known for work up to 1000 V when handling, touching or cutting the electric car's bodywork or cables. Rubber safety gloves can be used with advantage.

Due to the risk of fire, the smoke diver's hole should prepare for deployment with full respiratory protection, which is provided in case of smoke, risk of fire in the high-voltage battery or suspected development of dangerous gases.

You should work with a safety distance during extinguishing work due to the risk of electricity. There should be increased attention in efforts where both water and voltage are handled
the electric car.

Consideration should be given to the fact that water - such as rain/snow and extinguishing water - increases conductivity significantly. The risk of arcing should be considered when selecting PPE and proper tools and equipment.

Acting at the scene of the
accident Several authorities are part of the effort in connection with traffic accidents, if there is a danger to people or animals, and the rescue services have been called.

The deployed forces should have information as early as possible that an electric car is involved in the accident.

- The site of injury should be marked as a workplace with high voltage as early as possible at a distance of min. 1 m from the electric car. This can be done by blocking off with black/ yellow mine strip and visible marking with danger signs on and around the elbi
only.

- If there is a development of smoke or gas from the high-voltage battery, it is ensured by blocking that no one stays in the smoke plume except for personnel wearing full respiratory protection.

The police and the health emergency services can, if they arrive at the scene of the accident before the emergency services, assist with the above.

In an emergency, an emergency evacuation of injured persons who cannot get out of the vehicle themselves can be carried out, if contact with damaged parts of cables and bodywork can be avoided.

Two people should be present when working with voltage, so that a shoulder push can be carried out if necessary.

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Use of equipment and protective equipment

A rescue effort or a traffic accident with an electric car entails special risks compared to a similar effort in a conventional petrol or diesel-powered passenger car.

In relation to the use of equipment and protective equipment, it is important that the crew is instructed and trained in using this and that they are aware of the special risks before they are deployed.

In the event of a rescue operation, electrical components cover both obvious electrical components, such as cables, wires and the high-voltage battery itself, to components that are assessed as potentially conducting voltage - especially metal parts, bodywork, chassis, vans, etc.

EN 50110-1 states that screens, barriers, enclosures or insulating coverings of electrical parts can be used with advantage when working near live parts.

Personal protective equipment (PPE – Personal Protective Equipment) together with electrically insulating covering and insulated tools are essential measures to address risks when working with electric cars under voltage.

Personal protective equipment, such as protective glasses and rubber gloves, should be used in case of direct or risk of contact with the electrical and voltage-conducting components of the electric car.

In principle, electric cars should not be touched without the correct PPE, including safety gloves approved for 1000 V. The following list indicates European standards for different types of personal protective equipment (PPE), where the latest editions of these should be used:

Subject	Personal protective equipment (PPE)
Main	Suitable home - EN 50365:2003
Eyes	Suitable visor or glasses - EN 166:2002
Body	Emergency suit - EN 61482-1 and 2
Feet/Body	ESD approved footwear – EN 15090:2012, type F2A
Hands	Suitable gloves EN 60903:2004
Other coverage	"Rubber mats" DIN VDE 0680/1 IN 61111 , IN 61112

Consideration should be given to the fact that water – such as rain/snow and extinguishing water – significantly increases conductivity. The risk of arcing should be considered when selecting PPE and proper tools and equipment.

You can read more about requirements for PPE and the use of mist in appendix 3 on 'Tools, equipment and protective equipment'.

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Use of safety gloves

Photo: The National Emergency Management Agency

Assessment of voltage in the electric car In the specific effort, it will be the technical manager who assesses whether the electric car and not least the high-voltage battery is sufficiently intact for it to be secured, i.e. be de-energized, cf. the manufacturer's description or rescue sheets.

However, the high-voltage battery will not be de-energized. But disconnecting the main switch will result in no voltage coming from the battery.

In practice, the mere fact that the electric car has been in an accident (where the emergency services have been called) will make it difficult to assess whether the high-voltage battery is still intact.

If there is doubt about this, it should be assumed as a starting point that no safety functions in the electric car work normally, and that it is therefore assumed that 'all' parts of the electric car can potentially be energized.

The assumption that there may be voltage on the electric car means that, according to EN 50110-1, suitable and sufficient personal protective equipment (PPE) should be used for work under voltage. PPE, insulated tools and electrically insulating covering of conductive materials minimizes the possibility of contact in the areas of the electric car where there may be a risk of contact during work.

In general, it would not make sense to carry out a control measurement of voltage in the electric car in an investment context. Components with voltage will not necessarily be visible.
They can also be damaged, so that voltage can be conducted via any randomly conducting material in the electric car, simply by small mechanical impacts on the body etc.

The rescue services are not expected to be able to carry out this measurement, as it will require previous skills (e.g. an electrician) to assess the possibility of use and to carry out the correct type of measurement in relation to the voltage level.

The emergency crew should pay extra attention to whether the high-voltage battery starts emitting fumes, sounds, sparks, etc. This may indicate that a heat effect in the high-voltage battery is developing. In addition, as with all work with cars, attention should be paid to the regular 12 V battery.

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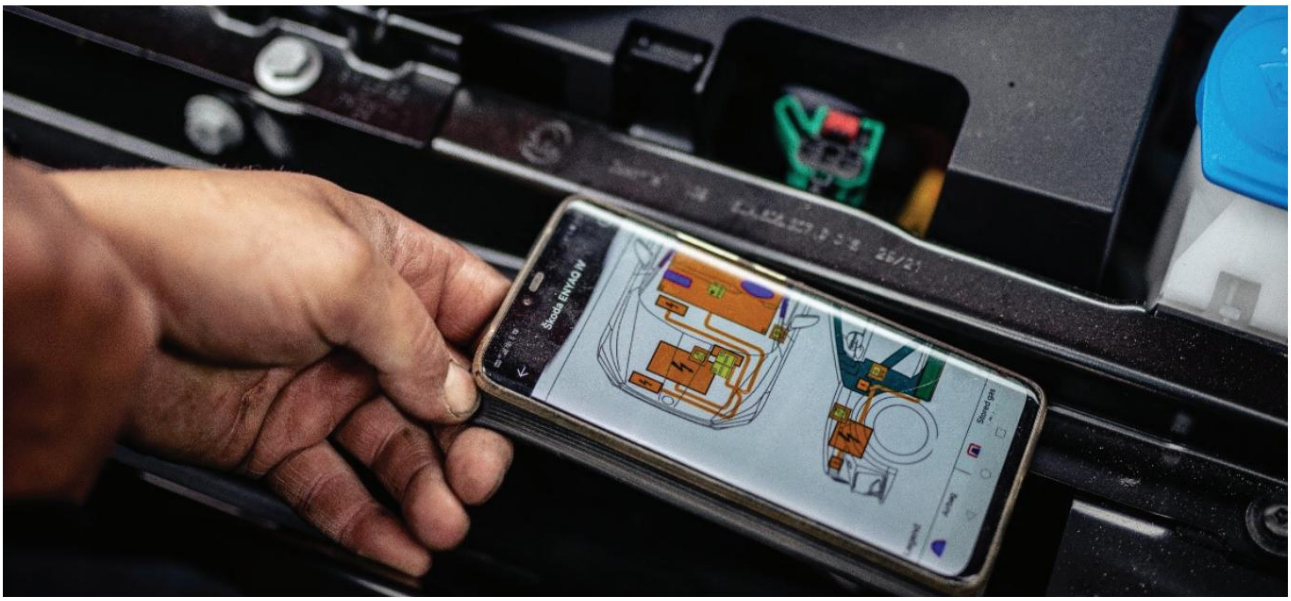
Internationally, there are e.g. rescue sheets and other information from manufacturers and rescue services that can contribute to the assessment of voltage in the electric car. However, it is important to be aware that they do not necessarily cover all situations where an electric car has an accident or catches fire.

It also requires that the technical manager and the crew have access to rescue sheets on the effort itself. The crew should have trained in the use of this type of information in advance, so that it can best be used in a situation where the electric car is expected to be deformed.



Rescue sheets indicate the structure of the electric car

Photo: The National Emergency Management Agency

Tools and marking In electric cars, marking/signage is used by the manufacturer, which warns the crew and other emergency responders against the danger of electric shock. This marking/ signage is visible in the places in the car where there is a risk of coming into contact with the high voltages from the high-voltage battery.

Orange colored cables will be high voltage. It is recommended that all contact or work with the electrical components – even without visible damage – be carried out using insulated tools approved for 1000 V, as well as the use of approved safety gloves and other PPE.

In an effort with electric cars, the work area should be blocked off and separated against the risk of high voltage. As a general rule, this will correspond to a cordon off of a danger area with a min. distance of 1 m to the electric car. Blocking can be done physically with e.g. black/ yellow mine strip or marking in the form of fire hoses and a statement of the danger area.

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A further visibility of the risk of contact with voltage in and around the electric car can be made by marking the electric car with stickers or magnets with a danger sign for high voltage.

Markings with mine strips and danger signs are maintained at the end of the effort, when the crew is released from the scene of the accident and delivers the crashed electric car to other actors such as the police and transporter.

When handing over, information about the condition of the electric car, the status of the switching equipment, including the charging cable, disconnection of the main switch, ignition and any safety devices, should be clearly communicated to the new person responsible at the scene of the accident, corresponding to the instructions in EN 50110-1 for communication when working on electrical installations .

See possibly more in Appendix 6: Handing over and moving a damaged electric car.

IMPORTANT REGARDING VOLTAGE ON THE ELECTRIC CAR

- Pay attention to the labeling of the vehicle for components with high voltage.
- The high-voltage battery cannot be de-energized.
- Avoid touching or cutting orange cables.
- Due to visible and hidden damage in the electric car, a control measurement of voltage will be required in the electric car could not be done in practice.
- Possibility of using step mats, safety cover etc.
- Tools, instruments and accessories should meet DS/EN 61010-1 or equivalent.
- Use of personal protective equipment (PPE) approved for 1000 V.
- The risk of arcing should be taken into account when choosing PPE, insulated tools and equipment.
- The workplace (danger area) where the electric car is located is demarcated and clearly marked at a distance of min. 1 m from the electric car.
- Handing over to the police or carrier when the scene of the accident is released.

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Special conditions in connection with rescue

A rescue operation in an electric car, including the release of trapped persons in the event of a traffic accident, may result in the need to handle a damaged high-voltage battery or potential voltage in the electric car's bodywork, cables, etc.

It is important that the deployed personnel take these risks into account, both in the tactical priorities in the effort, as well as by using the right equipment, equipment and personal protective equipment (PPE), and they can handle risks around the high-voltage batteries (up to 1000 V).

The individual manufacturer's own response instructions (rescue sheets) are followed as far as possible2.

There is a focus on the rescue effort in traffic accidents with electric cars, where the emergency services are called to solve a task, and where there may be an ambulance is requested. Thematic booklet builds on the Swedish Emergency Management Agency's booklet on 'Exemption from vehicles' (2014), as this only describes conditions surrounding electric cars to a limited extent.

Handling traffic-damaged electric cars or a rescue effort with the release of people in an electric car will often place different demands on the technical management than in a similar rescue task in a conventional passenger car.

It is necessary that the operative forces are familiar with the special characteristics and risk points of electric cars, so that appropriate action can be taken if, for example, clipped into a car to free a trapped person.

The theme booklet illuminates the operational tactical possibilities and can thereby support the technical manager in handling this type of traffic accident - regardless of whether there are people who need to be freed or not.

The technical manager marks the location of clips on the electric car

Photo: The National Emergency Management Agency

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Especially for extrication from crashed electric cars. Instructions for working with electrical installations state that you must make the workplace de-energized and check that it is de-energized with an approved measuring instrument.

However, this procedure cannot be transferred to traffic-damaged electric cars, which must be assessed as non-intact. On an electric car damaged in traffic, it can give false reassurance to measure whether individual parts of the bodywork are energized, as voltage can be conducted via any random conductive material, simply by small mechanical influences on the components.

Firefighters are basically highly instructed in noticing risks and avoiding dangers, but not trained in making this decision, unless they can be described as experts and have training such as e.g. an electrician.

Therefore, the recommendation is to always assume that there may be voltage on all parts of the electric car, until a person with the right professional knowledge of voltage can determine otherwise with certainty.

In particular, the technical manager should be aware of a clear role in ensuring that the main switch is disconnected; marking where release tools may be used; marking with mine strip and danger signs as well as contributing to the passing on of information at the end of the operation to either the operation manager or the police.

The need for personal protective equipment (PPE), which is approved for 1000 V, should be a focus for the entire crew. Both when it comes to an effort with an acute risk to life or an effort that allows for better 'planning' of the effort, as both types will entail a number of special measures in relation to a safe working environment.

It is recommended that two people are always present when working under voltage so that there is someone who can step in in the event of an electric shock. During a rescue effort, this means that the security man has a special focus on this risk.

If there is an accident, it is important that the person who has to help the person in distress is also wearing personal protective equipment and a shoulder push or similar should be used if the person in distress is stuck due to an electric shock.

The main switch

High-voltage batteries in an electric car have high electrical direct current and contain a significantly greater amount of energy than the ordinary 12 V batteries in a passenger car with a petrol or diesel engine.

When working in an electric car, it is essential for the crew to disconnect the main switch, if this has not happened, and thus de-energize all the electric car's systems. The main switch is located differently, depending on the brand or model.

Electric cars typically have one or more 12 V batteries, which are disconnected in the usual way. There will continue to be voltage on the 12 V part until one of the battery poles is dismantled in the 'normal' way. Please note that the battery pack itself (Li-ion) cannot be de-energized.

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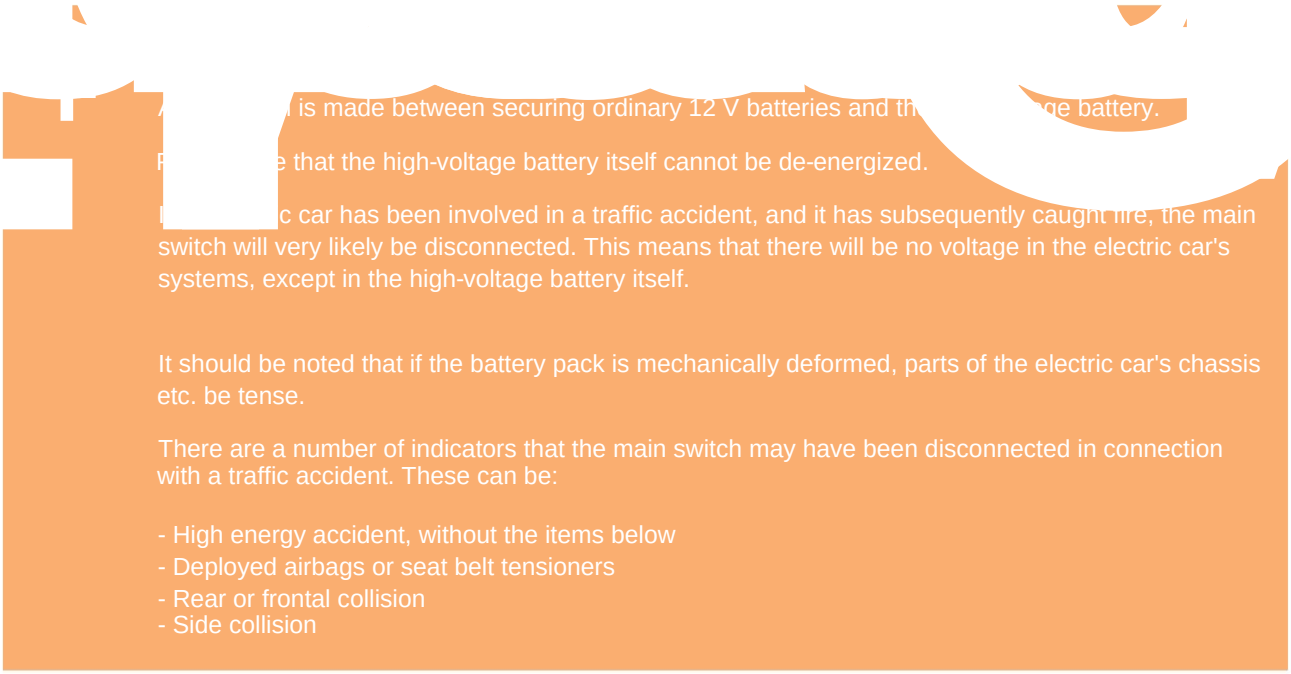

A distinction is made between securing ordinary 12 V batteries and the high-voltage battery.

Please note that the high-voltage battery itself cannot be de-energized.

If an electric car has been involved in a traffic accident, and it has subsequently caught fire, the main switch will very likely be disconnected. This means that there will be no voltage in the electric car's systems, except in the high-voltage battery itself.

It should be noted that if the battery pack is mechanically deformed, parts of the electric car's chassis etc. be tense.

There are a number of indicators that the main switch may have been disconnected in connection with a traffic accident. These can be:

- High energy accident, without the items below
- Deployed airbags or seat belt tensioners
- Rear or frontal collision
- Side collision

Risk of fire In connection with the effort, the technical manager and the crew should be aware of the risk that a fire may occur spontaneously in a damaged high-voltage battery, and what consequences a fire may have for the effort.

'Thermal runaway': When exposed to high temperatures, the Li-ion battery can enter a critical state, which starts an internal self-reinforcing decomposition process ('thermal runaway'), which ends with each battery cell heating up strongly from the inside, when the stored chemical energy gives is triggered.

Fire, smoke and the damage/deformations that can clearly be seen on the electric car help to indicate a possible risk of a damaged high-voltage battery. It can be heat generation, 'thermal runaway', sounds, smoke generation, unnatural smells or liquid running out of the battery.

The purpose of installing fire hoses with a high water performance is to provide protection against people in the danger area (fuse) and to cool or if possible, limit fire development to the surrounding environment and other vehicles (extinguishing). It is therefore recommended that safety hoses with a total water output of min. 400 l/min3.

Work is carried out with a safety distance corresponding to water output, beam pattern and extinguishing agent. The following are recommended distances for extinguishing electrical fires (c-tap pipe with pressure of 5 bar - DIN VDE 0132). The safety distance can be projected to the safety hose.

- Unknown low voltage <1000 V, 200 l/min: – scattered beam - min 1 m; total beam - min 5 m
- Unknown high voltage >1000 V, 200 l/min: – scattered beam - min 5 m; total beam - min 10 m

Personnel who are deployed are prepared for the installation of full respiratory protection.

You can read about action time, tactics, etc. in case of fire or risk of fire in the themed booklet 'Investment in case of fire in electric and hybrid cars' in the section on response tactics and technical management.

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SAFETY NON-INTACT ELECTRIC CARS

The following measures are particularly important to achieve the best safety when handling a non-intact or burning electric car:

- If the electric car is connected with a charging cable to a charging stand, this should, if possible, be removed or disconnected completely before any further work is carried out directly on the electric car, for example by disconnecting the power supply to the cable by disconnecting the group in the HPFI/electrical panel.
- Insulated mats can be used, the ground conductor/charging cable cannot be interrupted of the.
- If possible, the main switch in the car should be disconnected before further work on and near the electric car - location can be found via relevant notices in the rescue sheets.
- Note, however, that if the high-voltage battery is damaged or the electric car is mechanical, be it in the form of pressure or breakage of metal parts, it should be considered unsafe and with a risk of accidental voltage on the car, even if the charging cable and the main switch are disconnected.
- If direct contact with a damaged electric car is required, it is always recommended to use personal protective equipment (PPE) and equipment as previously described, as well as safety cover.

Location of the high-voltage battery
Depending on the car brand, the high-voltage battery can be located in different places in the electric car. Certain car brands have the batteries located in the same place, regardless of model, whereas other car brands have the batteries located in different places in different models.

Larger battery packs will often be located at the bottom of the electric car, but can also be in the boot, under the bonnet or in the middle of the car, between the front seats.

In general, access to the high-voltage battery can be very complicated, due to the membranes in the battery pack and a location where accessibility can be extremely limited due to damage to the bodywork.

This has an impact on the effort and the time aspect for freeing a trapped person, as it can be problematic to get to the live objects and ensure the necessary shielding or insulation of the battery pack and the live components.

The location of the high-voltage battery and whether it is damaged has an impact on the technique and response tactics that the crew should use during the response.

In order to create access to the essential components of the electric car, it is important not to cut holes in the bonnet or cut into the car's sides, as there is a risk of hitting components with high voltage if the main switch is not switched off.

Cables and high-voltage systems will typically be colored orange. Please note that the high voltage battery itself cannot be de-energized.

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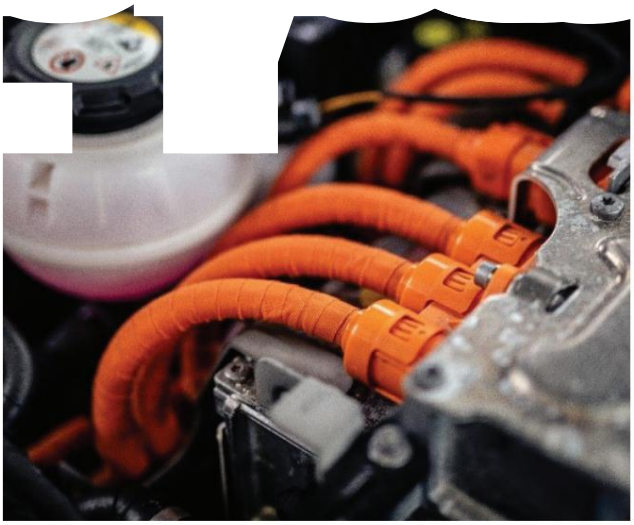
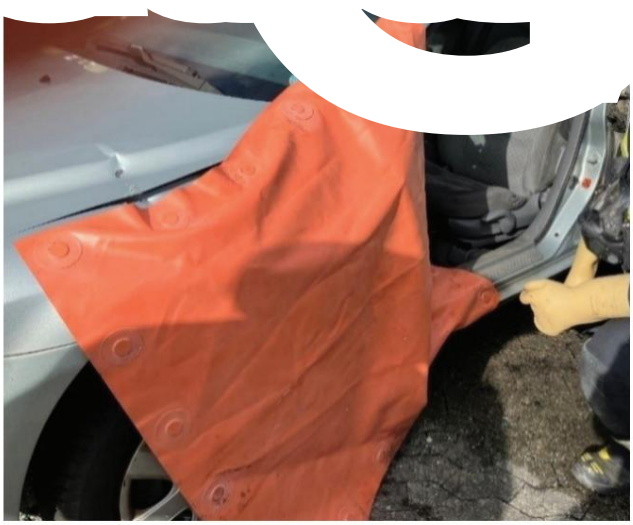


Cables with high voltage will most often be colored orange, as here in the engine compartment

Illustration: The National Emergency Management Agency



Covering exposed cables and part of the bodywork as an additional safety barrier

Photo: The National Emergency Management Agency

If chain rescue is used tactically, it can pose a risk of uncontrollable formations of the electric car's bodywork, cables, wires and the high-voltage battery, which the technical manager should be aware of.

You can read more about safety, special risks and applicable legislation, regulations and standards in Appendix 2 on 'Safety when working with electric cars'.

SAFETY WHEN CUTTING

- If there is a risk of contact with live objects, it can be shielded with insulating rubber mats.
- Chain protection can pose a risk of uncontrollable deformations of the electric car bodywork, cables, wires and the high-voltage battery.
- Cutting a hole in the bonnet or clipping the car's fenders should be avoided, as there is a risk of hitting components with high voltage if the main switch is not switched off.

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IMPORTANT KNOWLEDGE FOR THE FIREFIGHTER

- Personal protective equipment (PPE) that is approved for 1000 V: Safety gloves, protective mask (protection against electric arcs), safety helmet with visor - alternatively protective glasses/eye protection, approved footwear or foot mat for contact with the electric car and release.

- Safety gloves should be regularly examined before use, by breathing into them and check tightness. Leaking safety gloves should be destroyed. To protect the safety gloves, they can be used together with work gloves, which overall minimize the risk of breakage of the safety gloves.
- Please note that safety gloves for 1000 V cannot replace safe safety/work gloves which are normally used for release.
- Safety equipment: Tools approved for 1000 V. Insulating rubber mats can be used to cover conductive material protective cover. High voltage batteries in an electric car have a high electrical direct voltage and contain a significantly larger amount of energy than the ordinary 12 V starter batteries in a passenger car with a petrol or diesel engine.

- When working in an electric car, it is essential for the crew to disconnect the main switch if possible and thus de-energize all the electric car's systems.

- If this is not possible, it is important that a safety distance is taken into account in connection with the extinguishing, depending on water performance and extinguishing technique.

- Be aware that the high-voltage battery itself cannot be de-energized.
- Two people should be present when working under voltage so that there is someone who can step in in the event of an electric shock. During a rescue effort, this means that the security man has a special focus on this risk.
- Marking of the danger area with signs against high voltage - this vertical hole des when releasing the damage site (min. 1 m)
- Assessment of the condition of the car's high-voltage battery, disconnection of the main switch, voltage, damage to cables.
- Pay attention to following the technical manager's instructions before mowing in the electric car.
- Extra attention if sounds, smoke development or abnormality are observed just smells from the battery or liquid leaking out of the battery. This may indicate heat development or 'thermal runaway' in the high-voltage battery.
- Marking with barriers and signage with 'Danger - high voltage' is maintained according to the effort when handing over to the police or carrier. As far as possible, avoid unnecessary twisting of the car during the operation and while it is being loaded onto the sweeper.

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Response guide

Traffic accidents – General

Before effort

When it comes to traffic accidents where an electric car is involved, the technical manager will direct the focus on the damage the electric car has received as well as the visualization that can be seen on whether the electric car unit divisible appears intact or non-intact.

The damage that can clearly be seen on the electric car helps to indicate a possible risk of a damaged high-voltage battery and possible exposure of high-voltage cables. As a starting point, a visual overview will help to establish visible damage or indications of damage to the electric car, such as exposed wires and cables, deployed airbags, type of accident, e.g. collision.

The damage entails a theoretical possibility that there may be tension in the electric car's bodywork, which could pose a risk to the crew.
The damage may also indicate an increased risk of fire in the high-voltage battery.

The first impression can contribute to considerations about the access road for the transporter and, for example, the use of a thermal camera for temperature development of the electric car's high-voltage battery.
If in the effort there are no indications that the electric car catches fire, the technical manager will start his assessment of the situation in and around the electric car and other vehicles as a starting point.

It is important that the technical manager is aware of a number of conditions early in the operation to secure the electric car, before the crew is deployed for rescue work in and around the electric car.

The manufacturer's instructions for handling a specific electric car model are followed, but a number of precautions should be taken, as an electric car damaged in traffic could have serious damage to the high-voltage battery and cables, which are not immediately visible, cf. the manufacturer's instructions.

The technical manager can also use resource tools, such as the app's Euro Rescue or others for locating the main switch as well as the location of cables, wires, 12 V and high-voltage batteries, motors, etc. For further reconnaissance for damage and breakage of bodywork and components, a thermal camera can also in some cases is used.

On arrival at the scene of the accident, it is the technical manager who directs the location of the emergency vehicles and ensures the safety of the deployed forces at the scene of the accident. The technical manager should include in his considerations how the internal barrier is established as well as the construction of the accident site with its facilities and the location of material, waste and personnel depots.

The site of injury or at least the danger area should be marked and separated as a high voltage workplace. Whether this can be done so early in the effort as a physical marking with mine strip or a statement to the crew will be a concrete assessment.

When setting up the scene of the accident and danger area, it is important that the technical manager ensures that the danger area is large enough so that crews and any other emergency responders who are in the vicinity of the area are wearing the necessary protective equipment.

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Work with high voltage is cordoned off and separated as a minimum around the danger area. Here the risk of the electric car spontaneously bursting into flames due to damage to the battery pack should be taken into account.

It is recommended that safety hoses with a total water output of min. 400 l/min – also without visible smoke from the high-voltage battery.
The high water output is due to the imminent danger of fire in the high-voltage battery (due to deformations) a large water consumption over a long period of time must be expected if the high-voltage battery catches fire and needs to be cooled.

During the rescue operation A special feature of a rescue operation is that it will involve physical contact with the electric car. Therefore, all preparation for release such as unblocking the electric car, disconnecting the main switch and the 12 V battery, etc. handled with an extra focus on the crew's work with excitement.

In terms of safety, the focus is on correct use of equipment (tools) and personal protective equipment (PPE).

The crew is deployed with insulated tools and safety equipment, including includes face shield, insert mouth ring (approved for protection against electric arcs EN 61482-1 and 2), safety gloves (approved up to 1000 V) and possibly insulating cover in case of damage and cuts to the electric car.

It is also assessed whether insulated tools, equipment and protective equipment should be used if the crew is later to assist with moving the electric car.

See in detail in the section on the use of equipment and protective equipment and in the appendix on 'Tools, equipment and protective equipment'.

The crew must not be deployed until the technical manager has made his assessment of the situation at the scene of the accident. Designing the scene of the accident as well as the danger area is important in this process. It is important that ambulance rescuers do not have physical contact with the electric car, as they are not supposed to be wearing the right clothing.

As there is a possible risk that the crew may come into contact with the electric car's electrical components in connection with the work, it is ensured that only crews with approved safety equipment work in the cordoned off/ marked danger area.

It is of significant importance that the main switch in the electric car is disconnected, if this has not happened automatically. Thus, a risk of electric shock only arises if damage has occurred to the high-voltage electrical components, here under the high-voltage battery, or if a fire has occurred in the high-voltage battery.

Often, the electric car's propulsion system will be connected with a main switch, which is disconnected in the event of a traffic accident. The high-voltage battery and the electrical components are built as a closed system that functions independently and is separated from the rest of the electric car's construction.

By disconnecting the main switch, it is ensured in intact electric cars that all live cables and wires in the electric car are de-energized, then only the battery pack itself is live.

The high-voltage battery itself cannot be de-energized.

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to the effort. In ıe efforts, there will probably not be a dange ew getting an electric shock ne electr ctrical components or the high-e battery

However, the focus should be on the fact that damage to the electric car has resulted in the safety systems not working correctly, cf. the manufacturer's instructions.

It is mostly likely that the electric car cannot drive by itself when the main switch is disconnected. If the main switch is not switched off, there is a minimal risk that – if the electric car is in gear – it can drive on its own.

It is therefore important that the electric car is secured if the ne risk is assessed to be present. Electric cars have a large torque, which means that the fuse must be effective. The electric car can be secured by putting it out of gear, making a block or using wedges under the fenders.

Due to the risk of contact with live parts, the technical manager should make clear markings on the body where the crew may cut.

A first aider may only be deployed in the car's cabin when the technical manager has ensured that there is no risk of voltage in the bodywork or contact with voltage. A safety cover approved for 1000 V can be used on cables or other items that are not considered safe. The first aider should be wearing the correct personal protective equipment (PPE).

In order to minimize the risk of damage to people or equipment, it is important that the technical manager and the crew continuously assess the situation in relation to the development of damage as well as the current risks of developing a fire in the high-voltage battery during the entire effort.

Attention is directed to the risk of the effort developing, as the fire smoke from a

hydrofluoric acid.

The deployed personnel sh
install full respiratory protection, w in the event of a fire developing in the electric car, so as to avoid exposure to fire smoke mv.

A distinction is generally made between whether there is a risk of exposure to fire smoke or gases and liquids from the electric car's high-voltage battery.

As with the reconnaissance at the start of the deployment, a thermal camera can be advantageously used to monitor any temperature changes in the high-voltage battery. See other precautions in the event of a fire in electric cars in the themed booklet 'Efforts in the event of a fire in electric and hybrid cars'

When a fire develops in the electric car, it should be taken into account that persons without respiratory protection do not stay in a possible plume of smoke or in areas suspected of various escaping gases that are not ignited.

After action

After release, the crew can continuously take temperature measurements to monitor a possible temperature change in the high-voltage battery.
If a temperature rise is detected, it must be assumed that a 'thermal runaway' has started in the battery pack.

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Due to this process and a continued voltage on the battery, the high-voltage battery can generate heat long after the accident has occurred or a possible fire has been extinguished, and the electric car appears cooled down. This can be 24 hours after ignition or damage to the high-voltage battery.

The technical manager at the scene of the accident should ensure that the electric car does not roll or drive. This can be done by turning off the main switch and handing the ignition key to the transporter, who must handle the task afterwards, if this exists.

If there are exposed wires, cables or a visibly defective battery, this should be marked so that there is no risk of injury to other emergency responders and the transporter.

Safety markings in the form of cordoning and signage are maintained after the rescue team has completed the effort.

Before the place of damage is handed over, an adequate handover of damage to the electric car and handling of the electric car should be carried out to the police or the carrier.

If the deployed crew has been in contact with fire smoke, gases from the high-voltage battery or extinguishing water with a presumed high concentration of hydrofluoric acid, increased attention should be paid to removing masking, cleaning, etc., as well as attention to any symptoms.

IMPORTANT KNOWLEDGE FOR THE FIREFIGHTER

When it comes to an electric car, the work tasks change in the five phases of the release.

- Tools and equipment approved for 1000 V are used throughout the effort.
- Personal protective equipment (PPE) if for work with tension and the risk of fire, smoke and gases - preparation for the installation of full respiratory protection.
- Laying out safety hoses with a water output of 400 l/min.
- Marking with mine strip (black/yellow) - distance min. 1 m from the electric car.
- Avoid touching the electric car unnecessarily.
- Personal safety when disconnecting the electric car's main switch.
- Follow the technical manager's instructions and marking of clips on the electric car.
- Two people work with tension to be able to give a shoulder push by colleague's contact with tension.
- Avoid twisting and pulling on the electric car's bodywork and parts around the high-voltage battery as far as possible.
- Safety distance when extinguishing work in live parts.
- Monitoring the development of heat in the battery, which may indicate 'thermal runaway'.
- See also overview of work tasks for the five phases of liberation

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been injured efined as a traffic accident with a vehicl blic road, street, square or ar, whe t one of the parties involved accide en the driver of a vehicle and can stand without damage. No one needs emergency treatment.

Before action During the drive, information is obtained about which electric car is involved. It is advantageous to use the resource tool as soon as possible and, if necessary, post in the rescue sheets.

Upon arrival, a visualization is made of whether the electric car immediately works intact or not.

Damage, including any deformations in the battery pack, can cause a risk of voltage and the risk of fire increases. Provision is made for this in the effort.

Follow the manufacturer's instructions with attention to the consequences of any damage to the high-voltage battery and cables.

Emergency response vehicles are directed to a location that ensures the safety of the deployed forces. In constructing the scene of damage and danger area, it is important to ensure that the danger area can be adapted if the effort develops.

It is ensured that the crew is deployed in the danger zone (min. 1 m from the electric car) with the correct use of tools and equipment and personal protective equipment (PPE), which is approved for 1000 V.

It is recommended th ses with a t water output of min. 40 smoke from the high-voltag

If the electric car is not moved by the emergency services, the electric car can be secured so that it cannot move. The technical manager can also request the electric car's ignition key.

When 'Traffic accident - No injury' has been assessed as a tactic, the technical manager knows that the crew has more time to handle the electric car, where there will be a risk of tension in the body etc.

Under effort

Damage or exposure to the electric car's high-voltage battery, cables and wires with high voltage increases the risk that there may be high voltage in the electric car's body when the crew has to handle the electric car.

The crew must not be deployed until the technical manager has made his assessment of the situation and looked at the damage site. It is ensured that only personnel with approved safety equipment work in the danger area.

Disconnecting the main switch will de-energize live cables and wires in intact electric cars.

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However, the focus should be on the fact that damage to the electric car has meant that it is not intact and that the safety systems are not working correctly, cf. the manufacturer's instructions.

Attention is directed to the risk of the effort developing. The deployed crew puts on full respiratory protection in the event of a fire developing in the electric car.

Any temperature changes in the high-voltage battery are monitored.

When a fire develops in the electric car, it should be taken into account that people without respiratory protection do not stay in a possible plume of smoke.

After effort

The technical manager at the scene of the accident should ensure that the electric car does not roll or drive. This can be done by turning off the main switch.

The ignition key is delivered to the carrier, who must handle the task afterwards. In addition, an adequate survivability of the electric car should be carried out.

Blocking off and signage will be maintained after the emergency services have completed their efforts. Barely laid wires, cables or a visibly defective battery should be marked.

Continuous monitoring of any temperature changes in the high-voltage battery continues.

It is ensured that the employed personnel take off their mouthpieces and respiratory protection according to correct instructions

Photo: The National Emergency Management Agency

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the casualty' n is stable at ABC and non-critical in tim is tactic, the focus is on ving the the injured person, and ne other und, with a time estimate of approx. 20-25 min. Controlled release is also carried out using the five phases of release.

Before action During the drive, information is obtained about which electric car is involved. It is advantageous to use the resource tool as soon as possible and, if necessary, post in the rescue sheets.

Upon arrival, a visualization is made of whether the electric car immediately works intact or not.

As a starting point, a visual overview will help to establish visible damage or indications of damage to the electric car, such as exposed wires and cables, deployed airbags, type of accident, e.g. collision.

The first impression can contribute to considerations about the access route for first aid, ambulance, transporter, etc. as well as the use of a thermal camera for temperature development of the electric car's high-voltage battery.

Damage, including any deformations in the battery pack, can cause a risk of voltage and the risk of fire increases. Provision is made for this in the effort.

Follow the manufacturer's instructions with attention to the consequences of any damage to the high-voltage battery and cables.

Emergency response vehicles are directed to a location that ensures the safety of the deployed forces. In constructing the scene of damage and danger area, it is important to ensure that the danger area can be adapted if the effort develops.

equipment (PPE), wh ved for 100

Marking of the injury site/d with high voltage is establishe manager should include in his considerations how the internal barrier is established as well as the structure of the accident site with its facilities and the location of material, waste and personnel depots.

Since there is a need for release, it must be expected that the high-voltage battery may be damaged. This increases the risk of fire, which can cause i.a. large quantities of dangerous gases, i.a. hydrogen fluoride (HF gas).

In the event of a fire developing in the electric car installation, full respiratory protection is provided to avoid exposure to fire smoke. When a fire develops in the electric car, it is taken into account that persons without respiratory protection do not stay in a possible plume of smoke.

It is recommended that safety hoses with a total water output of min. 400 l/min – also without visible smoke from the high-voltage battery.

A thermal ka can be advantageously used

mera to monitor any temperature changes in and around the high-voltage battery.

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If the electric car is not moved by the emergency services, the electric car can be secured so that it cannot move. The technical manager can also request the electric car's ignition key.

If in the effort there are no indications that the electric car catches fire, the technical manager will start his assessment of the situation in and around the electric car as well as other vehicles and the release itself.

When 'Controlled release' has been assessed as a tactic, the technical manager knows that the crew must handle the electric car, where there will be a risk of tension in the body etc., and that they must enter the electric car.

The five phases of liberation help to structure the process. It is important that the crew takes the necessary precautions when working around and inside the electric car.

During the effort

Depending on the deformation of the electric car's body series, and the immediate damage that can be seen, the technical manager will assess the tactical approach to the effort.

It is to be expected that the high-voltage battery and the electrical components, due to damage, can no longer be described as a closed system, and that there will thereby be physical connections with the rest of the electric car's construction.

There will be a probable danger of the crew getting an electric shock from the electric car's electrical components or the high-voltage battery if the necessary precautions are not taken.

The technical manager should be aware that the manufacturer's instructions for safety, here when disconnecting the main switch in the electric car, do not necessarily work as intended.

In order to minimize the risk of damage to people or equipment, it is important that the technical manager and the crew continuously assess the situation in relation to the development of damage and the current risks.

The condition of persons who are unable or unable to get out of the electric car by themselves is checked, either by the crew or the health services. It is important that ambulance rescuers do not have physical contact with the electric car, as they are not supposed to be wearing the right protective clothing.

The person can be trapped or not trapped depending on the need for an actual release. As sub-points, the person can be critical or non-critical on ABC.

In the case of controlled release, the firmly clamped is assessed as not time-critical.

In the event that it is assessed that there has been damage to the electric car's high-voltage battery, cables or wires with high voltage have been exposed, there will be a risk of exposure to high voltage in the electric car's bodywork when the crew
have contact with or need to enter the electric car.

First aiders wearing correct personal protective equipment (PPE) can be deployed when the technical manager has ensured that there is no risk of voltage in the bodywork or contact with voltage, including the high-voltage battery.

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collar and safe approved up to 1000 V).

ting cov ed on all potential live parts that can be touched and where there is cutting.

If the main switch is disconnected, the electric car should not be able to start and drive by itself. The electric car may possibly be bricked up.

Only if it is assessed that the electric car, apart from the battery, is voltage-free and without risk of voltage in the body, the safety equipment used against voltage can be removed.
However, there will always be voltage on the battery pack itself.

If, on the other hand, voltage is found in the bodywork, cables, wires, etc. do not remove the safety equipment against voltage. If it is possible to remove, insulate or cover cables and wires that pose a risk, this is done with caution.

The handling of the injured person is carried out by the personnel who are in the danger area. Other emergency responders are directed to the correct safety equipment or, alternatively, a location outside the danger area.

There should always be two people present when working with tension to make a shoulder push. This task can be assigned to the security guard.

Attention is directed to the risk that the effort may develop. The deployed crew applies full respiratory protection in the event of a fire developing in the electric car.

account that persons w ving equipm not stay in a possible plu

Any temperature changes in the high-voltage battery are monitored.

After effort

The technical manager at the scene of the accident should ensure that the electric car does not roll or drive. This can be done by turning off the main switch.

The ignition key is delivered to the transporter, who must handle the task afterwards. In addition, an adequate survivability of the electric car should be carried out.

Blocking off and signage will be maintained after the emergency services have completed their efforts. Barely laid wires, cables or a visibly defective battery should be marked.

It is ensured that the employed personnel take off their mouthpieces and respiratory protection according to correct instructions.

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Instant release

Definition: An immediate release is used when it is assessed that the injured person is unstable on ABC and time critical. With this tactic, the focus is on the necessity of rescuing the injured within 10 minutes.

Before
action During the drive, information is obtained about which electric car is involved. It is advantageous to use the resource tool as soon as possible and, if necessary, post in the rescue sheets.

Upon arrival, a visualization is made of whether the electric car immediately works intact or not.

As a starting point, a visual overview will help to establish visible damage or indications of damage to the electric car, such as exposed wires and cables, deployed airbags, type of accident, e.g. collision.

The first impression can contribute to considerations about the access route for first aid, ambulance, transporter, etc. as well as the use of a thermal camera for temperature development of the electric car's high-voltage battery.

Damage, including any deformations in the battery pack, can cause a risk of voltage and the risk of fire increases. Provision is made for this in the effort.

Follow the manufacturer's instructions with attention to the consequences of any damage to the high-voltage battery and cables.

Emergency response vehicles are directed to a location that ensures the safety of the deployed forces. In constructing the scene of damage and danger area, it is important to ensure that the danger area can be adapted if the effort develops.

It is ensured that the crew is deployed in the danger zone (min. 1 m from the electric car) with the correct use of tools and equipment and personal protective equipment (PPE), which is approved for 1000 V.

Marking of the injury site/danger area as a workplace with high voltage is established. The technical manager should include in his considerations how the internal barrier is established as well as the structure of the accident site with its facilities and the location of material, waste and personnel depots.

Since there is a need for release, it must be expected that the high-voltage battery may be damaged. This increases the risk of fire, which can cause i.a. large quantities of i.a. HF gas.

In the event of a fire developing in the electric car installation, full respiratory protection is provided to avoid exposure to fire smoke. When a fire develops in the electric car, it is taken into account that persons without respiratory protection do not stay in a possible plume of smoke.

It is recommended that safety hoses with a total water output of min. 400 l/min – also without visible smoke from the high-voltage battery.

A thermal ka can be advantageously used
mera to monitor any temperature changes in and around the high-voltage battery.

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key.

e effort th indications that the electric car catches fire, the technical manager will start his assessment of the situation in and around the electric car as well as other vehicles and the release itself.

When 'Immediate release' has been assessed as a tactic, the technical manager knows that the crew must handle the electric car, where there will be a risk of tension in the body etc., and that they must enter the electric car.

The five phases of the liberation will, to the extent possible, help to structure the process, and it is important that the crew takes the necessary team rules when they work around and inside
the electric car.

The technical manager starts from the five phases of liberation, but the time horizon is a significant factor in this process. The assessment of the right technical cuts is important, as one should prioritize as few cuts as possible and a plan B should a need arise for a faster rescue. The technical manager marks the place ring of clip..

Consideration will be given to both the time for the rescue and the safety of the crew when cutting and other physical contact with bodywork etc. The focus will be on the risks that may arise around the areas that are released

from.

During the effort

Depending on the deformation of the electric car's body series, and the immediate damage that can be seen, the technical manager will assess the tactical approach to the effort.

It is to be expected that the high-voltage battery and the electrical components will not lean due to damage

There will be a probable d
electric shock from the electri
or the high-voltage battery if the nece ions are not taken.

The technical manager should be aware that the manufacturer's instructions for safety, here when disconnecting the main switch in the electric car, do not necessarily work as intended.

In order to minimize the risk of damage to people or equipment, it is important that the crew and the technical manager continuously assess the situation in relation to the development of damage and the current risks.

The condition of persons who are unable or unable to get out of the electric car by themselves is checked, either by the crew or the health services. The person may be trapped or not trapped depending on the need for an actual release. As subpoints, the person can be critical or non-critical on ABC.

In case of immediate release, the jammed person is assessed as time critical.

In the event that it is assessed that there has been damage to the electric car's high-voltage battery, cables or wires with high voltage have been exposed, there will be a risk of exposure to high voltage in the electric car's bodywork when the crew
have contact with or need to enter the electric car.

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First aiders wearing correct personal protective equipment (PPE) can be deployed when the technical manager has ensured that there is no risk of voltage in the bodywork or contact with voltage, including the high-voltage battery.

In terms of safety, the focus is on correct use of insulated tools and equipment, as well as personal protective equipment (PPE), i.a. helmet with visor, insert collar and safety gloves (approved up to 1000 V).

Insulating covering is used on all potential live parts that can be touched and where there is cutting.

If the main switch is disconnected, the electric car should not be able to start and drive by itself. The electric car may possibly be bricked up.

Only if it is assessed that the electric car, apart from the battery, is voltage-free and without risk of voltage in the body, the safety equipment used against voltage can be removed.
However, there will always be voltage on the battery pack itself.

If, on the other hand, voltage is found in the bodywork, cables, wires, etc. the safety equipment against voltage is not removed. If it is possible to remove, insulate or cover cables and wires which pose a risk, this should be done with caution.

The handling of the injured person is carried out by the personnel who are in the danger area. Other emergency responders are directed to the correct safety equipment or, alternatively, a location outside the danger area.

There should always be two people present when working with tension to make a shoulder push. This task can be assigned to the security guard.

Attention is directed to the risk that the effort may develop. The deployed crew puts on full respiratory protection in case of a fire developing in the electric car.

It is recommended that safety hoses with a total water output of min. 400 l/min – also without visible smoke from the high-voltage battery. When a fire develops in the electric car, it should be taken into account that people without respiratory protection do not stay in a possible plume of smoke.

Any temperature changes in the high-voltage battery are monitored.

After effort

The technical manager at the scene of the accident should ensure that the electric car does not roll or drive. This can be done by turning off the main switch.

The ignition key is delivered to the carrier, who must handle the task afterwards. In addition, an adequate survivability of the electric car should be carried out.

Blocking off and signage will be maintained after the emergency services have completed their efforts. Barely laid wires, cables or a visibly defective battery should be marked.

It is ensured that the employed personnel take off their mouthpieces and respiratory protection according to correct instructions.

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assessed that sk of fire in the electric car, in the event of ar with dangerous substances, if ured pe conscious without breathing or emergen s assess the injured person's ability to be ve. With this tactic, the focus is on life rather than behavior, and the deliverance must take place here and now.

Before action

During the drive, information is obtained about which electric car is involved. It is advantageous to use the resource tool as soon as possible and, if necessary, post in the rescue sheets.

Upon arrival, a visualization is made of whether the electric car immediately works intact or not.

As a starting point, a visual overview will help to establish visible damage or indications of damage to the electric car, such as exposed wires and cables, deployed airbags, type of accident, e.g. collision.

The first impression can contribute to considerations about the access route for first aid, ambulance, transporter, etc. as well as the use of a thermal camera for temperature development of the electric car's high-voltage battery.

Damage, including any deformations in the battery pack, can cause a risk of voltage and the risk of fire increases. Provision is made for this in the effort.

Follow the manufacturer's instructions with attention to the consequences of any damage to the high-voltage battery and cables.

important to ensure that rea can be a if the effort develops.

It is ensured that the crew is deployed in the danger zone (min. 1 m from the electric car) with the correct use of tools and equipment and personal protective equipment (PPE), which is approved for 1000 V.

Marking of the injury site/danger area as a workplace with high voltage is established if possible. In practice, emergency relocation will be a notification of the danger zone.

Since there is a need for release, it must be expected that the high-voltage battery may be damaged.
This increases the risk of fire, which can cause i.a. large quantities of i.a. HF gas.

In the event of a fire developing in the electric car installation, full respiratory protection is provided to avoid exposure to fire smoke. When a fire develops in the electric car, it is taken into account that persons without respiratory protection do not stay in a possible plume of smoke.

It is recommended that safety hoses with a total water output of min. 400 l/min – also without visible smoke from the high-voltage battery.

A thermal ka can be advantageously used
mera to monitor any temperature changes in and around the high-voltage battery.

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If the electric car is not moved by the emergency services, the electric car can be secured so that it cannot move. The technical manager can also request the electric car's ignition key.

If in the effort there are no indications that the electric car catches fire, the technical manager will start his assessment of the situation in and around the electric car as well as other vehicles and the emergency evacuation itself.

When 'Emergency relocation' has been assessed as a tactic, the technical manager knows that the crew must handle the electric car, where there will be a risk of tension in the body etc., and that they must have physical contact with the electric car.

Parts of the release's five phases will, if possible, help to structure the process, and it is important that the crew take the necessary precautions when working around and inside the electric car. The challenge of this tactic is that the rescue must take place here and now, but safety for the crew is important in this process.

The technical manager assesses, in collaboration with the health emergency services, whether the emergency evacuation process is the correct tactic with the safety challenges it can pose for the crew.

The technical manager starts from the five phases of liberation, but the time horizon is a significant factor in this process. The assessment of the right technical clips is important, as you should prioritize as few clips as possible and a plan B.
The technical manager marks the location of clips.

For the injured person, it will be about life rather than mobility. Consideration will be given to both the time for the emergency relocation and the safety of the crew when cutting and other physical contact with bodywork etc. Attention will be quite close to the risks that may arise around the areas being released from.

During the effort

Depending on the deformation of the electric car's body series, and the immediate damage that can be seen, the technical manager will assess the tactical approach to the effort.

It is to be expected that the high-voltage battery and the electrical components, due to damage, can no longer be described as a closed system, and that there will thereby be physical connections with the rest of the electric car's construction.

There will be a probable danger of the crew getting an electric shock from the electric car's electrical components or the high-voltage battery if the necessary precautions are not taken.

It is important that ambulance rescuers do not have physical contact with the electric car, as they are not supposed to be wearing the right clothing.

The technical manager should be aware that the manufacturer's instructions for safety, here when disconnecting the main switch in the electric car, do not necessarily work as intended.
In order to minimize the risk of damage to people or equipment, it is important that the technical manager and the crew continually assess the situation in relation to the development of damage and the current risks.

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is taken into a e risk assessment of the crew's safety.

ondition ured persons who cannot or cannot get out of the electric car on their own is checked continuously by either the crew or the health emergency services.

In the event that it is assessed that there has been damage to the electric car's high-voltage battery, cables or wires with high voltage have been exposed, there will be a risk of exposure to high voltage in the electric car's bodywork when the crew have contact with or need to enter the electric car.

First aiders wearing correct PPE can be deployed when the technical manager has ensured that there is no risk of voltage in the bodywork or contact with voltage, including the high-voltage battery.

In terms of safety, the focus is on correct use of insulated tools and equipment, as well as personal protective equipment (PPE), i.a. helmet with visor, insert collar and safety gloves (approved up to 1000 V).

Insulating covering is used on all potential live parts that can be touched and where there is cutting.

If the main switch is disconnected, the electric car should not be able to start and drive by itself. The electric car may possibly be bricked up.

The handling of the injured person is carried out by the personnel who are in the danger area. Other emergency responders are directed to the correct safety equipment or, alternatively, a location outside the danger area.

Attention is drawn to the ris
The deployed crew wears full resp ion in the event of a fire developing in the electric car.

Safety hoses (total water output of at least 400 l/min) are also maintained throughout the operation. When a fire develops in the electric car, it should be taken into account that persons without life-saving equipment do not stay in a possible plume of smoke.

Any temperature changes in the high-voltage battery are monitored.

After effort

The technical manager at the scene of the accident should ensure that the electric car does not roll or drive. This can be done by turning off the main switch.

The ignition key is delivered to the carrier, who must handle the task afterwards. In addition, an adequate survivability of the electric car should be carried out.

Blocking off and signage will be maintained after the emergency services have completed their efforts. Barely laid wires, cables or a visibly defective battery should be marked.

It is ensured that the employed personnel take off their mouthpieces and respiratory protection according to correct instructions.

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Effort with chain rescue

Before action In most rescue situations where it is about freeing trapped people, it is important to act quickly. It may present certain challenges for the technical manager at the scene of the accident to choose the 'chain rescue' method if it is an electric car. There will be a need for them to refine exactly which car model is being worked with, as well as knowledge of the various resource tools that can be used.

Most electric cars now have a flat Li-ion battery located at the bottom of the body. This means that the driver and passengers are sitting (tightly clamped) on top of an electrical system with a high voltage of up to 1000 V. It is not without risk to use the 'chain rescue' method.

When it is assessed that 'Chain rescue' is the right method for a quick release, in the specific situation it will be a collaboration between the technical manager and the health emergency services at the scene of the accident to make this decision.

When using chain rescue, standard cuts will be carried out as part of the technique. The technical manager assesses – during the process of chain rescue – whether it will be a sound technique with the safety-related challenges it may pose for the crew.

The technical manager starts from the chain rescue system, but the time horizon is a significant factor in this process. For the trapped, it will be about life rather than equality.

Consideration will be given to both time for chain rescue and safety for the crew when cutting and other physical contact with bodywork etc. The focus will be on the risks that may arise around the areas that are released from.

During action

Depending on the condition of the electric car, deformation of the bodywork, and the damage that can be seen, the technical manager will assess the tactical approach to the action. It is to be expected that the high-voltage battery and the electrical components can no longer be described as a closed system due to damage.

There will thereby be physical connections with the rest of the electric car's construction. There will be a probable danger of the crew getting an electric shock from the electric car's electrical components or the high-voltage battery if the necessary precautions are not taken.

In the process of securing the electric car, it is therefore important that there is a focus on the personal safety of the crew and any other actors who are at the scene of the accident and the danger area.

As a starting point, a visual overview will help to establish visible damage or indications of damage to the electric car, where deployed air bags indicate de-energized cables in the car's bodywork. This will minimize the risk that the technical clips in the chain rescue pose a risk to the crew.

If the airbags are not triggered, the location of the main switch is ensured, so that the risk of voltage in the bodywork or cables is shut down. However, the high-voltage battery will always be live and direct contact with this should be avoided.

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not necessaril ntended.

er to mi risk of damage to people or
nent, it i nt that the technical manager and the crew continuously assess the situation in relation to the development of damage as well as the current risks where the chain rescue is used. As a starting point, the time horizon for using the 'chain rescue' method is approx. 10 minutes to get the stuck one out.

drives on the electric c

It is important to minimize t
with the battery pack. The technical side can benefit from using resource tools - here, as previously mentioned, we are thinking of apps such as Euro Rescue or others for the placement of cables, etc.

Photo: The National Emergency Management Agency

Marking cuts on the electric car

In order to minimize the risk of damage to people or equipment, it is important that the technical manager and the crew continually assess the situation in relation to the development of damage as well as the current risks that may arise when technical relief cuts are carried out at the visible markings that the technical manager has indicated on the electric car.

Depending on which tactics are used to free someone stuck in an electric car, the technical manager instructs the safety in the placement of relief and technical clips. In order to secure the strategy, the technical manager should visibly mark the places on the electric car where the technical clips are placed.

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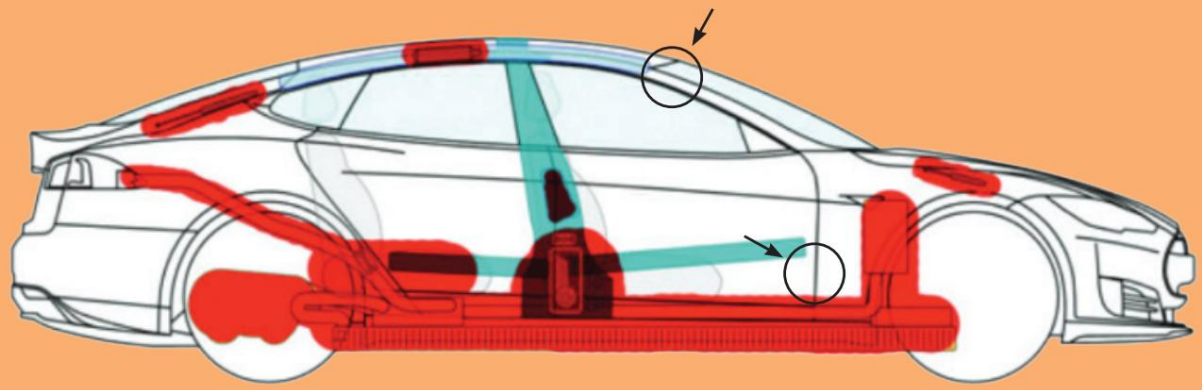
LOCATION OF RELIEF CLIPS



The picture shows an electric car, where the technical relief clips are drawn with circles. You can also see the areas (in red), particularly at the bottom of the car, where the battery pack is taken into account.

Relief clips located at the exit of the A-pillar do not pose a risk of contact with the battery pack, which may be located at the bottom or other low location, for example under the seats or in the luggage compartment.

Relief clips located at the bottom of the front door can be made without risk of contact with the battery pack. But it requires extra attention and knowledge about the placement of the battery pack compared to the placement of the top clip. Therefore, it should be the technical manager who records the location, including the maximum depth of the relief rock.

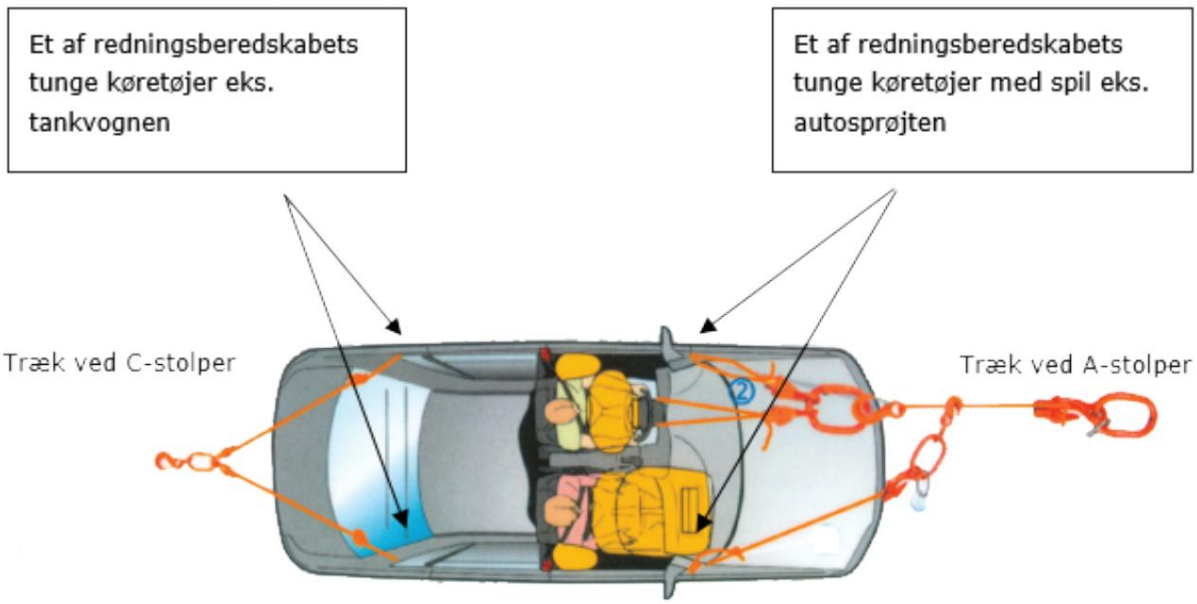
The points where the electric car is pulled are supplied with large forces, which can pose a risk to the battery pack itself. As the front end of the car is pulled or bent down towards the ground, at the same time as the rest of the electric car is tilted up into the air, pressure or displacement of the battery pack may occur, depending on where it is placed.

The extent of deformation and the size of the battery pack may increase the risk of a chemical reaction in the battery pack which could lead to a spontaneous fire.

Machine Translated by Google

do not neces k as intended.
It should be considered whether chain
e is initi his could lead to impact or
mation h-voltage battery and thus
increase the risk of fire.

important that the loc pull is car
assessed for the impac
cables with high voltage, in and
the steering column (indicated with Z in the
illustration below).



The illustration is a three-chain system, which differs from the two-chain system by having a pull around the steering column. Traction is anchored to, for example, one of the rescue services' heavy vehicles, which are not shown in the illustration.

Monitoring of any temperature changes in and around the high-voltage battery is carried out throughout the operation.

Safety hoses are also maintained throughout the effort. When a fire develops in an electric car, it is taken into account that persons without fire protection do not stay in a possible plume of smoke

After effort

The technical manager at the scene of the accident should ensure that the electric car does not roll or drive. It can be done in that the main switch is disconnected and that the ignition key is delivered to the recovery company, which will handle the task afterwards.

If there are exposed wires, cables or a visibly defective battery, this should be marked so that there is no risk of injury to other emergency responders and rescue personnel.

There should also be an adequate handover of the electric car for further handling.

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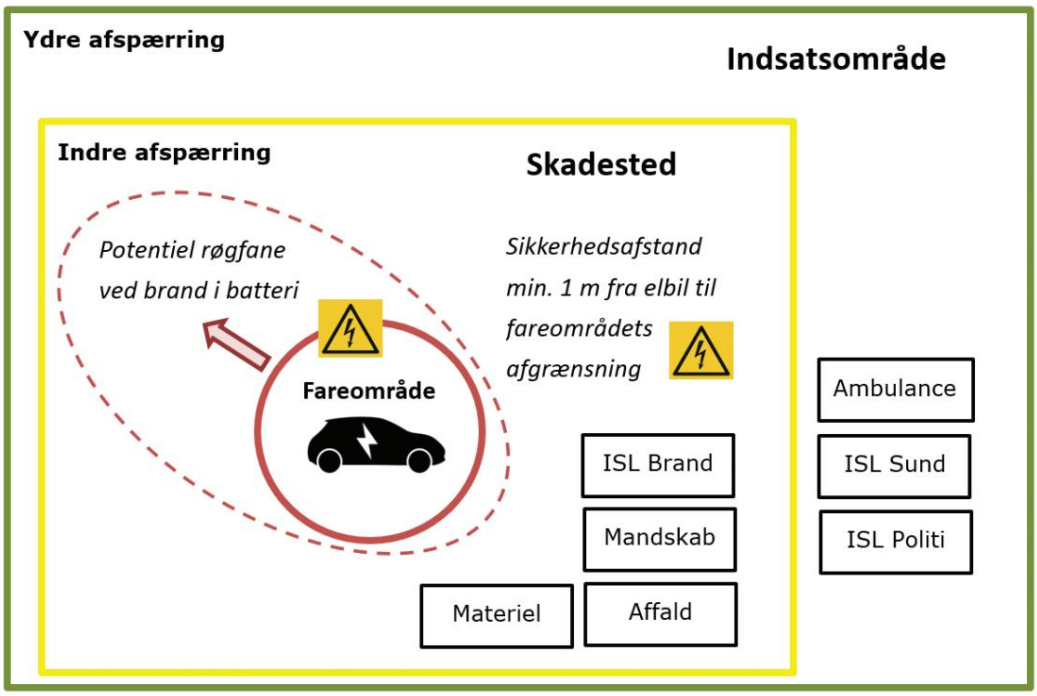
The technical manager's challenges

Construction of the damage site and danger area
Securing the work area in the form of marking with mine strips around the danger area is important and is implemented quickly. Distance to the electric car should be min. 1 m. It is important that the technical manager ensures that the internal barrier is large enough so that personnel who have not put on full respiratory protection and other emergency responders around the scene of the accident are not exposed to possible fire smoke.

This also applies to the location of depots (material, personnel and waste) and investment vehicles. Since there is a risk of a fire developing in the event of damage to the high-voltage battery, there are a number of conditions that the technical director should include in the build-up of the damage site early in the response process. It is:

- Need for extra manpower and material, as the effort may risk being long-lasting.
- Fixed or continuous water supply.
- Logistics around fire suits, compressed air devices, etc
- Blocking off the danger area with markings for work with high voltage.
- Potential plume of smoke in the event of a fire in the battery pack ken.

Furthermore, the technical manager should be aware that the effort risks developing, as the fire smoke from an electric car's high-voltage battery develops large quantities of HF gas and other gases. The described elements should be taken into account by the technical manager when internal containment is established and the structure of the accident site with its facilities is placed.



The structure of the scene in the event of a traffic accident with the need to free trapped persons or risk of fire.
Illustration: The National Emergency Management Agency

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operations in ıal cars. Calling in a task manager sho ısidered. The team leader can ally be tl al leader in the effort, and a ole effor an be the tactical leader. Depending on the situation, the two roles are adapted.

In particular, the risk assessment plays an important role for the project leader and the team leader, as the focus should be on both rescue and the risk of fire. In practice, this will mean that the first phase of the five phases of liberation will often be more resource- and time-consuming than usual.

When an electric car is involved in a traffic accident – with or without personal injury – the high-voltage battery is exposed to a mechanical impact that can damage it and thus initiate a process in the battery – 'thermal runaway' – even long after the initial response has been completed .

Risk assessment
The first phase of the release's five phases, with an overview and securing of the scene of damage, will be challenging for the response team's desire to initiate the effort and ensure action towards the injured person or persons.

Furthermore, it is essential that the danger area is identified and determined, so that all deployed personnel; fire, ambulance and police, are knowledgeable about where it is safe and where it is not safe. This places special demands on the technical manager's risk assessment, as the safety of the deployed crew has the highest priority.

It is important that the technical manager makes a decision as soon as possible on response tactics with an immediate (life-threatening) or controlled (non-life-threatening) release due to the casualty's condition. But the risk assessment should be continuously reassessed.

right decision. In this ı is recommer that the technical mana possible task leader to reve .s.

Response
tactics The duration of the response will generally be longer, both in the acute phase and in the subsequent clean-up phase. The reason for this is that the focus on one's own safety is essential and that it is time-consuming to secure the crew against accidental incidents, especially in relation to tension when they are deployed for release.

In order to ensure a quick and efficient release, it is essential that an overview is quickly secured of where it is possible to cut and spread the bodywork apart, without compromising the safety of the deployed crew.

If there is damage to the battery, this could be aggravated by twisting the bodywork. It should be weighed based on the risk assessment, which tactics should be used with a view to causing minimal damage to the electric car's battery pack and cables.

Expected greater resource consumption
Rescue from traffic accidents involving electric cars is generally more manpower-intensive than traffic accidents involving conventional cars. This is particularly evident when freeing trapped people, where there is a greater need for manpower, as account should be taken of the special danger posed by the electric car's high-voltage battery, if for tension in the bodywork and 'thermal runaway'.

The phase and role division of the liberation requires extra work for e.g. the security man if no additional manpower is provided. This is due, among other things, to the need to man safety hoses with a total water output of at least 400 l/min.

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This means that in the event of a traffic accident with a person trapped, there should be a focus on rescue efforts, but also on a possible fire effort, as it may be a combination effort.

It will also be a question of a more complex effort than usual, as resources are used to secure the danger area and ensure that other actors at the scene of the accident do not come into contact with the electric car, as well as managerial tasks such as cooperation with the health sector about the injured person and handing over the electric car to the transporter or the police.

Exposure to fire smoke or dangerous gases from the battery

If, during the operation, the crew has been exposed to a possible exposure to fire smoke or outgassing from the high-voltage battery, information should be sought as soon as possible in the 'Dangerous substances' app for the potential health risk at the same time as subsequent observation of the person is initiated.

On the Emergency Management Agency's app 'Dangerous substances' there is information about the dangerousness of substances, safety distance, health risk etc.

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person(s) conc tion should be paid to the following:

evelopme the battery.
•Corrosive and flammable liquids. •Dangerous electrical voltage. •Avoid contact with the electric car. •Avoid open flames.

The damage site should therefore be secured with mine strips and signage with high voltage. In addition, information should be given about the dangers that can be associated with moving the car, including pulling, pushing and lifting it, as this impact can cause a change in the battery's condition, so that, for example, 'thermal runaway' occurs.

Therefore, the incident leader can advantageously engage in dialogue with the police and the transporter to ensure that the transporter that will remove the car is trained in towing electric cars. If there is tension in the body, then knowledge should be obtained from a specialist, e.g. from the manufacturer of the car, who is able to handle this, including the further process of removal.

Overall flow diagram for emergency electric cars

When handing over the scene of the accident to the police or when moving the electric car, the electric car should be placed in a quarantine zone with min. 1 m marking with yellow/black mine strip around the car, as well as maintenance of signage for high voltage, fire hazard and chemicals.

If the transporter is there, der should e
the measures that have be
cf. flow in the task, which can b
the bottom. Alternatively, the information should be given to the police so that they can pass on to the transporter:

- It is an electric car and possibly model.
- Brief description of the efforts of the rescue services: fire extinguishing, extrication (damage to cables).
- Assessment of the condition of the car's high-voltage battery, disconnection of the main switch, voltage.
- The risk of 'thermal runaway' during transport to the workshop and what the transporter should do if this happens.
- Challenge by measuring the tension of the bodywork before loading the car of.
- That the electric car should be placed min. 5 m away from buildings and other flammable material.

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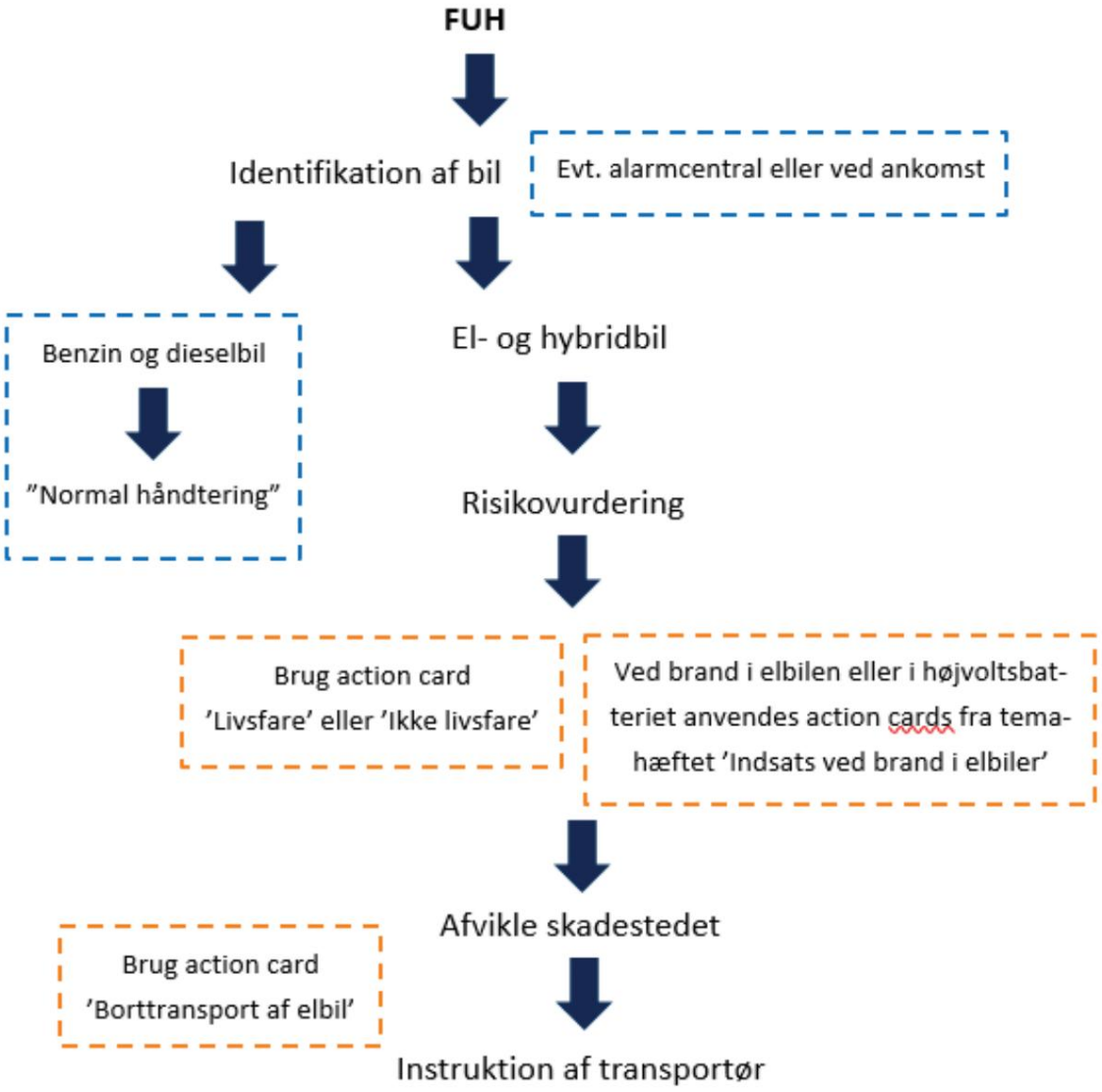
The starting point is action tactics that are well known. The illustration below is a flow diagram which shows where in the response to a traffic accident (FUH) there should be an increased attention to risks that are not necessarily seen when handling petrol and diesel cars (orange dotted boxes).



Flow diagram in the event of a traffic accident

Illustration: The National Emergency Management Agency

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Description of [illegible]

A distinction is made between two types of traffic accidents based on whether or not the persons involved are critical, i.e. life-threatening or non-critical. In addition, it is assessed whether the injured person is stable on ABC.

Not critical - not life threatening
Types of non-fatal accidents:

- Stable on ABC
- Out of the car
- Stuck
- Non-clamped

Critical - life-threatening
Types of life-threatening accidents:

- Unstable on ABC
- Stuck
- Fire in car/battery pack
- Tension in bodywork

Unstable on ABC
The injured person(s) are in danger if they are threatened by one of the three elements:

- Clear airways; state of consciousness
- Threatened their breathing
- Larger open or closed bleeding

ASSESSMENT OF THE INJURED'S CONDITION

- Assessment of whether casualties are critical or non-critical - Trapped or not trapped?

Is the injured person stable on ABC:

- Clear airways? State of consciousness?
- Threatened their breathing?
- Larger open or closed bleeding?
- The assessment of ABC can be usefully stated.

Risk of fire with a threat to people?

- Is there a fire in the electric car?
- Are people trapped or not trapped in the event of a fire?
- Fire protection is provided. To protect against a sudden fire or 'thermal runaway' during the rescue effort, safety hoses with a total water output of at least 400 l/min are laid out.
- Special attention when working with electricity and extinguishing water.

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Identification of the car
A conventional petrol or diesel-powered car has a number of characteristic features, such as the fuel tank, tank cover, exhaust pipe, radiator grille, etc. An electric car, on the other hand, can be more difficult to immediately identify, as it can have some of the same characteristic signs as a fuel-powered car. A number of special characteristics will be able to draw attention to the fact that it is an electric car, for example:

- EV, BEV or ZEV for electric cars as well as PHEV or HEV for hybrid cars and others.
- Some car brands, e.g. Tesla, can be recognized via logo or name, e.g. the text: Zero Emission, Electric, driveE or the letter e or E.

- Presence of a cover for the charging connector (possibly behind the tank cover), charging status indicator in the dashboard, missing engine noise, missing exhaust and missing cooling grille.

- High-voltage cables are colored orange, and warning signs will normally be placed in places in the car where
risk of coming into contact with high voltages from the battery.

Risk assessment
On arrival at the scene of the accident, a 360-degree risk assessment should be carried out, which should include at least the following:

Own risk assessment -
Own safety at the scene of the accident in relation to the surroundings.
- Tension in the bodywork.
- The risk of triggering voltage during work on the electric car.
- Possibility of disconnecting the main switch.
- Location of the ignition key.
- Securing the electric car against driving, possibly like building blocks.
- Contact with the electric car when released from the car only.
-Risiko for 'thermal runaway'.
- Indications of fire in the high-voltage battery or the electric car.

The injured person
- Critical: Threatened at ABC - immediate release rescue or emergency evacuation.
- Non-critical: Non-threatened at ABC – controlled release.
- Risk that damage may occur during removal.

- Access road and safety for first aiders in the electric car. Material to support the risk assessment - Resource tools
(reference works, database) that can identify the special dangers of the electric car.

- Thermic camera.

Marking the site of injury When it comes to work with high voltage, the danger area should be marked, e.g. with mine strip with clear instructions, marking or signage of what it is that constitutes the danger. It is cordoned off with approved black/yellow mine strip with attached signs indicating that there is a voltage hazard behind the cordon. The barrier should be set up at the necessary distance from the potential danger - as min. 1 m from the electric car.

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e.g. a cable b a plug being pulled out of a socket. It is es at the location of these is fied and ıain switch is disconnected.

The crew should be aware that there will typically be several batteries in the individual electric car, both batteries with high voltage and all friendly 12 V operating batteries. The manufacturer's instructions for disconnection are followed as far as possible relation to deformations.

Tools, equipment and protective equipment During the rescue operation, only tools that are approved for use when working with high voltage (1000 V) may be used. Examples of this are insulated tools or other approved tools, if there is an exceptional need to use them on live parts of the electric car.
Ordinary tools, hydraulic release equipment, etc. is not normally approved for work with voltage, which should be taken into account in the effort.

Personal protective equipment (PPE) should always be used to protect the crew against shock when there is or is suspected to be electrical voltage in the bodywork. This applies to all actors at the scene of the accident who come close to or in it
direct contact with the electric car or the bodywork.
This equipment is i.a. safety gloves, protective clothing, boots, helmet with face visor, which is approved for 1000 V.

Protection against fire In order to protect against a sudden fire or 'thermal runaway' during a rescue operation, safety hoses are laid out with a total water output of at least 400 l/min, so that a quick and effective protection of people and possible cooling of the fire.

must transport the elec ay from the of damage. In connectio car on a grill or sweeping bla in the car, which may cause an accidental event with 'thermal runaway' or create an electrical voltage in the bodywork.

The carrier should focus on:

- Risk of fire.
- Heat development.
- Sound.
- Degassing.
- Odors.

When the scene of the accident is left and handed over to other actors, such as the transporter or the police, information on the condition of the electric car and battery pack, the status of switching equipment and any safety devices should be passed on.

Signs and marking of the risk of high voltage are maintained.

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The five phases of liberation and associated tasks

When a rescue effort is carried out in the event of a traffic accident with trapped people, the effort is traditionally carried out according to the five phases of extrication, where each person in the crew has predefined tasks that should be carried out at different times in the effort.

The five phases of a release are:

1. Overview and security.
2. Create access to first aiders.
3. Create space for treatment.
4. Final release.
5. Technical evaluation and defusing.

The individual work tasks for freeing trapped people are defined prior to action in the event of a traffic accident and are carried out with e.g. 6 people divided into team leader, tool operator, foreman, security man and engine attendant.

The team leader is basically the technical leader in the effort, and a possible effort leader will be the tactical leader. Depending on the situation, the two roles are adapted.

Overall, there are the same risks as investing in an ordinary car.

ICE (Internal Combustion Engine)	EV (Electric Vehicle)
Impact, Tearing and Compression	-//-
Fragments (eyes)	-//-
Touch of chemistry	-//-
Protection against rolling or driving	-//-
Sudden ignition of fuel	Delayed reaction in battery
	Risk of electric shock

The above shows the difference in risks in petrol and diesel powered cars and electric cars

Electric car release As a starting point, the five phases are followed in chronological order, also when it comes to efforts in electric cars. There may, however, be deviations in relation to a release from a conventional car with a combustion engine. When it comes to freeing people stuck in an electric car, there will likely be more tasks than men the cabinet normally handles. This is particularly true when vehicles have been involved in:

- High-energy accidents (speed over 70 km/h).
- Traffic accidents where parts of the battery pack are exposed.
- Deformation of the battery pack.

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the battery pa erefore important that the
crew is ready on this combination if there
unexpec opment of heat in the battery

The task of cooling, extinguishing or preventing a fire in the battery pack will go beyond the task that the safety man normally has.
Therefore, there should be personnel specially dedicated to this purpose, as the possible risk of fire in the battery pack entails a number of additional tasks:

- Placement of clip (team lead
- Assessment of risk
- Use of personal protec
- Disconnecting the main switch (high-voltage battery).
- Blocking off and marking with mine-strip.
- Covering with insulating mats.
- Measurement/monitoring of temperature in the bath the tery.
- Laying out safety hose with min. 400 l/min.
- Preparation of the fire response team.

Team leader/technical manager

Situation assessment
Commandment
Assessing access road
Evaluates space options
Assessing release method

Information acquisition
Vehicle data
360 degree risk assessment

1 + 2 - Tool operator

Stabilization
Creates access to battery
Creates access to first aid
Creates space
Liberator

Do not start before permission from the team leader has been given
If there is a risk of tension in the bodywork, personal protective equipment must be fitted

3 - First aid

Visual check of the injured
Provide life-saving first aid and general first aid
Helping therapists
Shielding of therapists and injured persons

Do not start before permission from the team leader has been given

4 - Security guard

Assesses external hazards
Internal barrier
Clears glass
Covers sharp edges
Monitor stabilization
Foreclosure

Disconnect the main switch
Set up physical barriers and signage
Ensure proper covering in accordance with for the intervention
tactic Measuring temperature development

Engine fitter

Lay out the safety hose
Lay out material depot
Carrying clippings to depot

Take care of the work of the 3-year-old when laying out safety hoses

6 + 7 Fire response team

Carry out 1st and 2nd work on safety hoses with a water output of min. 400 l/min.
Install a fume hood, but not air

The figure above shows an example of the distribution of tasks with a fire response team corresponding to HL+ 7. The 'normal' liberation tasks are described in the blue boxes. The additional tasks for electric cars are described in the orange boxes.

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	Team leader	1´er - 2´er	First aid	Security man	Engine fitter	6´er – 7´er
Everyone wears the necessary personal protective equipment (PPE), which meets the individual's risk of exposure to voltage in the electric car as well as gases and fire smoke. Especially when working in the vicinity of or in contact with the electric car, use PPE approved for work with 1000 V.						
Tasks in the 1st phase	Situation assessment Obtain vehicle data 360 degree risk assessment Commandment	Stabilization of the vehicle Install smoke diving equipment if necessary	Assess the injured person(s): Critical? Stable on ABC? Stuck?	Assess external hazards Secure internal containment as well as the danger area Disconnect if possible main switch Measuring temperature in high voltage battery	Prepare material mv. Help the security man, for example, with temperature measurement	Install smoke diving equipment so that air can be installed in the event of leaking gas or a sudden fire in the electric car, or the battery
Tasks in the 2nd phase	Assess access road Assess space options Assess release method r Place branches	Create access to the battery in the vehicle	Keep the focus on the injured Assessment of whether there is a risk of them being exposed to voltage, gases or fire smoke?	Lay out insulating mats if necessary Clean up glass Secure with cover Measure temperature Monitor stabilization of electric car	Lay out B-hose for branches Ensure water supply to the sprayer	Lay out safety hoses Minimum water output of, for example, 400 l/ min with 1st and 2nd. C attack
Tasks in the 3rd phase	Continued assessment and reassessment Possibly take over monitoring of temperature development in the battery	Create space for first aid Create access to the battery pack if necessary	Provide first aid Shield the injured against voltage if necessary Assist pre- hospital staff	Clean up glass Secure any covering sharp edges Monitor stabilization of electric car Ready for shoulder thrust	Operate material depot	Help security man and motor attendant Be ready to secure people and surroundings against gases and fire smoke
Tasks in the 4th phase	Continued assessment and reassessment Possibly take over monitoring of temperature development in the battery	Release jammed	Assist prehospital staff	Secure any covering and shielding Monitor stabilization of temperature Ready for shoulder thrust	Operate material depot	Help security man and motor fitter Be ready to secure people and surroundings against gases and fire smoke
Tasks in the 5th phase	• Handing over the scene of the accident to the police or transporter (team leader) • Review of the effort with a view to. learning points for future efforts electric cars • 'Normal' technical evaluation as well as debriefing if necessary					

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Appendix 1: Characteristics of electric and hybrid cars

Identification

There are quite a few different types of electric cars in the passenger vehicle class, where the propellant is wholly or partly a high-voltage battery based on Li-ion technology. What these have in common is that, in addition to the high-voltage battery, there are live components in the form of cables, wires and converters in the electric car, which have significantly higher voltages than the crew is used to in conventional car systems and 12 V batteries.

The theme booklet focuses on all the types, where the overall term 'electric car' covers both electric cars with Li-ion batteries as the only fuel and the various types of hybrid and plug-in hybrid cars, which are built with both a high-voltage battery (Li-ion) and a petrol or diesel engine. Attention is drawn to the fact that hybrid and plug-in hybrid cars often look like conventional cars, as they have a radiator hood and exhaust from the engine.

Different types of electric vehicles – EV, HEV and PHEV

Electric cars EV (Electric Vehicle) are characterized by the fact that the electric motor together with a 'high voltage battery' is the only source of propulsion. The battery is therefore larger than in a hybrid car, and is typically 45-100 kWh. Other designations can be e.g. BEV (Battery Electric Vehicle) and ZEV (Zero Emission Vehicle). Charging takes place via a charging stand.

In a hybrid car (HEV and PHEV), the 'high-voltage battery' is a supplement to another fuel (petrol/diesel) and has a relatively limited performance - typically 10-20 kWh. The battery can be charged either by consumption of the car's internal combustion engine during regeneration or by cable from a charging station, as with an EV. In a PHEV (Plug-in Hybrid Electric Vehicle), the 'high voltage battery' is typically larger than in an HEV (Hybrid Electrical Ve hicle).

The three photos show different ways of identifying an EV – logo, missing radiator grille, missing exhaust. Photo: The National Emergency Management Agency

A Li-ion battery in an electric car can be described as a high-voltage battery that is characterized by being a compact, lightweight battery that can withstand many discharges and recharging conditions. The batteries are basically safe if they are original and used with the equipment they were sold with or are well known for.

Compared to a conventional petrol- or diesel-powered car, a modern electric car is generally designed based on a central and low-lying battery pack, e.g. in the bottom of the car. The electric car's motors are often located directly at the wheels, which makes the traditional transmission redundant and reduces the number of moving parts.

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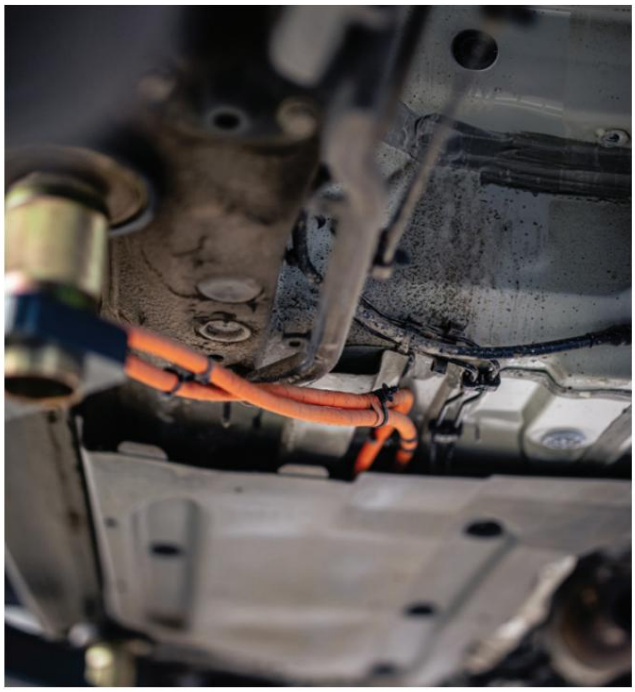
Cables in an electric car The high-voltage battery is connected to various components via the electrical control unit (OBC, converter) and cable routing for e.g. heating system, air conditioning, charger for 12 V battery system, main charger etc. In the case of non-intact electric cars, it is important to know where any damaged cables and wires are located and thereby avoid touching them. Main cables with high voltage are most often routed in a protected central location in the electric car.



The two photos show the battery pack removed and cables in the bottom of the body

Photo: The National Emergency Management Agency

Cables and wires with high voltage, especially in newer electric cars, will be orange in color (orange insulation, orange flex hose), and warning signs will usually be placed in places in the car, where there may be a risk of coming into contact with high voltages from the battery. However, it is important to pay extra attention to all cables that do not look like the regular 12 V wires or are positioned differently, as older cars are not necessarily built according to these guidelines and therefore do not have orange colored cables.

For safety reasons, the high-voltage battery and cables with high voltage as the starting point in an intact electric car are not connected to the car's bodywork, but it cannot be ruled out that such a connection is created in connection with an accident and damage to the electric car's chassis or other construction.

Overall, it is important during the entire rescue effort to focus on the two voltage systems in electric cars – the high-voltage battery and 12 V – as they entail different risks, which are handled independently of each other. The main switch for the high-voltage battery should be disconnected as soon as possible, which is done differently depending on the model. This disconnects voltage in the system, but the high-voltage battery itself will still be under voltage.

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Appendix 2: Safety when working with electric cars

High-voltage batteries in an electric car have a high electrical direct voltage and contain a significantly greater amount of energy than the ordinary 12 V starting batteries in a passenger car with a petrol or diesel-powered engine. By an effort in an electric car is

it is essential for the crew to disconnect the main switch and thereby de-energize all the electric car's systems. The main switch is located differently, depending on the brand/model in question. Electric cars usually have one or more 12 volt batteries, which are disconnected in the usual way. There will continue to be voltage on the 12 V part until one of the battery poles

is dismantled.

High-voltage batteries in an electric car vary in size, voltage and capacity, but typically have a battery voltage between 300 and 600 V. However, there is a trend towards larger electric cars, where the battery voltage is just below the low-voltage limit of 1000 V AC and 1500 V DC. According to IEC 61140:2016 (International Electrotechni

cal Commission) the level of high voltage is above 1000 V AC (alternating current) and 1500 V DC (direct voltage).

At a voltage level less than or equal to 1000 V AC and 1500 V DC, according to IEC, this is not high voltage, but low voltage. This means that technically there is no high voltage in the cars electrical system. When the term 'high voltage' is used in the theme booklet, it must be seen in relation to the voltage normally found in cars with conventional petrol or diesel-powered engines, i.e. the normal 12 V.

Special risks when working with Li-ion batteries High-

voltage batteries in electric cars, which are based on Li-ion technology, have the energy stored using chemicals. Particularly in the event of a fire involving the battery, fire smoke gases such as e.g.
HF gas, CO2, CO and NOxs. Experiments have shown that

The two photos show the location of the main switch in an electric car model with two approaches to the switch - under the bonnet and behind the rear trim in the compartment to the left of the steering wheel.

Photo: The National Emergency Management Agency

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Li-ion batteries in themselves are no more fire dangerous than other batteries, provided the batteries are not damaged or charged with non-approved equipment.

Depending on the car brand, the high-voltage battery can be located in different places in the electric car. Certain car brands have the batteries located in the same place, regardless of model, whereas other car brands have the batteries located in different places. The battery can be located at the bottom of the car, the trunk, under the bonnet or in the middle of the car, between the front seats.

In general, access to the high-voltage battery can be very complicated due to the membranes in the battery pack and a location where accessibility can be extremely limited due to damage to the bodywork. This has an impact on the effort and the time aspect for freeing a stuck person, as it can be problematic to get to the live items and ensure the necessary shielding or insulation of the battery pack and live components.

The location of the high-voltage battery and whether it is damaged has an impact on the technique and response tactics that the crew should use during the response. If chain rescue is used tactically, it can pose a risk of uncontrollable deformations of the electric car's bodywork, cables, wires and the high-voltage battery, which the technical manager should be aware of.

In order to create access to the electric car's essential components, it is important not to cut holes in the bonnet or cut into the car's fenders, as there is a risk of hitting components with high voltage if the main switch is not switched off. Cables and high-voltage systems will typically be colored orange.

Applicable legislation, regulations and standards

The Emergency Response Act applies to the rescue services' efforts in relation to rescuing people life and animals in connection with traffic accidents. The theme booklet is based on some general principles for response tactics and cooperation with other emergency response actors in the response area. Attention is drawn to the fact that the descriptions in the section for other actors at the scene of the accident (Police, Health Emergency Services and transporter) are exclusively input to attention points on a number of tasks which are not necessarily is covered by the Emergency Response Act.

The Electrical Safety Act4 is safety-relevant regarding working methods and protective equipment, as it applies to e.g. electrical installations where the voltage is so high or the current is so great that people may be at risk. It should be noted, however, that the law – apart from electric motor vehicle charging sockets – does not apply to electrical installations in motor vehicles that are intended for the operation of the motor vehicle.

The Swedish Safety Agency has prepared a number of relevant descriptions of protective equipment and work methods on safe work on electrical installations that are connected to a supply system or have their own supply5.
The descriptions are based on the harmonized standard EN 50110-16, which is applicable for activities on or near electricity make installations in accordance with the Electrical Installations Notice7.

Electric cars are not covered by the executive order, but the standard (EN 50110-1) states which areas it can be used for, including '... when working on or at e.g. electrical installations in vehicles, electrical traction systems and experimental electrical research work when no other rules exist'.

The regulations in the standard are therefore considered to be relevant to the work of the rescue services in terms of working methods, division of responsibilities and personal protection, as no other relevant Danish regulations or requirements have been found.

As a supplement to which safety measures should be observed when working on

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pre-accident electric cars, it is useful to look at the required requirements for safety measures and equipment in electric cars. The international regulation UN-ECE R1008 describes requirements (primary basis for the Danish requirements) for the electrical safety of electric vehicles. UN-ECE R100 also applies to road-going conventional cars which have been converted to use electricity as a drive medium part 9. It should be noted that the regulation does not apply to cars damaged in traffic, as the safety measures described in UN-ECE R100 cannot be expected to be active in electric cars that have been involved in a traffic accident. UN-ECE R100 deals with:

- Describes isolation requirements, IP class, labeling of electrical parts, etc.
- Makes demands on the safety of the battery pack.
- Describes design requirements, but does not handle ring.

There is no authorization scheme for people who work with electric cars, but there is a requirement that people who carry out work on or near a live electrical installation are sufficiently qualified to carry out the work so that they can avoid the dangers ,

that electricity can create. There must be periodic and, to the extent necessary, instruction in correct safety behavior in relation to this work10.

The Industry's Industry Working Environment Council has drawn up a guide11 on safety during the repair and maintenance of electric and hybrid cars.

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Appendix 3: Tools, equipment and protective equipment

Much of the legislation and regulations found in the area deal with intact electric cars and do not apply to the handling of crashed (not intact) electric cars, which must be expected to have minor or major damage to the high-voltage battery, which could pose a risk to the crew. This section is made based on current legislation, rules and standards, which are described in the section on safety.

By starting from relevant rules, standards, etc. for work on, with or in the vicinity of electrical installations, in connection with efforts with crashed electric cars, a proper effort can be ensured, even if the tactics in some cases will be based on a precautionary principle, as it cannot be ruled out that there is still voltage in parts of the electric car's components.

Depending on the size of the electric car and the performance of the high-voltage battery, many electric cars on the market in 2022 primarily use a battery voltage between 300 and 500 V. However, the trend is towards high-voltage batteries with higher voltage – between 600 and 900 V – in the new and larger electric cars that come on the market. The low-voltage limit, which regulates work on electric cars under voltage, is 1000 V AC and 1500 V DC in a technical and regulatory context12.

Risk of tension in the bodywork!

In the event of a traffic accident with electric and hybrid cars, there may be a risk that there may be voltage in the body series. This is particularly so if the battery has been exposed to a high-energy accident, is deformed or penetrated in connection with the collision.

In the event of a traffic accident where the battery box is deformed, it is difficult to rule out that there is tension in the body parts. If in doubt, one should therefore estimate that the parts are under tension. Control measurement of voltage will not be possible in practice in an operational context.

In order to minimize situations where the crew can come into contact with voltage, well-known emergency uniforms and other protective equipment (PPE) are used that meet current standards for protection against electric arcs or clothing with similar properties. Likewise, insulated tools are used which are approved up to 1000 V.

Insulating rubber cloth of suitable sizes should also be used to cover any electrically conductive materials in the work area. This protects against accidental contact with non-insulated tools or body parts not covered by proper personal protective equipment (PPE).

If a non-intact electric car is connected to a charger, there will be an increased risk for people who come into direct contact with the electric car. The reason for this is that a voltage path can be created through the earth conductor, which means that the person can be shocked by contact with one pole.

Interruption of the earth connection through the charger can be done by either pulling the plug out of the electric car or out of the charging stand. If this is not possible, the cable can be disconnected as a last resort with tools approved according to EN IEC 60900 and wearing personal protective equipment (PPE) as prescribed for live work.

Depending on the type of protective clothing and footwear (ESD-approved), additional clothing (well-known 1000 V) will not be necessary.

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In the event of a rescue operation, electrical components cover both obvious electrical components, such as cables, wires and the high-voltage battery itself, to components that are assessed as potentially conducting voltage - especially straight metal parts, bodywork, chassis, vans, etc. EN 50110-1 states that screens, barriers, enclosures or insulating coverings of electrical parts can be used with advantage when working near live parts.

Approved equipment and personal protective equipment

For voltages below 1000 V (AC or DC), 'work under voltage' is defined in EN 50110-1 as direct contact with conductive parts, and 'work near voltage' is defined as work within 300 mm of conductive parts. Tools and equipment, including personal protective equipment (PPE), must meet a number of requirements, cf.
EN 50110-1. On this basis, it is recommended that the following be used and taken into account when working under or near voltage:

- Safety gloves that protect against electrical voltage - low voltage with marking and approval for 1000 V.

- Helmet with visor that protects the entire face and eyes against all objects, sparks, particles from short ends or electric arcs. If there is no space for a visor during work, protective glasses/eye protection must be used as a minimum.
- Electrically insulating rubber cloth of appropriate size to cover any electrically conductive materials in the work area. This also protects against accidental contact with electrical components with uncovered body parts or tools. It is recommended to have several tablecloths available, and that they may be adapted into special shapes. There are also different versions and sizes of insulating magnetic rubber covers with encapsulated magnets.

- A car standing on air-filled tires with no other contact with the ground can normally be considered isolated from the ground. If it is assessed that the electric car may have an electrical connection to an electrically conductive surface, an electrically insulating cloth can also be used as an insulating mat, in the event that footwear is not approved for work with voltage.
- Approved clothing that meets the applicable standard for clothing for protection against electric arcs or clothing with similar properties.
- Jewellery, watches, rings, metal glasses and the like can cause an electrical short circuit and should be removed before starting work13 together with other electrically conductive objects that may fall out of pockets in the clothing, which should also be removed before starting work.

The following list indicates European standards for different types of personal protective equipment, where the latest editions must be used:

- Electrical insulating cover DIN VDE 0680/114, EN 6111115, EN 6111216
- Safety glasses/eye protection EN 166:2002
- Gloves EN 60903:200418 [12]
- Clothing for protection against electric arcs EN 61482-1 and 2 19, 20, 21
- Electrical insulating safety helmet EN 50365:200322

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Assessment of voltage in the electric car
In the concrete effort, it will be that technology
be a manager who must assess whether the electric car and not least the high-voltage battery is sufficiently intact for it to be secured, i.e. must be de-energized, cf. the manufacturer's description.

In practice, the mere fact that the electric car has been in a traffic accident (where the emergency services have been called) will make it difficult to assess whether the high-voltage battery is still intact.
If there is doubt about this, it should be assumed as a starting point that no safety functions in the electric car work normally, and that it is therefore assumed that 'all' parts of the electric car can potentially be energized.

The assumption that there may be voltage on the electric car means that, according to EN 50110-1, suitable and sufficient personal protective equipment (PPE) must be used. The personal protective equipment and electrically insulating covering of conductive materials minimize the possibility of contact in the areas of the electric car where there may be a risk of contact during work.

There should also be extra care, as with all work with high-voltage batteries, including the regular 12 V battery, and especially if the Li ion battery starts to emit fumes, sounds, sparks etc. which indicates that a heat effect in the high-voltage battery is developing.

Internationally, there are e.g. rescue sheets and other information from manufacturers and rescue services that can contribute to the assessment of voltage in the electric car. However, it is important to be aware that they do not necessarily cover all situations where a
electric car is in an accident. It also presupposes that the technical manager has access to the information and rescue sheets, and that they are put into practice with insight into when they can
you sell

Tools and marking In electric
cars, marking/signage is used by the manufacturer, which warns the crew and other emergency responders against the danger of electric shock. This marking/signage is visible in the places in the car where there is a risk of coming into contact with the high voltages from the high-voltage battery. It is recommended that all contact or work with the electrical components – even without visible damage – be carried out using insulated tools approved for 1000 V.

From a safety point of view, tools, instruments and accessories are used which meet DS/EN 61010-1 or have the same safety level. Only isolated or hybrid hand tools are used for work on or near energized low-voltage installations (1000 V AC / 1500 V DC) that meet EN IEC 6090023 or equivalent.

When working under voltage, the work area where the electric car is located, cf. EN 50110-1, must be demarcated and clearly marked. In practice, this can be done with black/yellow barrier tape or similar, on which clear signage is applied,
that indicate electrical danger, e.g. according to ISO 7010:201924.

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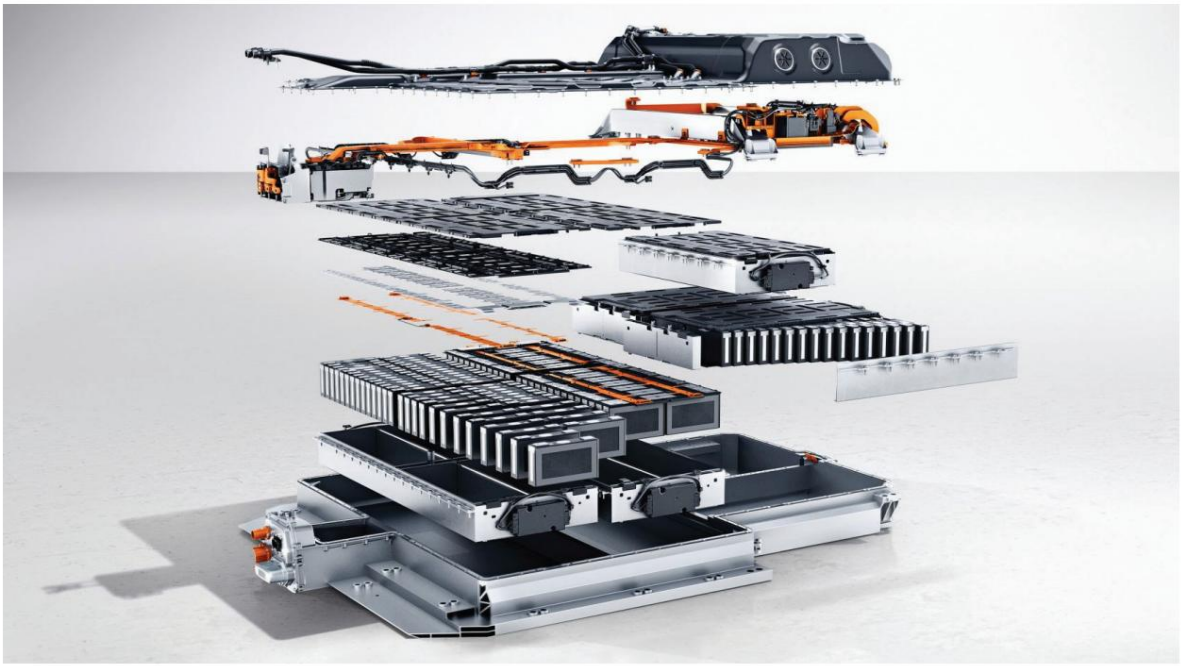
Appendix 4: Technical conditions - batteries and charging sockets

A Li-ion battery works by transferring an electrical charge (ions) from a lithium metal cathode (output of current) through an electrolyte consisting of an organic solvent
containing lithium salts over to a carbon anode (supply of current). In the electric cars, the high-voltage battery will consist of many smaller battery cells in a battery pack, which can be difficult to access, as it is protected by membranes and a protective outer packaging.



The illustration shows the structure of the high-voltage battery in a Mercedes
Photo: Mercedes

Common to all types of electric cars is that they are equipped with high-voltage motor and transmission systems, as well as a smaller 12 V battery, which is seen in conventional petrol or diesel-powered cars. In the case of electric cars that do not have a petrol or diesel-powered engine, the risk assessment takes into account the larger dimensions of the high-voltage battery, in addition to the voltage-carrying parts and the supplementary 12 V battery. 12 V batteries can also be of the Li-ion type25 and can be placed in connection with the high-voltage battery as a combined high-voltage/low-voltage battery pack.

Chargers and charging sockets Electric cars are characterized by being equipped with a Li-ion battery, which can be charged externally via a charging socket or through wireless induction charging, as well as one or more electric motors. There the battery can also be charged via regenerative braking - i.e. that the car recovers the energy that would otherwise normally be lost when the car brakes.

Some types of electric cars work by changing the battery. However, charging an electric car will often be via a charging stand. All types of charging via a charging station will basically use alternating current (AC) from the mains. Via a charger or converter (on-board charger/OBC), which is located in the electric car, the alternating current is converted into direct current (DC), as it can be charged in the electric car's high-voltage battery. The vast majority of fast chargers use DC in the stand, as the car's on-board system has a power limit. Electric cars are charged above the grid in three different ways with power from the grid26.

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- Normal charging is carried out with one phase, below 22 kW and works by connecting the plug to the socket. The charging time is typically four to eight hours, depending on battery capacity and charge level.
- Fast charging is carried out with three phases, over 22 kW. The duration of charging lasts between half and three hours, depending on the size and charge level of the battery.
- Lightning charging is DC voltage up to 250 kW. The duration of the charge corresponds to refueling a conventional car.

There is no overarching standard that describes what type a charging plug must be. It is solely up to the manufacturer to choose in relation to the battery capacity of the individual high-voltage battery, and whether AC or DC is charged into the electric car's system from the charging station.

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Appendix 5: Police and health emergency services at the scene of the accident

The police and the health emergency services can partly read in more detail in the sections which, for example, be writes an intervention with an acute danger to the life or health of the injured person, emergency evacuation, construction of the scene of the accident and other actors on the site of the injury.

In the event of a traffic accident with electric cars, there is a significantly greater risk that the crew may be injured due to possible high voltage in the bodywork, a sudden fire in the battery and leaking gases.

Based on this and a risk assessment carried out by the first patrol car or ambulance on the scene, the rescue services should be called, if this has not happened on the report, if the following is visible to the crew:

- All types of high-energy accident (the electric car is deformed).
- Visible electrical cables – orange (dangerous electrical voltage).
- Sparks, smoke, steam from the battery (indication of fire).
- Leakage of fluids and/or noise from the battery.

If one or more of the above points are present, the crew should weigh the risks of working in or near the electric car in relation to available PPE.

In principle, electric cars should not be touched without proper personal protective equipment (PPE). The following list indicates European standards for different types of PPE.

Subject	Personal protective equipment (PPE)
Main	Suitable home - EN 50365:2003
Eyes	Suitable visor or glasses - EN 166:2002
Body	Emergency suit - EN 61482-1 and 2
Feet/Body	ESD approved footwear – EN 15090:2012, type F2A
Hands	Suitable gloves EN 60903:2004

The rescue team can be deployed with the correct equipment and PPE. If the police or the health emergency services have to start the effort before the arrival of the emergency services - for example in case of emergency evacuation or emergency treatment - this should be done with extreme caution.

If a person is deployed without proper PPE, there is a risk of exposure to fire smoke, outgassing from the high-voltage battery or shock. The possibility of observation should be considered. The Danish Emergency Management Agency's app 'Dangerous substances' provides information on dangerous substances, safety distance, health risk, etc.

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On the Emergency Management Agency's app 'Dangerous substances' there is information about the dangerousness of substances, safety distance, health risk etc.

Identification of electric car In general, the first vehicle in the accident should be aware of whether it is an electric car that is involved. The alarm center can contribute to a significant coverage, which is carried out by the alarm operator at the time of notification. When sending the correct reason code, a choice must be made: Electric car or not electric car.

This information should be reported to the duty center or AMK as early as possible, so that the rescue response can initiate the necessary procedures and operational tactical considerations to ensure the safety of the crew when handling the electric vehicle.

Via the website "motorregister.skat.dk" under the "Find vehicle" tab, information about the fuel can be retrieved by entering the registration number. However, there are exceptions to this, as registration numbers for special vehicles with e.g. police, defense and emergency services are not publicly available.

Resource persons or other persons at the scene of the accident can, for example, with the help of car mares ket or the entire registration number, contribute to an early identification of whether it is an electric car.

Electric cars are often confusingly similar to a regular petrol or diesel-powered car. A number of electric cars have special characteristics of the vehicle, which draw attention to the possibility of these designations:

- EV, BEV or ZEV for electric cars and PHEV or HEV for hybrid cars.
- Some car brands, e.g. Tesla, can be recognized via logo or name, e.g. the text: Zero Emission, Electric, driveE or the letter e or E.

- Presence of a charging plug (possibly behind the tank cover), charge status indicator in the dashboard, lack of engine noise, lack of exhaust and missing cooling grid. However, this does not apply to hybrid cars, as they have both a combustion engine and an electric motor.

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Risk of fire Traffic-
damaged electric cars run the risk of the battery pack spontaneously bursting into flames. Signs of this can be in the form of smoke, degassing/evaporation, seeping liquids and deformation of the electric car's bodywork. The alarm center can also contribute to a significant cover-up, which is carried out by the alarm operator at the time of notification. The alarm operator can inquire about visible smoke or fire development.

In the event of a fire, dangerous fire smoke is emitted, and particularly large amounts of HF gas will be dangerous for people to inhale. Therefore, staying in a possible plume of smoke should be avoided.

Blocking off
Electric cars damaged in traffic will be at risk for damage to the battery pack or exposed high voltage cables, which can cause shocks when touching the electric car.

The first vehicle at the scene of the accident should create a barrier that ensures the necessary distance to the electric car (min. 1 m), mark the area with a risk of high voltage and ensure that people without the correct mouth and protective equipment (PPE) come near the electric car.

Emergency evacuation It should, to the greatest extent possible, be the rescue personnel who work in and around the electric car. They are equipped with the right tools and emergency clothing.

In special cases where there is a need to move an injured person in an emergency, this can be done if it is possible to avoid touching the electric car and that the injured person is not trapped, but can be pulled directly out of the electric car. As a safety measure, a colleague should be present to be able to do a shoulder push away from the car.

Use of approved safety gloves up to 1000 V will protect against accidental contact with the electric car.

See detailed description of tasks: Action card – POLICE, Action card – HEALTH DEPARTMENT
TOOL

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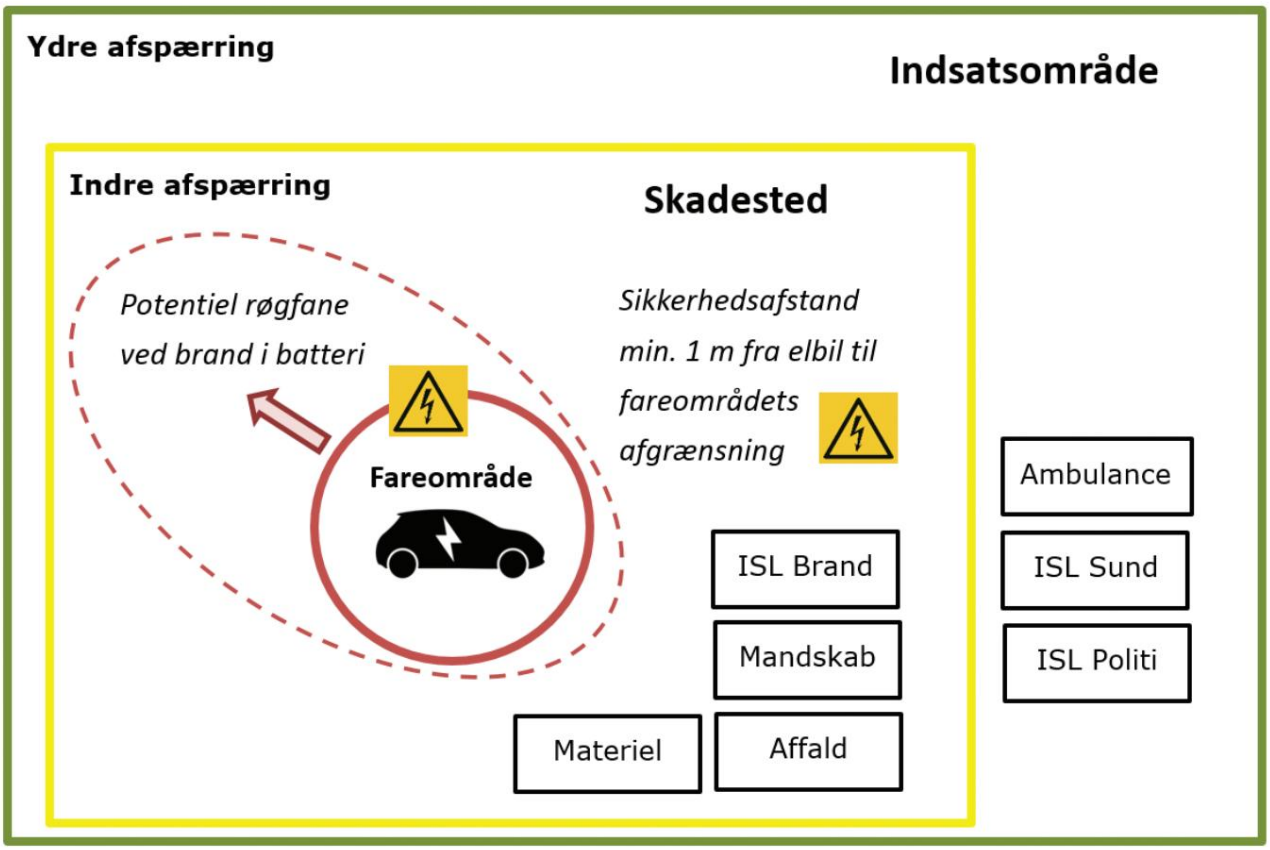

The structure of the scene in the event of a traffic accident with the need to free trapped persons or risk of fire.

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Appendix 6: Handing over and moving a damaged electric car

After carrying out a rescue effort in an electric car, it is important that the leader of the effort gives informative instructions to the police or the transporter who must collect the electric car. The tow ring is outside the scope of the emergency response, unless, for example, there is a risk of fire in the high-voltage battery. In general, the manufacturer's instructions for transport should be followed.

The carrier should be aware of the following:

- •Development of fire in the battery
- •Corrosive and flammable liquids
- •Dangerous electrical voltage
- •Avoid contact with the electric car
- •Avoid open flames
- •If the electric car battery has been exposed to fire, there may be residues of toxic fluorine material (Hydrogen fluoride, Phosphorus pentafluoride , Phosphoryl fluoride).

Before the electric car is moved from the scene of damage, it should be assessed whether the high-voltage systems have been damaged. It can, among other things, be high-voltage cables, which are in danger of getting pinched in body serial parts, or physical damage or deformation of the high-voltage battery itself.

Marking with mine strip is maintained until handover. However, the battery will always be under voltage, even if the main switch is off
clean is disconnected.

Be aware that voltage can be disturbed when the car is towed on the wheels. In this way, the engine functions as a generator, which tries to send voltage back to the engine control unit and the battery. If the motor control or the battery is switched off, defective, or unable to absorb voltage, the voltage can become so high that components are destroyed. To avoid disturbing the battery, the electric car should be transported on a sweeper if possible.

Even at very low speeds, wheels connected to electric motors produce voltage that is stored as high voltage in the wheels' capacitors. The manufacturer's instructions are therefore followed.

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If the electric car is parked inappropriately or in a nuisance, it may be necessary to move the car to e.g. emergency lane in order to quickly clear the motorway. Before such an emergency move is initiated by the emergency services, the main switch should be disconnected according to the manufacturer's instructions.

Be aware that several types of electric cars go into emergency mode when the main switch is disconnected, which means that the drive wheels (depending on whether there are motors on 2 or 4 wheels) cannot move. In the manufacturer's instructions, it will be indicated which wheels are placed on "roller skates". If an electric car is equipped with electric motor power on all 4 wheels, it may be necessary to use roller skates on all 4 wheels or a crane if the car has to be moved in an emergency.

The high-voltage battery can, if it has been exposed to a violent impact (high-energy accident), develop heat and there is a risk of 'thermal runa way' if it has not yet occurred - even in the case of non-visible damage to the battery pack.

It is therefore important that the electric car is transported away on a sweeper. There must be no unnecessary pulling and twisting in the electric car, as this can create a connection between the cells of the high-voltage battery. The same applies when the electric car is recorded on the sweeper.

A damaged electric car should be placed at a suitable distance from buildings and with a proper marking for high voltage. At the final destination for the electric car, this means that it should be positioned in such a way that a fire does not spread to other vehicles, buildings or storage in the open if the high-voltage battery or the electric car catches fire.

The electric car should be quarantined if possible for at least 48 hours or as prescribed by the manufacturer. The workshop or wrecker should be informed by the carrier about the condition of the car27.

See action card for 'Removal of electric car'.

QR code for video with 'thermal runaway' during reading on sweeper blade.

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Action card – Question guide for the call centre, AMK and first vehicle

Input from the scene of the accident to Vagtcentral and AMK plays an important role in contributing to the identification of whether an electric car is involved in a traffic accident and in passing this information on to the first vehicle at the scene of the accident.

The role of the alarm center can be a significant cover-up of the question of whether an electric car is involved. This coverage is carried out by the alarm operator at the time of notification. When sending the correct reason code, make a choice: Electric car or non-electric car. Coverage will be a quick assessment of electric car / non-electric car and fire / non-fire.

The alarm center can choose to connect the healthcare visitor to the call (conference call). After this, the following questions can be asked by the healthcare visitor at AMK. If the alarm operator judges that it makes sense to listen in, the operator does this. More information can be sent to the rescue services in the form of dispatch 2 (additional information).

QUESTIONS REGARDING INJURED	
ARE THERE INJURIES IN THE VEHICLE? **YES** - How many? - Where are they located in the vehicle? - Are they immediately stuck?	ARE THERE INJURIES OUTSIDE THE VEHICLE? **YES** - How many? - Where are they located?
IF YES, WHAT IS THE CONDITION OF THE INJURED? - Do they have visible damage? - Unconscious; Conscious? - Not contactable; Contactable? - Unstable on ABC; stable on ABC? - Can the injured get out themselves the vehicle? ÿ **YES** – consider it if to the risk of fire in the vehicle	**ATTENTION** - All contact with defective/exposed cables and wires should be avoided - If you start removing the damaged parts, there may be a risk of voltage in the car's body due to deformation of the battery pack - If the car's airbags are deployed, the cables from the battery pack will be de-energized, and possibly first aid or emergency evacuation can be started if the injured person is threatened at ABC
DO INJURIES RECEIVE FHJ IN THE DRIVING CLOTHING? **YES** - How many receive FHJ? - How many does FHJ provide to injured people? - Can the injured get out of the car the clothes? - Are the injured trapped?	DO INJURIES RECEIVE FHJ OUTSIDE THE VEHICLE? **YES** - How many receive FHJ? - How many does FHJ provide to injured people? - If you provide FHJ at a safe distance to drive the clothes? - Have they been injured inside the vehicle or outside (hit)?
DO INJURIES RECEIVE FHJ IN THE VEHICLE? **NO** - Is there a reason why FHJ is not provided?	DO INJURIES OUTSIDE THE VEHICLE RECEIVE FHJ? **NO** - Is there a reason why FHJ is not provided?

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IS THERE FIRE, SMOKE OR GAS EVOLUTION IN/FROM THE ELECTRIC CAR?

-Is there visible smoke or flames from driving the clothes?
- Is there a hissing sound from the vehicle?
  Is there a jet-like flame from approx. 1 – 2 from the bottom section of the vehicle?
- What color is the smoke?
  White dense smoke – speed of the smoke?
- Smells or sounds from the vehicle?
  Small banging noises/noises from the vehicle all the time etc. sometimes?

-Is there a fire in other/several cars?
- Is the car located close to a building?
- How many are electric cars?

Especially for hydrogen cars:
- Noise/ from hydrogen tank (hissing)
- Leakage of gas from the hydrogen tank (https://kemikalieberedskab.dk/)

WHAT TYPE OF VEHICLE IS IT ABOUT?

Check the registration number on the website motorregister.skat.dk

Visible characteristics electric car: -Electric car logo: Tesla; ID3; ID4 etc.
- Electric car: EV; BEV; PEV; ZEV;
  Drive E; Zero emission; I-on; Electrical; Ie - Charging socket, but no fuel cap - No exhaust pipe -
No cooling grille - No engine noise

Visible characteristics hybrid car:
-Hybrid car: PHEV; HEAVY; MHEV and others
- Charging socket and/or tank cover

Visible characteristics hydrogen car:
- Hydrogen logo e.g. Hydrogen

QUESTIONS ABOUT THE VEHICLE

WHERE DID THE TRAFFIC ACCIDENT OCCUR?
- Motorway - country road - urban / residential road - gravel road; in water? (lake, harbor, stream, etc.)?
-Is the vehicle a nuisance to the flow of traffic on the road, path, etc.?
- Is it on the road? Which track;
  inner, outer, middle or emergency tracks; off the roadway; lies on the side of the road; opposite lane?
- Does it stand on all 4 wheels – lying on its side – upside down – opposite direction of travel lane?

IS IT ABOUT AN ELECTRIC CAR – ONE OR MORE VEHICLES INVOLVED?
- How many vehicles?
- How many electric cars are involved?
- Keeps the vehicle alone or together with other vehicles?
- Does the vehicle pull into the vehicle in front?
- Has the vehicle been hit from behind?
- Holds the vehicle together like an accordion shock?

Visible damage to the electric car
- Damage to the front or rear
- Damage to the left or right side
- Exposed or damaged orange cables from the vehicle
- Are the airbags deployed

Visible damage to the battery pack
- Holds the vehicle in the guardrail
- Is there leakage of liquids from the battery pack
- Deformation of the battery pack
- Battery pack exposed

HOW FAST WAS THE CAR DRIVING AT THE ACCIDENT? (BEST RATING)
- Above or below 70 km/h?

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Action card – Danger to life
- immediate release/emergency evacuation

If there is a threat to life and the immediate release/ emergency relocation of the injured person is to be carried out, there are a number of words/concepts that the individual can rely on in the decision-making process.

In the first phase of the liberation, which deals with securing the scene of the accident, it is the special team leader who, in cooperation with the security man and the first aid, should focus on the extra tasks and ensure the right flow in deployed its.

Attention is drawn to the fact that the team leader is the technical leader and a potential task leader is the tactical leader.

ASSIGNMENT	PHASE	WHO	CONTENTS
360 degree risk assessment	1	Operations leader or team leader, possibly in cooperation with the security guard	- Own security - Information gathering - Tension in bodywork - Switch off the main switch -'Thermal runaway' - Fire extinguishing/safety hose -Patient safety when moving - Safety when freeing stuck people
Life threatened	1	Technical manager cooperation with first aid	Unstable on ABC Pinched Non-clamped Fire in car Tension in bodywork
Safety equipment	1	Technical manager in collaboration with security man	PPE Insulating mats Insulating tool Marking of work area Thermic camera
Emergency evacuation/ immediate release/operation	2	First aid	First aid / Treatment Emergency evacuation or immediate release Risk assessment is continuously reassessed
Reassessment of security	2-4	Safety man PPE	Voltage indicator Thermic camera
Settlement of the damage site	4	Security guard Ensure	that markings are intact Instructions for removal carrier

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Action card – Not Life threatening
- controlled release

If there is NOT a threat to life, but instead time is "enough" and a controlled release of the injured person must be carried out, there are a number of words/concepts that the individual can rely on in their decision-making process.

In the first phase of the release, which deals with securing the scene of the accident, it is specially team-led cleaner, who in collaboration with the security man and the first aider, should focus on the extra tasks and ensure the right flow in deployed its.

Attention is drawn to the fact that the team leader is the technical leader and a potential task leader is the tactical leader.

ASSIGNMENT	PHASE	WHO	CONTENTS
360 degree risk assessment	1	Operations leader or team leader, possibly in cooperation with the security guard	- Own security - Information gathering - Tension in bodywork - Switch off the main switch -'Thermal runaway' - Fire extinguishing/safety hose -Patient safety when moving - Safety when freeing stuck people
Not life threatening	1	Team leader in collaboration with first aid	Stable on ABC Pinched Non-clamped Out of the car
Safety equipment	1	Team leader in collaboration with security man	PPE Insulating mats Insulating tool Marking of work area Thermic camera
Emergency evacuation/ immediate release/operation	2	First aid	First aid/treatment Controlled release Risk assessment is continuously reassessed
Reassessment of security	2-4	Safety man PPE	Voltage indicator Thermic camera
Settlement of the damage site	4	Security guard Ensure	that markings are intact Instructions for removal carrier

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Action card - Police

This action card provides a number of attention points for proper handling of electric cars until the arrival of the emergency services.

In the event of a traffic accident with electric cars, there is a significantly greater risk of possible high voltage in the bodywork, a sudden fire in the battery and leaking gases.

Particular attention is paid to the following:

- •All types of high-energy accident (the electric car is deformed).
- •Visible electrical cables – orange (dangerous electrical voltage).
- •Sparks, smoke, steam from the battery (indication of fire). • Leakage

of fluids and/or noise from the battery.

On the Emergency Management Agency's app 'Dangerous substances' there is information about the dangerousness of substances, safety distance, health risk etc.

In principle, electric cars should not be touched without proper PPE. If one or more of the above points are present, the first patrol car should weigh the risks of working in or near the electric vehicle against the proper personal protective equipment (PPE) that is available.

Staying in the plume of smoke or when gases and liquid seep from the battery is associated with the risk of poisoning. On the Emergency Management Agency's app 'Dangerous substances' there is information about dangerous substances, safety distance, health risk,

The first patrol car can be helpful in securing the scene of the accident. This includes blocking off, removing people around the electric car and in any smoke plume. We work based on the below principle for building up damage
place.

There is a risk of high voltage when contacting cables/ wires or live parts.

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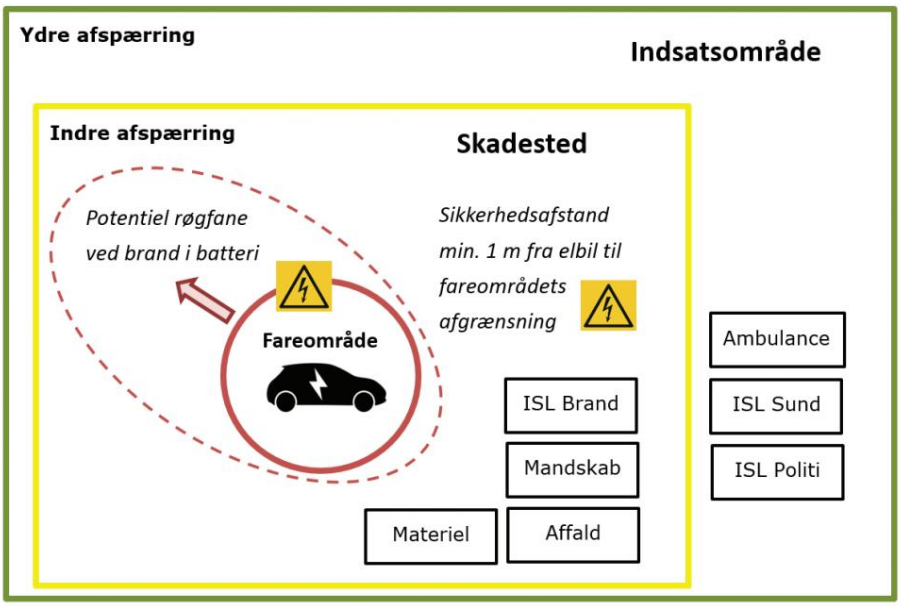

The structure of the scene in the event of a traffic accident with the need to free trapped persons or risk of fire.

Illustration: The National Emergency Management Agency

QR code for video with 'thermal runaway' during reading on sweeper blade.

Machine Translated by Google

PATROL CAR ARRIVES AT THE SCENE OF THE INJURY AS THE FIRST CAR	
Insurance of the place of damage	- Stopping traffic - Blocking off the site of damage - Securing own personnel and persons against any plume of smoke
Overview	- Fire / no fire in the vehicle? - Persons in danger / not in danger? In or out of vehicle? - Person – Unstable on ABC, Unconscious? ÿ Need to withdraw ÿ Emergency move? - Person – stable on ABC, Conscious? ÿ No need to remove casualties
Fire/risk of fire	-Fire: flames or smoke (black) - Risk of fire: sounds; odors; white smoke (degassing from battery) - Avoid staying in the smoke plume or gases (all without PPE)
Type of vehicle (electric car/plug-in/hybrid electric car)	- Confirmed/ not confirmed electric car? - Location at the scene of the accident – on/off the road, in the water, etc. - Location on the roof, on the side, etc.
Damage to the electric car ÿ risk of shock	- Exposed or damaged cables? - Deformations in bodywork, battery? - Triggered airbags = live cables. The battery pack cannot be de-energized
Handling casualties? - Only if it is possible and safe: -Need for emergency evacuation	of the injured from the vehicle? - FJH of injured persons outside the vehicle? - FJH of injured persons in vehicle ÿ without contact with electric car?
Disclosure of information to ISL BRAND, ISL SUND	- Actions cf.: - Securing the scene of the accident - Overview of the injured ÿ Handling? - Type of vehicle (electric car/ hybrid) - Fire/risk of fire - Damage to the electric car

POSSIBLY. ADDITIONAL INFORMATION

- What type of vehicle is it - registration number? Electric car, plug-in/hybrid electric car?
- Are there injured people in the vehicle? Are they stuck?
- Have we removed the injured and bystanders to a safe distance from the scene of the accident?
- Have people been exposed to smoke (crew, injured, other people)?
- What location is the vehicle (on the road, in a ditch, in water, upside down, etc.)
- Is there visible smoke or outgassing from the vehicle?
- Sounds; Smoke development; Unnatural smells or liquid leaking from the battery?
- Danger of voltage at the vehicle - danger of high voltage, exposed, broken cables?

For more details on observations at the scene of the accident, see Action card – Question guide for the call centre, AMK and first vehicle'

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Action card - Health preparedness

There may be situations where the ambulance arrives first at the scene of the accident. This action card provides a number of attention points for proper rescue handling
the effort with electric cars until the arrival of the rescue services.

In the event of a traffic accident with electric cars, there is a significantly greater risk that the crew may be injured due to possible high voltage in the bodywork, a sudden fire in the battery and leaking gases.

Based on this and a risk assessment carried out by the first vehicle on the scene, the rescue services should be called, if this has not happened on the report, if the following is visible to the crew:

- All types of high-energy accident (the electric car is deformed).
- Visible electrical cables – orange (dangerous electrical voltage).
- Sparks, smoke, steam from the battery (indication of fire). • Leakage of liquids and/or noise from the battery.

In principle, electric cars should not be touched without proper PPE. If one or more of the above points are present, the first vehicle/ambulance should weigh the risks of working in or near the electric vehicle against the correct personal protective equipment (PPE) that is available.

Subject	Personal protective equipment (PPE)
Main	Suitable home - EN 50365:2003
Eyes	Suitable visor / glasses - EN 166:2002
Body	Emergency suit (typical enough) - EN 61482-1 and 2
Feet/Body	ESD approved footwear – EN 15090:2012, type F2A
Hands	Suitable gloves EN 60903:2004

Staying in the plume of smoke or when gases and liquid seep from the battery is associated with the risk of poisoning. On the Emergency Management Agency's app 'Dangerous substances' there is information about dangerous substances, safety distance, health risks, etc.

The first vehicle can be helpful in securing the scene of damage. It includes blocking, removal of people around the electric car and in any smoke plume. We work based on the principle below for building up the damage site.

There is a risk of high voltage when contacting cables/ wires or live parts.

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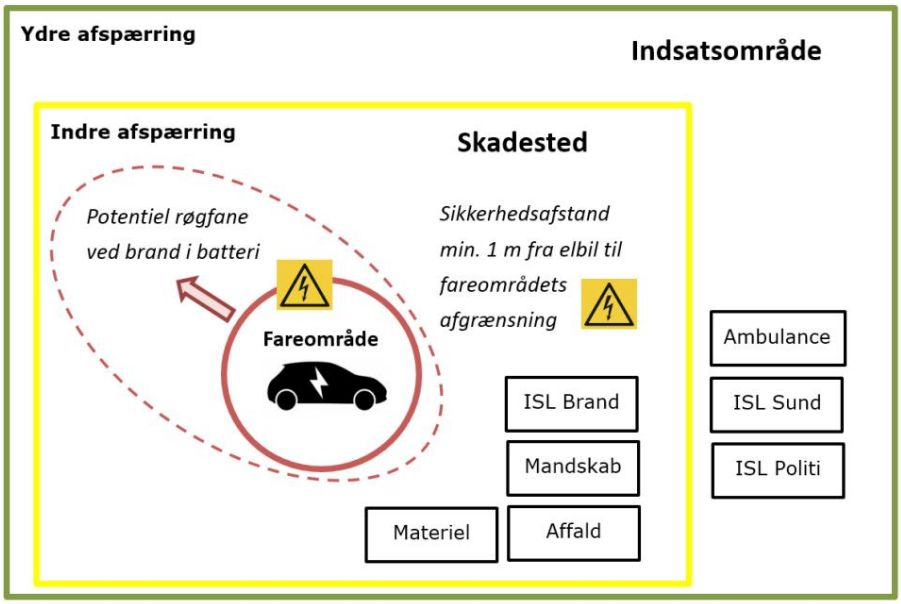
The Emergency Management Agency's app 'Dangerous substances' provides information on the dangerousness of substances, safety distance, health risk, etc.



The structure of the scene in the event of a traffic accident with the need to free trapped persons or risk of fire. Illustration: The National Emergency Management Agency

THE EMERGENCY SERVICE ARRIVES AT THE SCENE OF THE INJURY AS THE FIRST CAR (AMBULANCE, AMBULANCE, AMBULANCE)	
Insurance of the place of damage	- Stopping traffic - Blocking off the scene of the accident - Securing your own crew and people against possible plume of smoke
Overview	- Fire / no fire in the vehicle? - Persons in danger / not in danger? In or out of vehicle? - Stable on ABC / Unstable on ABC - Person trapped/ Not trapped ÿ Need for emergency relocation YES ÿ Possible and justifiable?
Fire/risk of fire	-Fire: flames or smoke (black) - Risk of fire: sounds; odors; white smoke (degassing from battery) - Avoid staying in the smoke plume or gases (all without PPE)
Type of vehicle (electric car/plug-in/hybrid electric car)	- Confirmed/ not confirmed electric car? - Location at the scene of the accident – on/off the road, in the water, etc. - Location on the roof, on the side, etc.

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Damage to the electric car ÿ risk of shock	Visible damage? -Is there one or more vehicles? – Electric cars? - Damage to the front or rear - Damage to the left or right side - Exposed or damaged orange cables from the vehicle - ATTENTION risk of high voltage in contact with cables/wires or live parts - Deformations in bodywork, battery? - Triggered airbags = live cables. The battery pack cannot be de-energized - Does the vehicle hold in the guard rail? - Speed above or below 70 km/h?
Handling casualties? - Only if it is possible and safe: -Need for emergency evacuation of the injured from the vehicle? - FJH of injured persons outside the vehicle? - FJH of injured persons in vehicle ÿ without contact with electric car? Attention - All contact with defective/exposed cables and wires should be avoided. - If you start removing the injured, there may be a risk of tension in the vehicle's bodywork due to deformation. - If the car's airbags are deployed, the cables from the battery pack will be de-energized, and extraction can begin if the injured person is threatened at ABC. - Insulating rubber mats and special protective equipment (PPE) should be used to protect personnel who must work in and around the electric car. Therefore, the emergency services should be called. - A safety distance of min. 1 m from the electric car, cf. EN 50110-1, where direct contact with conductive parts is defined as 'work under voltage' and work within 30 cm of conductive parts is defined as 'work near voltage'.	
Disclosure of information to ISL BRAND, ISL POLICE	- Actions cf.: - Securing the scene of the accident - Overview of the injured ÿ Handling? - Type of vehicle (electric car/ hybrid). - Fire/risk of fire. - The electric car's damage.

POSSIBLY. ADDITIONAL INFORMATION

- What type of vehicle is it - registration number? Electric car, plug-in/hybrid electric car?
- Are there injured people in the vehicle? Are they stuck?
- Have we removed the injured and bystanders to a safe distance from the scene of the accident?
- Have people been exposed to smoke (crew, injured, other people)?
- What location is the vehicle (on the road, in a ditch, in water, upside down, etc.)
- Is there visible smoke or outgassing from the vehicle?
- Sounds; Smoke development; Unnatural smells or liquid leaking from the battery?
- Danger of voltage at the vehicle - danger of high voltage, exposed, broken cables?

For more details on observations at the scene of the accident, see Action card – Question guide for the call centre, AMK and first vehicle'

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Action card - Settlement of the scene of damage

After the emergency services have invested in an electric car, it is important that one is given relevant instructions to the transporter who has to transport the electric car away, if it is on the way or to the police when the scene of the accident is released.

SETTLEMENT OF THE SITE OF DAMAGE	
Clean up the scene	- Marking of the danger area with signage against high voltage – this is maintained when the damage site is released (min. 1 m) - The scene of the accident/the electric car is handed over to the police or transporter, if this is at the scene of the accident, when the incident leader assesses that there is no longer a possibility of 'thermal runaway' - If working earthing has been carried out, it should be ensured that the electrical installer or equivalent expert, will be able to dismantle grounding when releasing the damage site.
Instructions for carrier	The carrier should have the following information: - It is an electric car/hybrid car. - Brief information on the rescue services' efforts: fire extinguishing, release (damage to cables). - Assessment of the condition of the car's high-voltage battery, disconnection of the main switch, voltage. -The risk of 'thermal runaway' during transport to the workshop and what the transporter should do if that happens. - That the electric car should be placed min. 5 m. away from buildings and other combustible material.

Examples of danger signs

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Action card - Away transport of electric car

After carrying out a rescue operation in an electric car, it is important that a relevant one is given instructions to the transporter who is to transport the electric car away or to the police, if the place is to be handed over to them.

Removal of electric car	
The carrier is informed of the following before the electric car is loaded	- This is an electric car/hybrid car. - Explain about the efforts of the rescue services. - Explain about the state of the car's battery and the possible danger of high voltage.
The transporter should pay attention when loading the electric car	-That the electric car can be loaded, transported and unloaded a safe and sound way, including the carrier's use of personal protective equipment (PPE). - That there is tension in the body as a starting point a security guard is present. - That no unnecessary twists are made in the car while it is being loaded onto the sweeper. - That it is observed for possible heat development or 'thermal runaway' in the battery while the car is being loaded. - Noises, smoke or unnatural smells from the battery. - Liquid leaking from the battery.
The transporter should pay attention to the following when transporting the electric car	To call 112 and provide relevant information if: -Fire/'thermal runaway' occurs in the battery. - Heat development in the battery. *Or significant changes in relation to:* - Sounds from the battery. - Smoke generation from the battery.
The transporter should be aware of the following when the electric car is unloaded at the final destination	- The electric car should not be placed in a building/ under cover. - The electric car should be placed at a suitable distance from surrounding buildings, roofs and other flammable storage, so that fire cannot spread here. - The electric car should be clearly marked with a barrier and sign with 'Danger - high voltage'. To call 112 and provide relevant information if: -Fire/'thermal runaway' occurs in the battery. - Heat development in the battery. - Liquid leaking from the battery. *Or significant changes in relation to:* - Sounds from the battery. - Smoke generation from the battery. - Unnatural odors from the battery.

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On the National Emergency Management Agency's website www.brs.dk you can find information on other publications, e.g

Laws and rules

Guidelines and instructions

Learning materials

Opinions and judgments

Historical material

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