



BMW i3



Sheer Driving Pleasure

THE BMW i3 RESCUE GUIDELINE.

EDITORIAL.

The year 2012 marked a global turning point in electric vehicles, as growth rates started to increase rapidly. In the years to come, the recovery of vehicles involved in an accident and fitted with a high-voltage battery is expected to become more and more of an issue for rescue crews such as yourself. You should therefore be prepared to have to recover such vehicles in the near future.

The German Association of the Automotive Industry (VDA) has drawn up a list of key recommendations for on-site emergency team operations. This list addresses general questions relating to the potential dangers of vehicles with high-voltage systems. However, as with conventional vehicles, different models have different requirements. This also applies to the BMW i3, which completely redefines electro-mobility. As the safety of rescue crews was at the forefront when designing the BMW i3, it comes with its own recommendations.

In close cooperation with several experts therefore, two documents have been created that are crucial to how you behave at the scene of an accident: the rescue manual and the rescue card.

Both documents are available to download free of charge from the BMW website:

<https://oss.bmw.de/index.jsp>

The VDA answers frequently asked questions. These can be downloaded at the following address:

http://www.vda.de/en/publikationen/publikationen_downloads/index.html

These documents are also supplemented by the rescue guideline. The aim of this guideline is to clearly present the BMW i3 and its key safety features. Please use the manual to gain a general overview. More detailed and binding instructions for specific accidents – which we hope are rare – can be found in the rescue card and manual.

The following chapter provides an introduction to the BMW i3, followed by an overview of the relevant safety features for rescue crews such as yourself. The order of presentation follows the order of events in an accident:

- 1 THE BMW i3 AT A GLANCE.**
- 2 SAFETY FEATURES OF THE BMW i3 AT A GLANCE.**
- 3 RESCUE.**
ELECTRICAL HAZARD.
THE PRACTICABILITY OF THE RESCUE ITSELF.
- 4 EXTINGUISH.**
- 5 RECOVER.**
- 6 BREAKDOWN ASSISTANCE AND MINOR ACCIDENTS.**
- 7 STORE, INSPECT, SECURE.**

A list of resources can be found from page 40 onwards.

1 THE BMW i3 AT A GLANCE.



THE BMW i3 IS THE FIRST REVOLUTION WHICH STANDS IN THE SERVICE OF SAFETY.

The BMW i3 completely redefines not only the automobile, but also the entire automobile industry.

No other vehicle takes such a holistic approach to sustainability throughout the value chain: in the BMW factory in Leipzig, carbon is mass-produced using 100% renewable energies. Sustainable materials preserve resources while simultaneously fulfilling the highest premium standards. The emission-free drive system eDrive ensures incomparable acceleration from a standstill. And last but not least, thanks to the LifeDrive concept, the entire vehicle architecture is purpose-built to meet electro-mobility requirements. One such requirement is safety. A factor that was prioritised right from the development stage.

The result:
A vehicle that also redefines safety.

THE LIFEDRIVE CONCEPT. TWO MODULES, ONE GOAL: SUSTAINABLE SAFETY.

Unlike conventional electric vehicles, an electric motor is not simply integrated in the traditional vehicle architecture. With its LifeDrive concept, the BMW i3 architecture is designed to meet the needs of electro-mobility.

For example, the passenger cell and thus the Life module are made almost entirely from carbon. The result is a vehicle that weighs just 1,195 kg, offsetting the additional weight of the high-voltage battery. This is mounted in the underbody of the Drive module, where it ensures a low centre of gravity and outstanding performance characteristics. Furthermore, besides being positioned exactly where statistically the least impact is expected in the event of an accident, it is also well protected in the event of a side crash.

TOGETHER, THE LIFE AND DRIVE MODULES REVOLUTIONISE THE SAFETY OF AUTOMOBILES:

While the carbon cell creates an extremely robust survival space for passengers, the aluminium Drive module at the front and rear of the vehicle effectively absorbs the energy despite the relatively short crumple zone.

The result: The BMW i3 achieved the highest rating of five stars in the Euro NCAP crash tests governing occupant protection and child protection that coincided with its market launch. As expected, the electric car matches the performance of the best conventionally powered vehicles in its segment in the area of passive safety. The testers noted an exceptionally low risk of injury in both front and side impacts, as well as in the Pole Side Impact test. Particularly striking here was the low degree of deformation in the CFRP passenger cell, which also enhances the effectiveness of the restraint systems.



THE HIGH-VOLTAGE BATTERY. DESIGNED BY BMW. HIGHLY PRAISED BY THE PRESS.

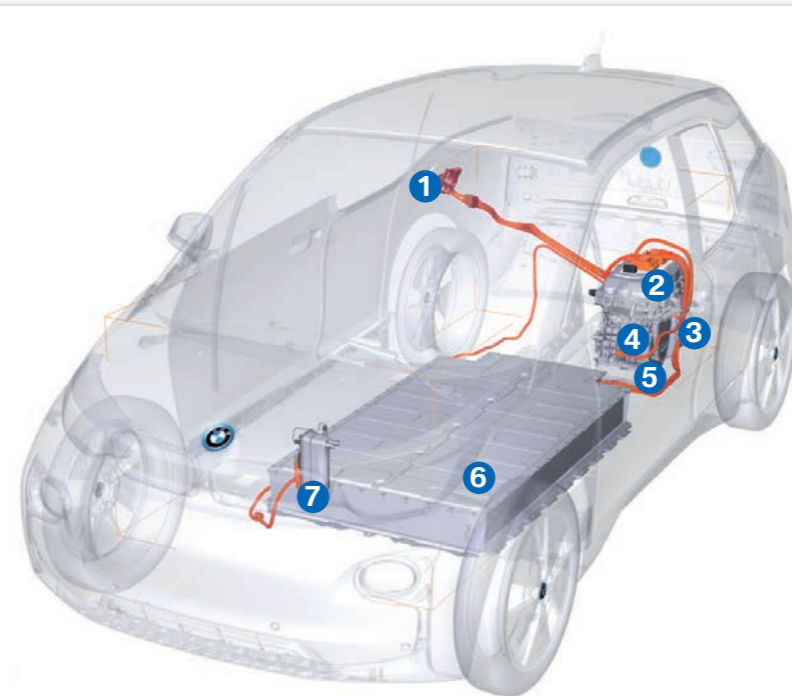
The high-voltage battery is what we like to call the BMW i3's tank. It provides the necessary power to the electric motor. Unlike other manufacturers, BMW designs these batteries itself. This ensures maximum safety and outstanding performance. Here, too, we find the perfect symbiosis of dynamics and sustainability: the regenerative energy used to produce aluminium and the green electricity used for charging fully offset the emissions generated during battery production. The driving characteristics of the BMW i3 have been highly praised by journalists from all over the world who tested the vehicle in Maisach. We therefore highly recommend experiencing the BMW i3 for yourself on a test drive.

Uwe Dreher, global marketing director for BMW, writes:

The fascinating and unique driving feeling and typical BMW driving pleasure that the electric BMW i3 has to offer is best experienced by actually driving the car.

The high-voltage battery is so safe in the underbody of the vehicle that it will remain intact in most accidents. This increases the safety of both occupants and rescue crews.

- 1 Vehicle charging socket at the vehicle.
- 2 Electrical machine electronics.
- 3 Convenient charging electronics.
- 4 Electrical machine.
- 5 Electrical refrigerant compressor.
- 6 High-voltage battery unit.
- 7 Electric heating.



SUMMARY. PURPOSE-BUILT FOR ELECTRO-MOBILITY. AND FOR MAXIMUM SAFETY.

The BMW i3 is the world's first purpose-built premium electric vehicle. This means that every detail was designed to meet electro-mobility requirements. And from the very start, safety was a top priority.

Not just the safety of occupants, but also of rescue crews such as yourself. This brochure provides a detailed introduction to the BMW i3 safety concept and is dedicated to you.

2 SAFETY FEATURES OF THE BMW i3 AT A GLANCE.



THE BMW i3 OFFERS A HIGH LEVEL OF SAFETY. FOR RESCUE CREWS, TOO.

The BMW i3 was rolled out in October 2013. And naturally, even an electric vehicle as safe as this can be involved in an accident. So how does this affect you? Will there be any risks involved during rescue, recovery and extinguishing operations? Can an electrical, thermal and toxic hazard ever be completely ruled out? The following will provide answers to the most important questions. Even before its market launch, the BMW i3 demonstrated a high level of safety for occupants and rescue crews in extensive tests.

You can therefore rest assured that:

The BMW i3 offers maximum safety for rescue crews, too.

ELECTRICAL HAZARD: HAVE NO FEAR.

You may be wondering whether you are at risk of an electric shock when touching the BMW i3 after an accident. Because safety was a top priority from the outset when designing the vehicle, you can rest assured that the BMW i3 is safe to touch.

The BMW i3 is fundamentally an 'intrinsically safe' high-voltage vehicle. In this case, 'intrinsically safe' means that the system switches itself off in the event of a crash with airbag deployment. Simultaneously, the cables outside of the high-voltage battery automatically discharge in just a few seconds. Therefore, by the time you arrive at the scene of the accident, there will no longer be any electrical potential in the orange cables. Additional measures have also been taken. The entire high-voltage system is self-contained.

THIS MEANS:

It is completely isolated and has no conductive connection to the body. Furthermore, all high-voltage components in the vehicle are positioned in such a way that they will only be damaged in the event of an extremely serious accident. Take, for example, the high-voltage battery: this is housed in a sealed compartment in the underbody of the vehicle, which is outside the crash zone for most accidents. All these measures virtually exclude almost any risk for rescue crews such as yourself.

The German Association of the Automotive Industry (VDA) clearly concluded that:
'The risk of personal injury caused by an electric shock can very likely be excluded.'¹

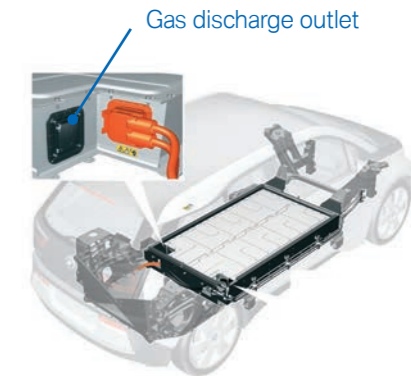
THERMAL HAZARD DUE TO HIGH-VOLTAGE BATTERY: AT LEAST AS SAFE AS CONVENTIONAL VEHICLES.

The most pressing concern in the event of a fire is whether the high-voltage battery will explode. Extensive measures have also been taken here. The high-voltage battery and its individual cells are fitted with mechanical safety devices, for example gas discharge vent in the individual lithium-ion cells as well as a gas discharge vent in the high-voltage battery. These open when the temperature or pressure increases. This ensures the targeted release of gas and pressure, for instance in the event of a fire.

The battery has also proven safe in the event of a fire.

The vehicle inspection association DEKRA reached the following conclusion:
'We have carried out extensive tests – including the fire behaviour, temperature and smoke development, and what would be required to extinguish the fire, plus the pollution caused by run-off of the water used for fighting the fire. We have concluded that electric and hybrid vehicles fitted with lithium-ion drive batteries are at least as safe as vehicles with conventional drive systems in the event of a fire.'²

Basically, it can be said that much less smoke and flames develop from energy stores than from burning petrol. The German Association of the Automotive Industry (VDA) also ascertained that:
'An explosion of high-voltage energy stores can almost certainly be ruled out.'³



TOXIC HAZARD GENERATED BY FIRE GASES: FIRE BEHAVIOUR SIMILAR TO CONVENTIONAL VEHICLES.

At close proximity, the gases released are irritating, flammable and health hazardous and must therefore not be inhaled. Otherwise, experience has shown that there are no significant differences between the plastics used in the BMW i3 and the blend of plastics used in conventional vehicles in terms of fire behaviour and the ability to be extinguished. The BMW i3 is no different in that burning materials such as plastics may cause hazardous fumes.

The general rule is:

As with conventional vehicles, personal protective equipment and breathing protection should be worn.

SUMMARY.

! THE BMW i3 IS AS SAFE AS CONVENTIONAL VEHICLES.

Both the safety of passengers and rescue crews was in the focus when designing the BMW i3. The result: The BMW i3 is as safe as conventional vehicles.

3 RESCUE. ELECTRICAL HAZARD.

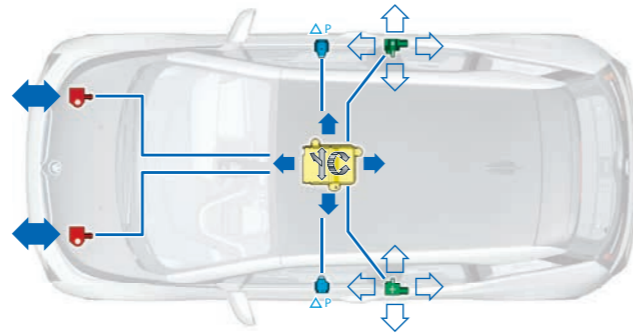


THE BEST PROTECTION AGAINST DANGEROUS CURRENT IS OFFERED BY THE BMW i3 ITSELF.

People don't always recognise the dangers of electrical current because they can't smell, hear or see it. So how can you be sure that you won't come into contact with electrical current in a BMW i3 that has been involved in an accident? The best protection is offered by the vehicle itself, as it has already taken numerous safety measures on your behalf: the crash safety module monitors the vehicle and instantly detects an accident. Furthermore, as a rule the intrinsically safe high-voltage system automatically switches off in the event of a crash with airbag deployment.

THE FIRST STEP IN PROTECTION IS RECOGNISING AN ACCIDENT.

A central element is the crash safety module, which permanently monitors and evaluates all signals from vehicle-round sensors. These not only instantly detect an accident, but also the direction of the crash and the strength of the impact. The airbags are also deployed as needed.



TRIPLE-SAFETY HIGH-VOLTAGE SYSTEM: SWITCH OFF, DISCONNECT, DISCHARGE.

The high-voltage system is intrinsically safe and automatically switches off in the event of a crash with airbag deployment. The high-voltage battery disconnects from the high-voltage system, ensuring no more electrical potential is present. Simultaneously, the cables and components of the high-voltage system discharge in just a few seconds. The entire high-voltage system is then fully discharged. An electrical hazard can then basically be ruled out.

OTHER KEY SAFETY FEATURES INCLUDE:

- 1 The entire high-voltage system is completely isolated and has no conductive connection to the body.
- 2 As a rule, this allows you to touch the body of the vehicle without being exposed to an electrical hazard.
- 3 The high-voltage battery is safely mounted in the underbody of the vehicle and thus protected against severe shock.

DOS AND DON'TS.



As a rule, do not touch damaged high-voltage cables or components (these are always orange).



If in doubt, call the relevant rescue coordination centre for qualified electricians.

For more information, please refer to the rescue manual and the chapter entitled **RECOVER** in this brochure.

SUMMARY.

! THE BMW i3 INCLUDES MANY SAFETY FEATURES FOR AVOIDING RISKS.

The BMW i3 is packed with innovative safety features. The system is completely isolated so that no electrical potential is connected to the body. In addition, the high-voltage system is intrinsically safe and automatically switches off in the event of a crash with airbag deployment. Simultaneously, the high-voltage system's cables discharge in just a few seconds. Therefore, as a rule, by the time you arrive at the scene of the accident, there will no longer be any electrical potential left in the orange cables.

3

RESCUE.

THE PRACTICABILITY OF THE RESCUE ITSELF.



THE RESCUE PROCESS FOR A BMW i3 IS SIMILAR TO THAT FOR CONVENTIONAL VEHICLES.

Besides your own safety, you do of course also have to focus on rescuing vehicle occupants. Since the BMW i3 is primarily made of aluminium and carbon, you will be faced with a slightly different situation. In case you are wondering how you are going to get inside the vehicle, here's your answer: the rescue process can be carried out using standard tools and is similar to that for conventional vehicles.

AS SAFE AS CONVENTIONAL CARS, ONLY FASTER.

We also considered the easiest possible way of rescuing occupants during the development stage. The use of rescue cutters and spreaders should therefore not be a problem. In fact, there are even advantages over conventional vehicles made of high-grade steel. That is because aluminium and carbon can be more easily cut. Generally, you have nothing to worry about when carrying out a rescue.

Gerhard Schmöller from Munich's professional fire service confirms:

'During standardised cutting tests, the professional fire service in Munich and the fire services in Schönau/Königsee have already had the opportunity to verify the similarities between the BMW i3 and conventional vehicles when it comes to rescuing occupants from vehicles that have been involved in an accident. Developments in the area of emergency rescue operations have already reached a very high level – despite the completely innovative vehicle concept and the wide-scale use of CFRP. We are impressed by the determination and judiciousness of the BMW engineers to write automobile history without losing sight of passenger safety.'⁴

A distinct advantage in terms of safety is offered by the extremely stable carbon passenger cell, which generally remains intact even in the event of a side impact. In most cases, the doors can be opened. This gives you much faster access to occupants. Please note, however, that the front and rear doors open in opposite directions.

1 The areas mark the points at which the roof can be severed.

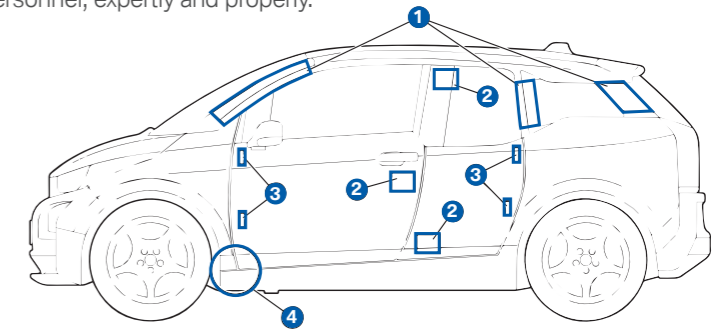
Modern high-performance cutters are required for cutting open the body; older hydraulic cutting devices may be insufficient.

The high-performance cutters must be used by trained personnel, expertly and properly.

2 Door locks.

3 Door hinges.

4 Area for relief cut.



SUMMARY.**NOTHING NEW TO RESCUE CREWS – BUT NEW TO THE BMW i3.**

As with conventional vehicles, you also have to switch off the BMW i3 and prevent it from rolling away. Due to the new control concept of the BMW i3, you may find some switches in unfamiliar places. We would therefore like to give you a brief overview. Further information can be found on the rescue card and in the rescue manual:



1 Press the start/stop button; the system switches off.



2 Pull up the switch for the electronic parking brake.



3 Press the 'P' button.

SUMMARY.**SAFER FOR OCCUPANTS, EVEN DURING RESCUE OPERATIONS.**

The extremely rigid passenger cell deforms only slightly, especially in the event of a side crash. Furthermore, rescue equipment can cut through carbon much more easily. This makes rescue and recovery operations for the BMW i3 and conventional vehicles identical.



4 EXTINGUISH.



EXTENSIVELY TESTED IN FIRE SIMULATIONS: LITHIUM-ION BATTERIES IN ELECTRIC CARS.

The more electric cars on the roads, the more likely you are to be confronted with a fire. This gives rise to several questions. How much flame and smoke development will there be? Is there a risk of explosion? And can fire services even extinguish such fires? The results of extinguishing tests carried out by DEKRA show that electric cars with lithium-ion batteries are also safe in the event of a fire.

Electric cars with lithium-ion batteries are also safe in the event of a fire.

LITHIUM-ION BATTERIES DO BURN. BUT NOT AS INTENSIVELY AS PETROL.

The tests carried out by DEKRA involved setting three batteries alight using petrol. After a few minutes of being exposed to flames at temperatures exceeding 800°C, the batteries began to burn. Flame and smoke development was much less than with vehicles with combustion engines. The pressure generated inside the batteries as a result of the fire was dissipated outwards through the in-built pressure relief vents, resulting in smaller flash fires – less intense than those seen in petrol fires.

BRANDSchutz / Deutsche Feuerwehr-Zeitung, the leading German publication for fire services, reaches a resounding conclusion: 'There were no explosions. There was much less smoke generated from the batteries burning than generated by burning petrol/ diesel or a vehicle fire. The same applies to heat radiation. The temperatures tended to stay below those of burning fuel.'¹⁵

Markus Egelhaaf from DEKRA accident research comments:

'The risk of the fire rapidly spreading is much lower with these batteries. Because unlike vehicles with conventional fuels such as petrol or diesel, there are no burning liquids to flow away and set neighbouring objects alight.'¹⁶

A FIRE CAN EASILY BE EXTINGUISHED – WITH WATER.

In principle, a lithium-ion battery fire can be extinguished with water. Furthermore, all standard and approved extinguishing agents can be used whilst respecting the relevant safety guidelines and observing the safe distances. It is also important to note that the carbon fibres in the passenger cell are non-flammable. However, since these fibres are bound together by a resin, high temperatures can result in a resin fire (and smoke development). In any case, as with conventional vehicle fires, you should wear personal protective equipment and breathing protection.

SUMMARY.

! THE BMW i3 ALSO OFFERS MAXIMUM SAFETY IN THE EVENT OF A FIRE.

'Electric and hybrid cars with lithium-ion drive batteries are at least as safe as petrol and diesel vehicles in the event of a fire.'¹⁷



Furthermore, electrolyte is unlikely to leak out, and no more water is needed to extinguish the fire than is needed for conventional cars. By taking the necessary safety precautions and observing safe distances, the safety of lithium-ion batteries can also be ensured in the event of a fire.

5 RECOVER.



RECOVERING A BMW i3 IS NEARLY ALWAYS THE SAME AS RECOVERING A CONVENTIONAL VEHICLE.

In this case, 'recover' means removing the vehicle from the scene of the accident rather than transporting it back to the workshop. Nevertheless, it also involves having to move the vehicle. And naturally, it is important to know whether this is easily possible.

THE GENERAL RULE IS:

In nearly all cases, the BMW i3 is intrinsically safe, also for recovery. Therefore, it can virtually always be handled like a conventional vehicle. As always, should you have any questions, please refer to the rescue manual.

THE DEPLOYED AIRBAG INDICATES WHETHER THE HIGH-VOLTAGE BATTERY IS SWITCHED OFF.

In the event of normal and serious accidents, you can generally assume that the high-voltage system is switched off. This is ensured by the crash safety cut-off mechanism, which is activated when the airbags are deployed.

THIS GIVES YOU A CLEAR INDICATION:

If the airbag has been deployed, the high-voltage system is switched off. As the BMW i3 is intrinsically safe, the vehicle can be recovered by any fire or recovery service.



IF YOU OBSERVE THE GUIDELINES, YOU CAN'T GO WRONG.

Naturally, the general emergency rescue guidelines must be observed when recovering a BMW i3, too. For example, the earth cable (black negative lead) on the 12-volt battery should be disconnected. Further information can be found in the rescue manual.

THERE ARE EXCEPTIONS. BUT VERY RARELY:

As with conventional vehicles, there are also a few exceptions with electric cars. For example, it may be the case that the BMW i3 is not in an intrinsically safe state. In order to exclude any risk, it is strongly advised that no further action be taken before consulting the rescue card and rescue manual:



RECOVERING THE BMW i3 FROM THE WATER.



RECOVERING THE BMW i3 AFTER A FIRE.



DAMAGE TO THE HIGH-VOLTAGE BATTERY.

SUMMARY.

BE ON THE SAFE SIDE WHEN RECOVERING A VEHICLE.

The BMW i3 can nearly always be recovered like conventional vehicles. As the airbag is deployed in the event of most serious accidents, the high-voltage battery is also switched off. In a few exceptional cases, the clear instructions in the rescue manual will assist you further. Often just a few precautionary measures are necessary to be on the safe side.

6 BREAKDOWN ASSISTANCE AND MINOR ACCIDENTS.



THE BMW i3 IS SAFE IN THE EVENT OF AN ACCIDENT. AND IN THE EVENT OF A BREAKDOWN.

Thanks to a variety of measures, drivers of electric vehicles can rest assured that they are not exposed to an electrical hazard. This applies to most accidents – minor to serious – and, of course, breakdowns. But does it also apply to you whilst providing breakdown assistance?

You'll be pleased to know that the answer is yes. This is because the vehicle should basically be considered electrically intrinsically safe in the event of a breakdown. However, you should still take a few safety precautions.

DON'T DO TWO THINGS AND YOU'LL BE SAFE.

Because the BMW i3 is intrinsically safe, no problems will occur in the event of a minor accident. However, one factor should be taken into account in contrast to serious accidents: since the airbags are not usually deployed in the case of minor accidents and breakdowns, the high-voltage system does not automatically switch off. Care should therefore be taken when handling the vehicle. As a rule, please do not touch the high-voltage components and orange cables.

YOU SHOULD THEN FOLLOW THE RECOMMENDATIONS OF THE RESCUE CARD:

- Proceed as described in the rescue card: Press the START-STOPP button to switch off the system. Then pull off the earth lead of the 12 Volt battery and pull the high-voltage safety connector to deactivate the high-voltage system.
- No work should be carried out on the high-voltage components. This also applies if high-voltage components are damaged, or damage is ascertained whilst providing breakdown assistance. This should only be done by those qualified to work on vehicles with high-voltage systems. Work on high-voltage components may only be carried out in a certified workshop.
- Even after the high-voltage system has been switched off, there will be residual voltage. This will dissipate, however, in a few seconds.

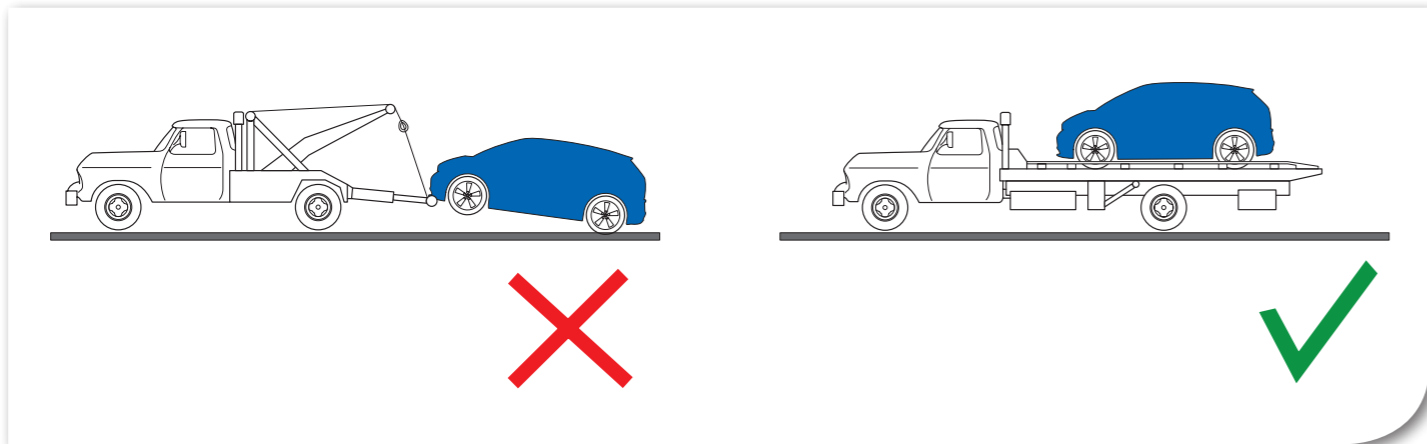


A BREAKDOWN NEEDN'T BE A PROBLEM IF YOU FOLLOW THESE TIPS.

The BMW i3 should therefore be considered intrinsically safe in the event of a breakdown and minor accident.

A FEW TIPS TO HELP YOU PROVIDE ON-SITE ASSISTANCE:

- If the 12-volt onboard electrical system is still working, you can make the vehicle roll by switching the selector lever to N.
- Jump-starting or charging the vehicle via the 12-volt onboard electrical system in the event of a breakdown is not permitted.
- The vehicle may not be towed by the axles, as the electric motor could supply current to the high-voltage system. The car may only be transported on a flatbed vehicle.
- To bring the vehicle out of a danger zone, you may pull it extremely slowly over a short distance of no more than 500 m. If possible, make it rollable first by switching the selector lever to N.
- Secure the vehicle during transport, for example using tension straps pulled through the wheel rims.
- Please observe national regulations.



SUMMARY.

MINOR ACCIDENTS SHOULDN'T BE A PROBLEM. EVEN WHEN IT COMES TO SAFETY.

In most cases, there is absolutely no risk involved in providing breakdown assistance for the BMW i3. If you observe a few ground rules, such as not touching the high-voltage cables, the basic procedures are exactly the same as for vehicles with conventional drive systems.

According to the VBG, the general rule for providing breakdown assistance for electric vehicles is: 'There is no risk involved in providing breakdown assistance for vehicles with high-voltage systems, as long as no attempts are made to eliminate faults by interfering with the high-voltage system.'¹⁸

7 STORE THE VEHICLE.



STORING THE BMW i3: FOLLOW THESE GUIDELINES AND YOU CAN'T GO WRONG.

If the BMW i3 is not taken straight to a BMW i service workshop after an accident, it must be stored in a parking area especially for vehicles involved in an accident. Basically, there are no surprises in store. This is because as an intrinsically safe vehicle, the same safety regulations apply as with conventional vehicles.

Please be sure to leave ample space between the vehicle and other vehicles, buildings and flammable objects. It goes without saying that the parking area should be accessible for the fire service and secured against unauthorised access. You should also mark the BMW i3 as an electric vehicle.

8 RESOURCES.



REFERENCES.

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- p. 26 | ⁶ DEKRA e.V. press release No. 142 dated 29.10.2012
- p. 27 | ⁷ DEKRA e.V. press release No. 142 dated 29.10.2012
- p. 37 | ⁸ Flyer on breakdown assistance for electric and hybrid vehicles by the German Social Accident Insurance Institution for the administrative sector (VBG), dated June 2011