Emergency response guide for emergency crews

According to DIN ISO 17840

Foreword

Ensuring optimum safety under all conditions is one of the most important priorities in the development and implementation of vehicles in the BMW Group. These BMW Group vehicles include all BMW, MINI and Rolls-Royce models. By taking an holistic view, the precisely-coordinated active and passive safety systems exceed the requirements set down by law.

In addition to the emergency response guide, BMW also makes available model-specific rescue sheets containing detailed information. The respective current version can be found at https://aos.bmwgroup.com/service.

Legal notice

The rescue sheets have been drawn up exclusively for emergency crews who have special training in the field of technical assistance after traffic accidents and consequently are able to perform the operations described in these sheets.

Specifications and optional equipment of BMW vehicles and the range of BMW AG vehicles are subject to constant changes. BMW therefore reserves the right to adjust the content or make changes to the emergency response guide at any time.

Note:

In the rescue sheets, the maximum possible equipment of a vehicle is always shown in accordance with the equipment specifications provided by BMW for a model.

The information contained in the emergency response guide is not intended for customers, workshops or retailers. Customers can find detailed information about the functions of their vehicle as well as important details on vehicle and occupant safety in the Owner's Handbook for their respective BMW vehicle.

0. General information 7

List of abbreviations 9

Overview of BMW Group vehicles 10

BMW 10

MINI 12

ROLLS-ROYCE 13

1. Identification / recognition 14

Vehicle identification number 15

Identifying features by drive type 16

Vehicles with fuel tank 16

Possible identifying features 16

Vehicles with plug-in hybrid drive 17

Pure electric drive vehicles 18

Possible identifying features 18

Hydrogen Fuel Cell Electric Vehicle 19

2. Immobilisation / stabilisation / lifting 20

Possible fixation points 21

Towing eye 22

Jacking point on vehicle underbody 23

Inappropriate vehicle areas 24

Determining the vehicle condition 25

3. Disable direct hazards / safety regulations 26

Switching off the drive system 27

Immediate elimination of dangers 28

Information on accident-damaged vehicles with electric drives 29

Procedure during charging 30

Deactivating the high-voltage system 31
Automatic turn off 31
Manual turn off 31

Rescue disconnects 32
Service Disconnect in the boot 32
Rescue disconnect in the engine compartment/boot 32

Identification and avoidance of high-voltage cables 33
Colour coding and identification 33
Vehicle at charging point 34

4. Access to the occupants 35
General rescue instructions 36
Examining vehicle interior 36
Battery management 37
Removing the interior trim 38
Danger to airbag components 39
Body reinforcements 40
Side sill 40
A-pillar 41
A-pillar (convertible) 42
B-pillar 43
C-pillar 44
Side impact protection 45
VEHICLE GLAZING 46
Seat adjustment 47
Adjusting the seat automatically 47
Adjusting the seat manually 47
Steering 48

5. Stored energy / liquids / gases / solids 49
Overview of liquids used in vehicles 50
Fuel 50
Engine oil 50
Transmission oil 50
High-voltage vehicles 53
Exposure to high voltage 53

Exposure to materials used 54

Dangers in a non-fire situation 55

6. In case of fire 56

Dangers 58
Explosion hazard 58
Dangers 59
Explosive 59
Flammable 59
Corrosives 59
Hazardous to human health 59
Dangers 60
Explosive 60
Gases under pressure 60
Fuel tank 62

High-voltage components (electric/hybrid vehicles) 63

Electric motor (7), (10) 63
Power electronics 63
High-voltage wiring 63
Battery charger (on-board charger) 63
High-voltage heating and air conditioning compressor 64
Low-voltage battery 65
Other combustible materials 66
Extinguishing access points 67
Engine compartment 67
Passenger cell 67

7. In case of submersion 68

Electrical hazard 70
Corrosion and damage to high-voltage components 70
Insulation failure 70
Thermal risk 70
Danger of gas formation 70
Electrolysis 70
Potential fire hazard 71
Hydrogen gas formation (in fuel cell electric vehicles) 71

8. Towing / transportation / storage 72

Towing away 78

Storage 79
During quarantine accommodation, the following recommendations should be followed where possible: 86

9. Important additional information 87

Emergency call 88

Airbags and restraint systems 88
Driver's airbag 89
Front passenger airbag 89
Side airbag 90
Head airbag 90
Knee airbag 91
Seat seat belt pretensioner 92
Central airbag 93
Active bonnet 94
Child restraint system 94

10. Explanation of pictograms used 96

Pictograms for access to components 97
Pictograms for parking the vehicle 97
Pictograms for access to the occupants 98
Pictograms related to fire-fighting and safety 98
Globally uniform symbols 99
ISO 17840-4 100

0. General information

General information

This emergency response guide supplements the vehicle-specific rescue sheets with information on drive technologies, safety systems and innovations in BMW, MINI and Rolls-Royce vehicles. The chapters of this emergency response guide generally follow ISO 17840, adding concepts for specific accident situations (e.g. vehicle fire, high-voltage battery fire, recovery from water). The versions and equipment that are delivered ex works have been taken into account.

Retrofit solutions and modifications that have not been approved by BMW are not considered. Identifying the vehicle in an accident is of great importance because, depending on model series and vehicle type, various issues must be considered. For example, possible fixing and lifting points as well as techniques and prohibited points of attack are shown below. In addition to suggestions for eliminating direct dangers for accident victims and rescue crews, the applicable safety regulations, in particular when dealing with high voltages, are investigated. Voltages and alternatives to fuels are also discussed. In addition, various technical information is presented, for example on how to achieve access to vehicle occupants. Dangers and rules for handling stored energy, liquids, gases and potentially hazardous solids are also presented.

In addition, it is also explained which procedure is recommended in the event of a fire, in particular with regard to alternative drives such as battery-electric, hydrogen-based or gas-based drives. It is also shown how to treat and ultimately recover damaged vehicles in the event of immersion or submersion in water. Finally, information on towing away, storing and disposing of accident-damaged vehicles is provided and further information on safety systems is presented.

List of abbreviations

ABS	Antilock braking system
ASC	Slip Control
BEV	Battery Electric Vehicle
DAB	DAB tuner
DSC	Dynamic Stability Control
FCEV	Hydrogen-powered vehicle
FZG	Vehicle
HV	High voltage
ICE	Internal combustion engine
i-tafel	Instrument panel
KST	Fuel
Li	Left
LL	Left-hand drive
NV	Low-voltage
PDC	Park Distance Control
PHEV	Plug-in Hybrid Electric Vehicle
RFK	Reversing Assist Camera
RL	Right-hand drive
VSG	Laminated safety glass

Overview of BMW Group vehicles

BMW

BMW 1 Series
Petrol/gasoline
Diesel

BMW 2 Series
Petrol/gasoline
Diesel
Hybrid

BMW 3 Series
Petrol/gasoline
Diesel
Hybrid

BMW 4 *Series*
Petrol/gasoline
Diesel
Hybrid
Fully electric

BMW 5 *Series*
Petrol/gasoline
Diesel
Hybrid
Fully electric

General information

BMW 7 Series Hybrid Fully electric	
BMW 6 Series, 8 *Series* Petrol/gasoline Diesel	
BMW X models Petrol/gasoline Diesel Hybrid Fully electric	
BMW Z models Petrol/gasoline	
BMW I models fully electric	

MINI

MINI COOPER
Petrol/gasoline
Diesel
Hybrid
Fully electric

MINI ACEMAN
Petrol/gasoline
Diesel
Hybrid
Fully electric

MINI COUNTRYMAN
Petrol/gasoline
Diesel
Hybrid
Fully electric

MINI JCW
Petrol/gasoline
Diesel
Hybrid
Fully electric

ROLLS-ROYCE

ROLLS-ROYCE CULLINAN Petrol/gasoline	
ROLLS-ROYCE GHOST Petrol/gasoline	
ROLLS-ROYCE SPECTRE Fully electric	
ROLLS-ROYCE PHANTOM Petrol/gasoline	

1. Identification / recognition

Vehicle identification number

The VIN (vehicle identification number) can be placed at various positions on a BMW Group vehicle. The possible positions are shown in the graphic below.

Driver side dashboard:

- The VIN is visible through the windscreen, usually at the bottom corner of the driver's side.

Driver side door frame:

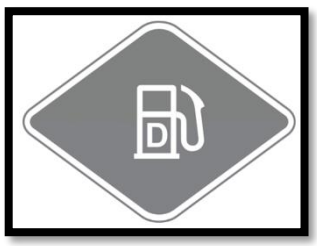
- A sticker or sign with F882452
- VIN is often located on the B-pillar, visible when the driver's door is open.

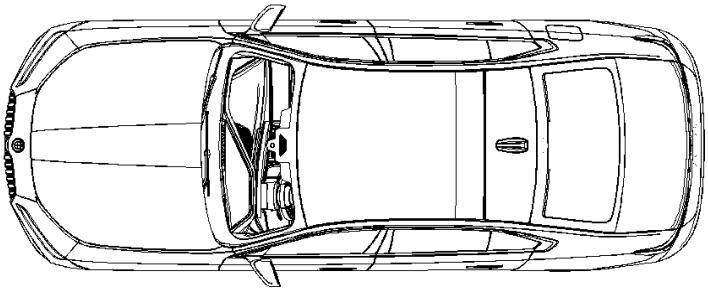
Engine compartment:

- The VIN may also be stamped into the engine compartment or affixed to a sign, usually on the right side.

Identifying features by drive type

Vehicles with fuel tank



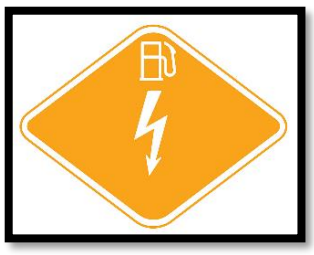


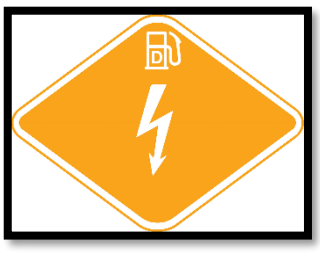
- Filler neck
- Exhaust system
- Type designation at the rear

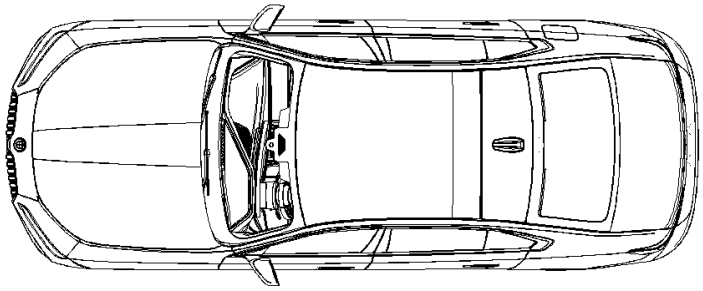
Possible identifying features

Identification / recognition

Vehicles with plug-in hybrid drive



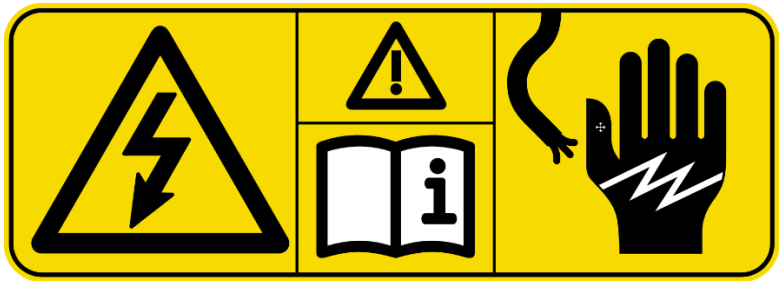




Number plate

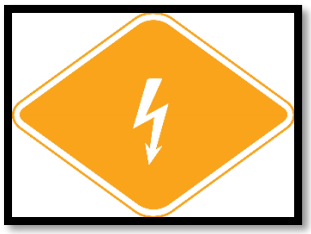
- Front side socket flap
- Filler neck
- Type designation at the rear

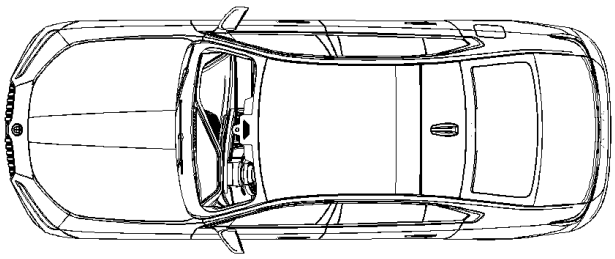
Possible identifying features



Identification / recognition

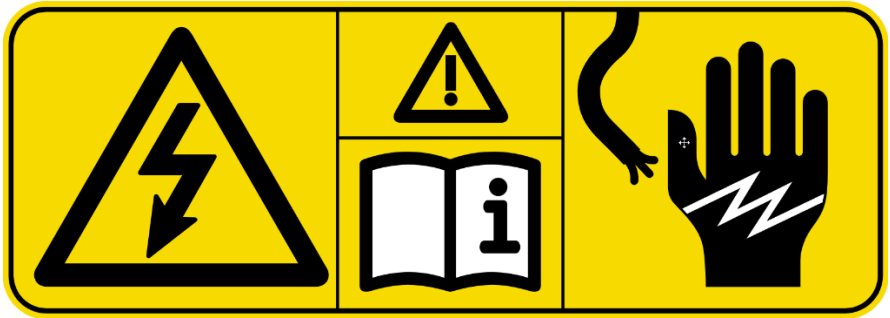
Pure electric drive vehicles





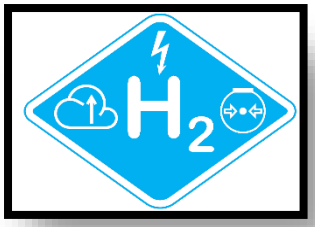
- Warning sticker
- Socket flap with socket at the rear
- Charge current supply
- Boot inscription

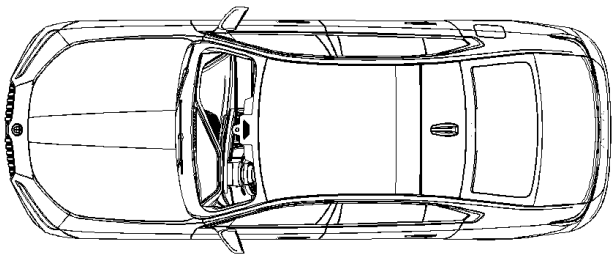
Possible identifying features



Identification / recognition

Hydrogen Fuel Cell Electric Vehicle





- Flap with socket

- Type designation (on the boot lid, on the radiator trim panel or on the front side panels)

Number plate

2. Immobilisation / stabilisation / lifting

Danger of injury due to unintentional body movements. Secure and stabilise the vehicle before working on the body.

Modern vehicles are equipped with components and systems that can also be active when a vehicle has an accident or is parked and when the combustion engine drive system is switched off.

Possible fixation points

Generally, axles, wheel suspensions and wheels, side members and crossbars, A, B and C-pillars as well as towing eyes and trailer tow hitches can serve as fixation points. When using tension belts and slings, ensure that they are placed over several points if possible in order to ensure an even distribution of the load. Trailer tow hitches/cross members or winches of the deployment vehicle can be used as suitable counterpoints.

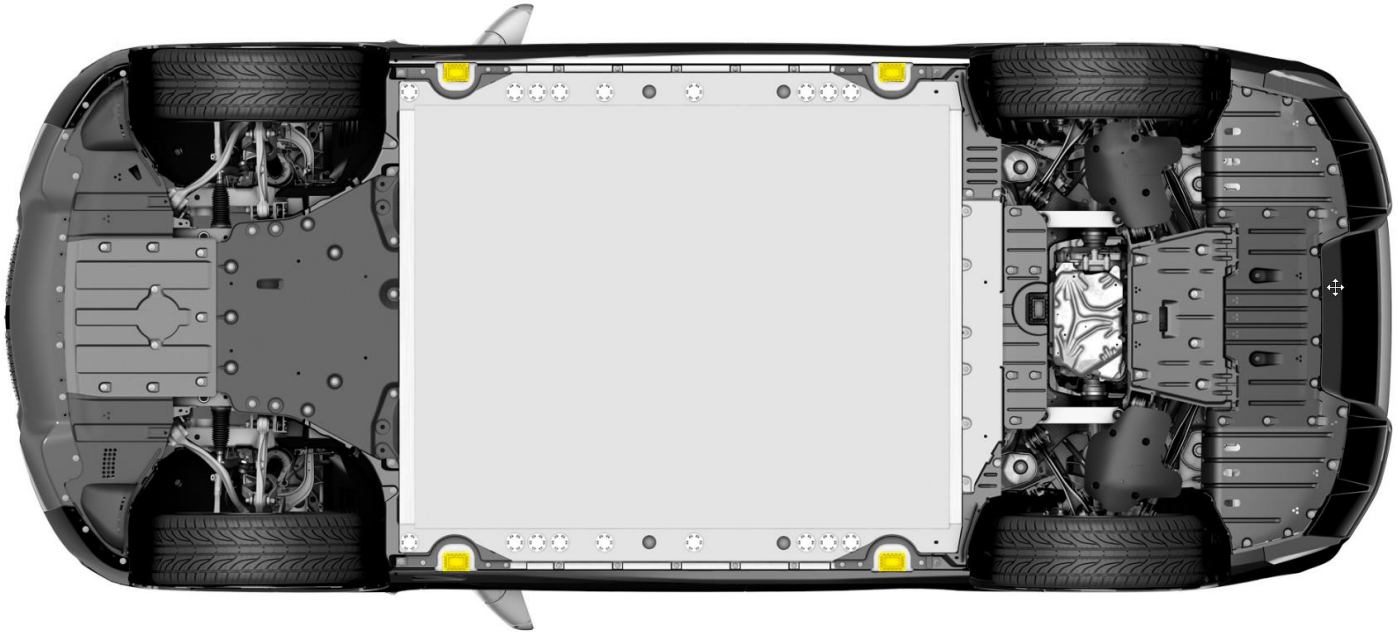
Danger to life if the vehicle slips or tilts when lifting. Only lift the vehicle at the mounting points specified by the vehicle manufacturer.

Towing eye

On BMW vehicles, the towing eye is under the boot or luggage compartment floor. On MINI models, it is located under the carpet of the front passenger footwell, in the footrest. For the vehicle-specific position, see the rescue card provided for the vehicle.

Jacking point on vehicle underbody

The jacking point on the vehicle underbody is a specially reinforced area that enables safe lifting of the vehicle. These points are usually described in the Owner's Handbook and are often identified by markings. They are made of sturdy material to support the weight of the vehicle and prevent damage to the underbody. It is recommended that you use these jacking points correctly to ensure safety during lifting.



Inappropriate vehicle areas

It is pointed out that under no circumstances should the vehicle be lifted at the locations of the fuel or gas tanks or the high-voltage battery. Such a procedure poses a considerable potential risk and can result in damage. Lifting the battery or powertrain components musr be avoided, as this can result in damage with a potentially high degree of danger. It must also be ensured that the support point is selected in such a way that no damage occurs. This can be ensured, for example, by using a single support. The vehicle may buckle in particular in the event of a large side opening below the B-pillar. When using rescue equipment, care must be taken to ensure that potentially dangerous components are not damaged. Potentially dangerous components include high-voltage batteries, high-voltage lines, gas and fuel tanks, stored gas inflators and accelerator pedals. Vehicle-specific information can be found in the relevant rescue sheet.

Determining the vehicle condition

There are various signs that can be used to determine what condition a vehicle is in. A look at the ignition lock on older models shows whether the key is inserted and which position it is in. When the engine is running, noise and vibration are noticeable. In addition, various indicator lights on the dashboard light up when the vehicle is switched on. The function of electronic devices such as radio and air-conditioning component also indicates that the vehicle is switched on. Visible exhaust gases from the tailpipes are also a clear sign that the engine is running. In modern vehicles, a diagnostic device can also be used to precisely check the vehicle status. These indicators make it possible to reliably identify whether a vehicle is switched on or off.

3. Disable direct hazards / safety regulations

Switching off the drive system

A BMW is switched off by pressing the Start-Stop button or, on older models, using the vehicle key.

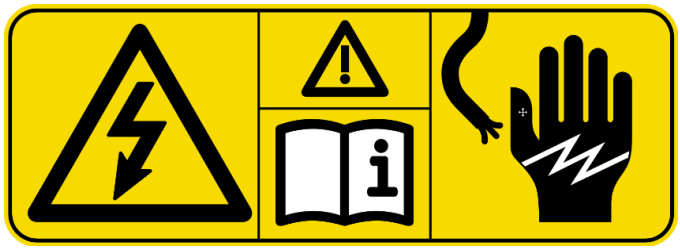
Ensuring personal integrity is an essential aspect of rescuing persons involved in an accident. This section discusses dangers that are relevant both for persons involved in an accident and for rescue crews. Measures that can minimise a risk are also discussed. When at least one of the restraint systems is triggered, the hazard warning lights are automatically switched on in newer models, provided that the voltage supply in the vehicle is active. In addition to securing the vehicle, the function is also used to display the active voltage supply.

Immediate elimination of dangers

As part of ensuring vehicle safety, specific measures are preferred for BMW vehicles, which immediately eliminate dangers. An essential component is BMW Breakdown and Accident Assistance, which is available around the clock and provides professional assistance quickly at the location. Securing the vehicle and performing necessary immediate measures are an essential part of the assistance. In addition, numerous BMW models are equipped with ConnectedDrive services, which enable the vehicle to automatically call for assistance in the event of a breakdown or accident. The system transmits the location of the vehicle and relevant data to the BMW assistance centre, which ensures a timely response.

Another important feature is the automatic emergency call function (eCall), which automatically makes an emergency call in the event of a serious accident and transmits the location and other relevant information to emergency services. This ensures timely medical care and support. BMW vehicles are also equipped with various warning and safety systems, including a tyre pressure monitoring system, electronic stability control and an automatic brake assistant. These systems are able to identify potential dangers at an early stage and warn the driver or intervene to prevent accidents. BMW vehicles also have a wide range of integrated safety features, including adaptive headlights, blind spot assist and lane keeping assistant. The integration of these technologies helps to minimise the risk of accidents and to support the driver in dangerous situations. The implemented measures and technologies ensure that immediate dangers are responded to promptly and effectively, in order to ensure the safety of occupants and other road users.

Information on accident-damaged vehicles with electric drives



A warning is attached to each high-voltage component housing, which intuitively alerts to the potential dangers of electrical voltage

Identification of the high-voltage battery

Rescue disconnect

High voltage

Low voltage device that disconnects high voltage

	If a BMW electric car catches fire, we recommend that you stop immediately, switch off the motor and exit the vehicle. Maintain a safe distance of at least 15 metres. Alert the fire brigade immediately and inform them that an electric vehicle is involved. Warn other persons in the vicinity and do not attempt to extinguish the fire yourself.

Procedure during charging

In the event of a fire when charging a BMW electric car, special precautionary measures are required. First, the charging process must be stopped immediately by disconnecting the charging cable from the vehicle or charging station, if this is safely possible. It is also important to exit the vehicle immediately and maintain a sufficient safety distance of at least 15 metres to protect yourself from potential battery dangers.

It is then necessary to immediately alert the fire brigade and point out that it is an electric vehicle that caught fire during the charging process. This information is crucial as electric vehicles require special fire safety measures. While waiting for the fire brigade, it is advisable to warn other persons in the vicinity and ask them to get to safety as well.

It is essential that no independent extinguishing attempts are made, as electric vehicles contain flammable batteries, which entail dangers. Fire fighting should only be carried out by professional personnel in order to minimise the risk of injuries or further damage.

Deactivating the high-voltage system

Automatic turn off

In the event of an accident, breaking off of the high-voltage cables can cause sparking or electric arcs when the vehicle's underbody impacts sharp-edged obstacles (e.g. guardrails). To minimise this risk, the high-voltage system is switched off in the event of an accident. On current BMW high-voltage vehicles, the crash safety module detects the accident and coordinates the safety systems. If the crash safety module detects an accident, the high-voltage system is switched off.

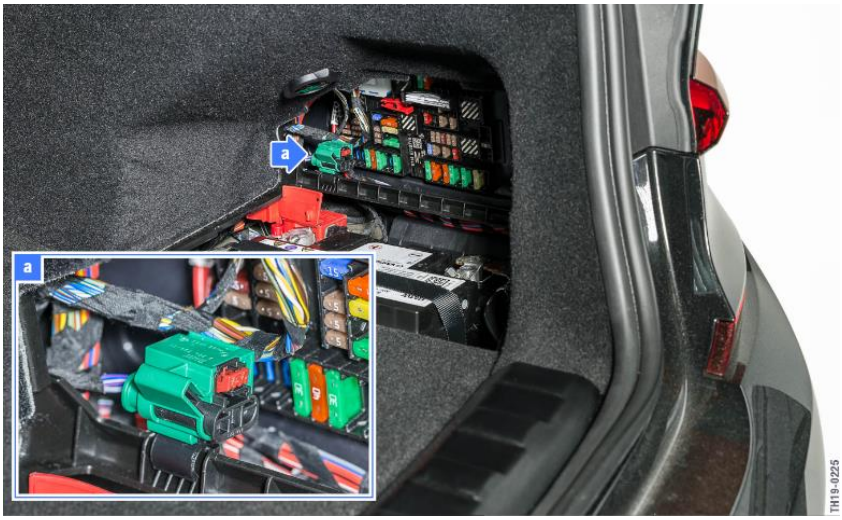
These technical measures ensure that the high-voltage system is switched off reliably and in the shortest possible time in the event of an accident. Dangers due to high voltages during or after the accident can therefore be virtually ruled out.

Manual turn off

Two rescue disconnects, which are located in the vehicle under the bonnet and in the boot, enable rescue workers to de-energise the vehicle before initiating further rescue measures. In addition to the rescue disconnects, there is also a so-called “Service Disconnect” in the boot. This also switches off the high-voltage components. Cutting the cables of the Service Disconnect deactivates the vehicle's high-voltage system.

Rescue disconnects

Service Disconnect in the boot



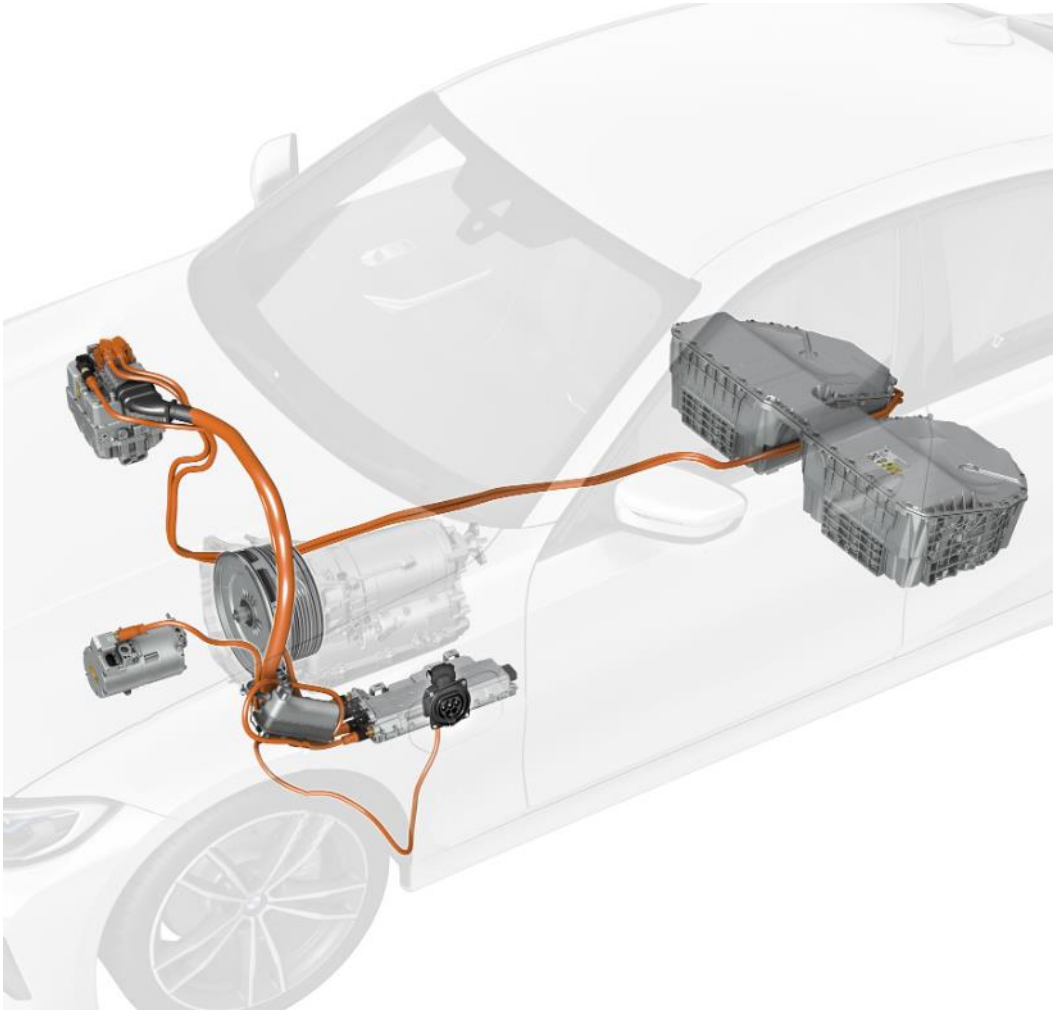
Rescue disconnect in the engine compartment/boot

Identification and avoidance of high-voltage cables

Colour coding and identification

The high-voltage cables connect the high-voltage components and are marked by orange cable sleeves. Manufacturers of high-voltage vehicles have agreed on uniform identification of high-voltage cables with the warning colour orange.

To connect the high-voltage cables to the high-voltage components, numerous high-voltage connectors are used.



Vehicle at charging point

The electric car is supplied with energy for the next trip at the charging station.

4. Access to the occupants

General rescue instructions

This section discusses dangers that are relevant both for persons involved in an accident and for rescue crews. Measures that can minimise a risk are also discussed. When at least one of the restraint systems is triggered, the hazard warning lights are automatically switched on in newer models, provided that the voltage supply in the vehicle is active. In addition to securing the vehicle, the function is also used to display the active voltage supply. Self-protection is paramount in all rescue measures. Suitable protective clothing must always be worn. Leaking fuel and escaping gas can ignite. In addition, gas above a certain concentration in the air can explode and may cause frostbite in contact with the skin. The use of brake fluid can cause corrosive effects on the skin. Fuel vapours are hazardous to health and should therefore not be inhaled.

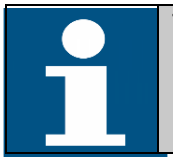
Examining vehicle interior

In order to determine the status of the safety systems, it is necessary to carry out an examination of the vehicle interior at the start of rescue work. All airbag modules are marked with the inscription “Airbag”. The identification is usually on or near the airbag module. Side airbags installed in the backrests may also be identified by means of a flag sewn into the backrest cover. Head airbags often have several identifications at the top of the body pillars or along the roof pillar. Seat belt pretensioners, if fitted, are not marked. Roll-over protection is only used on convertibles and is installed behind the rear head restraints. The roll-over protection cover is marked with the inscription “Do not cover”.

The maximum possible equipment of airbags, seat belt pretensioners and, if applicable, roll-over protection systems can be found in the rescue sheets.

Battery management

The majority of BMW Group vehicles are equipped with electrical ignition systems for the airbag. Electrical activation of the airbags by the safety systems control unit cannot take place when the voltage supply is interrupted. In order to deactivate the safety systems, it is necessary to de-energise the damaged vehicle. The procedures for switching off the engine or drive and deactivating/disconnecting the batteries are described in chapters 2 and 3.



The position of the batteries can be found in the rescue sheets.

After disconnecting the 12V battery, all electrical functions (lights, hazard warning lights, electric seat/steering column adjuster etc.) are without function. Before disconnecting, make sure that these functions are no longer required.

Removing the interior trim

Regardless of the design, it must be ensured that untriggered airbag stored gas inflators and untriggered seat belt pretensioners are not damaged. This is particularly important when removing the roof, in particular when separating the body pillars or when cutting through the B-pillar in the lower area. To prevent damage to belt drivers and stored gas inflators, the following options are recommended: It is recommended to remove the interior trim before cutting through the body pillars to avoid damaging the stored gas inflators and seat belt pretensioners. Any stored gas inflators or seat belt pretensioners that may be present are then visible and the path of the cut can be selected in such a way that damage is prevented. The stored gas inflators of head airbags are arranged in a mirror-inverted fashion. If the installation location on one side of the vehicle is known, the other stored gas inflator is in the same position on the other side of the vehicle. The mounting orientation can be checked using rescue sheets, which include display of the mounting orientation of stored gas inflators and seat belt pretensioners. The operational planning of rescue equipment is aimed at preventing damage to the affected components.

Danger to airbag components

The triggering of airbags, seat belt pretensioners and roll-over protection may impair the function of the airbag. This can result in the airbag being pushed away or even cut off. When the airbag is triggered and when it is compressed, dust may escape, which can cause slight irritation of the mucous membranes and skin. It is recommended to ventilate the vehicle interior whenever possible. It is recommended to wear protective gloves and safety goggles. Unprotected areas of skin should be washed with water as a precaution after the rescue operation. Because the area of the stored gas inflator may still be hot for some time, it is advisable not to touch a triggered airbag module.

Avoid damaging untriggered airbags, seat belt pretensioners and untriggered roll-over protection systems. It is also prohibited to cut into airbag modules. It must be ensured that damage to the safety system control unit during rescue work is prevented. The position of the control unit can be found in the rescue sheets. The control unit is usually located on the centre tunnel in the area of the gearshift lever.

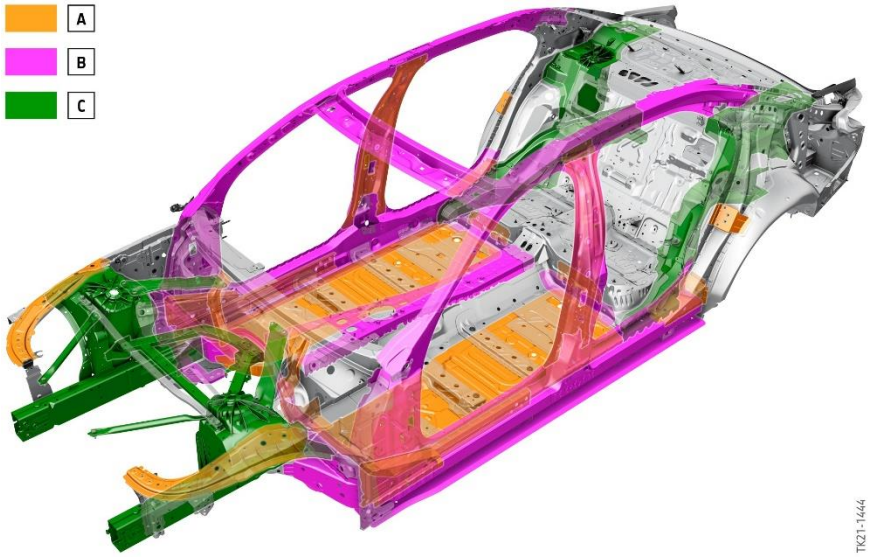
It must be ensured that no objects are placed on untriggered airbag modules and untriggered roll-over protection. Exposure of airbag modules to heat, for example through the use of cutting appliances, must be avoided. The stored gas inflator in the airbag has a self-ignition temperature of approx. 200°C. When vehicles are burning, the airbags are therefore triggered after prolonged exposure to heat.

It must be ensured that untriggered seat belt pretensioners are not damaged as far as possible. It should also be noted that care should be taken when tilting or lifting the vehicle when the ignition is switched on and the battery is connected. It is possible that untriggered roll-over protection will be activated.

Chapter 9 “Important additional information” describes which safety systems (airbags, seat belt pretensioners, roll-over protection, active pedestrian protection) are installed in today's vehicles.

Body reinforcements

Ensuring a high level of safety for vehicle occupants is achieved in particular by means of a rigidly designed passenger cell. In vehicle body construction, higher-strength and hot-formed steels, higher wall thicknesses and a multi-shell structure are used. These areas should primarily be avoided when rescuing injured occupants from modern vehicles or correspondingly powerful hydraulic cutting devices must be used.



A. Multiphase steel

B. Ultra-high-strength hot-formed steel

C. Aluminium

Hot-formed steel can only be cut using powerful cutting tools.

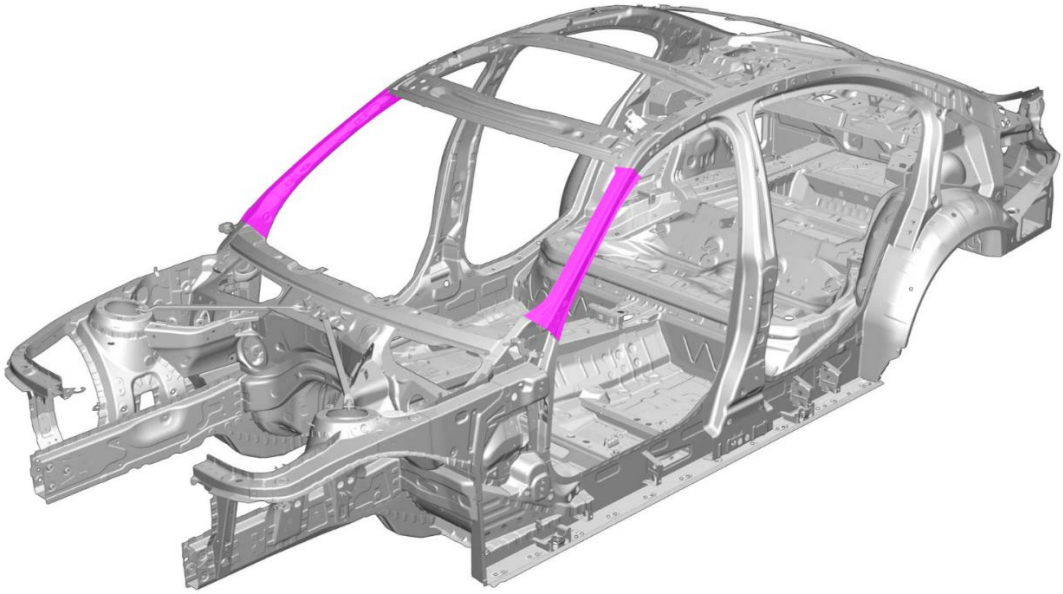
Information on the position of reinforcements is described in the vehicle-specific rescue sheets.

Side sill

Special steels are used in modern vehicles to reinforce the side sills. These are used to increase safety in the event of a side crash, particularly in the event of a pile collision.

A-pillar

In convertibles in particular, the body is additionally reinforced to achieve appropriate body rigidity without a roof. Tube reinforcements can be installed in the A-pillar at various points in the vehicle to improve the protection area in the event of vehicle rollover in conjunction with roll-over protection.

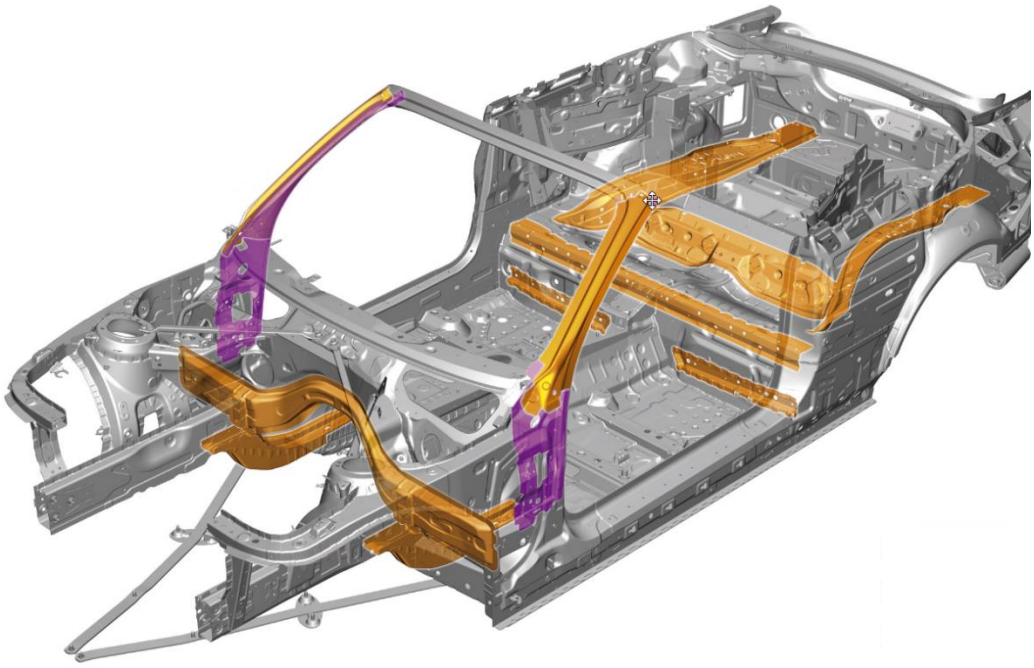


It is only possible to cut through the A-pillar in the area of A-pillar reinforcement using powerful rescue equipment.

The position of special reinforcement measures in the individual vehicles can be found in the rescue sheets.

A-pillar (convertible)

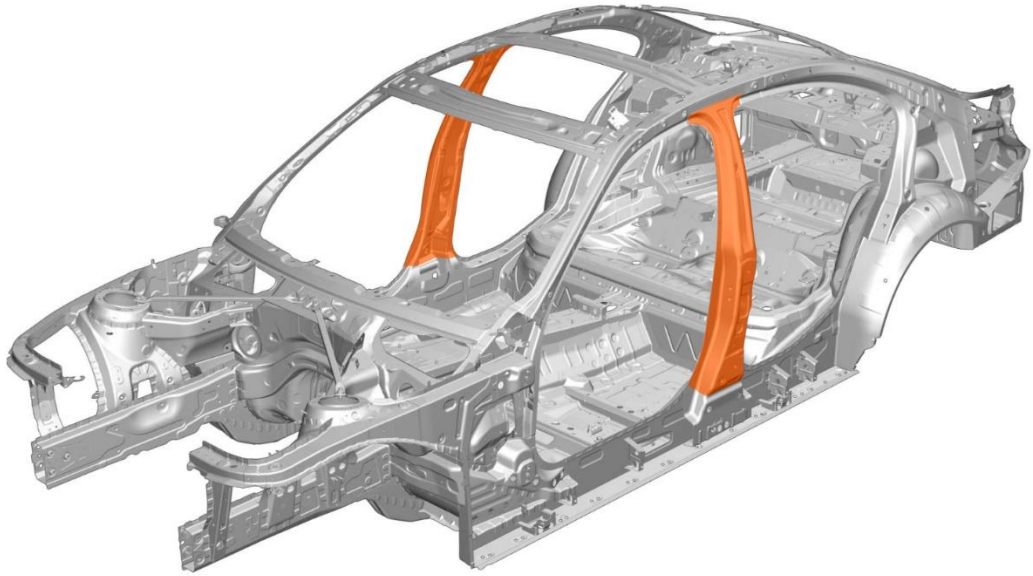
The A-pillar on a convertible has several special features compared to a vehicle with a fixed roof. Reinforcement is required to ensure structural rigidity and safety, for example. Because a convertible does not have a fixed roof, the A-pillar must be constructed more robustly, often with high-strength steel to prevent distortion. Another important function is roll-over protection, for which the A-pillar must also be able to withstand additional loads. In addition, mechanisms to secure and stow the folding roof must be integrated into the A-pillar. These special features make the design of the A-pillar in a convertible a demanding task.



	It is only possible to cut through the A-pillar in the area of A-pillar reinforcement using powerful rescue equipment.
	The position of special reinforcement measures in the individual vehicles can be found in the rescue sheets.

B-pillar

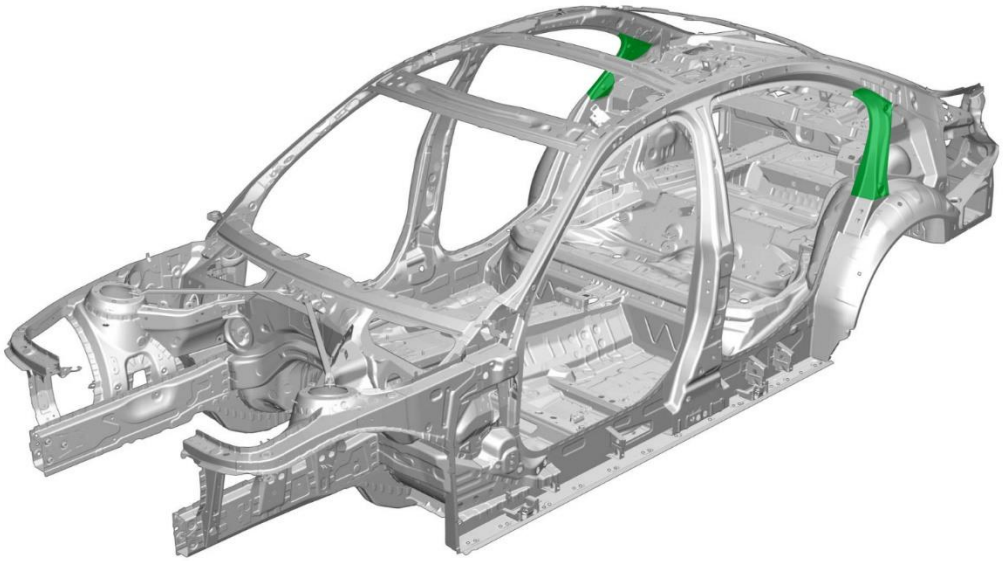
The B-pillar is reinforced by using higher-strength and hot-formed sheet metal as well as a multi-shell structure. In addition, modern B-pillars have a larger cross section. In the area of seat belt deflection, the B-pillar is additionally reinforced by the seat belt height adjustment, which makes cutting more difficult. These areas should therefore be specifically avoided.



It is easiest to cut through body pillars in the area above the seat belt height adjustment. The lower section of the pillar can also be cut through. However, it should be noted that the cross section of the pillar is very large and that the seat belt pretensioner is usually located there.

C-pillar

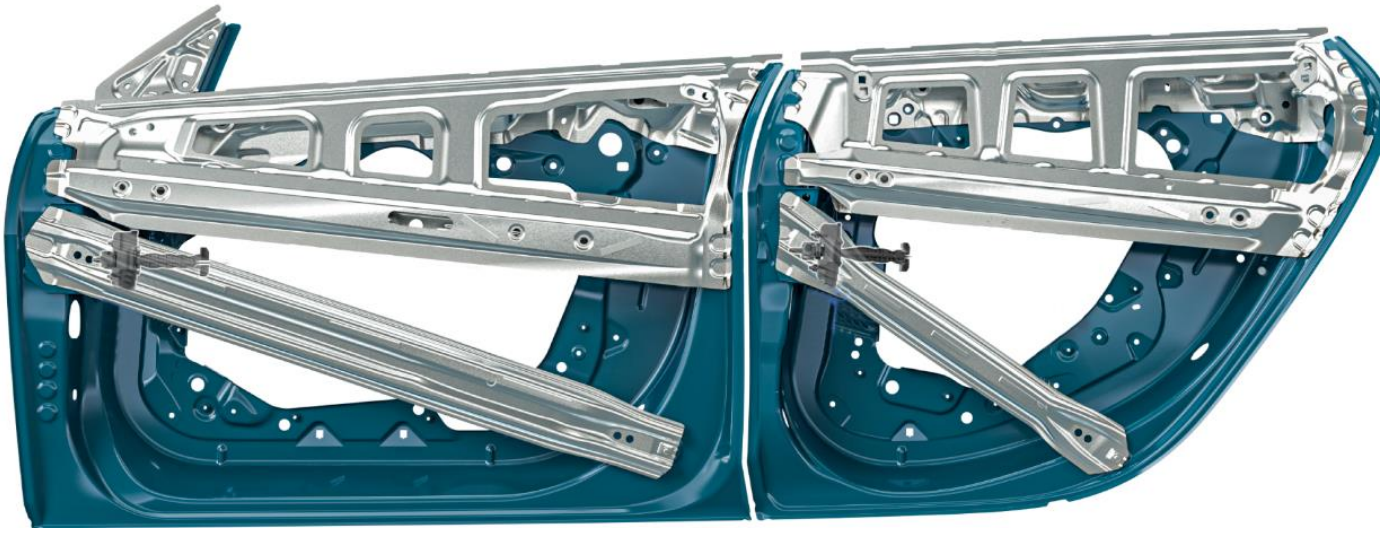
The C-pillar is an essential connection between the roof and the rear part of the vehicle and makes a significant contribution to structural rigidity. It plays an important role in side impact protection by absorbing and distributing impact energy. It also influences the exterior appearance and aerodynamics of the vehicle. In the vehicle interior, the C-pillar can also influence rear visibility and the sense of space.



The position of special reinforcement measures in the individual vehicles can be found in the rescue sheets.

Side impact protection

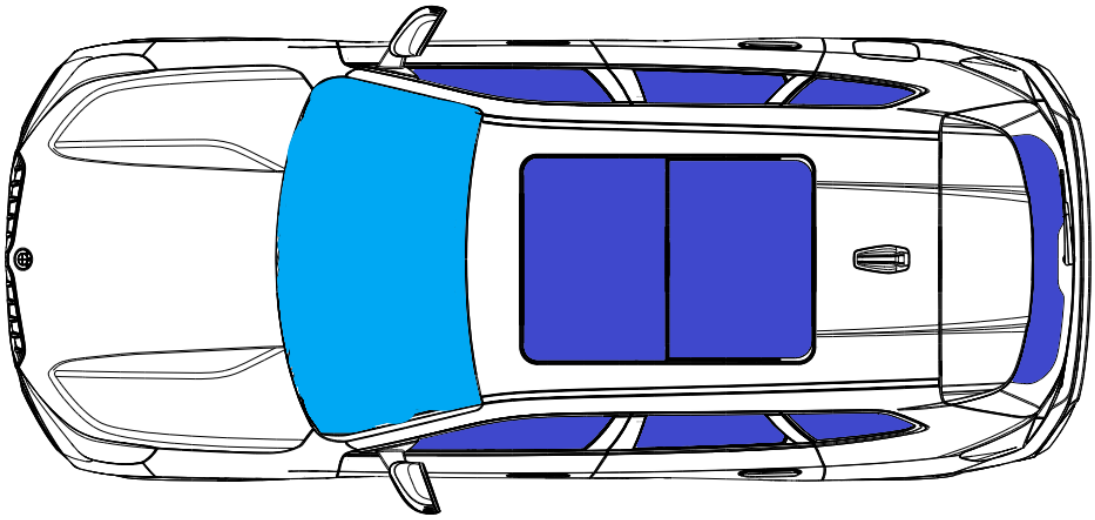
Side impact protection is installed in the doors. The tubes or profiles are arranged horizontally or diagonally behind the door outer skins. The high-strength profiles can be cut using powerful cutting devices.



The position of special reinforcement measures in the individual vehicles can be found in the rescue sheets.

VEHICLE GLAZING

The windows of BMW Group vehicles consist of single-layer and laminated safety glass. The windscreen is made of laminated safety glass (VSG) and the side, rear windows and panoramic sunroofs are designed as single-layer safety glass (ESG). Optionally, the side and rear windows can also be made of laminated safety glass (VSG).



- Laminated safety glass (VSG)
- Single-layer safety glass (ESG)

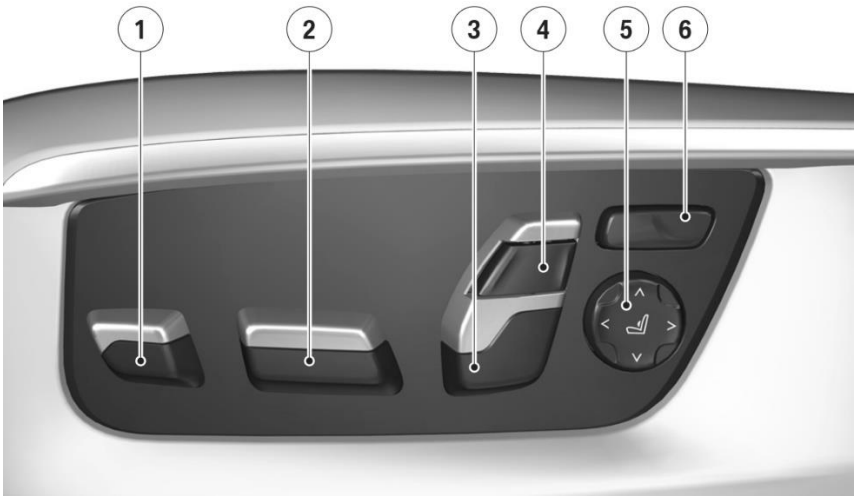
	Protect occupants against glass shards before removing the glass panes.

	Intact windows can suddenly shatter during rescue work on the vehicle. Depending on the accident situation and the scope of the rescue work, the glass panes should be removed beforehand. Glass panes can be removed by applying a pointed load e.g. using a spring centre punch or an emergency hammer. The glass panes should be secured beforehand.

Seat adjustment

Seat adjustment in BMW vehicles allows precise adjustment to the body size and preferences of the respective driver. Through the use of electrical adjustment and memory functions, BMW ensures the highest possible seating comfort.

Adjusting the seat automatically



Adjusting the seat manually

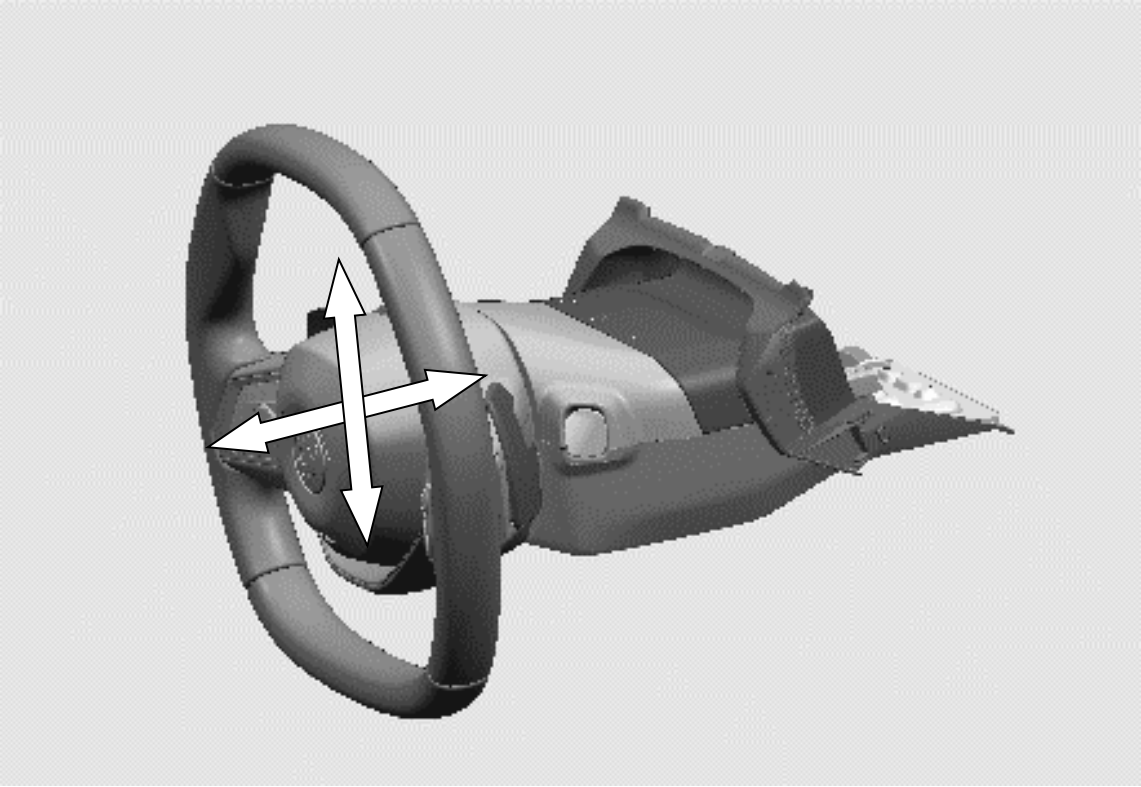
Steering

Depending on vehicle weight and axle design, considerable steering forces are sometimes required. In order to increase driving safety and comfort, all BMW Group vehicles are therefore equipped with steering assistance. This may be electrical or hydraulic.

Newer BMW Group vehicles will only use steering systems with electric steering assistance in the future.

Rack-and-pinion steering systems have electrical or hydraulic steering assistance.

The steering wheel position can also be adjusted mechanically or electrically, both in height as well as depth, depending on the equipment.



5. Stored energy / liquids / gases / solids

Overview of liquids used in vehicles

Fuel **Diesel engine**: - Diesel fuel DIN EN 590 **Petrol engine**: - Regular-grade fuel 91 - Super 95 RON - Super 95 RON E10 - Super Plus 98 - Super Plus 100 RON	Petrol, diesel, or other fuels may leak from the tank, fuel lines, or injector nozzles	
Engine oil 4 – 8 litres, depending on the model	Engine oil may leak out of the engine block, oil sump, gaskets, or oil lines	
Transmission oil Manual transmission: 1.5 – 2.5 litres Automatic transmission: 6 – 9 litres	In vehicles with automatic transmission, transmission oil may leak out of the transmission housing or lines	
Coolant 8 – 15 litres	Coolant may leak out of the radiator, hoses, radiator expansion tank, or coolant lines.	
Brake fluid Depending on the size of the vehicle 1 – 2 litres	Brake fluid can escape from brake lines, brake cylinders, or the brake servo	

Stored energy / liquids / gases / solids

Power steering fluid Similar to brake fluid: 1 – 2 litres	Power steering fluid can escape from lines, power steering reservoir, or power steering components	
Washer fluid 3 – 7 LITRES	Washer fluid can escape from the container or the washer fluid lines.	
AdBlue 12 – 25 litres	On vehicles with an SCR catalytic converter, AdBlue can escape from the AdBlue tank or the AdBlue lines	
Hydraulic fluid 1 – 2 litres	In vehicles with hydraulic systems (e.g. hydraulic clutch or hydraulic steering), hydraulic fluid can escape from the lines or the hydraulic components.	
Air from the tyres Front axle: - 2.2 – 2.7 bar Rear axle: - 2.2 – 2.7 bar	Although it is not an operating fluid in the conventional sense, air or tyre sealant can also escape from the tyres if they are damaged.	

Stored energy / liquids / gases / solids

Always wear appropriate personal protective equipment when handling escaping operating fluids.

Following an accident, all energy sources carried or stored (e.g. pyrotechnic seat belt pretensioners, airbags, gas pressure springs, fuels, gases etc.) pose the danger of sudden and explosive release of energy.

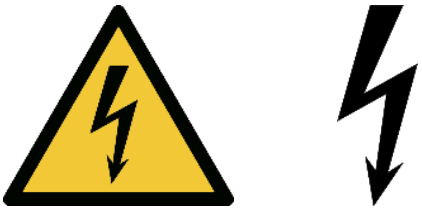
High-voltage vehicles

Working on components and systems with an alternating current voltage (AC) of 30 V or more or a direct current voltage (DC) of 60 V or more is life-threatening. Touching damaged or defective voltage-carrying components and cables, as well as uninsulated electrical connections and cables should be avoided.

Battery information

Exposure to high voltage

Exposure of the body to voltages of over 60 volts, which can occur in very rare cases when handling high-voltage components in accident vehicles, is associated with considerable risk and requires immediate measures. First, safety must be ensured by safely disconnecting the power source in order to stop the current flow. The rescue service or fire brigade must then be alerted immediately, with explicit reference to the fact that this is an electrical accident involving an electric vehicle and voltages of over 60 volts. If the victim is no longer in contact with the power source and there is no immediate danger to life, they should be carefully removed from the danger zone. It is essential that there is no direct contact with the victim as long as the power source is not safely isolated, in order to minimise the risk of further injuries.



Exposure to materials used

High-voltage batteries in electric vehicles use various materials with which humans should not come into direct contact, as they are potentially dangerous. Materials used in high-voltage batteries in electric vehicles primarily include lithium, which is the main component of lithium-ion batteries. Lithium reacts on contact with moisture or air and can cause fires or explosions as a result. The electrolyte in lithium-ion batteries is also problematic as it consists of a mixture of organic solvents and lithium salts, which are corrosive and can cause skin and eye irritation. High-voltage batteries also use various metals such as aluminium, copper and nickel, which can cause injuries due to their sharp-edged properties. In addition, electrode materials such as graphite can also have an irritating effect on the skin. Some electric vehicles also use coolants for controlling the temperature of the batteries, which may contain toxic or corrosive components. Persons who work with high-voltage batteries or remain in the vicinity of electric vehicles with such batteries, should be properly trained and informed in order to identify and avoid potential dangers.

Dangers in a non-fire situation

Inhaling these chemicals can be hazardous to human health and cause respiratory irritation, dizziness, nausea, or other symptoms.

Wearing a respiratory mask is recommended for accident-damaged electric vehicles with damaged batteries that are parked in enclosed spaces (e.g. underground car parks).

6. In case of fire

What to consider in the event of a fire

In general, all statutory requirements relating to a conventional vehicle on fire are to be observed. No explosion will occur in the event of a reaction of the lithium-ion high-voltage battery triggered by the fire. A quick thermal response will take place. Monitoring the high-voltage battery with a thermographic camera is therefore recommended.

Trapped persons can be rescued using suitable fire fighting equipment. As with conventional vehicles, a vehicle fire can cause smoke that is hazardous to human health (e.g. due to burning plastics).

	There is an electrical risk even after a vehicle has been on fire. Danger of injury! Use personal protective equipment identical to that for conventional vehicle fires. Do not touch high-voltage components.

	BGI/GUV-I 8677 electrical hazards at the scene of deployment. Danger of injury! Observe the following safety distance when extinguishing: - 1 m for spray jet - 5 m for full jet

Combustion-engine vehicles

Dangers

Explosion hazard

Uncontrolled ignition of the fuel-air mixture can cause serious damage to the vehicle surroundings and endanger the safety of the occupants.

Fire-fighting a burning vehicle requires specialised training and experience in order to be carried out effectively and safely. It is important to follow the fire brigade's instructions and not to endanger yourself.

Electric vehicles

Dangers

Explosive

Flammable

Corrosives

Hazardous to human health

In high-voltage vehicles, chemical energy storage devices (high-voltage batteries) are used for electric drives. These contain so-called hazardous substances, which require particularly careful handling. It is mandatory to document the associated information in safety data sheets. This guide only summarises the most important backgrounds and potential dangers.

In the event of fire, the high-voltage battery is to be cooled with plenty of water in order to prevent further reactions inside the battery. When extinguishing the fire, audible processes can occur inside the high-voltage battery. This takes place in the safety valves of the battery cells. This process is no source of danger. These audible processes can also occur after extinguishing the fire.

Fuel cell

Dangers

Explosive

Gases under pressure

If escaping hydrogen burns, extinguishing the hydrogen flame can result in a build-up of hydrogen. There is a danger of a subsequent explosion. If the automatic shut-down of the fuel cell system does fails (chapter “Turn off fuel cell system”), allow the hydrogen flame to extinguish by itself. Only prevent the fire from spreading further and ensure that the hydrogen burns off in a controlled manner. Use large amounts of water, particularly on the floor of the vehicle between the front and rear axles, in order to cool the fuel tanks.

Fire-fighting methods

The BMW Group attaches great importance to fire-fighting in its vehicles. Preventive measures such as electronic monitoring systems and strict quality control during production serve to prevent fires. The vehicles are equipped with fire protection technology, including fireproof materials, to react quickly in an emergency and protect the occupants. Cooperation with the emergency services ensures that effective emergency measures can be taken in the event of a fire. The safety of occupants is the top priority. BMW is continuously utilising technologies and processes to minimise the risk of fire and to enable a rapid response in an emergency.

Risk of fire due to vehicle components

Fuel tank

In BMW Group vehicles, the fuel tank is usually located under the rear seat bench or in the vehicle rear near the rear axle. This arrangement is typical of many modern vehicles, as it promotes balanced weight distribution and keeps the vehicle's centre of gravity low. This helps to improve driving dynamics and stability. However, the exact location may vary slightly depending on the model and year of manufacture. Specific information about a certain BMW model can be found in the Owner's Handbook for the vehicle or in the rescue sheet.

High-voltage components (electric/hybrid vehicles)

The high-voltage components in BMW vehicles, particularly in hybrid and electric vehicles, are located at various points in the vehicle. Here are the typical locations of the most important high-voltage components:

High-voltage battery (4)

This is usually located in the vehicle floor or under the rear seat bench. On some models, it may also be installed in the boot. Accommodation in the vehicle floor helps to lower the centre of gravity and improves driving stability.

Electric motor (7), (10)

The electric motor is usually arranged close to the drive axle. On front-wheel drive vehicles, it is usually in the engine compartment; on rear-wheel drive vehicles, it is close to the rear axle. Four-wheel drive vehicles can have several electric motors mounted on different axles.

Power electronics

This is usually located in the engine compartment, as it works closely with the electric motor and often requires direct cooling.

High-voltage wiring

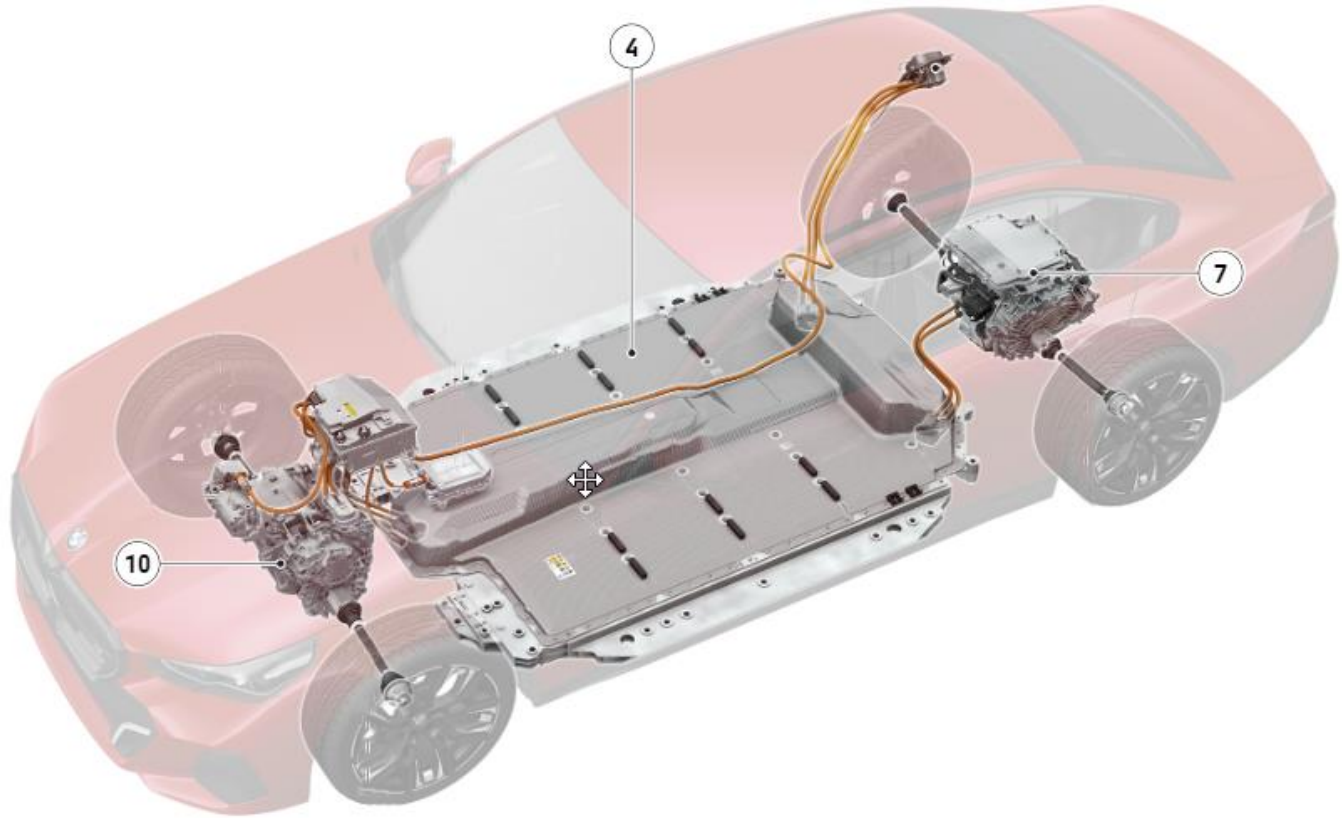
The orange wiring is routed through the vehicle to connect the battery with the electric motor and power electronics. It is well insulated and protected for safety reasons.

Battery charger (on-board charger)

This is often located in the front of the vehicle, near the engine compartment or in the boot.

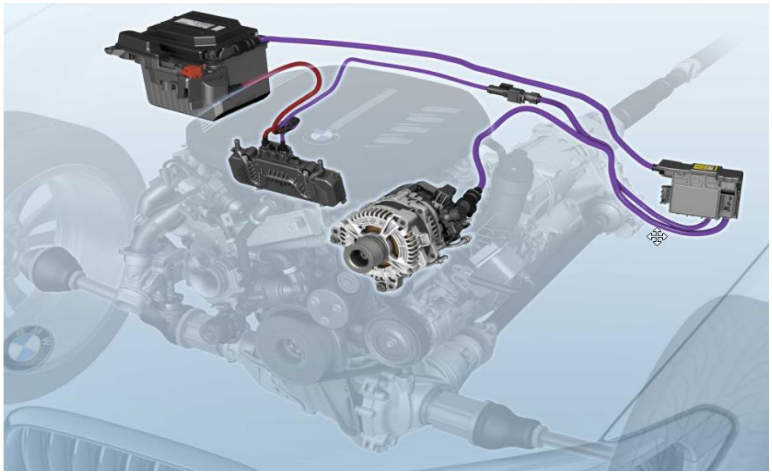
High-voltage heating and air conditioning compressor

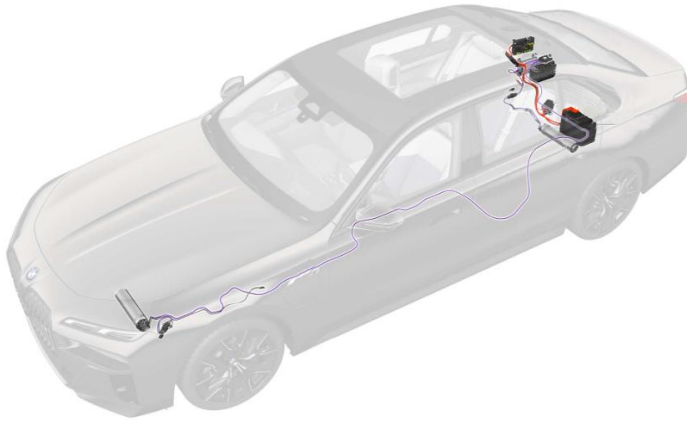
These components, which serve to air condition the vehicle interior, are also often located in the engine compartment or near the high-voltage battery. The exact location of these components may vary depending on the model and year of manufacture. Detailed information can be found in the technical manual for the vehicle or directly from the manufacturer. BMW attaches great importance to the safety and efficiency of its high-voltage systems, which is why these components are carefully integrated into the vehicle and are well protected.



Low-voltage battery

The location of the battery in BMW vehicles varies depending on the model and year of manufacture. On many BMW models, particularly rear-wheel or all-wheel drive vehicles, the battery is located in the boot. It is usually accommodated on the right or left side under a cover or in the spare wheel compartment. This arrangement contributes to improved weight distribution. On some older BMW models or some smaller models, the battery may be installed under the bonnet in a battery compartment on the front passenger or driver's side. There are also modern BMW models in which the battery is located under the rear seat bench. This also serves for better weight distribution and provides for space in the engine compartment. The exact locations of the batteries in the vehicle can be found in the vehicle-specific rescue sheet.





Other combustible materials

A BMW vehicle contains several combustible materials that are required for various functions and comfort features of the vehicle but are safe to use under normal conditions. The vehicle interior contains seats, carpets, door trim panels and headlining, which consist of plastics, foam materials and textiles and are usually treated with flame retardants. The dashboard and centre console are also often made of plastic, which can melt or burn at high temperatures, but is also often non-inflammable.

The insulation of the electrical cables in vehicles consists of plastics, which can be flammable if damaged or overheated, although modern vehicles often use materials that are difficult to ignite. The fuel tank and the lines that contain petrol or diesel are highly flammable. However, to ensure safety, the tank and the lines are designed to prevent leaks under normal conditions. Engine oil, transmission oil and other lubricants are also flammable, but are contained in closed systems.

The engine compartment also contains hoses, seals and covers made from combustible plastics and rubber materials. The 12V battery contains acid and can burn under certain conditions, such as a short circuit, is however equipped with safety mechanisms. Finally, foam materials and other insulating materials used in vehicles for noise and heat insulation are also flammable, but are often treated with flame retardants.

These materials are selected and processed under strict safety standards. In the event of an accident or vehicle fire, numerous safety systems work together to keep the risk to occupants as low as possible.

Fire-fighting measures

Extinguishing access points

The extinguishing access points on BMW vehicles represent special areas that are intended for rescue crews in order to be able to intervene adequately in the event of a fire. The exact descriptions of the extinguishing access points are described in detail in the vehicle documentation, such as the rescue sheet. The typical locations and accesses are explained below:

Engine compartment

Opening the bonnet allows access to the engine compartment. At this point, it is possible for the fire brigade to apply extinguishant to the engine/motor and surrounding areas. In addition, specific access points are often marked to ensure safe and efficient access to the engine compartment.

Passenger cell

The vehicle doors provide access to the passenger cell. In addition, interior parts such as seats and trim panels can catch fire, meaning that the fire brigade may have to gain access through doors or windows.

In the event of an emergency, it is possible to break the windscreen and side windows of the vehicle in order to gain rapid access to the vehicle interior.

7. In case of submersion

In case of submersion

A vehicle is deemed to have serious accident damage when it is completely or partially submerged in water (e.g. harbour basin, river or canal).

Vehicle in and under water

After recovering the vehicle from the water, the high-voltage system must be switched off by disconnecting the high-voltage service disconnect and the 12V or 48V battery (negative terminal). In case of airbag deployment, it can be assumed that the high-voltage system has been switched off. Touching high-voltage components and high-voltage cables must be avoided.

Dangers due to submersion

Submersion of a vehicle in water can constitute a dangerous situation that has serious consequences for the occupants as well as for the vehicle. Such a situation may arise as a result of various circumstances, including driving along flooded roads, exiting passable roads, or driving on insufficiently secured areas near water bodies.

One of the immediate dangers is water entering the vehicle interior. This can be via doors, windows, or other openings, particularly when the vehicle is heavily surrounded by water or is submerged. As soon as water enters the vehicle, it can lead to a number of problems that can endanger the well-being of the occupants.

One possible risk is that doors and windows are difficult or impossible to open due to water pressure or when electronics are switched off.

Electrical hazards can also arise when water comes into contact with electrical components of the vehicle. This can result in short circuits, which not only damage the vehicle's electrical system but also increase the risk of an electric fire.

Specific dangers and procedures for high-voltage vehicles

In case of submersion

Electrical hazard

Water entering a high-voltage vehicle can lead to a short circuit or electric shock. The presence of water near high-voltage components increases the risk of electrical faults.

Corrosion and damage to high-voltage components

Water can cause corrosion and damage to high-voltage electrical components. This can cause malfunctions and impair the safety of the vehicle.

Insulation failure

If water penetrates the battery system or other high-voltage components, it can cause failure of the insulation. This can increase the danger of a short circuit and cause serious damage to the electronics. Contact with water can lead to a sudden rise in temperature, increasing the risk of overheating or even thermal outbreaks.

Thermal risk

High-voltage batteries generate heat during operation. When water comes into contact with a hot battery, this can lead to a sudden rise in temperature (short circuit in the high-voltage battery), which increases the risk of overheating or even thermal outbreaks.

Danger of gas formation

Water reacting with certain materials in high-voltage components can release gases. These gases can be toxic or even form an explosive mixture, leading to additional hazards.

Electrolysis

When in contact with water, high-voltage components, in particular aluminium or copper components, can be damaged by electrolysis. This can result in leaks or other problems.

In case of submersion

Potential fire hazard

Although electric vehicles do not use flammable fuels, when in contact with water, there is a chance of an electrical malfunction that can result in a fire, particularly if the water causes a short circuit or the battery is damaged.

Hydrogen gas formation (in fuel cell electric vehicles)

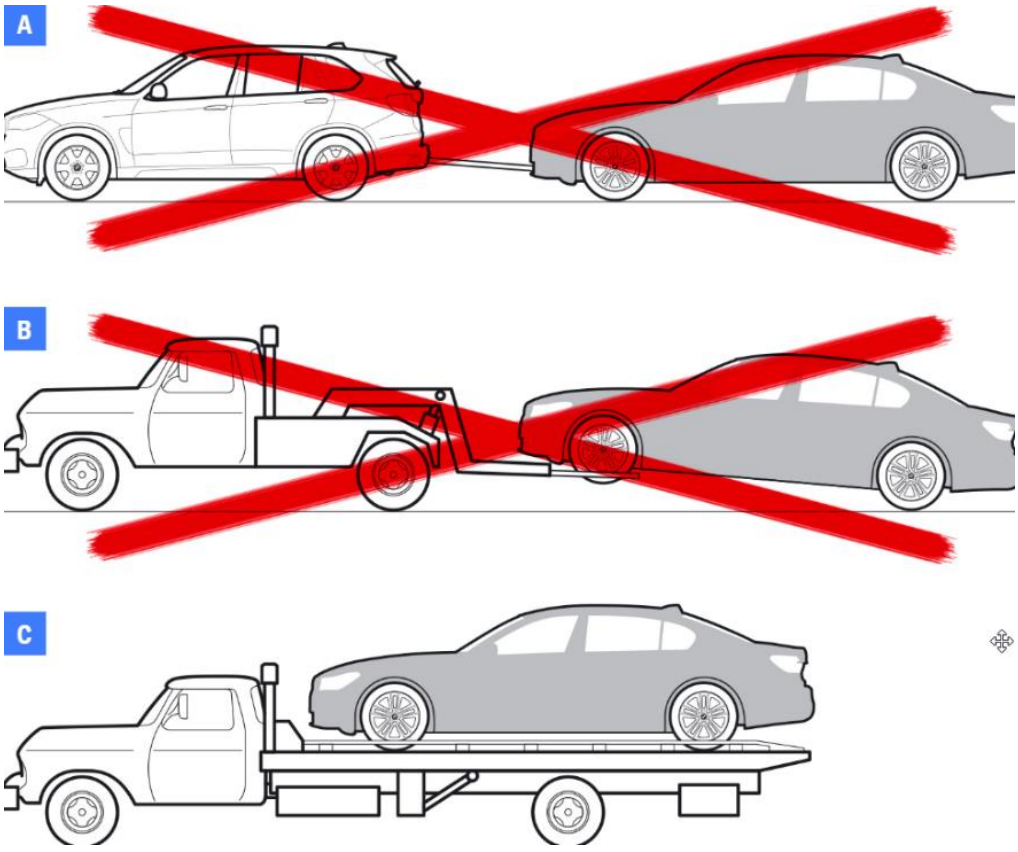
In hydrogen fuel cell electric vehicles, hydrogen gas can be produced by the reaction of water with the high-voltage components. This gas is flammable and can increase the risk of fire.

8. Towing / transportation / storage

What should be considered

The high-voltage system should be deactivated before loading (chapter 3). Notes on this can be found in the Owner's Handbook for the vehicle or in the emergency services datasheet. In the event of transfer to the authorities representative / recovery company, it is recommended that these are informed of the measures carried out by the fire service (high-voltage deactivation). Specifically, they must be informed of the potential danger from damaged high-voltage components (e.g. electric shock or risk of fire from the battery pack).

National regulations / standards for loading and transport must be observed. If the vehicle is transferred to third parties, it is recommended to communicate and confirm in written forms the measures carried out. When lifting with a crane/jack or loading, care should be taken not to damage any high-voltage components with the winch.



The vehicle should always be transported on a flatbed trailer or in accordance with the manufacturer's instructions. Towing away in the hoisting frame can cause damage to the electric/hybrid system if the drive axle remains on the road.

Take care in the case of four-wheel drive vehicles!

Where possible, vehicles with damaged batteries should be transported to the nearest suitable BMW authorised workshop or to a safe place of storage.

Emergency gearbox release

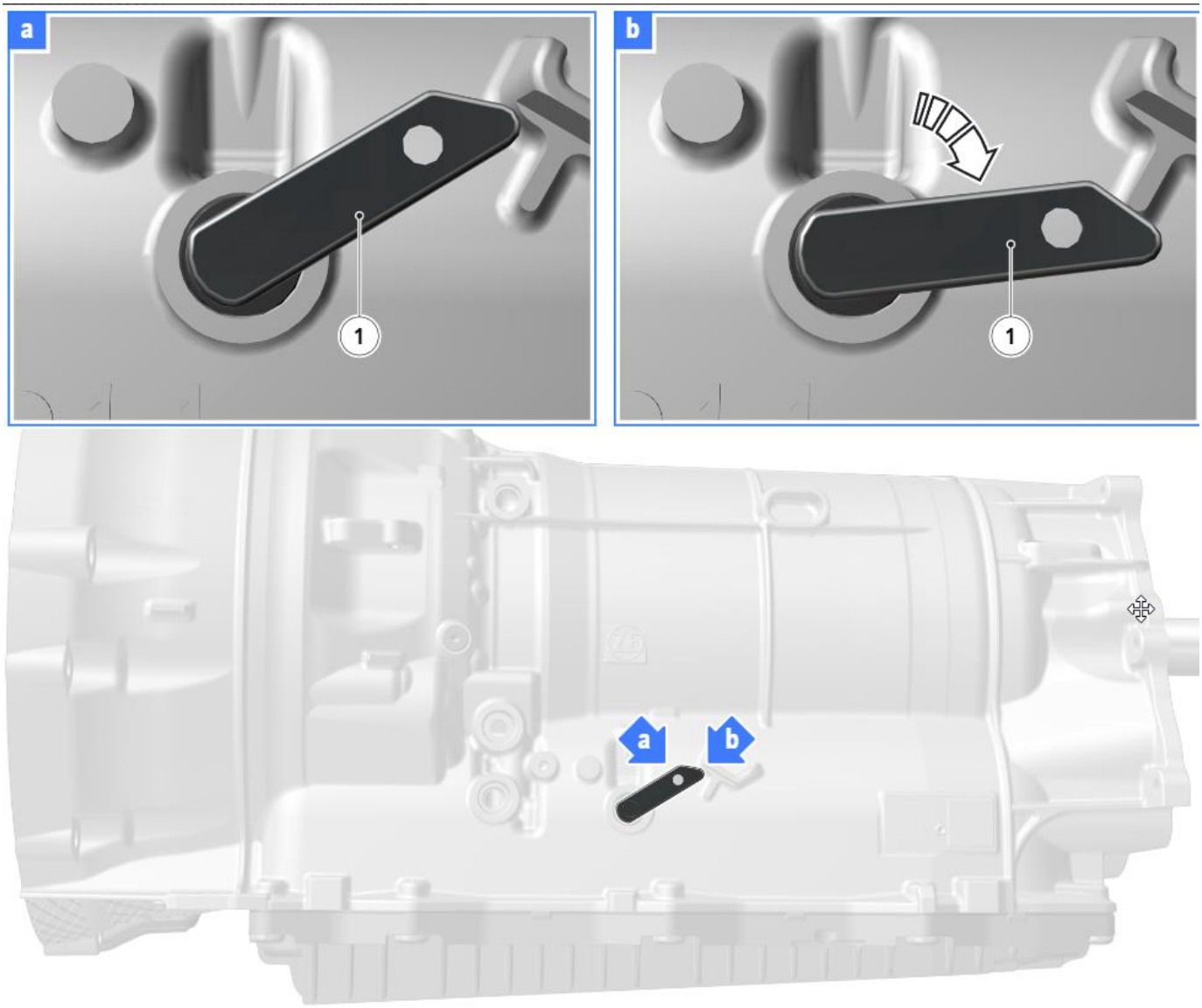
In the event of a breakdown, the automatic transmission can be emergency released in two different ways.

- Mechanical transmission emergency release
- Electronic transmission emergency release

Before performing emergency gearbox release, the vehicle must be secured against rolling away (chapter 2 “Immobilisation / stabilisation / lifting”).

The emergency gearbox release is primarily intended to make the vehicle manoeuvrable. Whether the vehicle can then be towed away or what special features must be considered can be found in the Owner's Handbook for the vehicle.

Mechanical emergency gearbox release



Electronic emergency gearbox release

Electronic emergency gearbox release is only possible if the engine does not start, but the starter motor rotates.

The electronic emergency gearbox release is active for 30 minutes. Wheel speed signals caused by moving the vehicle have no effect on the specified period of time, but they prevent the parking lock from being activated as long as they are being transmitted. For example, if a vehicle is moved shortly before the 30 minutes have elapsed, the parking lock is only activated when the vehicle comes to a standstill again. The time

period also depends on the battery capacity. When stored voltage thresholds are undercut, the parking lock is automatically activated regardless of the time period.

The following conditions can prevent or impede electronic emergency gearbox release:

- If the vehicle is positioned on an incline (tensions in the powertrain)
- At very high or low transmission oil temperatures (changed viscosity)

	After successful electronic emergency gearbox release, the vehicle can only be manoeuvred and cannot be towed.

	Detailed information on electronic emergency gearbox release can be found in the corresponding repair instructions and in the operating instructions.

Towing away

When towing away a severely damaged vehicle, the following points need to be observed:

Follow instructions for towing away in the rescue sheet or vehicle Owner's Handbook.

- The vehicle may only be towed away be trained personnel.
- The high-voltage system is to be switched off before transporting (de-energised).
- Insulating tensioning straps and lifting gear are to be used.
- Not specifically trained persons are to be kept away.
- Avoid transverse loads on the towing eye. For example, do not raise the vehicle by the towing eye.
- If the vehicle does not stand on its own wheels, adequate insulation material is to be used.
- The vehicle body may not have any metallic contact to the loading platform.
- The elements of the high-voltage battery can be lifted onto a truck with insulating facing on the loading platform and then be covered with an insulating cover.
- The vehicle is to be secured sufficiently in order to avoid further damage to the high-voltage battery due to movement.
- If the vehicle can be repaired, it should be transported to the nearest BMW authorised workshop if possible.

Storage

Damaged electric vehicles, especially those with lithium-ion batteries including high-voltage batteries, can pose a danger, e.g. after a serious collision.

Both electric hybrids and pure electric vehicles with potentially damaged batteries and high-voltage batteries must be parked in a quarantine area.

The quarantine area is intended to park a damaged vehicle so that, in the event of a delayed vehicle fire breaking out, it is prevented from spreading to neighbouring objects (e.g. vehicles, buildings, vegetation etc.). At the same time, potential environmental hazards due to leaking operating fluid is avoided.

The quarantine area is not designed to prevent a fire.

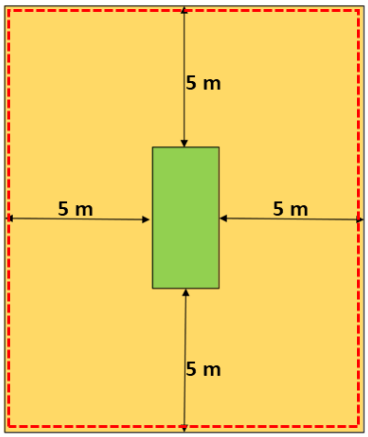
Towing / transportation / storage

This applies irrespective of the drive type:

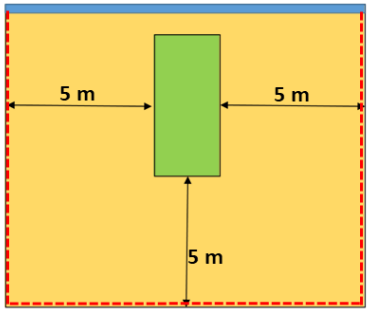
Securing against access by unauthorised persons

National regulations must be observed.

The fire-fighting water supply must be coordinated with the local department responsible for fire protection.

Example for quarantine areas (open air)	
	Vehicle footprint (length x width) Passenger car: 5 m x 2.5 m Commercial vehicle/bus <7.5 t: 7.5 m x 2.5 m Commercial vehicle/bus >7.5 t: 12.2 m x 2.7 m
	Safety zone barrier Identifications: Measures for early fire detection, such as: • Regular monitoring (e.g. temperature) • Inspection by personnel or video monitoring

Towing / transportation / storage

Example for quarantine areas (open air)	
 = reduced distance when a fire protection wall or adequate measure, such as a suitable fire barrier ceiling, is used	Vehicle footprint (length x width) Passenger car: 5 m x 2.5 m Commercial vehicle/bus <7.5 t: 7.5 m x 2.5 m Commercial vehicle/bus >7.5 t: 12.2 m x 2.7 m Safety zone barrier Identifications: Measures for early fire detection, such as: • Regular monitoring (e.g. temperature) • Inspection by personnel or video monitoring

Towing / transportation / storage

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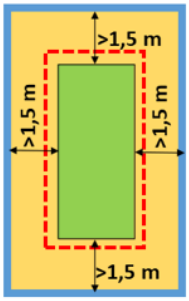 = reduced distance when a fire protection wall or adequate measure, such as a suitable fire barrier ceiling, is used	Vehicle footprint (length x width) Passenger car: 5 m x 2.5 m Commercial vehicle/bus <7.5 t: 7.5 m x 2.5 m Commercial vehicle/bus >7.5 t: 12.2 m x 2.7 m Safety zone barrier Identifications: Measures for early fire detection, such as: • Regular monitoring (e.g. temperature) • Inspection by personnel or video monitoring

Towing / transportation / storage

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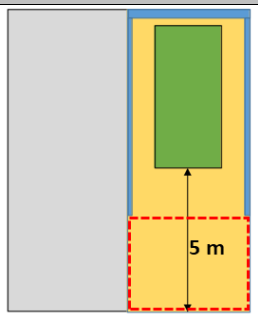
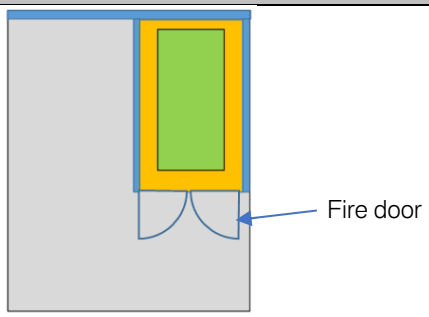
 = reduced distance when a fire protection wall or adequate measure, such as a suitable fire barrier ceiling, is used	Vehicle footprint (length x width) Passenger car: 5 m x 2.5 m Commercial vehicle/bus <7.5 t: 7.5 m x 2.5 m Commercial vehicle/bus >7.5 t: 12.2 m x 2.7 m Safety zone barrier Identifications: Measures for early fire detection, such as: • Regular monitoring (e.g. temperature) • Inspection by personnel or video monitoring

Towing / transportation / storage

<table>
<tr><th colspan="2">Example for quarantine areas (open air)</th></tr>
<tr><td> 

= reduced distance when a fire protection wall or adequate measure, such as a suitable fire barrier ceiling, is used</td><td>Vehicle footprint (length x width)

Passenger car:
m x 2.5 m
Commercial vehicle/bus <7.5 t:
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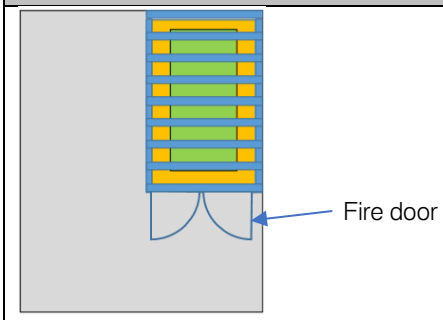
Commercial vehicle/bus >7.5 t:
12.2 m x 2.7 m

Safety zone barrier

Identifications:

Measures for early fire detection, such as:
• Regular monitoring (e.g. temperature)
• Inspection by personnel or video monitoring</td></tr>
</table>

Towing / transportation / storage

<table>
<tr><th colspan="2">Example of quarantine areas (ventilated sea container)</th></tr>
<tr>
<td> 

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Passenger car:
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Commercial vehicle/bus <7.5 t:
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12.2 m x 2.7 m

Safety zone barrier

Identifications:

Measures for early fire detection, such as:
• Regular monitoring (e.g. temperature)
• Inspection by personnel or video monitoring</td>
</tr>
</table>

During quarantine accommodation, the following recommendations should be followed where possible:

- Ensure early fire detection through regular checks of the electric vehicle
- During use, carry out remote monitoring by means of a video/heat imaging camera; if necessary, keep a test record including checking of the battery temperatures at regular intervals.
- Alternatively, adequate technical solutions for monitoring can be applied
- Monitoring for increase in temperature or increased temperature of the battery, unusual odour, leakage of fluids from the housing (in this case, the fire brigade must be alerted immediately)
- Identification and validation of the parking area and the vehicle
- Documentation of the accompanying circumstances (operation number, date, owner, contact details, collection date)
- Immediate contact with the owner for a risk assessment by a specialist workshop or by the vehicle manufacturer/importer, if necessary an expert tester.
- Protection of the electric vehicle against penetration of moisture into the vehicle interior or, if applicable, into the battery energy storage device, in particular due to rain
- Possible use of drip pans for any leaking operating fluids (e.g. coolants containing glycol)

9. Important additional information

Emergency call

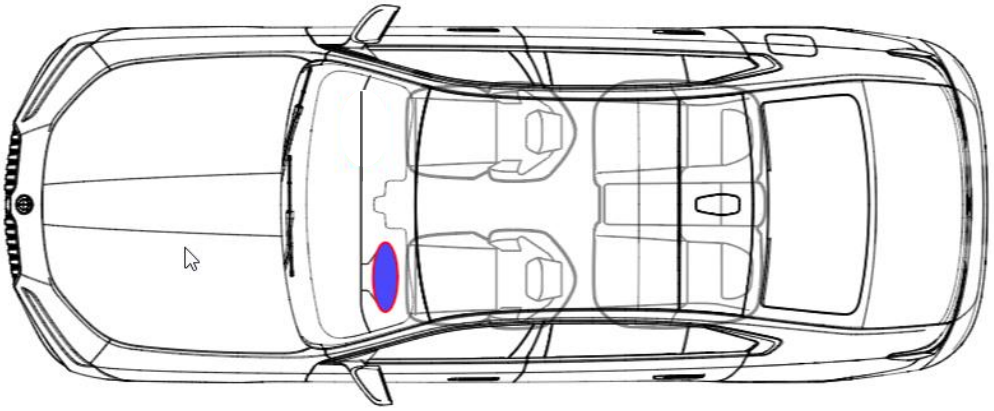
On newer vehicles, an emergency call (eCall) is triggered to the European emergency number 112 in the event of an accident, which sends a minimum data record directly to an emergency call centre. Parallel to this, voice contact to the emergency call centre is established. In addition to being triggered automatically in the event of an accident, eCall can also be triggered manually. The minimum data record includes the time of the accident, the exact coordinates of the accident location, the driving direction, vehicle identification number, service provider ID and eCall qualifier. It is optionally possible to transmit data from on-board safety systems, such as for example the severity of the accident and the number of passengers, whether the seat belts were fastened, whether the vehicle has rolled over.

Airbags and restraint systems

Complete overview of restraint and safety systems

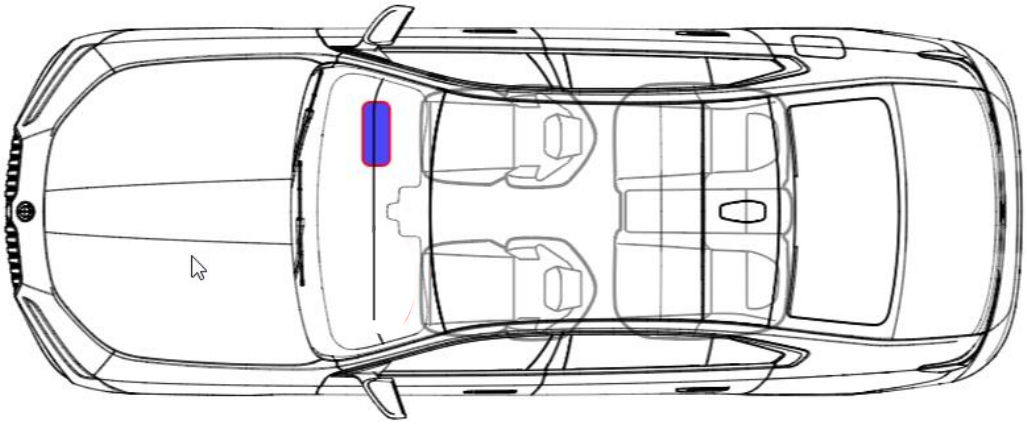
Driver's airbag

The task of the driver’s airbag, in conjunction with the seat belt, is to reduce the risk of injury to the driver in the event of a front-end collision. The driver's airbag is located in the impact plate of the steering wheel. Depending on the model and national-market version, the driver’s airbag is equipped with a single-stage or two-stage stored gas inflator.



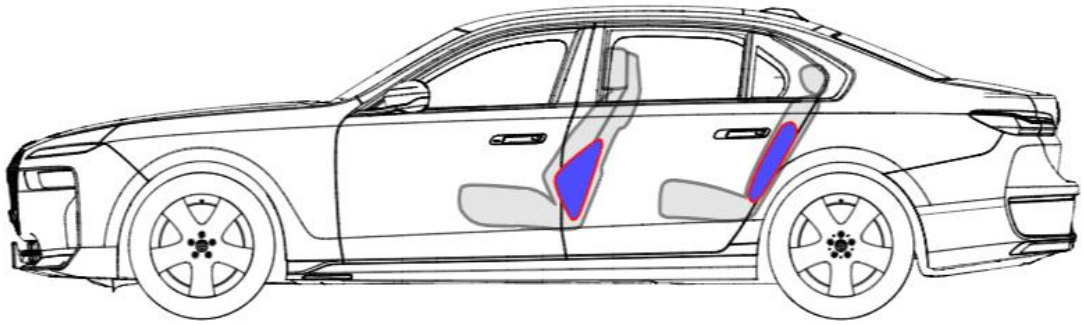
Front passenger airbag

The front passenger airbag is located in the instrument panel. When the front passenger airbag is deployed, the instrument panel breaks open at defined points. Depending on the model and national-market version, it is equipped with a single-stage or two-stage stored gas inflator.



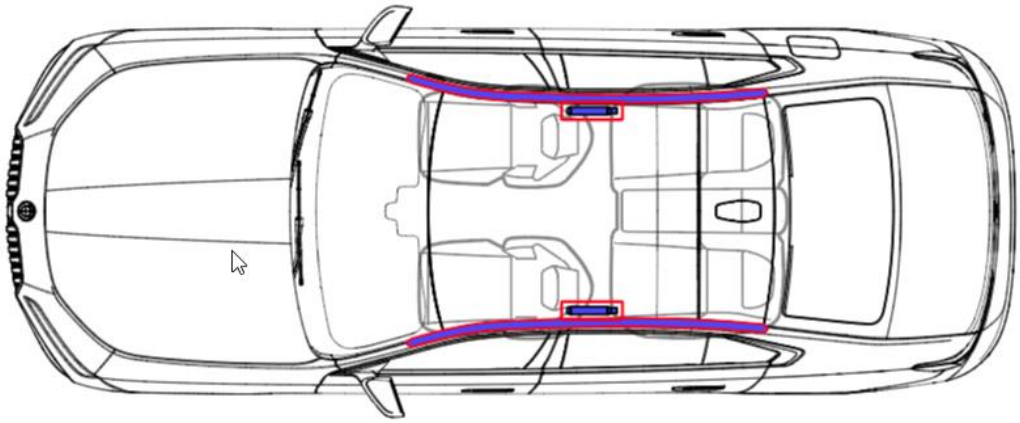
Side airbag

The purpose of side airbags is to minimise the risk of pelvic and trunk injuries to occupants in the event of a side collision. In all current BMW Group models, the front side airbag is deployed from the front seat backrest. The side airbags and the stored gas inflators are located in a plastic housing, the airbag module. The airbag module is installed in the front seat backrest and is covered by the seat cover.

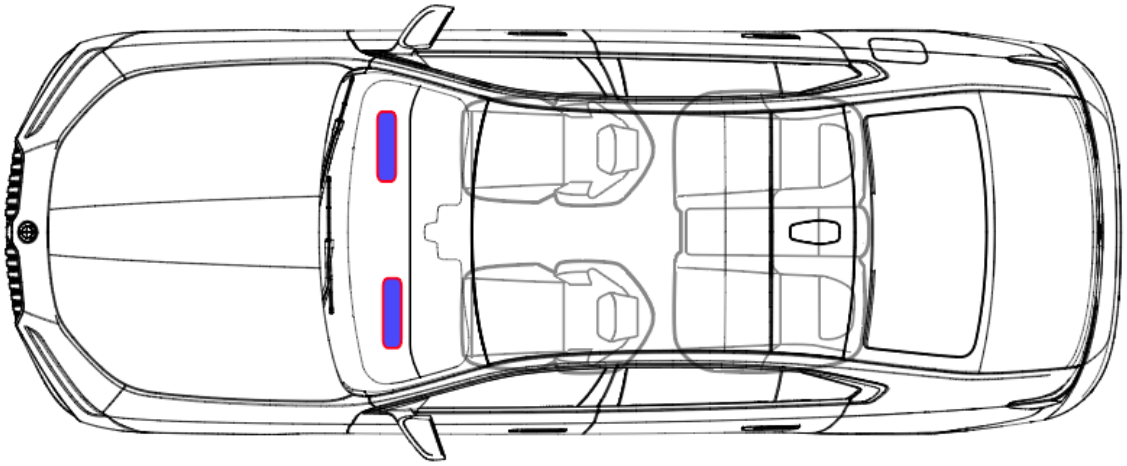


Head airbag

In the event of a side collision, unlike a front-end collision, fewer deformable sheet metal structures are available. Head airbags are installed to protect occupants in the event of a side collision. These range from the A-pillar to the C-pillar and cover the entire area of the side windows. The head airbag deploys between the occupants and the side structure.

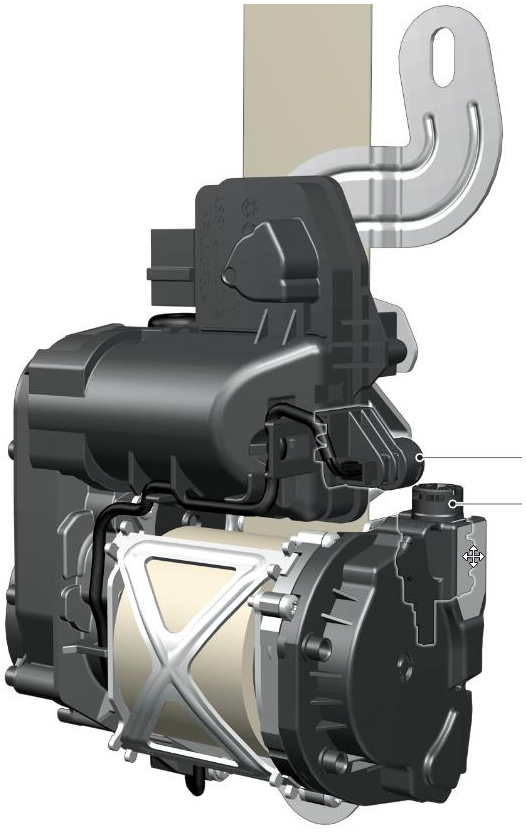


Knee airbag

Current European version vehicles have a knee airbag installed on the driver's side due to new requirements. This is located under a cover below the steering column. In the event of a collision with the front passenger not wearing a seat belt, the knee airbag provides knee support. This results in the upper body being shifted forwards in a controlled manner and being caught by the airbag. The knee airbag for the front passenger is also triggered when occupants are wearing seat belts, however when the accident is more severe than when an occupant is not wearing a seat belt. The knee airbag is a single-stage airbag with stored gas inflator  .

Seat seat belt pretensioner

In order to achieve a high level of acceptance for wearing the seat belt by customers, a high level of wearing comfort must be ensured. The wearing comfort is largely determined by the retraction force in the automatic reels. For this reason, a certain belt slack is permissible. However, the belt slack has a negative effect on the occupant's forward movement in the event of an accident. The belt slack must therefore be removed from the seat belt before the restraint effect is initiated. The seat belt pretensioner systems perform this task. The combination of an end fitting pretensioner and a seat belt buckle pretensioner prevents impact on the steering wheel, especially for smaller persons sitting close to the steering wheel. In addition, the airbag triggering times can be adjusted in such a way that the load on the occupants is reduced.



Central airbag

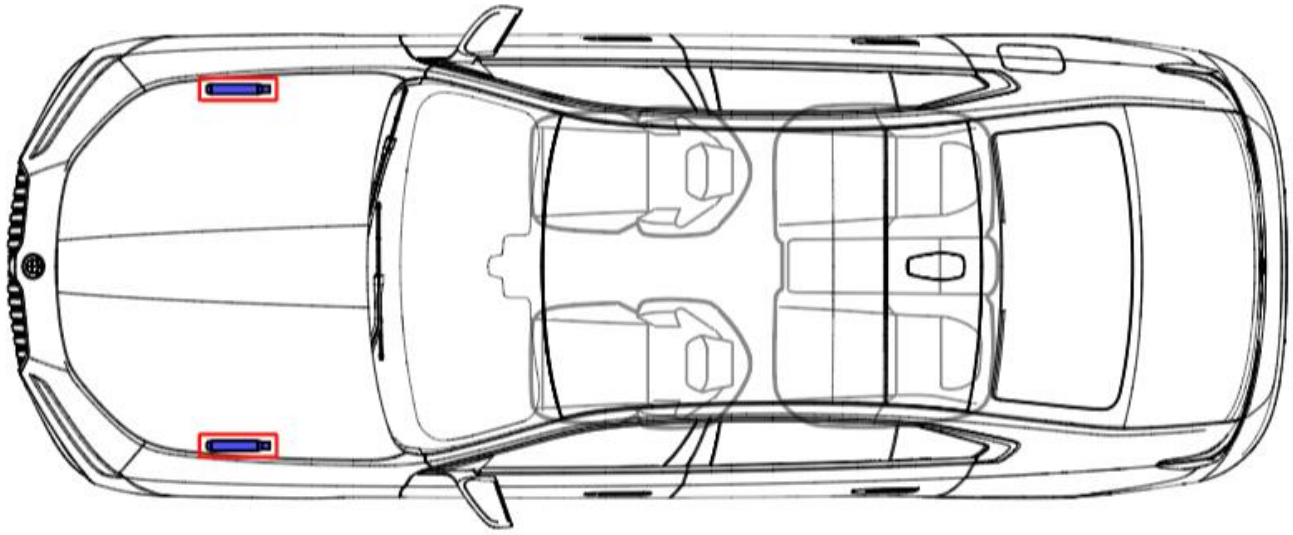
The purpose of the central airbag is to reduce the risk of injuries to occupants in the head area in the event of a side collision. The central airbag with stored gas inflator is located in a plastic housing, the airbag module. This is located in the side section of the driver's seat on the side facing the centre console. The cover and the seat cover have a defined predetermined breaking point. When triggered, the central airbag emerges from the backrest frame and deploys between the driver and front passenger. The air cushion between the occupants results in controlled impact absorption and thus to a reduction in occupant load.

Active bonnet

In the event of a collision with a pedestrian or cyclist, the active bonnet lifts very quickly at the front and rear areas. As a result, the impact is better cushioned, which significantly reduces the danger of injury.

The active bonnet is only triggered at speeds of approx. 20 km/h to 55 km/h. At these speeds, the additional effect is striking. Above and below this range, the advantages of the technology are not significant.

The active bonnet can be recognised by the generators (cartridge) in the rear hinge area.

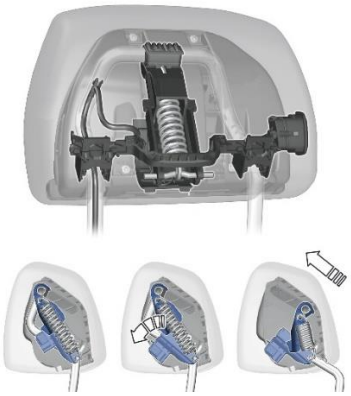


Child restraint system

Front passenger and side airbags can be switched off when using child restraint systems. Labels can be found near the airbag in question if this applies.

Active head restraint

The active head restraint is a vehicle safety system that prevents cervical spine injuries in the event of a rear-end impact. Sensors detect the collision and move the head restraint forward to support the head and prevent whiplash.



Roll-over protection

Roll-over protection in convertible vehicles protects the occupants in the event of a rollover. It consists of reinforced structures and rollover protection bars, which are automatically extended when required. Sensors detect an imminent rollover and immediately activate the protective mechanisms. These systems often work in conjunction with other safety devices, such as airbags and seat belts, to significantly reduce the risk of injury.

10. Explanation of pictograms used

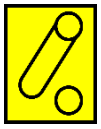
Explanation of pictograms used

Pictograms for access to components

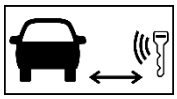
Bonnet

Boot

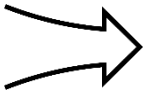
Pictograms for parking the vehicle



Device to shut down power in vehicle

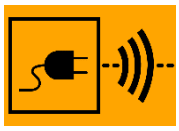


Remove smart key



Air intake

Dangerous voltage



Vehicle induction charging

Cable cut

High voltage device that disconnects high voltage

Low voltage device that disconnects high voltage

Explanation of pictograms used

Pictograms for access to the occupants

Steering wheel, tilt control

Seat height adjustment

Seat adjustment, longitudinal

Lifting point; central support

Pictograms related to fire-fighting and safety

Danger

Warning, Electricity

Warning; low temperature

Caution: Hydrogen burns with an almost colourless flame

Use thermal Infrared camera

Explanation of pictograms used

Automatic fire suppression system

Special battery access

Use water to extinguish the fire

Use wet foam to extinguish the fire

Use dry foam to extinguish the fire

Use ABC powder to extinguish the fire

Do not extinguish with water

Globally uniform symbols

Explosive

Flammable

Gases under pressure

Explanation of pictograms used

Oxidizer

Corrosives

Hazardous to human health

Acute toxicity

Environmental hazard

ISO 17840-4

Class 1 liquid fuel vehicle

Class 2 liquid fuel vehicle

Electric vehicle

Vehicle on CNG

Explanation of pictograms used

Vehicle on LPG

Vehicle on LNG

Hybrid Electric Vehicle on fuel of liquid group 2

Hybrid Electric Vehicle on fuel of liquid group 1

Hydrogen
Fuel Cell Electric Vehicle

Vehicle on DME