



Emergency Response Guide



2015.06
ER26V0E

TOYOTA MOTOR CORPORATION

Foreword

- This guide provides precautions for emergency responders when handling TOYOTA/LEXUS vehicles during an incident.
- It is important to read this guide thoroughly and understand the structure and features of TOYOTA/LEXUS vehicles to ensure safety.
- The illustrations used in this guide are representative examples. Refer to the Quick Reference Sheet (QRS) for each model for model specific information such as key identification points, component locations, etc.

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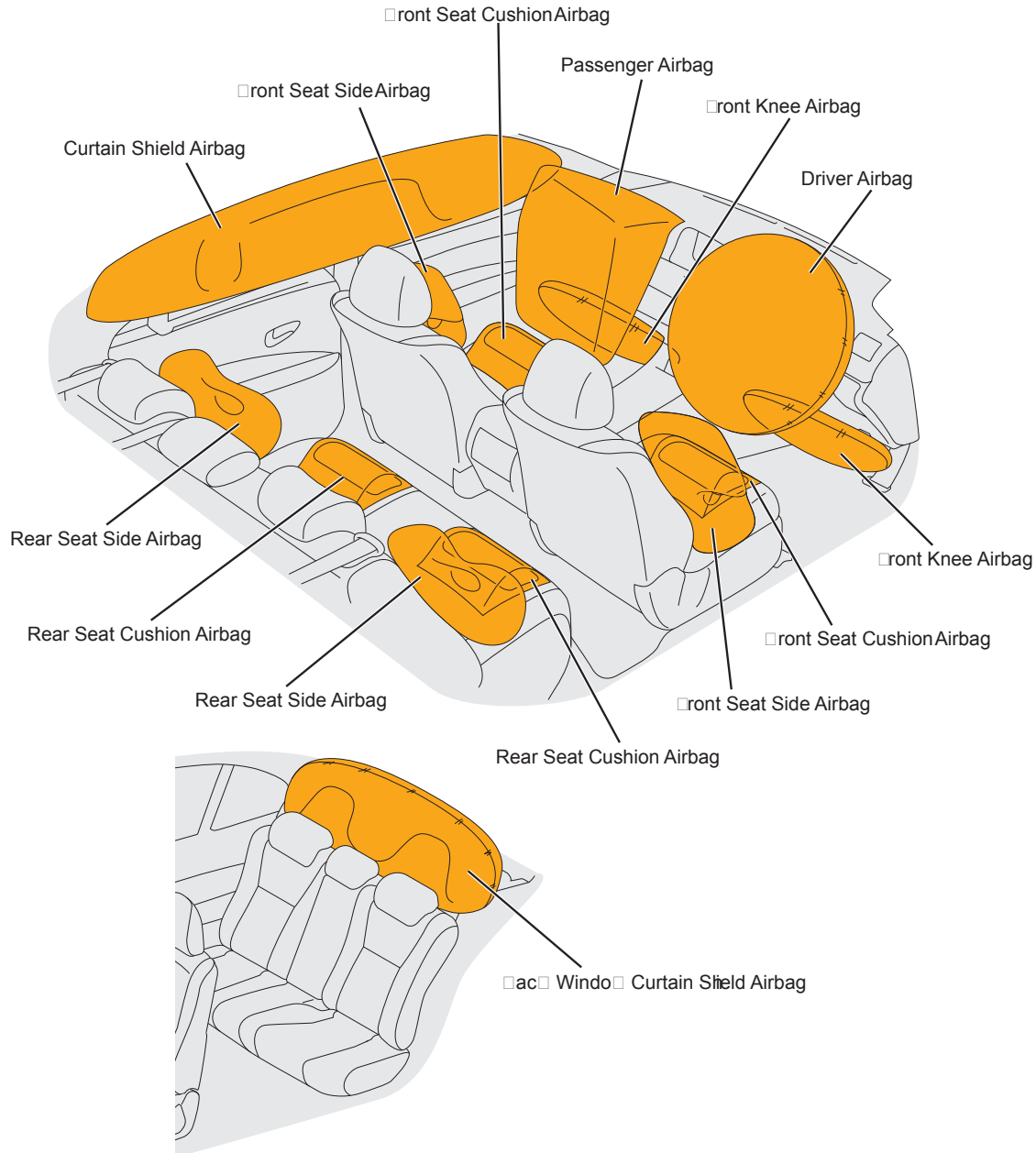
Components Requiring Special Attention

- The construction and functions of components requiring special attention during emergency response are described in this section.



SRS Airbags

- When a vehicle receives a strong impact that can cause serious injury to the occupants, the SRS airbags deploy and the seatbelts restrain the occupants to reduce impact to the body. Refer to the QRS for each model for the type and location of each SRS airbag.



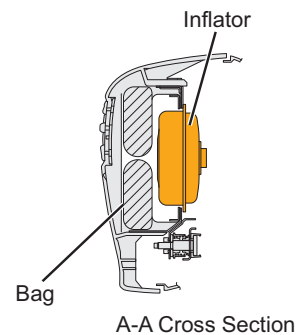
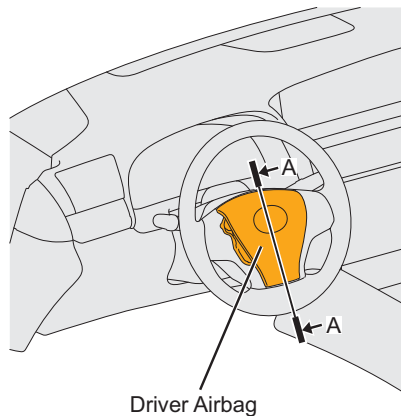
- The SRS airbags consist of an inflator (explosive), a bag and other components and are non-serviceable.
- When an airbag sensor detects a strong impact, an ignition signal is sent to an inflator. When the inflator is ignited, gas is generated to inflate a bag, helping reduce the impact to an occupant.



- The SRS airbag may remain powered for up to 90 seconds after the vehicle is shut off and disabled (see page 64). Wait at least 90 seconds before starting any operation. Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from unintentional deployment of the SRS airbag.
- Depending on the circumstances surrounding a collision, such as vehicle speed, point of impact, occupant detection etc., SRS airbags will not always be deployed. If an inflator of the undeployed SRS airbag is breached, the powder inside the inflator may ignite resulting in unintentional SRS airbag deployment. To prevent serious injury or death from unintentional SRS airbag deployment, avoid breaching the inflators.
- Immediately after an SRS airbag is deployed, the components are extremely hot and may cause burns if touched.
- If an SRS airbag deploys with all doors and windows closed, inflation gas may cause breathing difficulty.
- If residue that is produced during SRS airbag deployment comes in contact with skin, rinse it off immediately to prevent skin irritation.

Driver Airbag

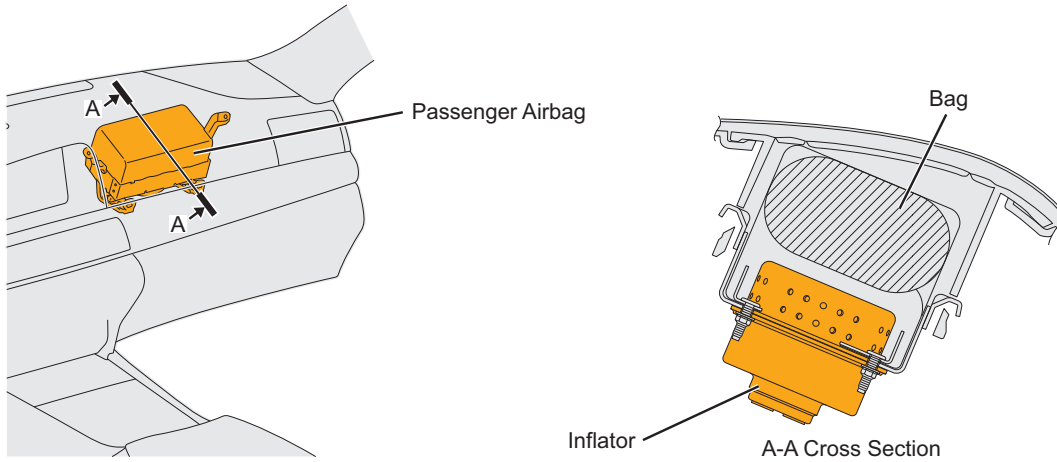
- A driver airbag is mounted in the steering wheel pad and activated in the event of a frontal collision.





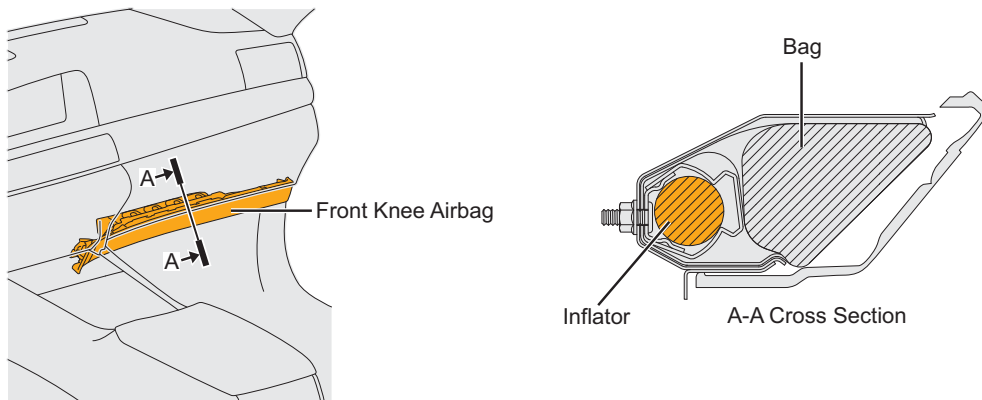
Passenger Airbag

- A passenger airbag is mounted in the upper portion of the passenger side instrument panel and activated in the event of a frontal collision.



Front Knee Airbag

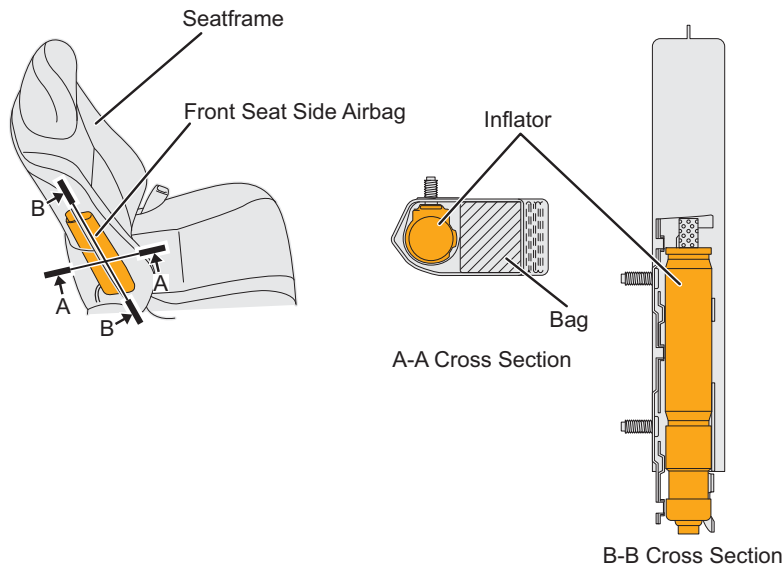
- Front knee airbags are mounted in the lower portion of the instrument panel on the driver side and the front passenger side, and activated in the event of a frontal collision.





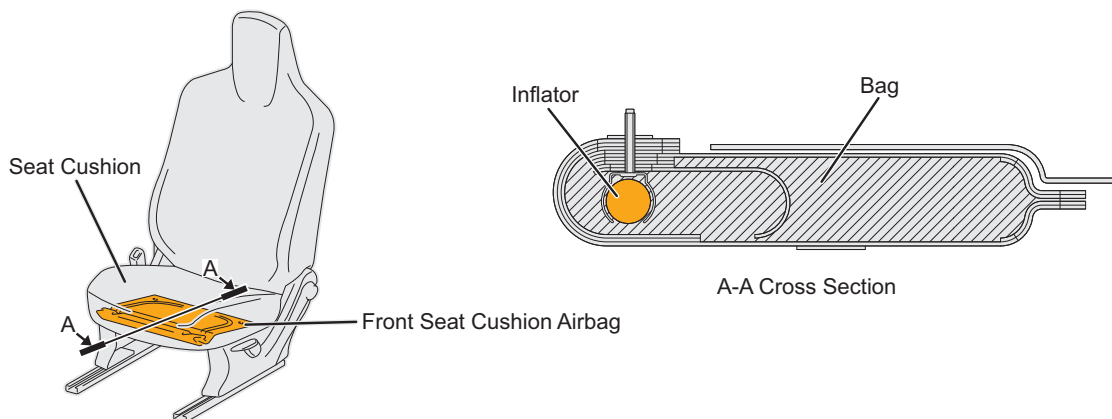
Front Seat Side Airbag

- Front seat side airbags are mounted in the seatframe of the driver seat and the front passenger seat, and activated in the event of a side collision.
- In some vehicles, front seat side airbags are also activated in the event of a frontal collision.



Front Seat Cushion Airbag

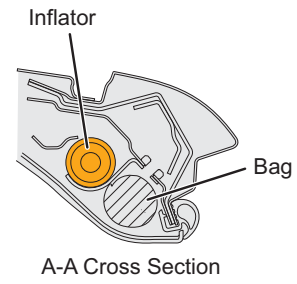
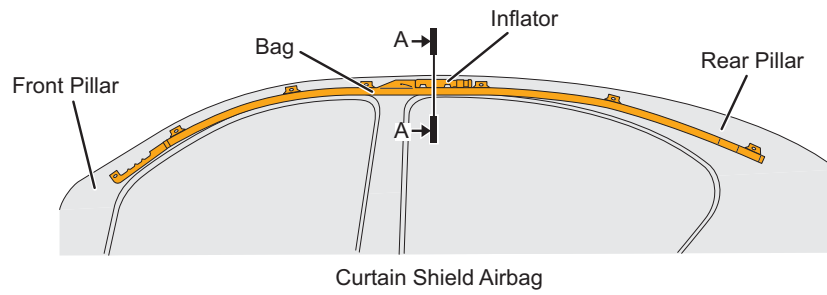
- Front seat cushion airbags are mounted in the seat cushion of the driver seat and the front passenger seat, and activated in the event of a frontal collision.





Curtain Shield Airbag

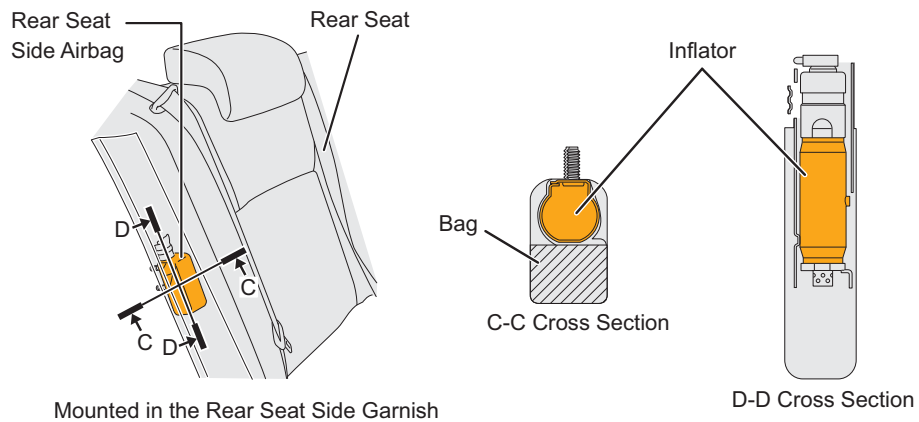
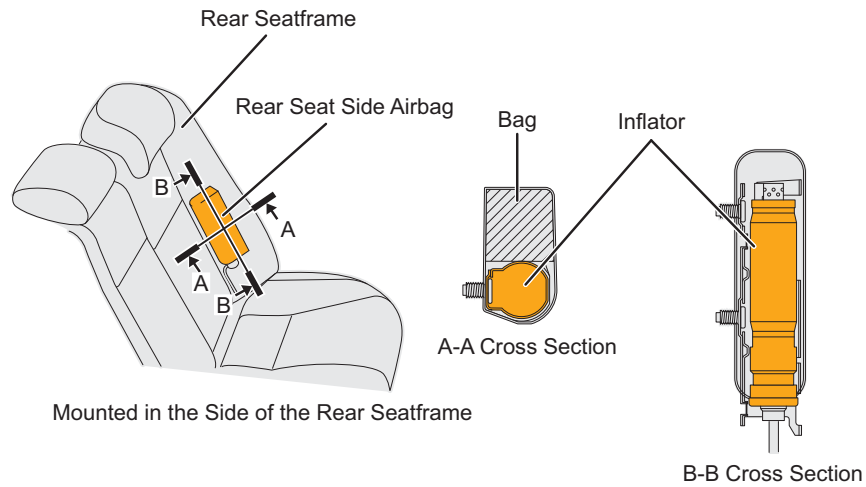
- Curtain shield airbags are mounted in the area between the front pillar and rear pillar on the driver side and the front passenger side, and activated in the event of a side collision.
- In some vehicles, curtain shield airbags are also activated in the event of a frontal collision.





Rear Seat Side Airbag

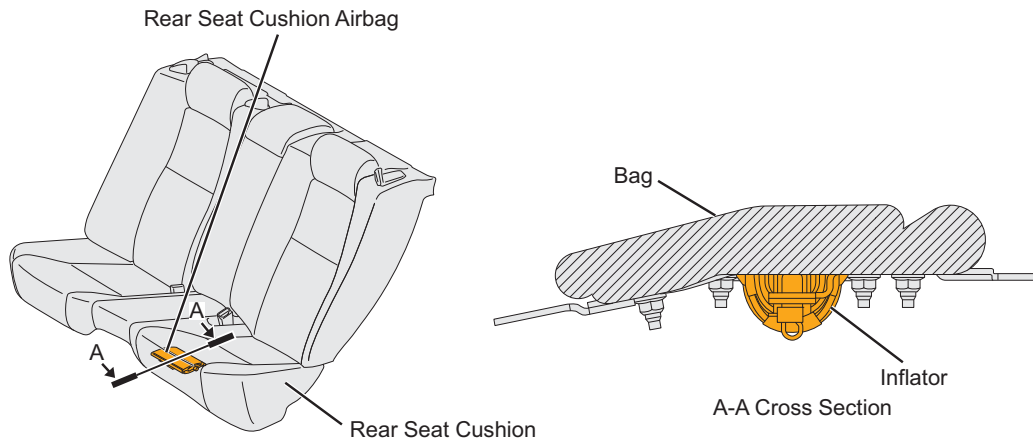
- Rear seat side airbags are mounted in the sides of the rear seatframe or rear seat side garnish and activated in the event of a side collision.
- In some vehicles, rear seat side airbags are also activated in the event of a frontal collision.





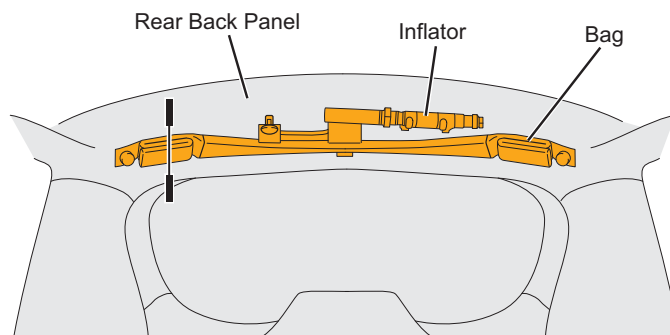
Rear Seat Cushion Airbag

- Rear seat cushion airbags are mounted in the rear seat cushions and activated in the event of a frontal collision.



Back Window Curtain Shield Airbag

- A back window curtain shield airbag is mounted in the upper portion of the rear back panel (back door mounting section) and activated in the event of a rear collision.

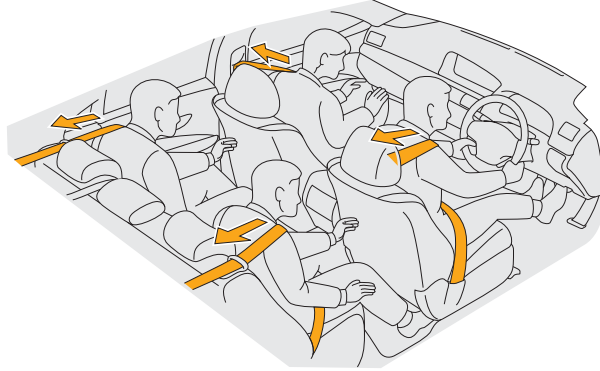


Back Window Curtain Shield Airbag

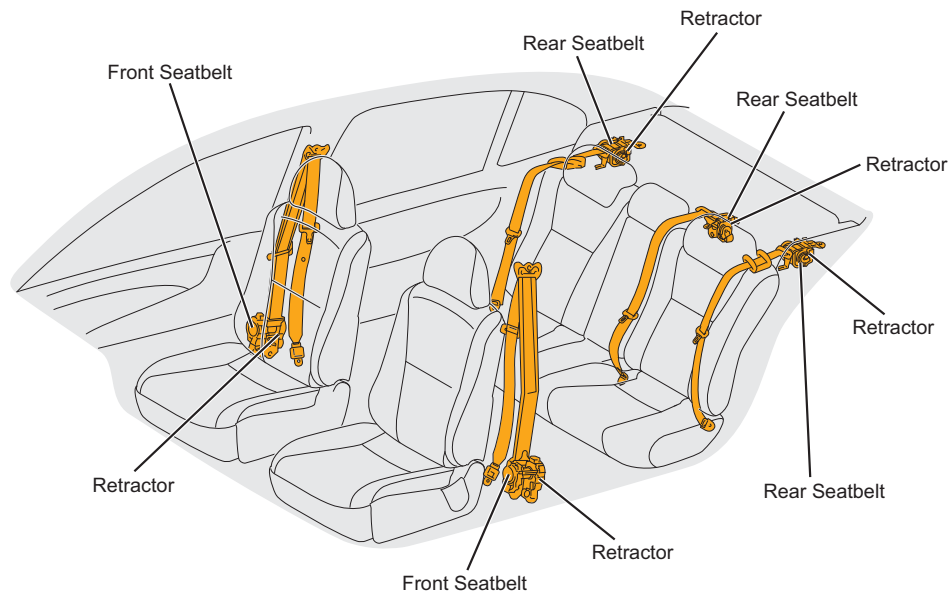


Seatbelt Pretensioner

- When the vehicle receives a strong impact from the front, the seatbelts are retracted to optimally restrain the occupants.
- In some vehicles, seatbelt pretensioners are also activated in the event of a side collision.



- A pretensioner mechanism is built into the retractor of each of the front seatbelts. Some models have a seatbelt pretensioner mechanism in the rear seatbelts.
- The pretensioner mechanism consists of a gas generator, a piston and a pinion gear.
- When an airbag sensor detects a strong impact, an ignition signal is sent to a gas generator. When the gas generator is ignited, gas is generated and its pressure rotates a gear that retracts the seatbelt.



- Refer to the QRS for each model for locations of the seatbelt pretensioners.

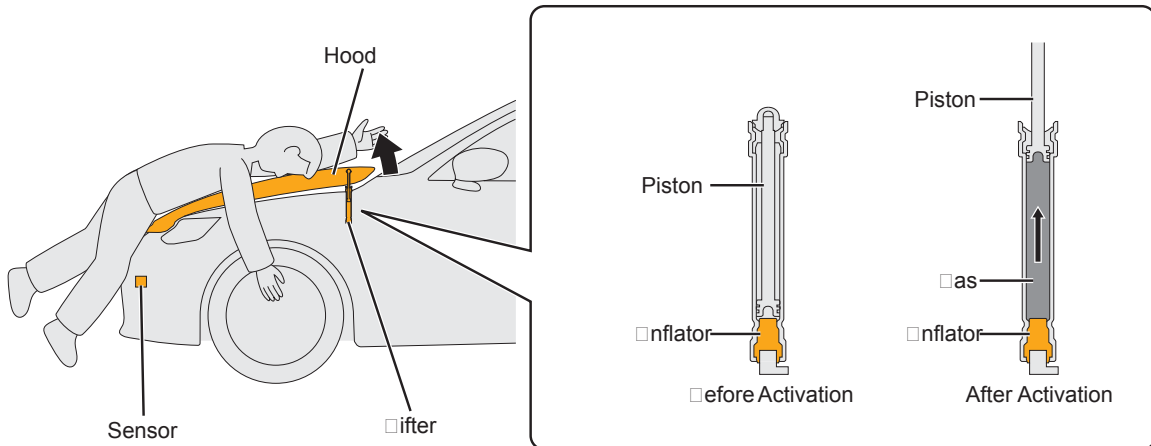


- The seatbelt pretensioners may remain powered for up to 90 seconds after the vehicle is shut off and disabled (see page 64). Wait at least 90 seconds before starting any operation. Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from unintentional actuation of the seatbelt pretensioner.
- To prevent serious injury or death from unintentional seatbelt pretensioners actuation, avoid breaching the seatbelt pretensioners.



Pop Up Hood

- A pop up hood lifts the rear of the hood in the event of a frontal collision to increase the space underneath the hood and help absorb impact to the pedestrian's head.
- When the sensor inside the front bumper detects a strong impact, an ignition signal is sent to the inflator. When the inflator is ignited, the piston inside the lifter is pushed up, lifting the hood.



- The pop up hood may remain powered for up to 90 seconds after the vehicle is shut off and disabled (see page 64). Wait at least 90 seconds before starting any operation. Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from unintentional actuation of the pop up hood.
- If a lifter is cut, the pop up hood inflator may unintentionally deploy. To prevent serious injury or death from unintentional pop up hood actuation, avoid breaching the lifters.
- If the hood release lever is pulled after the pop up hood is activated, the hood may rise more, possibly resulting in an injury.
- After the pop up hood is activated, the hood cannot be lowered by hand. If the hood is pushed down excessively, it may be deformed, possibly resulting in an injury.
- Immediately after the pop up hood is activated, the lifters are very hot and may cause burns if touched.



Gas-filled Damper

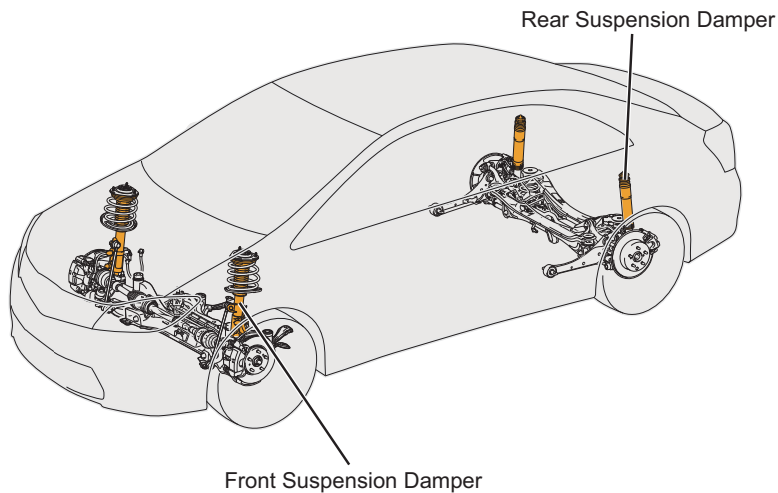
- Gas-filled dampers are used in various components, such as in the suspension (shock absorbers), engine hood stays, and for other various purposes. Nitrogen (N₂) gas is used in these dampers.
- Nitrogen (N₂) gas is colorless, odorless and harmless.
- Refer to the QRS for each model for the location of these gas-filled dampers.



- If a gas-filled damper is heated in an event of a vehicle fire, the damper may explode due to expanded nitrogen (N₂) gas, possibly causing an injury.
- If a gas-filled damper is cut, nitrogen (N₂) gas may cause metal shavings from the cut to scatter. Wear appropriate safety gear such as safety glasses when cutting a gas-filled damper.

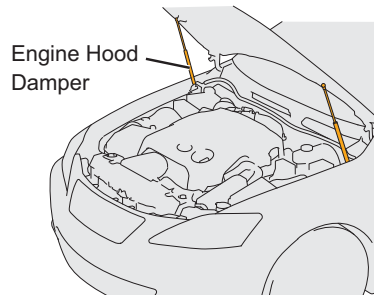
Front and Rear Suspension Dampers

- Suspension dampers are installed in the front and the rear suspension.



Engine Hood Damper

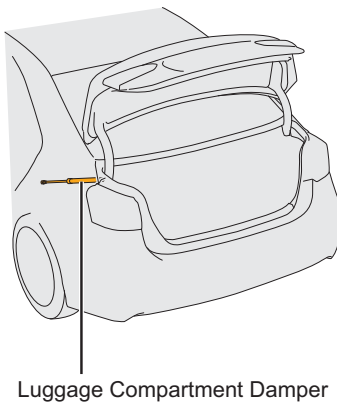
- Gas-filled dampers are installed as the stays for the engine hood.



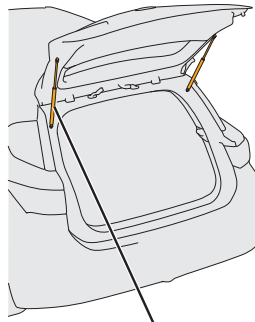


Luggage Compartment, Hatchback Door, Back Door Dampers

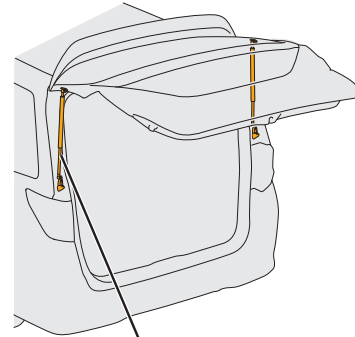
- Gas-filled dampers are installed as the stays for the luggage compartment, the hatchback door and the back door.



Luggage Compartment Damper



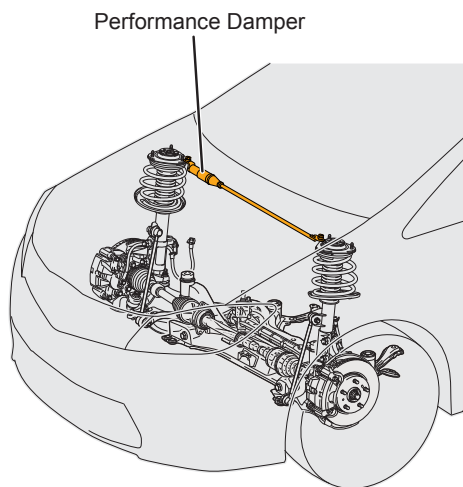
Hatchback Door Damper



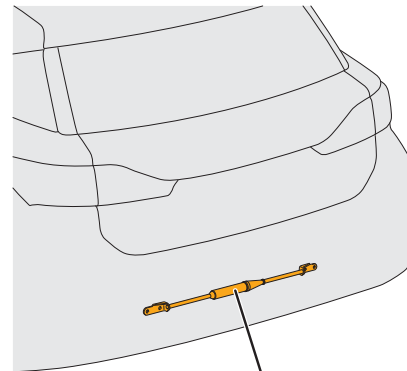
Back Door Damper

Performance Damper

- Performance dampers are installed across the front and the rear suspension towers and between the right and left sides of the rear lower structural frame (near the rear bumper).



Performance Damper

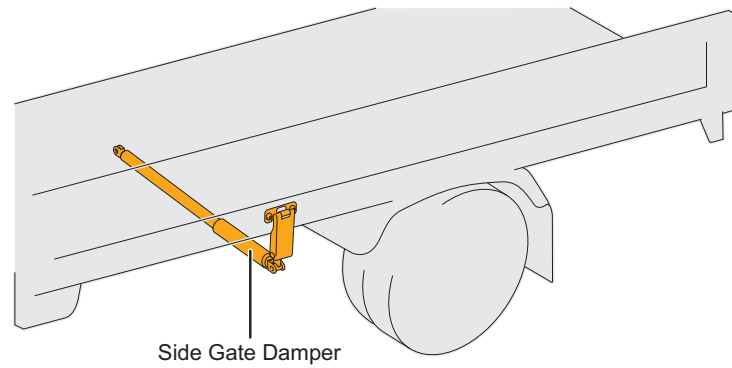
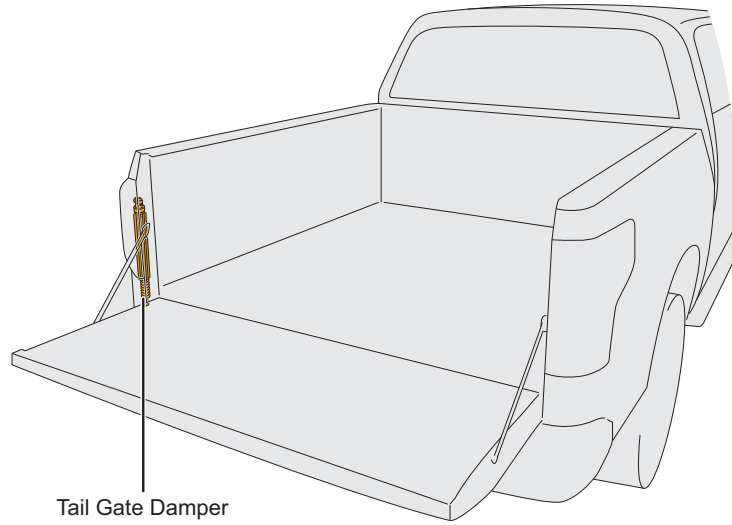


Performance Damper



Tail Gate Damper, Side Gate Damper

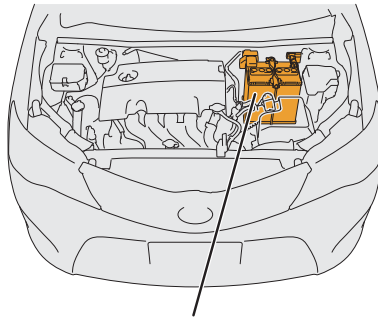
- Gas-filled dampers are installed as the stays for the tail gate and side gate.



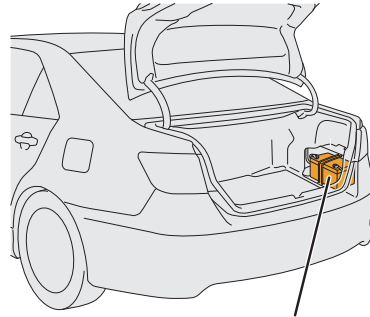


12 V Battery

- The 12 V battery supplies power to the ECUs that control various systems and auxiliary components such as the power door lock, power window, power tilt and telescopic steering, power seat, etc.
- To ensure safe emergency response operations, it is necessary to completely shut off the vehicle (see page 64). Disconnect the negative battery terminal from the 12 V battery before performing work and shut off the power to the electrical system to prevent electrical fires and to keep the vehicle from starting.
- 12 V battery electrolyte contains dilute sulfuric acid.
- Depending on the model the 12 V battery is installed in the engine compartment, luggage compartment, under the rear seats, etc.
- Refer to the QRS for each model for locations of the 12 V battery.



Engine Compartment



Luggage Compartment



Under Rear Seat



- There is a possibility of explosion due to ignition of the hydrogen gas generated from the 12 V battery. Therefore, do not allow any open sparks or open flames nearby the 12 V battery.
- Dilute sulfuric acid may cause irritation of the skin if contacted. Wear appropriate protective equipment such as rubber gloves and safety goggles when there is a risk of touching electrolyte.

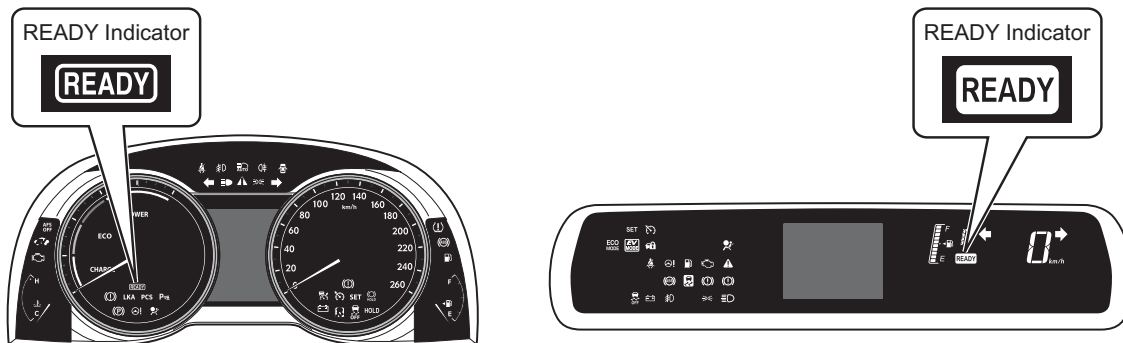


- Once the 12 V battery is disconnected (see page 64), power controls will not operate. To facilitate emergency response operations, lower the windows, open the back door, unlock the doors and take other necessary actions before shutting off the vehicle.
- 12 V battery electrolyte contains ingredients that damage painted surfaces. If any comes in contact with the vehicle body, discoloration or other damage may occur.



High Voltage System

- Hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) and fuel cell vehicles (FCV) use a motor driven by high voltage electricity (over 144 V, up to 650 V) to generate the driving torque. These vehicles are equipped with high voltage electrical components such as a high voltage battery, inverter/converter, transmission/transaxle (electric motor), A/C compressor, charger and voltage inverter as well as high voltage power cables.
- Refer to the Fuel Cell (FC) system (P31) for information on the high voltage parts specific to fuel cell vehicles (FCV).
- High voltage electrical components can be indicated by markings on their case/cover. High voltage power cables are indicated by an orange color.
- The cases/covers of the high voltage electrical components are insulated from the high voltage conductors inside the components. The vehicle body is insulated from the high voltage electrical components, and is safe to touch during normal conditions.
- The READY indicator in the combination meter turns on while the high voltage system is operating.



- The high voltage system is deactivated when the ignition switch or power switch is turned OFF. If an impact is detected (SRS airbag is activated) or if a high voltage leakage is detected, the high voltage system is automatically deactivated. When the high voltage is shut off, the READY indicator turns off. However, if the remote air conditioning system or plug-in charging system are being used, even if the READY indicator turns off, the high voltage system may still be active.
- For fuel cell vehicles (FCV), even if the READY indicator turns off, the high voltage system may still be active if the H₂O indicator in the combination meter is illuminated.



- Refer to the QRS for each model for the locations of the high voltage electrical components.

High Voltage System



- The high voltage system may remain charged for up to 10 minutes after the vehicle is shut off and disabled (see page 64). Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from severe burns and electric shock from the high voltage electrical system.
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.
- When the person(s) in charge of handling the damaged vehicle is away from the vehicle, other person(s) may accidentally touch the vehicle and be electrocuted, resulting in severe injury or death. To avoid this danger, display a "HIGH VOLTAGE DO NOT TOUCH" sign to warn others (print and use page 21 of this guide).



Person in charge: _____

CAUTION:
HIGH-VOLTAGE
DO NOT TOUCH.

CAUTION:
HIGH-VOLTAGE
DO NOT TOUCH.

Person in charge: _____

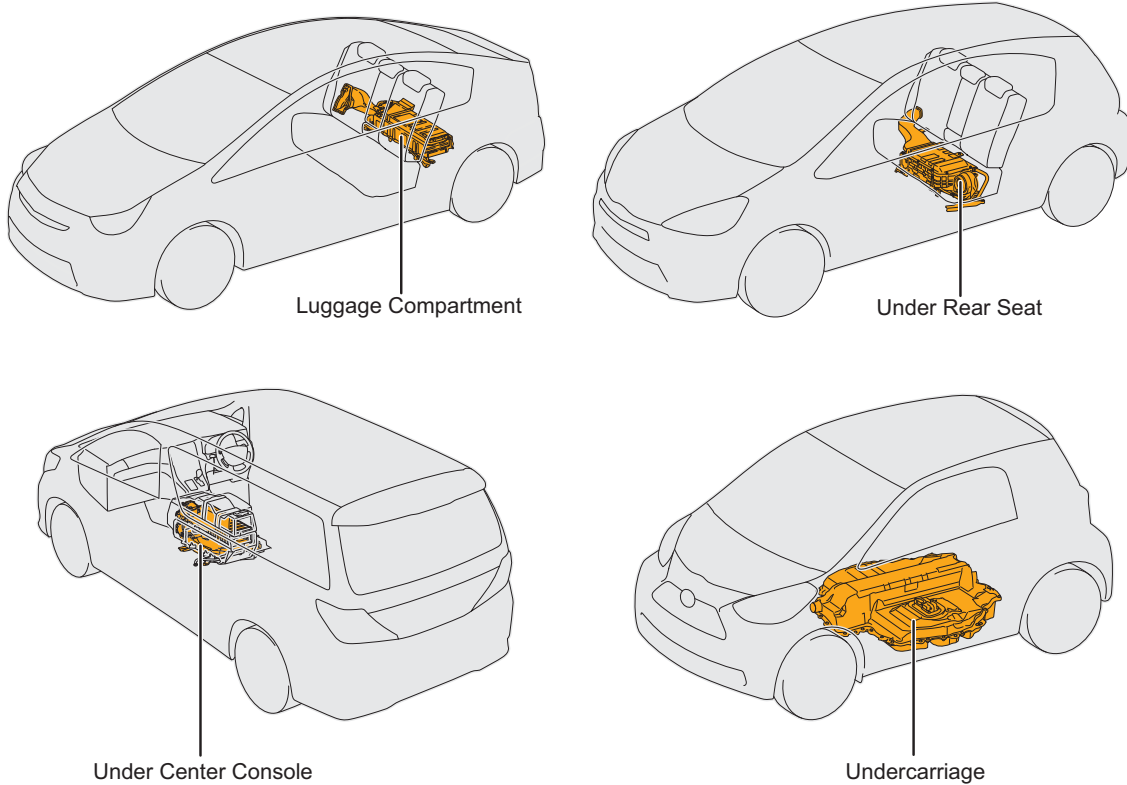
When performing work on the HV system, fold this sign and
put it on the roof of the vehicle.

High Voltage System

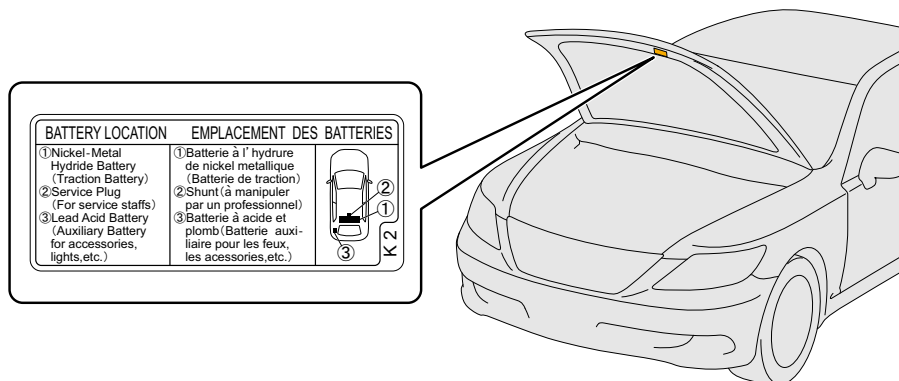


High Voltage Battery

- The high voltage battery for the motor stores high voltage electricity (144 to 288 V). Depending on the model the battery is installed in the luggage compartment, under the rear seats, under the center console or under the floor.



- An under-hood label shows the location of the high voltage battery.



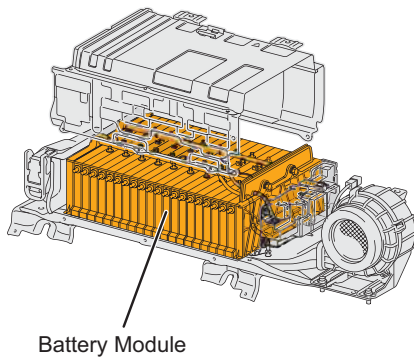
High Voltage System



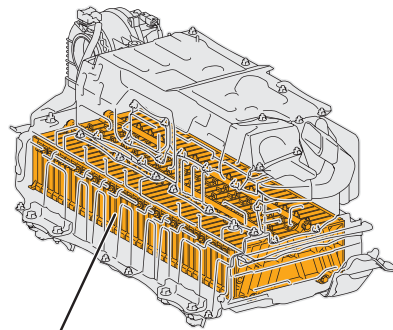
■ A Nickel-metal hydride (Ni-MH) battery or lithium ion (Li-ion) battery is used as the high voltage battery.

1. Nickel-metal hydride (Ni-MH) battery

- Ni-MH batteries consist of 20 to 40 modules, each consisting of six 1.2 V cells, connected in series to obtain high voltage (144 to 288 V).
- The battery modules are contained within a metal case and accessibility is limited.
- A catastrophic crash that would breach both the metal battery pack case and a metal battery module would be a rare occurrence.
- The Ni-MH battery contains a strong alkaline electrolyte (pH 13.5). The electrolyte, however, is absorbed in the cell plates and will not normally spill or leak out even if a battery module is cracked.
- Electrolyte leakage from the HV battery pack is unlikely due to its construction and the amount of available electrolyte contained within the Ni-MH modules. Any spillage would not warrant a declaration as a hazardous material incident.



Battery Module



Battery Module



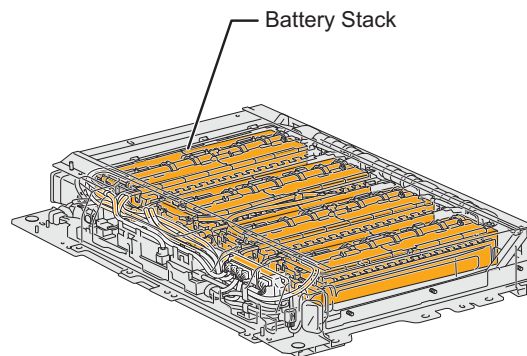
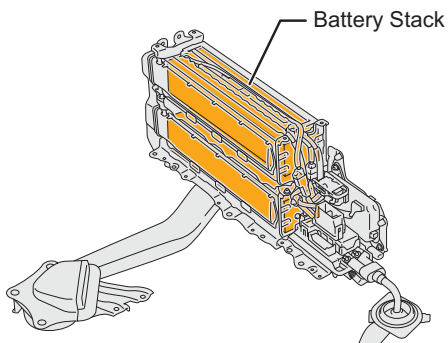
■ Strong alkaline electrolyte (pH 13.5) is harmful to the human body. To avoid injury by coming in contact with the electrolyte, wear appropriate protective equipment such as rubber gloves and safety goggles when there is a risk of touching electrolyte.

High Voltage System



2. Lithium ion (Li-ion) battery

- Li-ion batteries consist of multiple stacks, each stack consisting of 14 to 33 cells. Two to four battery stacks are connected in series to obtain high voltage (201.6 to 277.5 V).
- The battery cells are contained within a case and accessibility is limited.
- A catastrophic crash that would breach both the metal battery stack case or battery frame and a metal battery cells would be a rare occurrence.
- The Li-ion battery electrolyte, mainly consisted of carbonate ester, is a flammable organic electrolyte. The electrolyte is absorbed into the battery cell separators, even if the battery cells are crushed or cracked, it is unlikely that liquid electrolyte will leak.
- Any liquid electrolyte that leaks from a Li-ion battery cell quickly evaporates.

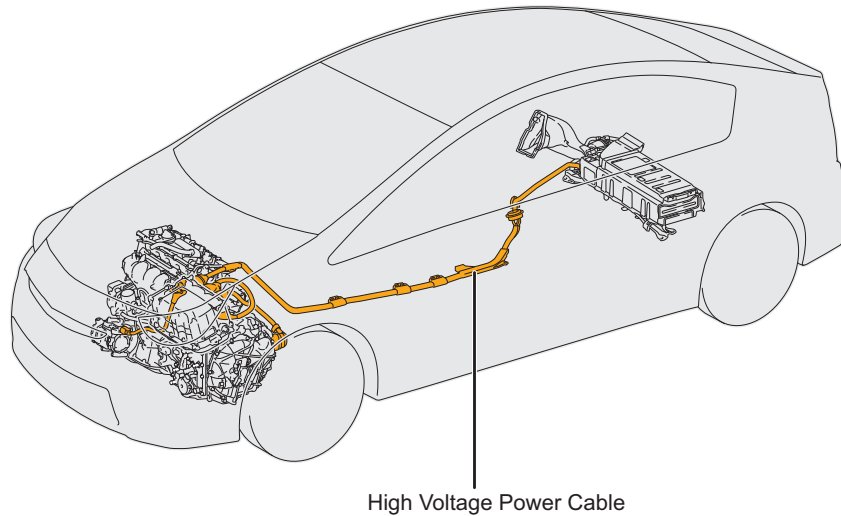


- The flammable organic electrolyte which primarily contains carbonate ester is harmful to the human body. In case of contact with the electrolyte, it may irritate the eyes, nose, throat and skin. In case of contact with the smoke or vapor from leaked electrolyte or a burning battery, it may irritate the eyes, nose or throat. To avoid injury by coming in contact with the electrolyte or vapor, wear appropriate protective equipment such as rubber gloves, safety goggles, protective mask or SCBA when there is a risk of touching electrolyte.
- If the electrolyte spills, keep it away from fire and ensure the area is well ventilated. Absorb the electrolyte with a waste cloth or equivalent absorbing material and keep it in an airtight container until disposed of.



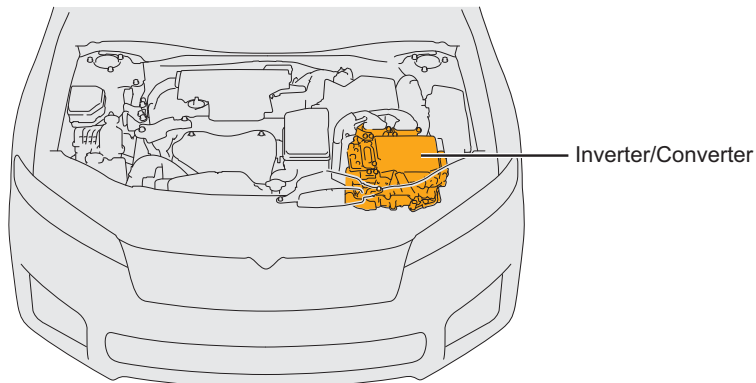
High Voltage Power Cable

- High voltage power cables are indicated by an orange color and are used to connect high voltage electrical components such as the high voltage battery inverter/converter, electric motor, A/C compressor and charger.
- The high voltage power cables are installed in the engine/motor compartment and in the center of the vehicle (routed through the center tunnel) or on either side away from the rocker panels.
- Also, high voltage cables are used in the plug-in charging system (refer to P28).



Inverter/Converter

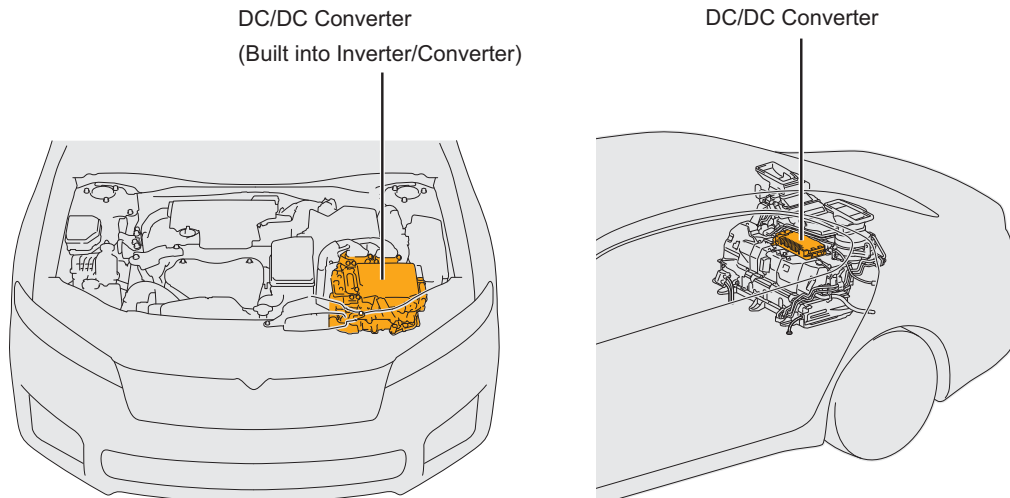
- The inverter/converter installed in the engine/motor compartment boosts and inverts the DC electricity from the high voltage battery to AC electricity that drives the electric motor.
- The inverter/converter of fuel cell vehicles (FCV) also supplies an electric current converted to AC to the FC air compressor.





DC/DC Converter

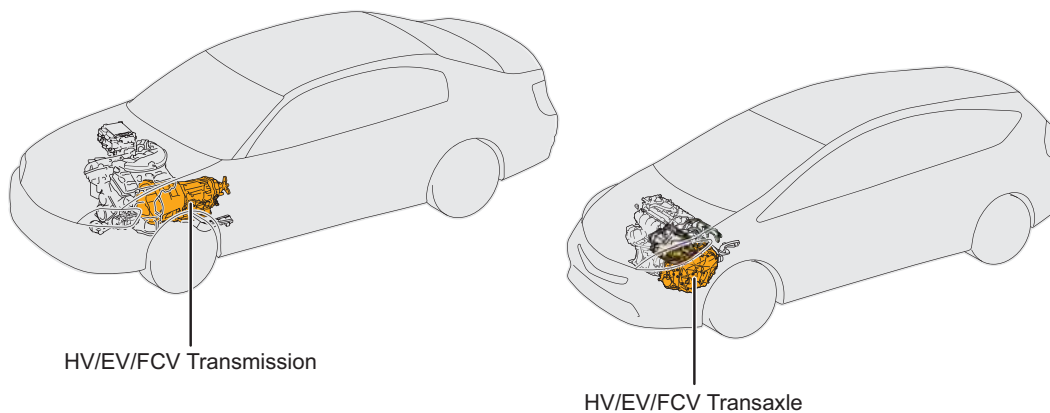
- The DC/DC converter lowers the DC electricity from the high voltage battery to supply it to electric accessories such as the headlights and power windows, and to charge the 12 V battery.
- The DC/DC converter is built into the inverter/converter or installed in the area near the high voltage battery on some models.



HV/EV/FCV Transmission

HV/EV/FCV Transaxle

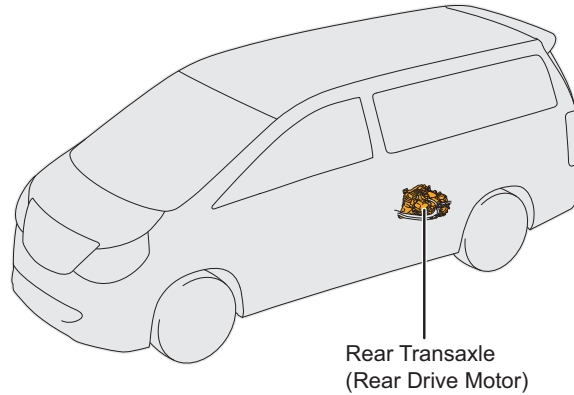
- The HV/EV/FCV transmission/transaxle contains an electric motor/generator that is powered by output voltage (up to 650 V) from the inverter/converter, and charges the high voltage battery.
- The HV/EV/FCV transmission/transaxle is installed in the engine compartment or motor compartment. Location varies depending on layout.





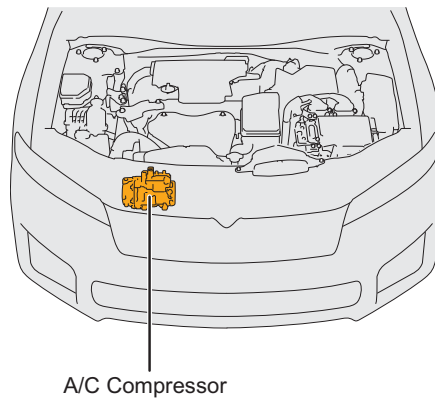
Rear Drive Motor

- The rear drive motor is powered by output voltage (up to 650 V) from the inverter/converter.
- It is built into the rear transaxle and located above the rear driveshafts.



A/C Compressor

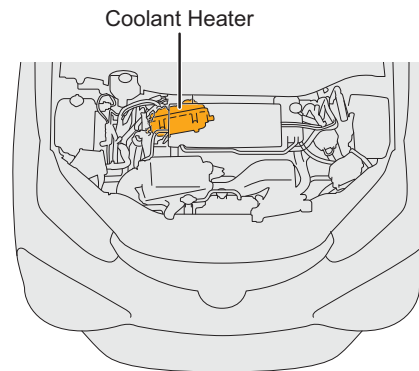
- The A/C compressor used on hybrid vehicles (HV), electric vehicles (EV) and fuel cell vehicles (FCV) contains an electric motor that is powered by electricity from the high voltage battery. It is installed in the engine/motor compartment.





Coolant Heater

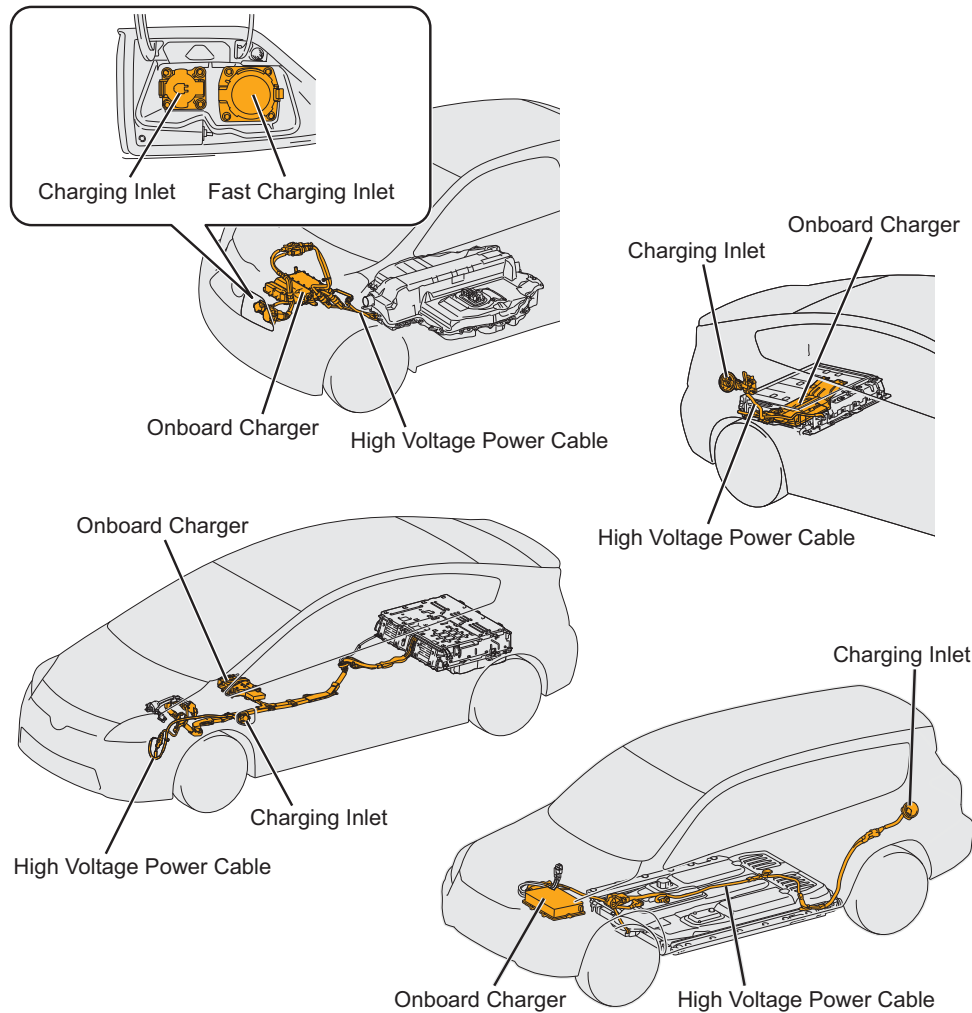
- Fuel cell vehicles (FCV) is equipped with a coolant heater to heat the coolant, installed inside the motor compartment.
- The coolant heater is operated using the power from the high voltage battery.



Plug-in Charging System

- Plug-in hybrid vehicles (PHV) and electric vehicles (EV) are equipped with a plug-in charging system in order to charge the high voltage battery from an external power source.
- The plug-in charging system is mainly comprised of an onboard charger and charging inlet.
- The onboard charger converts the AC supplied from an external power source to DC, boosts it, and then uses it to charge the high voltage battery.
- The charger inlet receives the charge to the high voltage battery from an external power source. Also, some electric vehicles have a separate fast charging inlet which can be used at fast chargers (DC 500 V).
- The orange power cables are connected to the charging inlet, which is supplied high voltage during charging.

High Voltage System

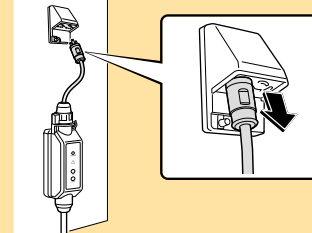
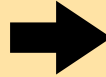
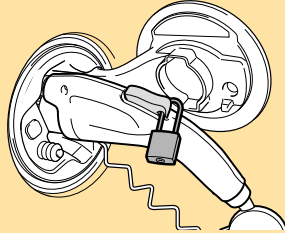


- To prevent serious injury or death from severe burns or electric shock, shut off the utility circuit supplying power to the charge cable before disconnecting it if the vehicle, charge cable or charger is submerged in water.

High Voltage System



- If the lock of the charge cable assembly connector cannot be released, turn OFF or unplug the external charger, or turn its main breaker OFF.



- The lock of the charge cable assembly connector cannot be released during fast charging. If charging does not stop even when the charger is turned OFF, turn its main breaker OFF.



Fuel Cell (FC) System

- Fuel cell vehicles (FCV) use a motor for driving force in the same way as hybrid vehicles. In order to drive the motor, a high voltage (over 200 V, up to 650 V) is used. Not having an engine, the vehicle uses a motor driven by the power generated by a chemical reaction between the hydrogen fuel and oxygen in the air.
- Fuel cell vehicles (FCV) are equipped with dedicated high voltage components such as an FC stack, hydrogen pump, FC water pump, FC water pump and hydrogen pump inverter, FC boost converter and FC air compressor.
- To use hydrogen for power generation, fuel cell vehicles (FCV) are equipped with hydrogen pipes and hydrogen-related parts such as an FC stack, hydrogen tanks, etc.
- The hydrogen tanks are filled with high pressure hydrogen gas (a maximum of 70 MPa (714 kgf/cm², 10,153 psi) at 15°C (59°F)).
- The hydrogen-related parts are inside cases/covers. Also, some of the insulation on high-pressure hydrogen pipes is in red.
- Hydrogen gas is colorless, odorless, and harmless.
- Hydrogen gas is flammable, and can ignite in a wide range of concentrations (4 to 74.5%). However, it diffuses easily and tends not to accumulate, so a small amount of leak would quickly dissipate to a concentration that cannot ignite.
- In the case of hydrogen leakage, the hydrogen detector equipped on the vehicle detects the hydrogen leak and shuts off the supply of hydrogen to prevent a mass leak. Also, hydrogen-related parts are located outside the cabin to allow leaked hydrogen to be easily diffused.
- If a collision is detected, the supply of hydrogen is shut off to prevent a mass leak due to vehicle damage.
- For details about the installation locations of hydrogen-related parts, refer to the QRS (Quick Reference Sheet) for the vehicle.



- If the sound of hydrogen leaking (a loud hissing sound) can be heard when working on the vehicle, or if the hydrogen concentration around the vehicle exceeds 4% when measured with a hydrogen concentration detector, immediately step away from the vehicle as there is a chance that the hydrogen gas may ignite.
- Even after the vehicle is stopped (refer to P64), hydrogen remains inside the FC stack, hydrogen tanks and other hydrogen-related parts, as well as inside the hydrogen pipe. In order to avoid fires and explosions, never cut or damage these hydrogen-related parts or the hydrogen pipe.
- When the person(s) in charge of handling the damaged vehicle are away from the vehicle and someone else accidentally approaches or touches the vehicle, death or serious injury may occur due to electrocution, a rupture, an explosion or fire. To avoid this danger, display "HIGH VOLTAGE DO NOT TOUCH" and "HIGH-PRESSURE GAS DO NOT TOUCH" signs to warn others (print and use page 21 and 32 of this guide).



CAUTION:
HIGH-PRESSURE GAS
DO NOT TOUCH.

Person in charge: _____

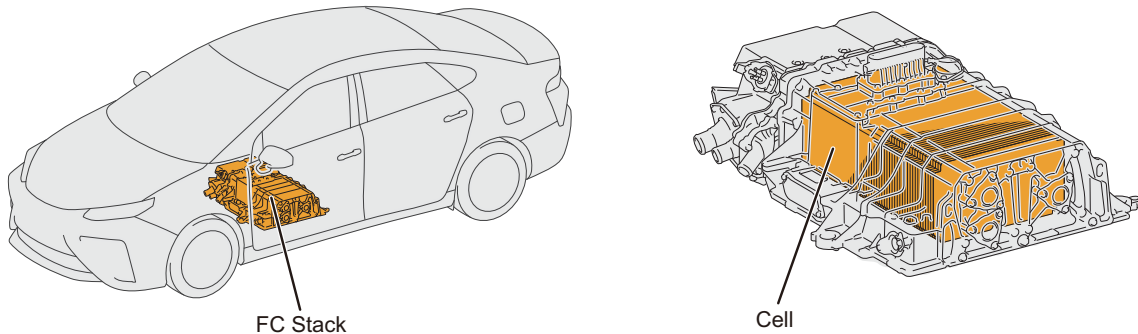
CAUTION:
HIGH-PRESSURE GAS
DO NOT TOUCH.

Person in charge: _____

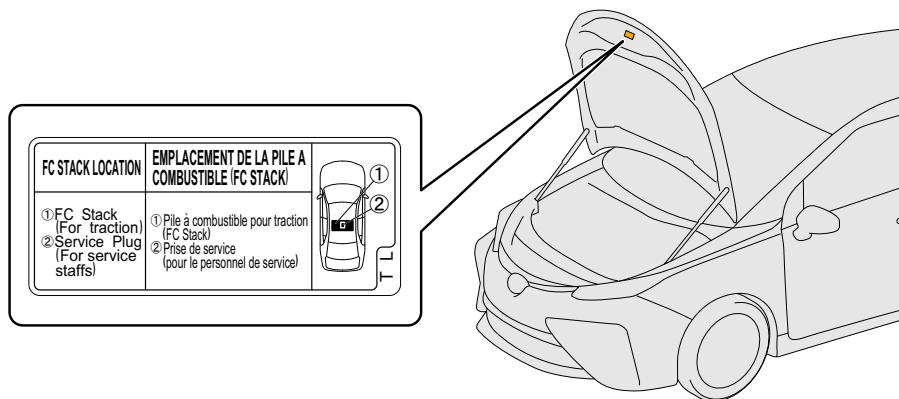


FC Stack

- The FC stack is a device to generate electricity through the chemical reaction between hydrogen and oxygen. Using the hydrogen supplied by the hydrogen tank and oxygen in the air drawn in from outside the vehicle, a high voltage of 200 V or higher is generated.
- The FC stack is installed underneath the floor.
- The FC stack generates power using so called “cells”, which are comprised of an electrolyte membrane sandwiched by separators. A few hundred cells are connected in a row to generate a high voltage.
- The cells are contained inside a metal case so that they are not easily touched.
- Water is generated through the chemical reaction between hydrogen and oxygen during power generation, and discharged via the discharge outlet.



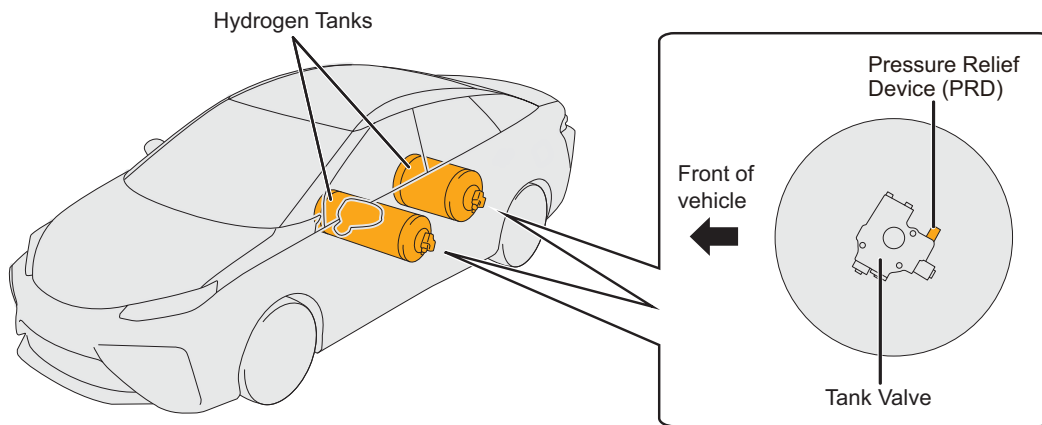
- An under-hood label shows the location of the FC stack.





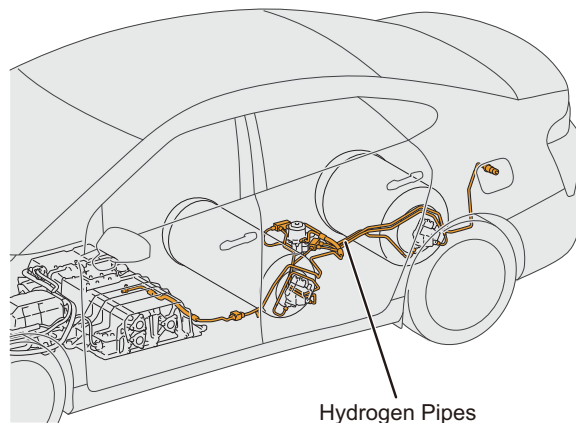
Hydrogen Tank

- The hydrogen tanks are filled with high pressure hydrogen gas (a maximum of 70 MPa (714 kgf/cm², 10,153 psi) at 15°C (59°F)) that is supplied to the FC stack.
- The hydrogen tanks are made of carbon fiber-reinforced plastic and located underneath the floor.
- The hydrogen detector used to detect hydrogen leaks is located near the tanks. If a specified concentration of hydrogen leakage is detected, the FC system cuts off the supply of hydrogen.
- Each tank is equipped with a pressure relief device (PRD) in order to prevent an explosion when the temperature of the hydrogen reaches abnormal levels due to a vehicle fire. The pressure relief device will open at approximately 110°C (230°F) to release the hydrogen gas in the tank outside of the vehicle.



Hydrogen Pipes

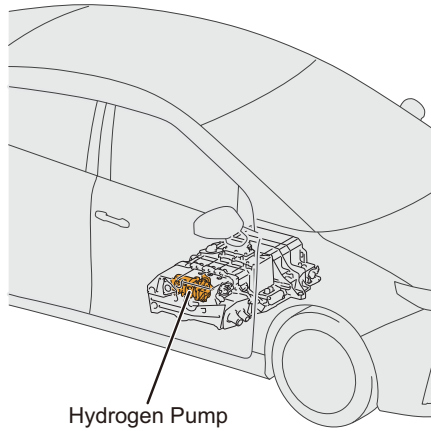
- The hydrogen pipes connect the hydrogen-related parts such as the FC stack and hydrogen tanks.
- The hydrogen pipes are located underneath the floor.
- Some of the high-pressure hydrogen pipes are identified in red.





Hydrogen Pump

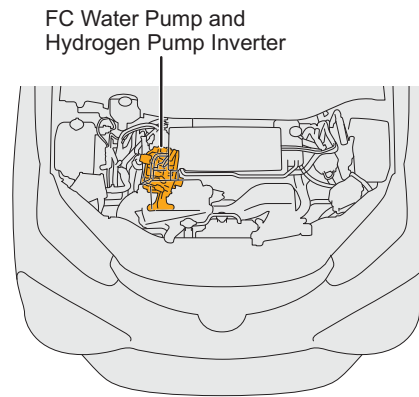
- The hydrogen pump circulates the hydrogen supplied from the hydrogen tanks into the FC stack.
- The hydrogen pump has a built-in motor that is operated using the high voltage from the FC water pump and hydrogen pump inverter. The hydrogen pump is installed underneath a cover at the side of the FC stack.





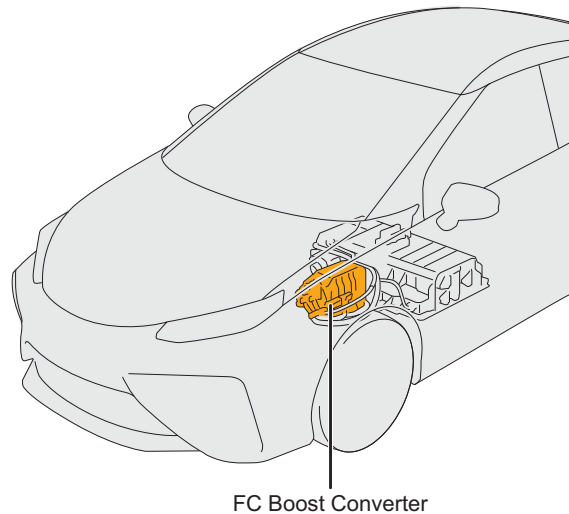
FC Water Pump and Hydrogen Pump Inverter

- The FC water pump and hydrogen pump inverter converts DC from the high voltage battery to AC, and supplies this current to the hydrogen pump and FC water pump.
- The FC water pump and hydrogen pump inverter is installed in the motor compartment.



FC Boost Converter

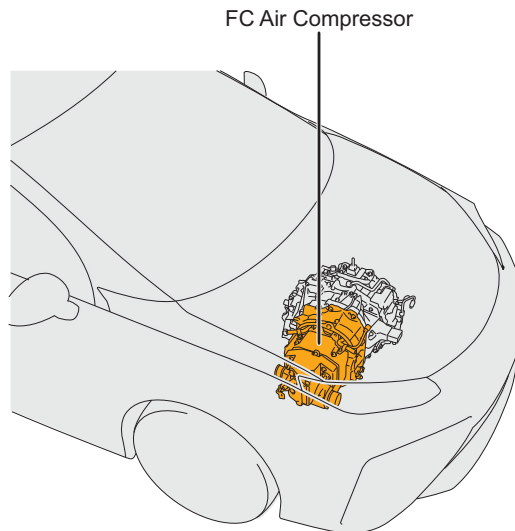
- The FC boost converter increases the voltage of DC generated by the FC stack to a maximum of 650 V for motor operation, and then supplies this current to the inverter/converter.
- The FC boost converter is installed in the center tunnel (outside the cabin).





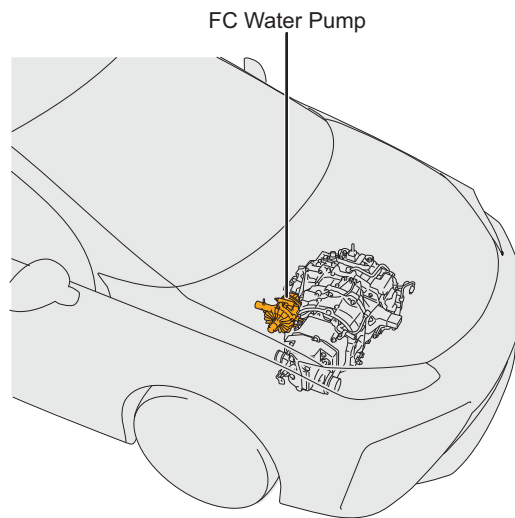
FC Air Compressor

- The FC air compressor supplies air (oxygen) to the FC stack.
- The FC air compressor has a built-in motor which is driven using the output voltage from the inverter/converter (up to 650 V), and is installed in the motor compartment.



FC Water Pump

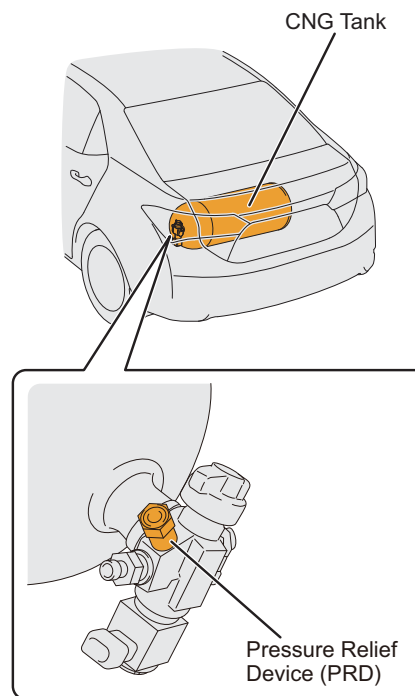
- The FC water pump circulates the coolant to cool the FC stack.
- The FC water pump has a built-in motor which is driven using the high voltage from the FC water pump and hydrogen pump inverter, and is installed in the motor compartment.





CNG Tank

- The Compressed Natural Gas (CNG) tank is filled with compressed natural gas that is used as fuel for the engine at a maximum pressure of 20 MPa (204 kgf/cm², 2,900 psi).
- The CNG tank is made of metal and located in the luggage compartment, etc.
- The CNG tank is equipped with a pressure relief device (PRD) in order to prevent an explosion when the temperature of the natural gas reaches abnormal levels due to a vehicle fire. The pressure relief device will open at approximately 110°C (230°F) to release the natural gas in the tank outside of the vehicle.
- Natural gas is flammable and can ignite within a concentration of 5.3 to 15.0%.
- Natural gas mainly consists of methane, is harmless and diffuses upwards as it is lighter than air. Also, the gas is infused with a smell so that a leak can be quickly detected.

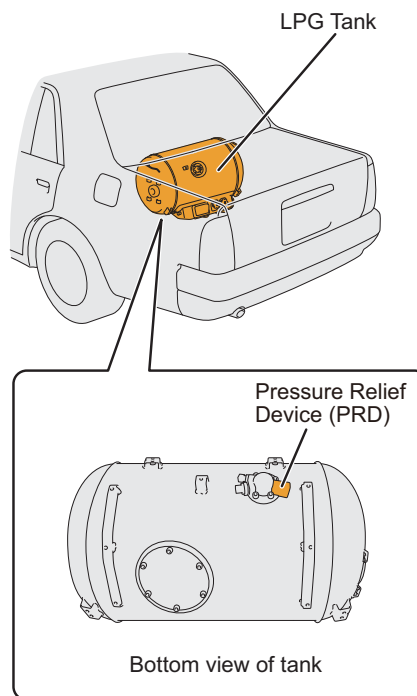


- If the sound of natural gas leaking (a loud hissing sound) can be heard when working on the vehicle, or if the smell of natural gas is present, immediately step away from the vehicle as there is a chance that the natural gas may ignite.



LPG Tank

- The Liquefied Petroleum Gas (LPG) tank is filled with compressed liquefied propane, butane, etc. that is used as fuel for the engine at a pressure of 1 MPa (10.2 kgf/cm², 145 psi) or less.
- The LPG tank is made of metal and located in the luggage compartment, etc.
- The LPG tank is equipped with a pressure relief device (PRD) in order to prevent an explosion when the pressure of the LPG reaches abnormal levels due to a vehicle fire. The pressure relief device will open when the pressure in the tank reaches a certain pressure to release the gas in the tank outside the vehicle.
- LPG is flammable and can ignite within a concentration of 2.4 to 9.5%.
- The main components of LPG, propane and butane are harmless and remain close to the ground as they are heavier than air. Also, the gas is infused with a smell so that a leak can be quickly detected.

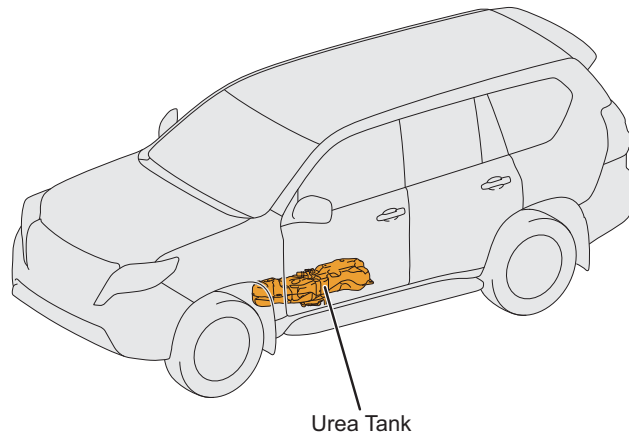


- If the sound of LPG leaking (a loud hissing sound) can be heard when working on the vehicle, or if the smell of LPG is present, immediately step away from the vehicle as there is a chance that the LPG may ignite.



Urea Selective Catalytic Reduction (SCR) System

- The urea Selective Catalytic Reduction (SCR) system reduces harmful nitrogen oxides (NOx) in the exhaust gas using a urea solution.
- The urea solution is stored in the urea tank installed below the floor, etc.
- The urea solution is a colorless, odorless and harmless liquid. However, when the temperature is high, such as in the summer, there is a possibility that an irritating odor is produced by the thermolysis of urea solution.
- The urea solution is noncombustible. However, if the urea solution is heated due to a fire, etc., it breaks down and may emit a harmful gas.



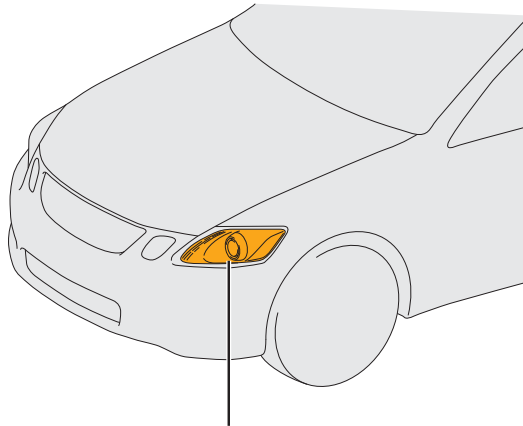
WARNING

- If you come in contact with smoke or vapor from a burning urea tank, it may irritate the eyes, nose or throat. To avoid injury by coming in contact with the smoke or vapor from a burning urea tank, wear appropriate protective equipment such as rubber gloves, safety goggles, a protective mask or SCBA when there is a risk of contacting the smoke or vapor.



High Intensity Discharge (HID) Headlights

- Headlights use High Intensity Discharge (HID) bulbs, which emit light by creating an electric discharge between electrodes inside the bulbs.
- When the HID headlights are turned on, high voltage of approximately 20,000 to 30,000 V is generated instantaneously. During illumination, the voltage from the 12 V battery is boosted to a maximum of 45 V in the electric circuit of the discharge headlights to drive the discharge headlights.



Discharge Headlights

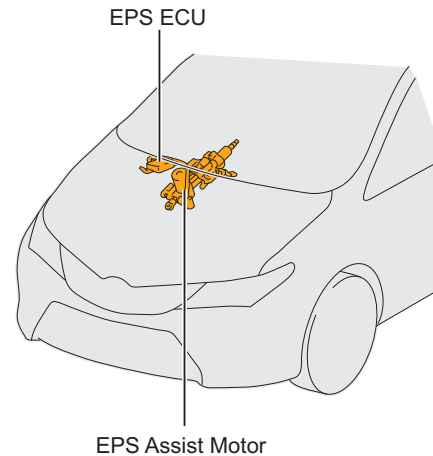
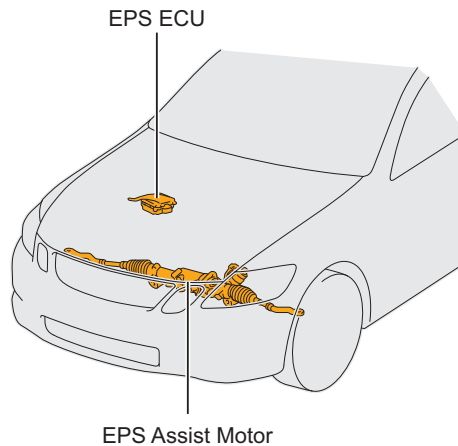


- To prevent serious injury or death from electric shock, avoid touching, cutting, or breaching the bulb, socket, electric circuit and components of the headlights.
- To prevent burns, avoid touching the metal parts on the back of the headlights and the high voltage sockets while the discharge headlights are turned on or immediately after they are turned off.

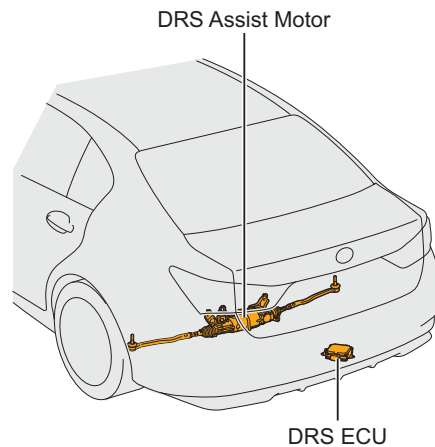


Electric Power Steering (EPS)

- The Electric Power Steering (EPS) system uses 12 V voltage which has been boosted to up to 46 V by the EPS ECU to drive an EPS assist motor.
- The EPS assist motor is built into the steering gear box or steering column.
- Some hybrid models use voltage from the high voltage battery to drive the EPS assist motor by lowering it to up to 46 V using an EPS the DC/DC converter.
- A wire which conducts up to 46 V connects the EPS ECU in the engine compartment or the instrument panel to the EPS assist motor.



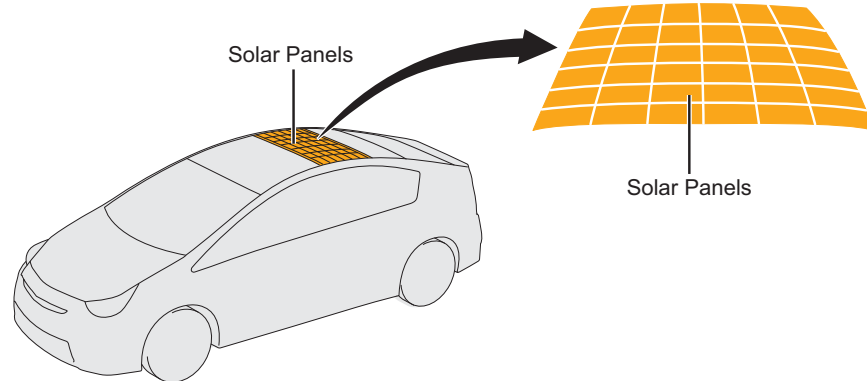
- The Dynamic Rear Steering (DRS) system equipped on some vehicle models uses 12 V voltage which has been boosted to up to 34 V by the DRS ECU to drive the DRS assist motor.





Solar Powered Ventilation System

- The solar powered ventilation system uses solar panels on the vehicle roof to generate up to 27 V of electricity. This electricity is used to power an electric fan which ventilates the cabin while the vehicle is parked in the hot sun.

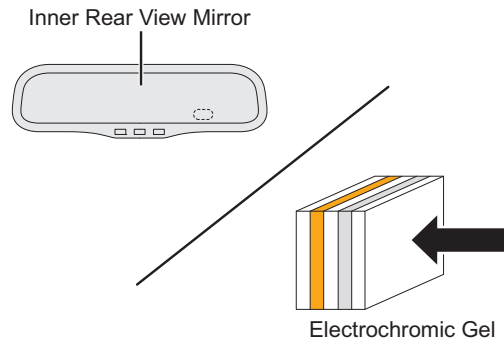


- The solar panels generate electricity with even a small amount of sunlight. To stop generation of electricity, cover the solar panels completely with a material that will block sunlight.



EC Mirror

- The inner rear view mirror has an auto glare-resistance function, which automatically changes the reflection rate of the mirror. This is done by controlling voltage applied to an electrochromic gel inside the mirror, according to the brightness sensed by a light sensor.



- The electrochromic gel contains organic solvents.



- Organic solvents may cause irritation of the skin if contacted. Wear appropriate protective equipment such as rubber gloves and safety goggles when there is a risk of touching electrochromic gel.

Structural Reinforcements

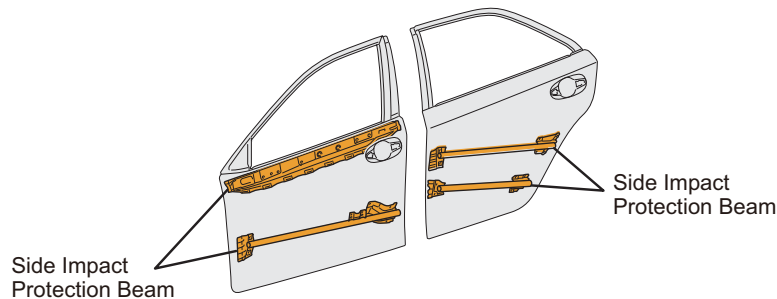
- A side impact protection beam and ultra high tensile strength sheet steel that are stronger than normal steel sheets are used as structural reinforcements.
- Refer to the QRS for each model for locations of the side impact protection beams and ultra high tensile strength sheet steel.



- Because the strength of side impact protection beam and ultra high tensile strength sheet steel is higher than sheet steel and high tensile strength sheet steel, it is difficult to cut through side impact protection beam and ultra high tensile strength sheet steel with conventional cutters. Avoid side impact protection beam and parts made from ultra high tensile strength sheet steel when cutting a vehicle.

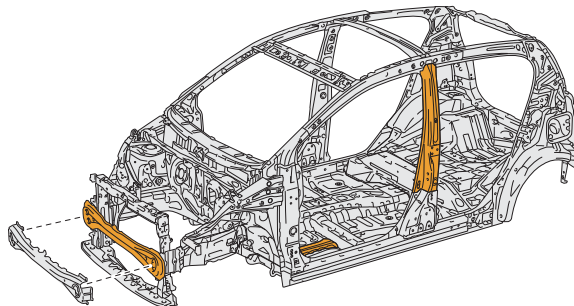
Side Impact Protection Beam

- Side impact protection beams are located inside the door.



Ultra High Tensile Strength Sheet

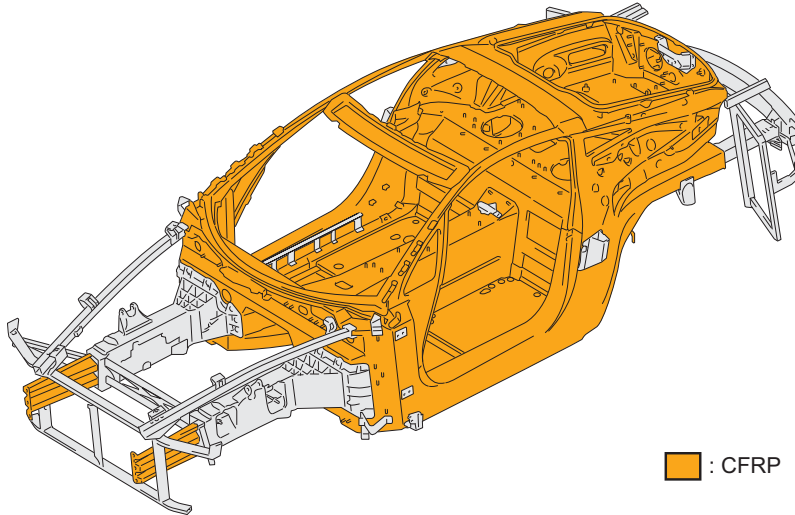
- Ultra high tensile strength sheet steel, which is approximately 1.5 times higher strength (1.5 GPa (15,296 kgf/cm², 217,557 psi) class) than standard high tensile strength sheet steel (under 1 GPa (10,197 kgf/cm², 145,038 psi) class), is used for some body structural components on certain models.



 : Ultra High Tensile Strength Sheet

Carbon Fiber Reinforced Plastic (CFRP)

- Lightweight and highly rigid Carbon Fiber Reinforced Plastic (CFRP) is used for some body structural parts of certain models.
- CFRP can be cut and deformed using cutters for rescue operations.



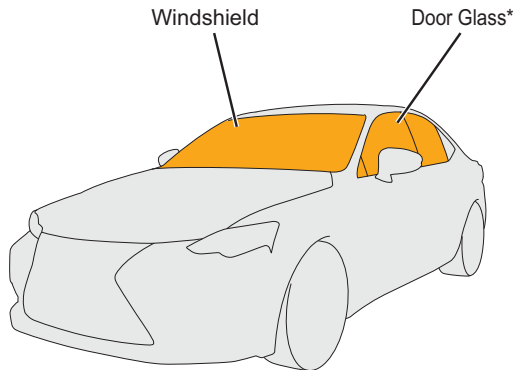
- Cutting CFRP using a grinder or a saw will create carbon fiber dust. Wear appropriate protective equipment such as a dust mask and safety gloves when cutting CFRP.
- CFRP is conductive. If carbon fiber dust attaches to an electrical circuit, a short circuit may result. Keep electrical circuits free from carbon fiber dust when cutting CFRP.

Window Glass

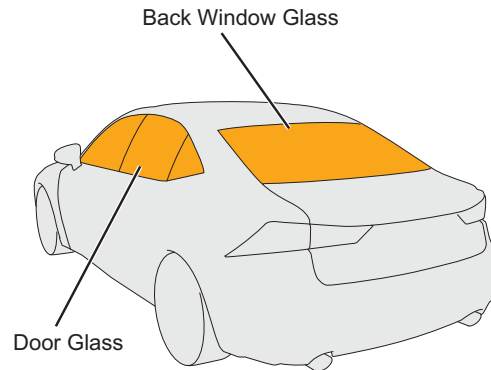
- Laminated glass and tempered glass are widely used for vehicle windows.

*Laminated glass is mainly used for the windshield. It is also used for the door glass on some vehicles.

- Tempered glass is mainly used for the door glass, the roof glass and the back window glass.

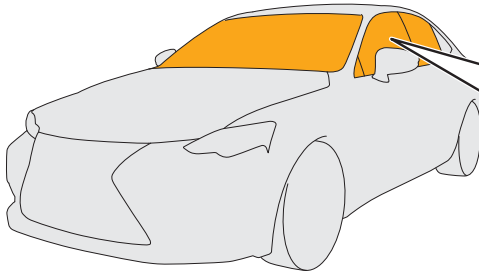


Laminated Glass Applications



Tempered Glass Applications

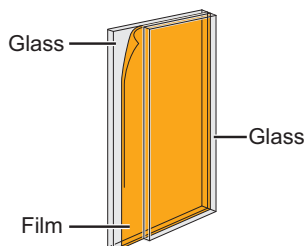
- Laminated glass and tempered glass are indicated respectively by “LAMISAFE” or “TEMPERLITE” printed on glass.



Laminated Glass

- Laminated glass consists of 2 layers of glass with a film in-between. Objects that strike the glass are less likely to penetrate the glass and glass shards tend to remain adhered to the film.

< LAMISAFE Structure >



< Broken Laminated Glass >



Tempered Glass

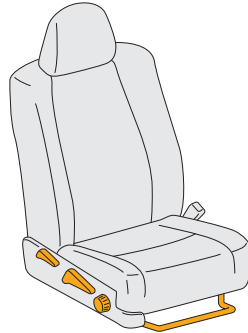
- Tempered glass is heated to near softening temperature, then rapidly cooled down to make it 3 to 5 times stronger than normal glass. When tempered glass is broken, it will break into very small pieces.



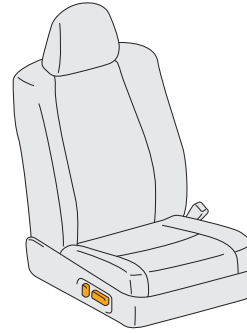
- Laminated glass consists of 2 layers of glass bonded together with a film. It does not break easily even when struck by an object.

Front Seat

- Two types of front seats, a manual seat and a power seat, are available. When adjusting the seat position, a lever or a knob is operated for the manual seat and a switch is operated for the power seat.



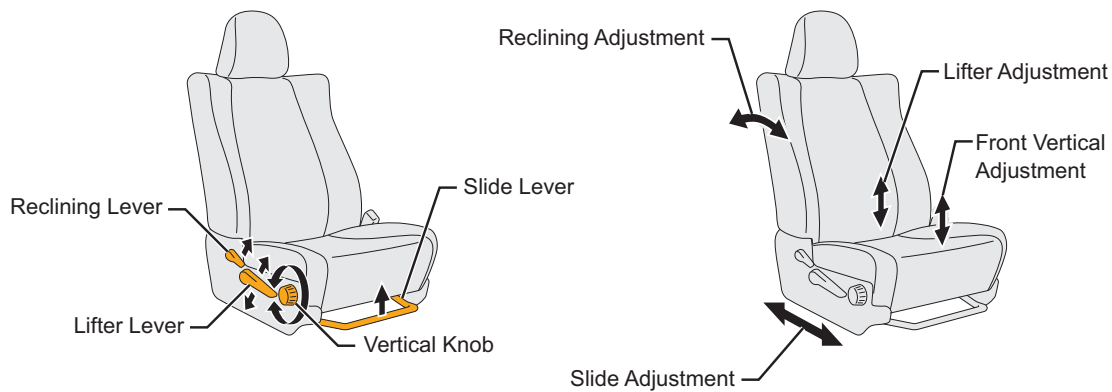
Manual Seat



Power Seat

Manual Seat

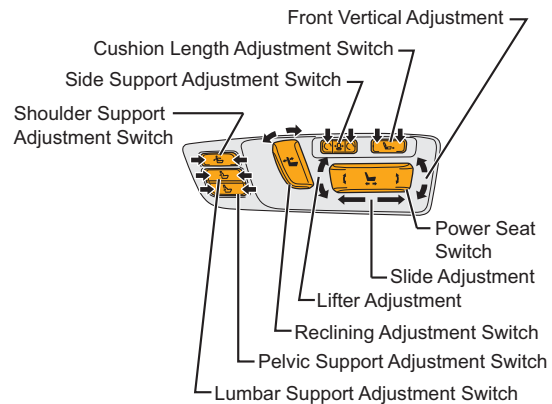
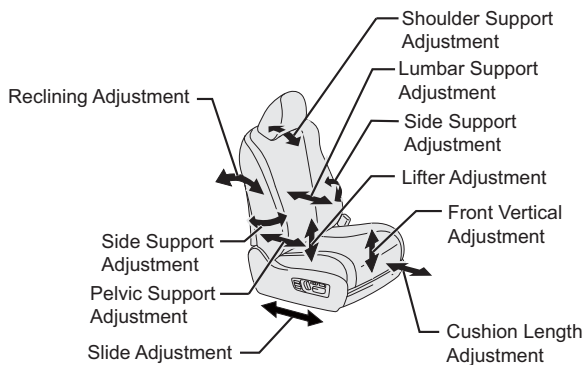
- The seat can be moved forward/backward by lifting the slide lever (slide adjustment).
- The seatback can be tilted forward/backward by lifting the reclining lever (reclining adjustment).
- The seat cushion can be raised/lowered by repeatedly pulling up/pushing down on the lever (lifter adjustment).
- The front end of the seat cushion can be raised/lowered by turning the vertical knob (front vertical adjustment).



Front Seat

Power Seat

- The seat can be moved forward/backward using the slide function of the power seat switch (slide adjustment).
- The entire seat cushion can be raised/lowered using the lifter function of the power seat switch (lifter adjustment).
- The front end of the seat cushion can be raised/lowered using the front vertical function of the power seat switch (front vertical adjustment).
- The seatback can be tilted forward/backward by operating the reclining adjustment switch (reclining adjustment).
- The lumbar support position can be moved forward/backward by operating the lumbar support adjustment switch (lumbar support adjustment).
- The side support position can be moved right/left by operating the side support position adjustment switch (side support adjustment).
- The pelvic support position can be moved forward/backward by operating the pelvic support position adjustment switch (pelvic support adjustment).
- The shoulder support position can be moved forward/backward by operating the shoulder support position adjustment switch (shoulder support adjustment).
- The length of the seat cushion can be adjusted by operating the cushion length adjustment switch (cushion length adjustment).

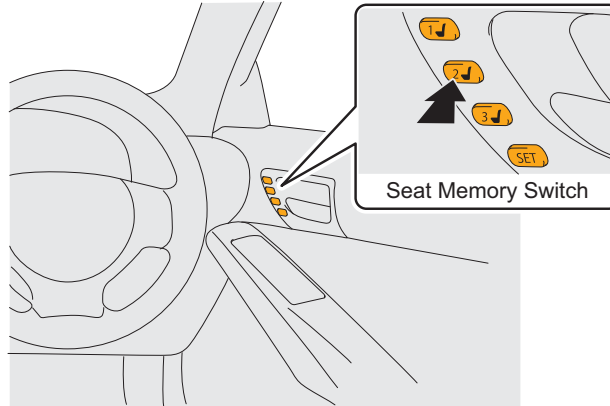


NOTICE

- The seat position adjustment functions of a power seat will be disabled when the 12 V battery is disconnected.

Front Seat

- When a vehicle is equipped with the driving position memory function, the driver seat automatically moves backward when the power switch is turned off (auto away function) and moves forward when the power switch is turned on (IG) (auto return function). Whether or not the vehicle is equipped with the driving position memory function can be confirmed by the existence of memory switches in the upper door trim.

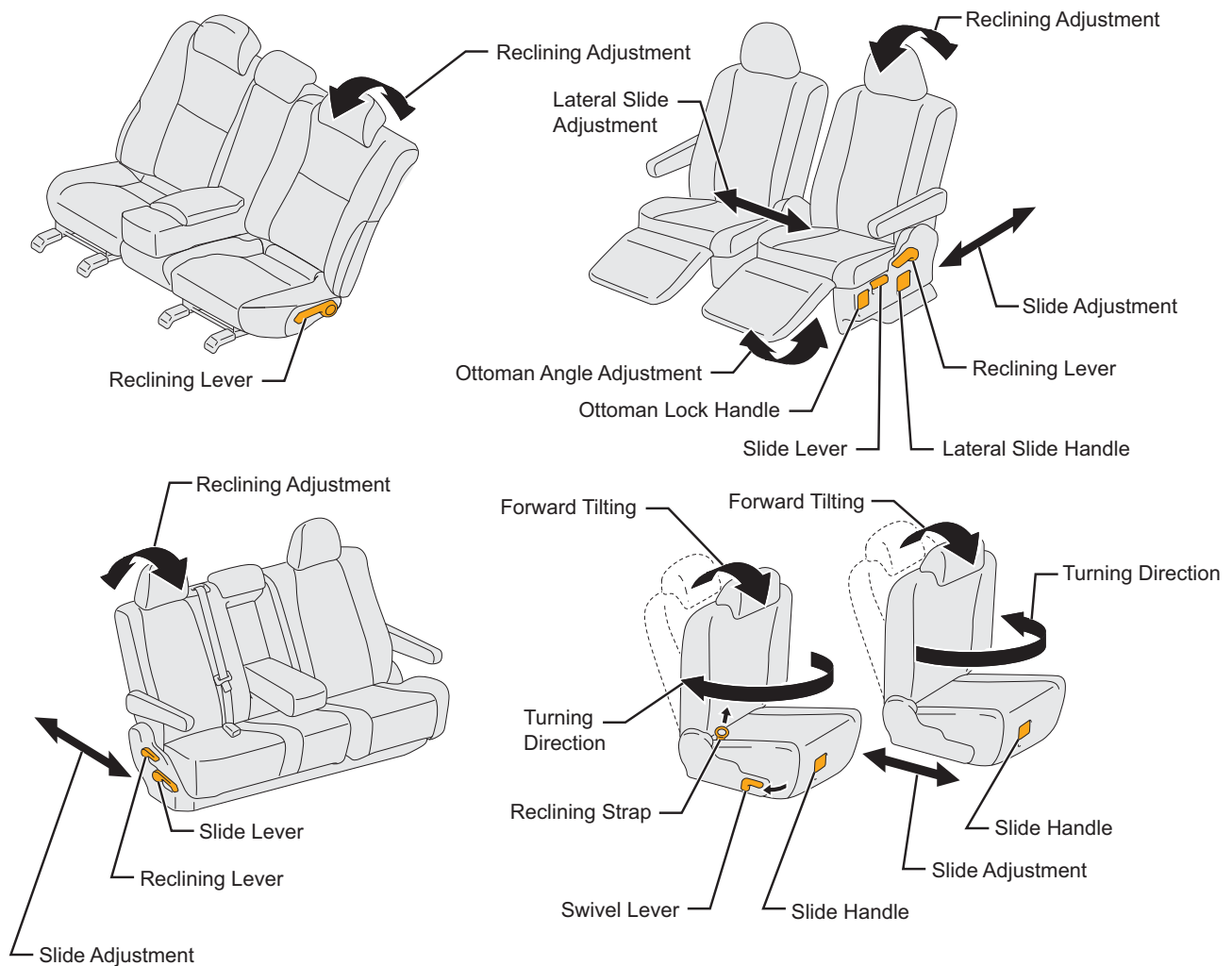


Rear Seat

- Two types of rear seats, a manual seat and a power seat, are available. When adjusting the seat position, a lever or a knob is operated for the manual seat and a switch is operated for the power seat.

Manual Seat

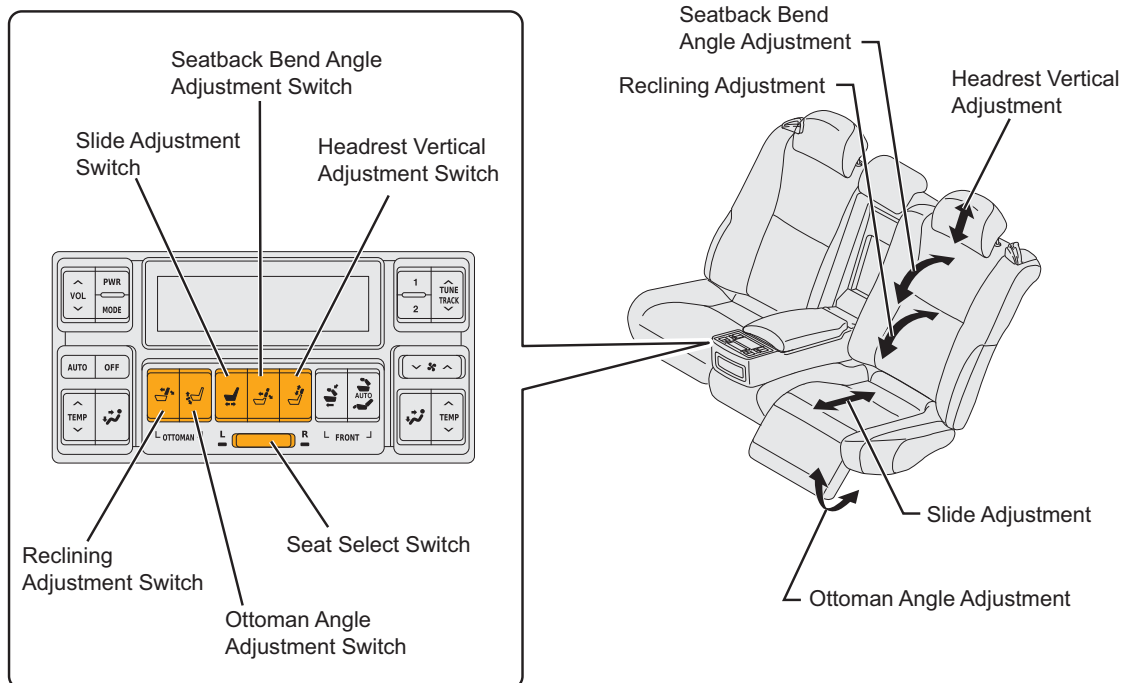
- The seat can be moved forward/backward by lifting the slide lever (slide adjustment).
- The seatback can be tilted forward/backward by lifting the reclining lever (reclining adjustment).
- The seat can be tilted forward by pulling the reclining strap.
- The seat can be moved leftward/rightward by lifting the lateral slide handle (lateral slide adjustment).
- The ottoman can be raised/lowered by lifting the ottoman lock handle (ottoman angle adjustment).
- The seat can be turned around by operating the swivel lever.



Rear Seat

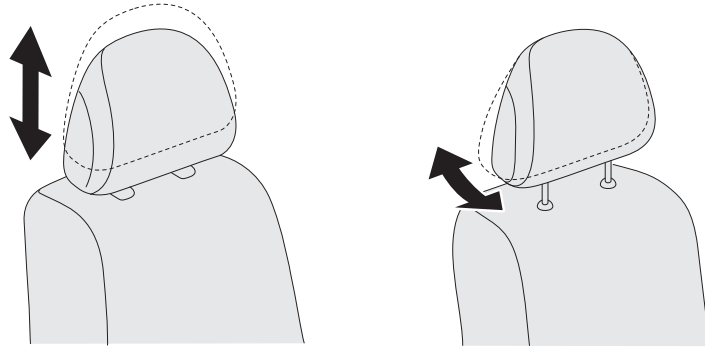
Power Seat

- The seat can be moved forward/backward by operating the slide adjustment switch (slide adjustment).
- The seatback can be tilted forward/backward by operating the reclining adjustment switch (reclining adjustment).
- The ottoman can be raised/lowered by operating the ottoman angle switch (ottoman angle adjustment).
- The angle of the upper seatback can be adjusted vertically by operating the seatback bend angle switch (seatback bend angle adjustment).
- The headrest can be raised/lowered by operating the headrest vertical adjustment switch (headrest vertical adjustment).



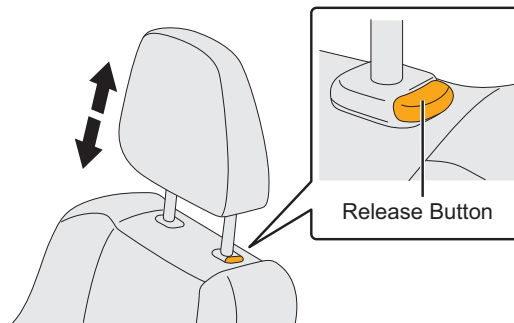
Headrest

- The position of the headrests can be adjusted vertically and horizontally.
- Two types of headrests, a manual headrest and a power headrest, are available. Vertical adjustment of the headrest is performed by hand on manual headrests or by operating a switch on power headrests. Horizontal adjustment can be performed by hand only.



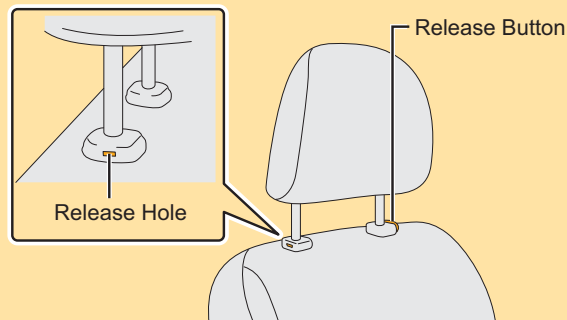
Manual Headrest

- When raising a manual headrest, pull up the headrest by hand. When lowering, push down the headrest while pushing the release button. To remove the headrest, pull out the headrest while pushing the release button.



NOTICE

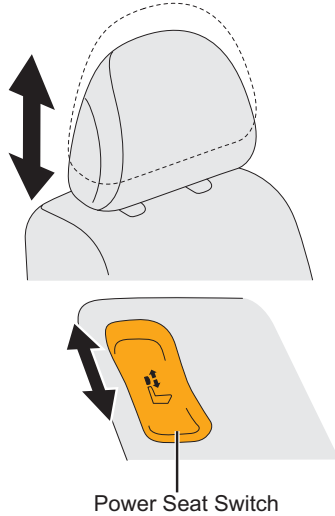
- If the headrest cannot be removed by pushing the release button, insert a screwdriver into the release hole provided on the opposite side of the headrest from the release button to release the lock and pull out the headrest.



Headrest

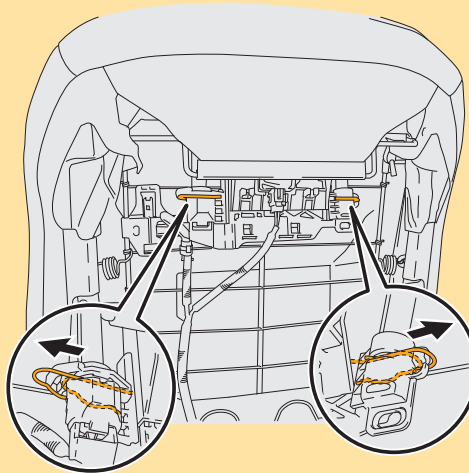
Power Headrest

- When raising a power headrest, raise/lower the headrest by operating the power seat switch located on the side of the seat.



- To remove the headrest, disengage the pins located inside the seatback and pull out the headrest.

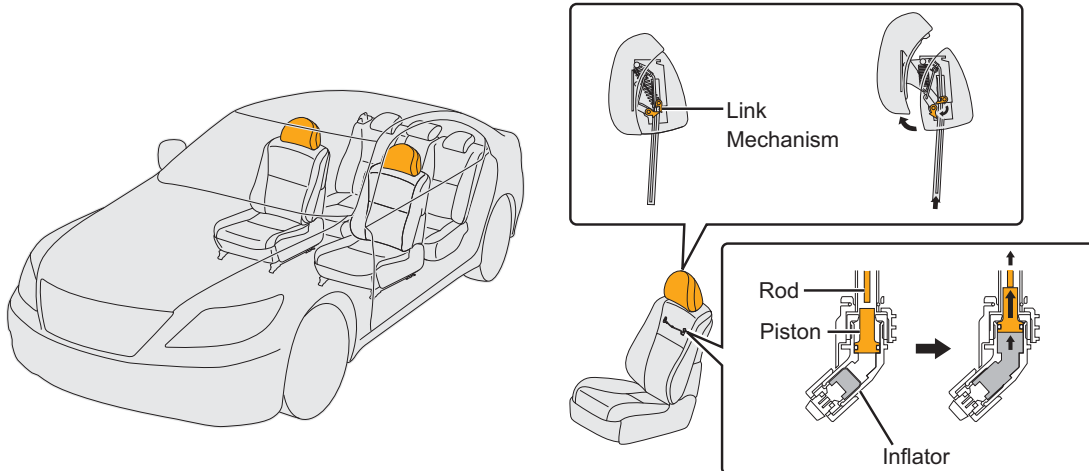
Back of the Seatback





Active Headrest System

- The active headrest system is built into the front headrests.
- The active headrest system consists of an inflator, a rod and a link mechanism.
- When the airbag sensor detects a rear impact, an ignition signal is sent to the inflators to activate the active headrest system. When an inflator is ignited, pressure inside the inflator rises, pushing up a piston. As the piston rises, the rod in the headrest stay is pushed up, a lock is released via the link mechanism and the headrest is pushed forward by a spring, helping reduce the possibility of whiplash injuries.



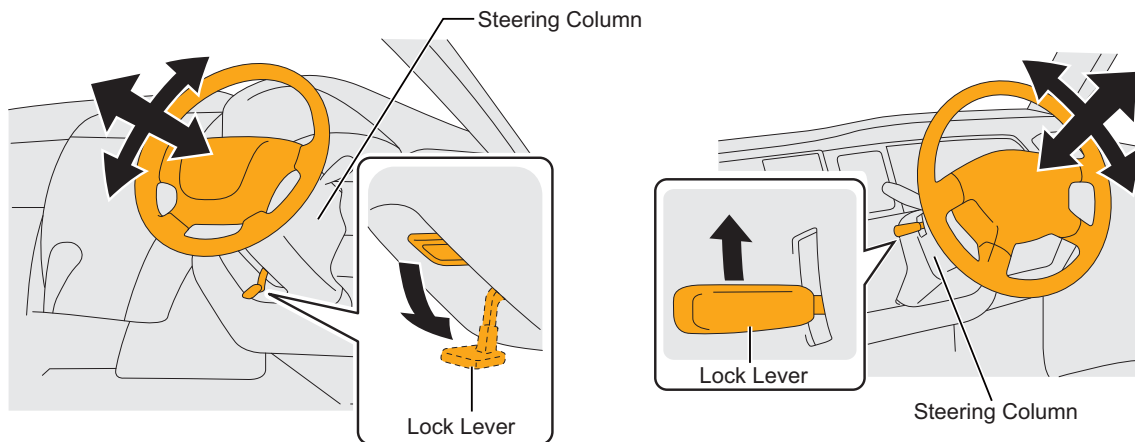
- The active headrest system may remain powered for up to 90 seconds after the vehicle is shut off and disabled (see page 64). Wait at least 90 seconds before starting any operation. Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from unintentional actuation of the active headrest.
- If an inflator is cut, the active headrest inflator may unintentionally deploy. To prevent serious injury or death from unintentional active headrest actuation, avoid breaching the inflators.

Tilt & Telescopic Steering

- The steering column has a tilt mechanism, which enables vertical adjustment of the steering wheel position, and a telescopic mechanism, which enables horizontal adjustment of the steering wheel position.
- Two types of tilt & telescopic steering, manual tilt & telescopic steering and power tilt & telescopic steering, are available. When adjusting the position of the steering wheel, a lever is operated for the manual tilt and telescopic mechanisms and a switch is operated for the power tilt and telescopic mechanisms.
- Some vehicles have only tilt or telescopic mechanism, not both. Also, some vehicles have a fixed type steering column (not equipped with tilt & telescopic mechanism), and some vehicles power mechanism is only for tilt or telescopic function.

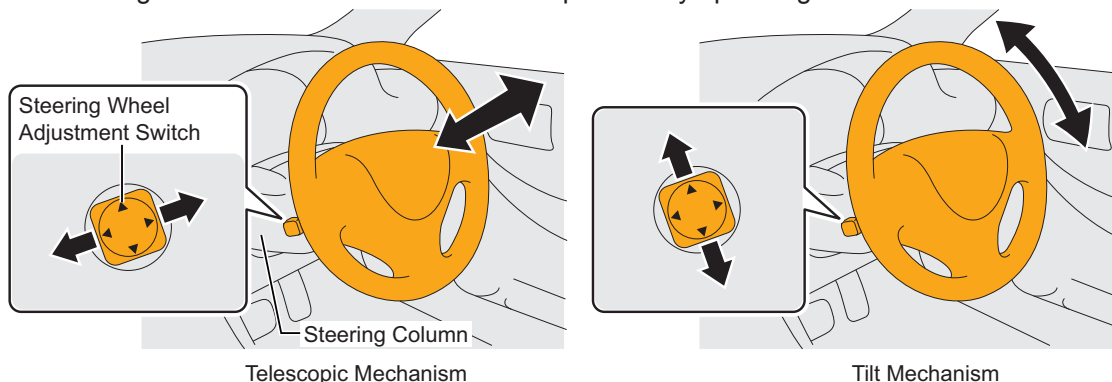
Manual Tilt & Telescopic

- The manual tilt & telescopic steering is provided with a lock lever under or side of steering column for releasing the lock when adjusting the steering wheel position.
- When the lock lever is operated, the lock is released, allowing adjustment of the steering wheel position. After adjustment, the steering wheel can be locked in the desired position by returning the lock lever.



Power Tilt & Telescopic

- The power tilt & telescopic steering is provided with a switch on the steering column for adjusting the steering wheel position.
- The steering wheel can be moved to a desired position by operating the switch.

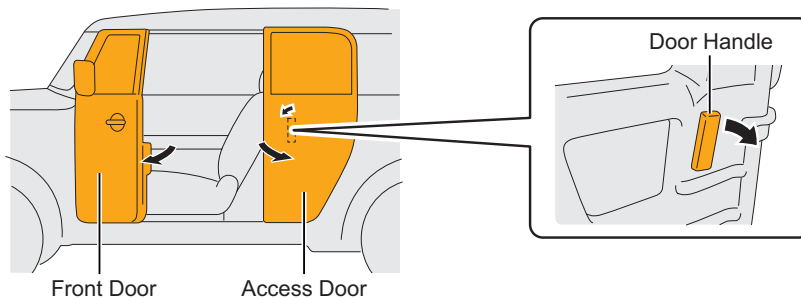


Doors

- The door is opened by operating the handle on the door.
- Some models are equipped with an access door (double door), which is opened using the inner door handle, or a back door, which is opened by using the back door handle after lowering the back window glass.

Access Door (Double door)

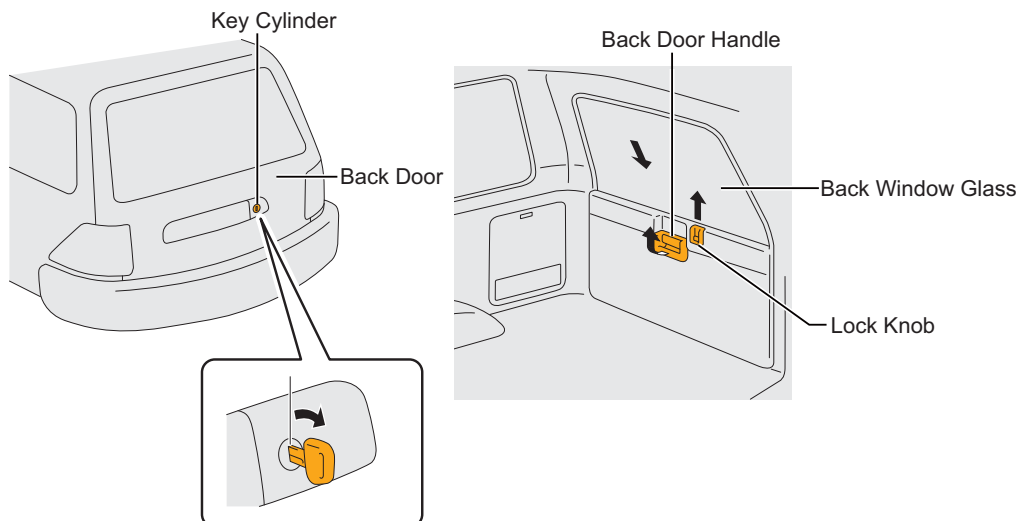
1. Open the front door as much as possible.
2. Pull the door handle on the access door forward.
3. Open the access door.



- Before opening either access doors, make sure the front seatbelt is unfastened. If the access door is opened with the front seatbelt fastened, the seatbelt may be locked and squeeze the front occupant, resulting in a serious injury.

Back Door

1. Insert a key into the key cylinder in the back door then turn the key clockwise to lower the back window glass.
2. Pull up the lock knob on the back door to release the lock.
3. Pull up the back door handle to open the back door.



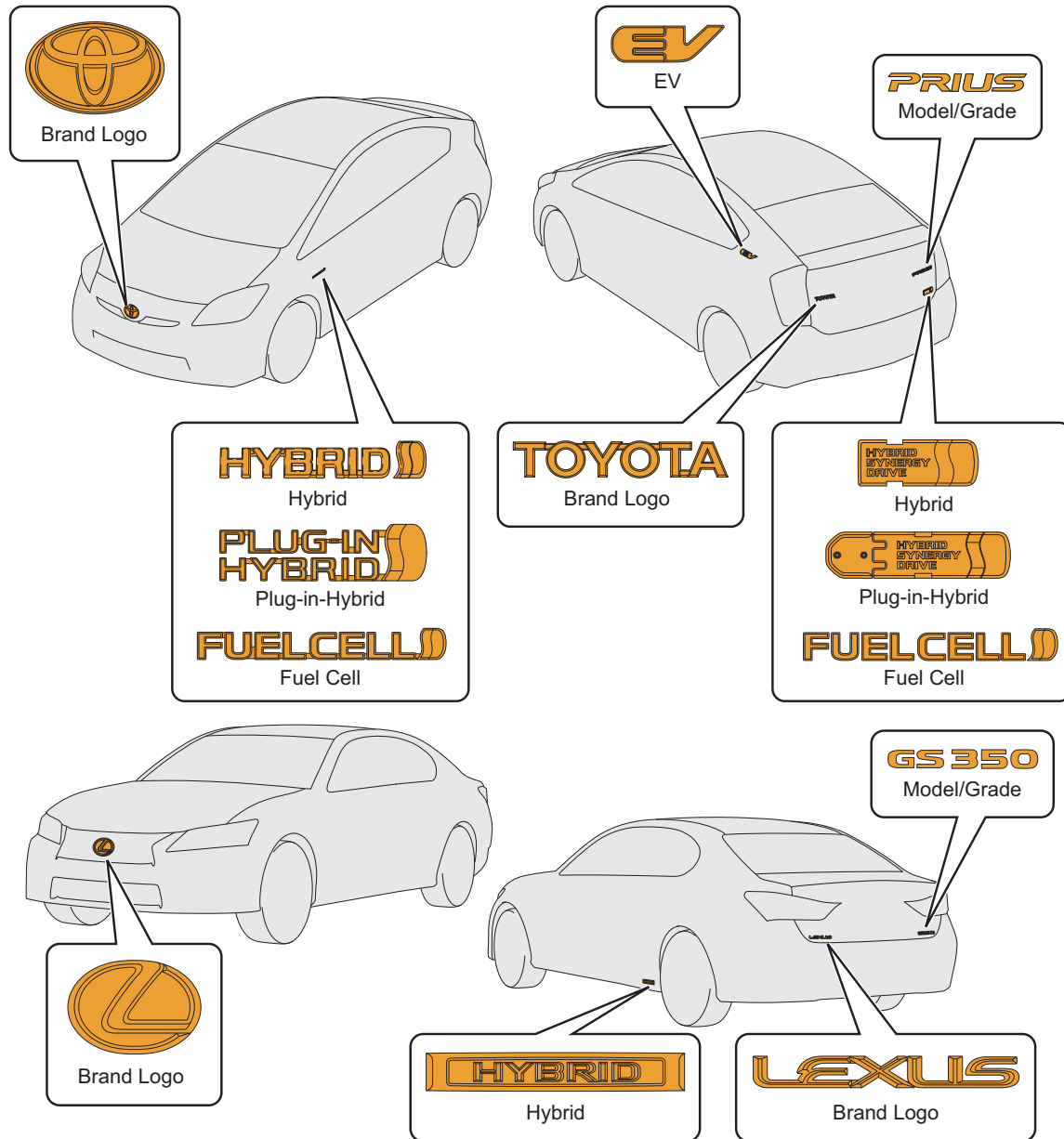
Emergency Response Key Points

- Procedures and points to be noted when handling TOYOTA/LEXUS vehicles during emergency response are provided in this section.
- Refer to the Quick Reference Sheet (QRS) for each model for model specific information such as vehicle identification points, component locations, etc.

Vehicle Identification

Appearance and Logos

- Identify the vehicle type based on exterior features and logos on the body.
- Logo marks represent the make, model, grade, and the vehicle type (hybrid/electric/fuel cell) if it uses a high voltage electrical system.
- Logo marks are attached to the trunk lid, back door/hatch, rocker panels, front grille and fender.

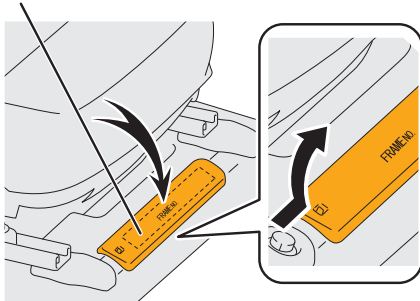


Vehicle Identification

Frame Number

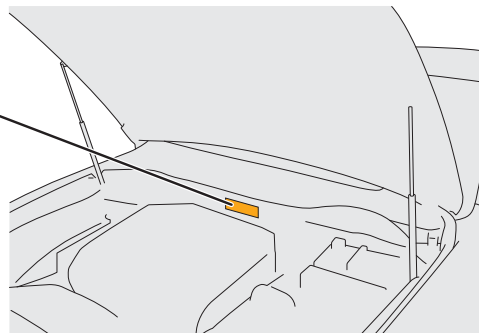
- A frame number is stamped on the name plate attached to the engine compartment and front passenger door pillar.
- Characters before a hyphen (e.g.: ○○○○○ for the frame number ○○○○○-△△△△△) represent the vehicle model.
- When a cover is installed under the driver seat, a frame number is stamped on the frame underneath the cover.

Frame No.



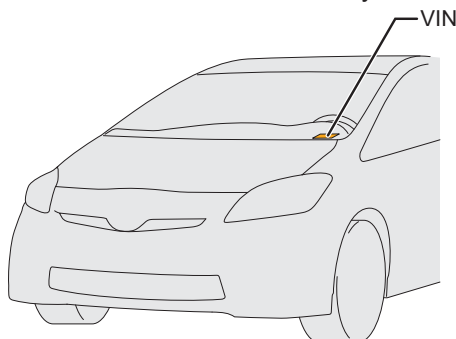
Name Plate

Frame No.

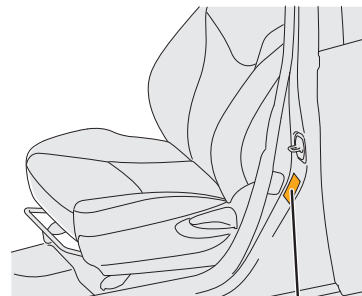


Vehicle Identification Number (VIN)

- The VIN is stamped on the name plate attached to the windshield cowl and driver door pillar.
- The vehicle model can be identified by the VIN.



VIN



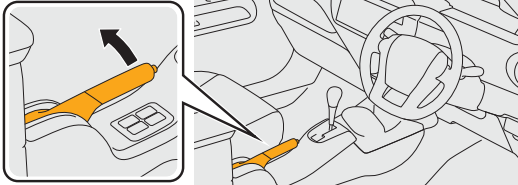
VIN

Immobilize Vehicle

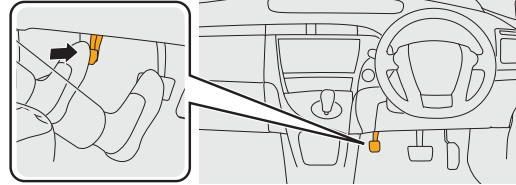
- On arrival, completely immobilize the vehicle by following procedures 1, 2 and 3 to ensure safe emergency response operations.

1. Chock wheels and set the parking brake.

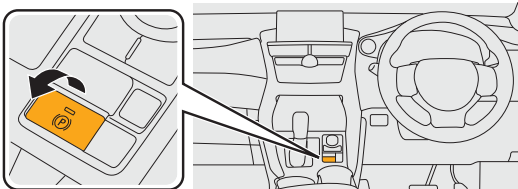
- The following types of parking brakes are available. Operate the parking brake accordingly.



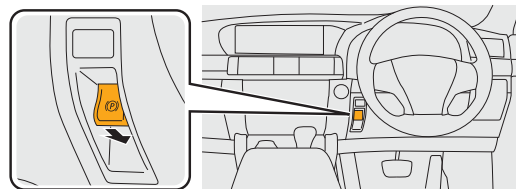
Lever Type



Foot Pedal Type



Switch Type
(Pull-type Switch)

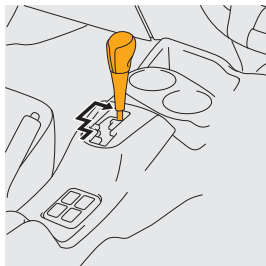


Switch Type
(Push-type Switch)

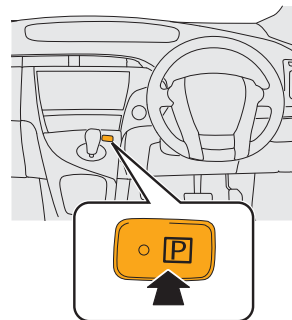
- For vehicles with a switch type, operate the switch twice in order to make sure that the vehicle is securely fixed in place.

2. For automatic vehicles, move the shift lever to the park (P) position. For manual vehicles, shut off the vehicle (see page 64), then move the shift lever to the 1st or reverse (R).

- Park (P) can be selected by the following methods. Operate the vehicle accordingly.



Shift Lever Type



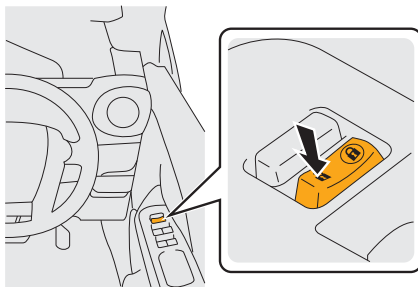
P Position Switch Type

Immobilize Vehicle

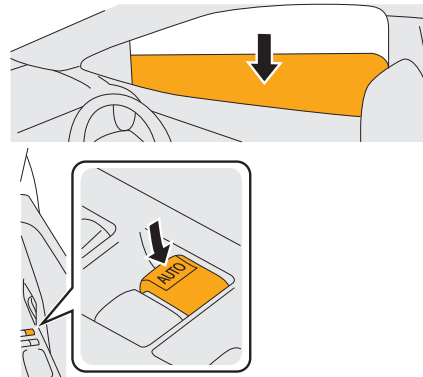
3. To facilitate emergency response operations, lower the windows, open the back door, unlock the doors and take other necessary actions before shutting off the vehicle.

■ The following systems are powered by the 12 V battery. Operate them as required before disconnecting the battery.

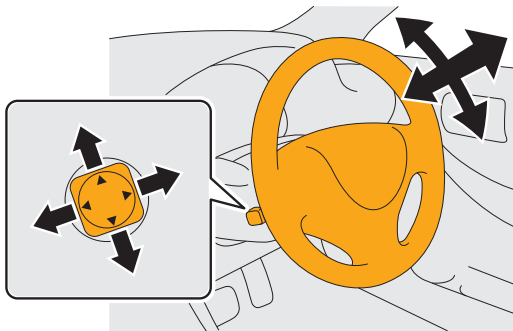
- Power door lock
- Power window
- Power tilt and telescopic steering
- Power seat



Door Unlock



Power Window Adjustment



Steering Wheel Adjustment



Seat Adjustment



NOTICE

■ Once the 12 V battery is disconnected (see page 64), power controls will not operate.

Vehicle with High Voltage Battery

- Hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) and fuel cell vehicles (FCV) are equipped with a high voltage electrical system (over 144 V, up to 650 V).



- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.

Vehicle with Hydrogen Gas

- Fuel cell vehicles (FCV) carry compressed hydrogen gas. Before performing the normal procedures to immobilize the vehicle, follow the steps below first.



- Hydrogen gas is colorless, odorless and flammable.
- Compared to gasoline or natural gas, hydrogen gas can ignite in a wide range of concentrations (4 to 74.5%). If the sound of hydrogen leaking (a loud hissing sound) can be heard when working on the vehicle, or if the hydrogen concentration around the vehicle exceeds 4% when measured with a hydrogen concentration detector, immediately step away from the vehicle as there is a chance that the hydrogen gas may ignite.

1. Confirm that there is no sound of hydrogen leakage (a loud hissing sound).
 - When approaching the vehicle, approach from the front.
 - If the sound of leakage can be heard, immediately step away from the vehicle, as the hydrogen may ignite.
 - Confirm that the sound of leakage is no longer present before proceeding to the next procedure.
2. Using a hydrogen concentration detector, measure the hydrogen concentration around the vehicle, and confirm that it does not exceed 4%.
 - If the concentration exceeds 4%, immediately step away from the vehicle, as the hydrogen may ignite.
 - If a ventilator is available, fanning the area can reduce the hydrogen concentration. Blow the fan from the front toward the rear of the vehicle. When approaching the vehicle, approach from the direction where the wind is coming from.
 - Measure the hydrogen concentration at regular intervals and confirm that the hydrogen concentration does not exceed 4% before proceeding to the next step.
3. Immobilize the vehicle according to the normal procedures.

Disable Vehicle

- To ensure safe emergency response operations, the vehicle must be completely turned off by shutting off the power from the fuel pump, SRS airbag, high voltage battery, plug-in charging system, etc.
- Confirm the vehicle status. If **any of the following conditions exist**, the vehicle may not shut off.

- Engine is running.
- Ignition switch is in ACC, ON or START position.
- Meters are illuminated.
- Air conditioning is operating.
- Audio system is operating.
- Wipers are operating.
- Navigation or other displays are turned on.



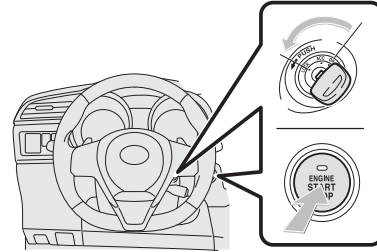
- NEVER assume the vehicle is shut off simply because it is silent. If the vehicle is equipped with an idling stop system, or the vehicle is a hybrid vehicle (HV) or plug-in hybrid vehicle (PHV), the engine is silent while the vehicle is on. Make sure none of the above conditions exist.
- Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from unintentional deployment of the SRS airbags or unintentional actuation of the seatbelt pretensioners, pop up hood, or active headrests.

- Completely shut off the vehicle by following procedures 1 or 2.

Disable Vehicle

Procedure 1

1. Turn the ignition switch to the LOCK (OFF) position or push the engine/power switch once to shut off the vehicle.



- If the vehicle is equipped with an engine/power switch the vehicle is shut off when **ALL of the following conditions are met**. With all of the following conditions met, do not push the engine/power switch as the vehicle will start.

- Engine is not running.
- Meters are not illuminated.
- Air conditioning is not operating.
- Audio system is not operating.
- Wipers are not operating.
- Navigation and other displays are turned off.



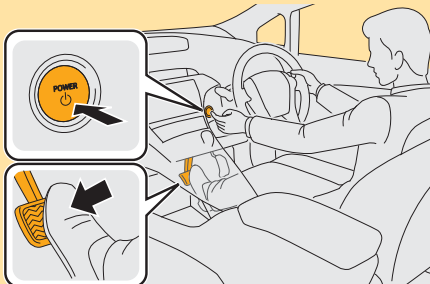
- The engine/power switch operates as follows.
With the brake pedal (for automatic vehicles) or the clutch pedal (for manual vehicles) depressed:

Vehicle Start → Stop → Start ... is repeated every time the switch is pushed.

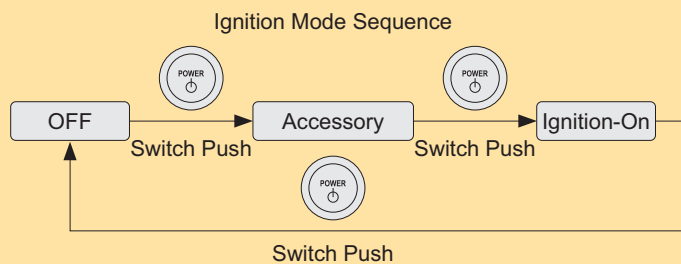
With the brake pedal (for automatic vehicles) or the clutch pedal (for manual vehicles) released:

Accessory → Ignition-On → Off → Accessory... is repeated.

- When in "Accessory" mode, the radio and other accessory components are operational.
- When in "Ignition-On" mode, the power windows, wipers, heater/air conditioner fan and other components including SRS system are operational.
- The vehicle will not start if the brake pedal (for automatic vehicles) or the clutch pedal (for manual vehicles) is not depressed, even if the switch is pushed.



Brake Pedal Depressed



Brake Pedal Released

Disable Vehicle

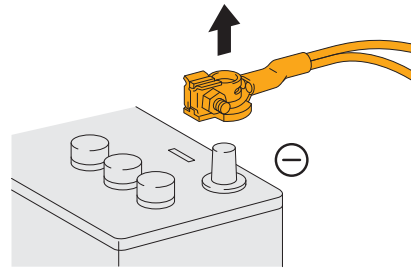
2. When the vehicle is equipped with an engine/power switch, keep the electrical key transmitter 5 meters (16.4 feet) or more away from the vehicle.



- If the electrical key transmitter is in the cabin or near the vehicle, the vehicle may start depending on what operations are performed. For example, if the engine/power switch is pushed.
- To prevent unexpected starting of the vehicle, place the electrical key transmitter outside of the detection area.

3. Disconnect the negative (-) terminal of the 12 V battery.

- The 12 V battery is installed in the engine compartment, in the luggage compartment or under the rear seat.
- Refer to the Quick Reference Sheet (QRS) for each model for the location of the 12 V battery.

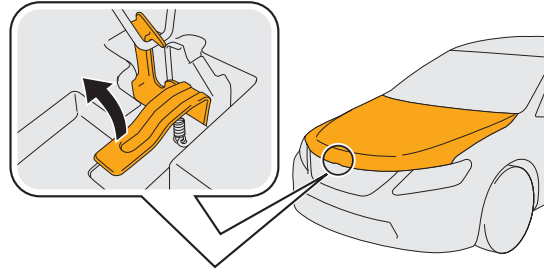


- Shut off the power to the electrical system to prevent electrical fires and to keep the vehicle from starting.

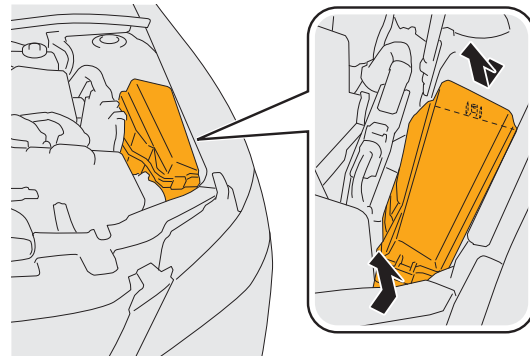
Disable Vehicle

Procedure 2 (Alternate if the ignition switch or power switch is inoperative)

1. Open the hood. Remove the engine room covers, if any are present.

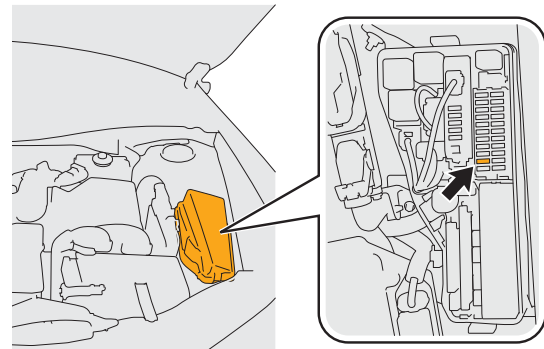


2. Remove the engine compartment fuse box cover.



3. Remove the appropriate fuse.

- Refer to the Quick Reference Sheet (QRS) for each model for the fuse to be removed.



NOTICE

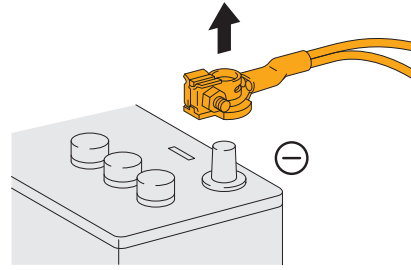
- If the correct fuse cannot be identified, pull **ALL** fuses in the fuse box **until all of the following conditions are met.**

- Engine is not running.
- Meters are turned off.
- Air conditioning is turned off.
- Audio system is turned off.
- Wipers are turned off.
- Navigation and other displays are turned off.

Disable Vehicle

4. Disconnect the negative (-) terminal of the 12 V battery.

- The 12 V battery is installed in the engine compartment, in the luggage compartment or under the rear seat.
- Refer to the Quick Reference Sheet (QRS) for each model for the location of the 12 V battery.



NOTICE

- Shut off the electrical system to prevent electrical fires and to keep the vehicle from starting.

Vehicle with High Voltage Battery

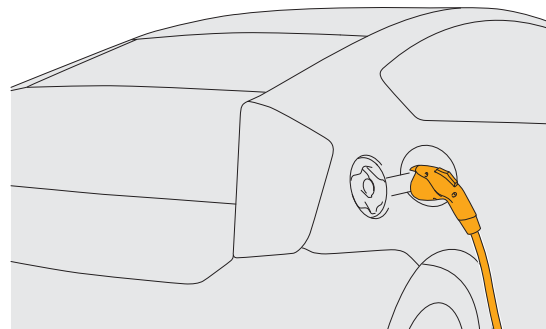
- Hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) and fuel cell vehicles (FCV) are equipped with a high voltage electrical system (over 144 V, up to 650 V).



- The high voltage system may remain charged for up to 10 minutes after the vehicle is shut off and disabled (see page 64). Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from severe burns and electric shock from the high voltage electrical system.
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.
- NEVER assume the hybrid vehicle (HV), plug-in hybrid vehicle (PHV) or electric vehicle (EV) is shut off simply because it is silent. Always observe the instrument cluster for the **READY** indicator status to verify whether the high voltage system is on or shut off. The high voltage system is shut off when the **READY** indicator is off.
- When the vehicle is equipped with a remote air conditioning system and the meters are illuminated, high voltage may be applied to the air conditioning system even though the **READY** indicator is off. Shut off and disable vehicle and ensure the meters are turned off.

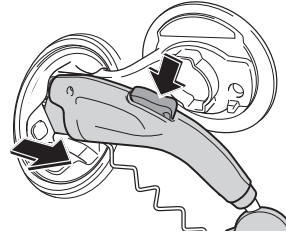
Vehicle with Plug-in Charge System

- Plug-in hybrid vehicles (PHV) and electric vehicles (EV) are equipped with a system to charge the high voltage battery using power from an external power source.
- If a charge cable is connected to the charging inlet of the vehicle, disconnect the charge cable as follows to stop charging.



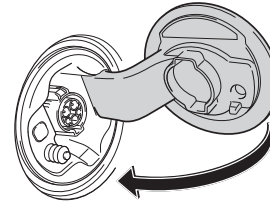
Disable Vehicle

1. Push the latch release button on the top of the charge cable connector and pull it away from the charging inlet of the vehicle.

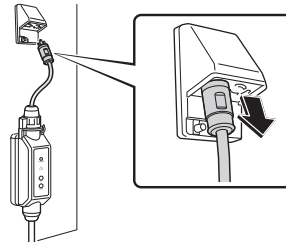


- If the lock of the charge cable assembly connector cannot be released, turn off the external charger.
- If the lock is still not released, stop charging by unplugging the external charger or turning the charger main breaker off. Then disconnect the charge cable assembly from the charge inlet.

2. Close the charging inlet cap and charging port lid.



3. Turn off the external charger by unplugging it or turning its main circuit circuit breaker off.



- To prevent serious injury or death from severe burns or electric shock, shut off the utility circuit supplying power to the charge cable before disconnecting it if the vehicle, charge cable or external charger is submerged in water.

Disable Vehicle

Vehicle with Hydrogen Gas

- Fuel cell vehicles (FCV) carry compressed hydrogen gas. In order to abort refueling, follow the steps below.

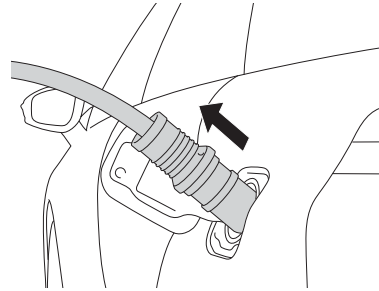
1. Operate the hydrogen station to abort refueling.



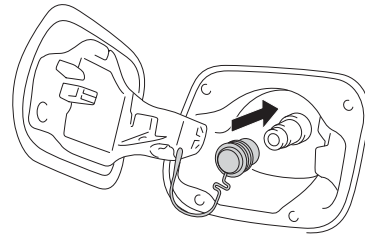
NOTE

- Hydrogen inside the hose will depressurized and the filling nozzle can now be removed.

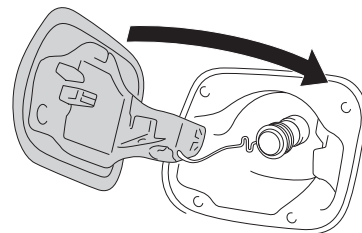
2. Remove the filling nozzle of the hydrogen station from the refueling port (receptacle).



3. Put the cap on the refueling port (receptacle).



4. Close the fuel door.

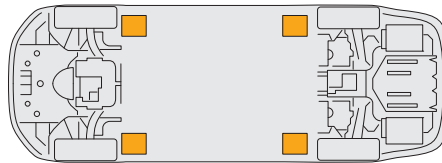
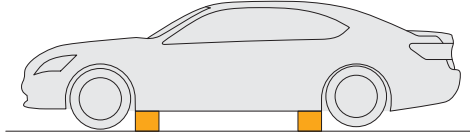


WARNING

- For fuel cell vehicles (FCV), even if the READY indicator turns off, the high voltage system may still be active if the H₂O indicator in the combination meter is illuminated. Shut off and disable the vehicle and ensure the meters are turned off.

Stabilize Vehicle

- Crib at four points directly under the front and rear pillars using wooden blocks or equivalent objects.



WARNING

- Do not place cribbing such as wooden blocks or rescue air lifting bags under the exhaust system, fuel system or high voltage power cables. Failure to do so may cause heat generation, bursting of the air lifting bags, damage to the high voltage power cables or damage to the hydrogen piping, resulting in a vehicle fire, crushing accident, electrical shock or gas leak, possibly leading to serious injury or death.

Access Patients

- Make sure that the vehicle is immobilized and disabled (see page 64), then open or remove windows and doors to access patients.
- Secure the necessary space for performing operations by adjusting the position of the steering wheel and seats and removing the head rests.
- Refer to “Components Requiring Special Attention” for details of adjustment and removal of components.



- The SRS airbags, seatbelt pretensioners, pop up hood and active headrests may remain powered for up to 90 seconds after the vehicle is shut off and disabled (see page 64). Wait at least 90 seconds before starting any operation. Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from unintentional deployment of the SRS airbags or unintentional actuation of the seatbelt pretensioners, pop up hood or active headrests.
- Depending on the circumstances surrounding a collision, such as vehicle speed, point of impact, occupant detection etc., the SRS airbags, seatbelt pretensioners, pop up hood or active headrests will not always be activated and may remain active. If an unactivated inflator of these systems is cut, the powder inside the inflator may ignite resulting in airbag deployment. To prevent serious injury or death from unintentional SRS airbag deployment or unintentional actuation of the seatbelt pretensioners, pop up hood or active headrests, avoid breaching the inflators.
- Immediately after an SRS airbag is deployed or a seatbelt pretensioner, the pop up hood or an active headrest is actuated, the components are extremely hot and may cause burns if touched.
- If an SRS airbag deploys with all doors and windows closed, inflation gas may cause breathing difficulty.
- If residue that is produced during the operation of SRS airbags, seatbelt pretensioners, pop up hood or active headrests comes in contact with skin, rinse it off immediately to prevent skin irritation.

Vehicle with High Voltage Battery

- Hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) and fuel cell vehicles (FCV) are equipped with a high voltage electrical system (over 144 V, up to 650 V).



- The high voltage system may remain charged for up to 10 minutes after the vehicle is shut off and disabled (see page 64). Failure to shut off and disable the vehicle before emergency response procedures are performed may result in serious injury or death from severe burns and electric shock from the high voltage electrical system.
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.

Vehicle with Hydrogen Gas

- Fuel cell vehicles (FCV) carry compressed hydrogen gas.

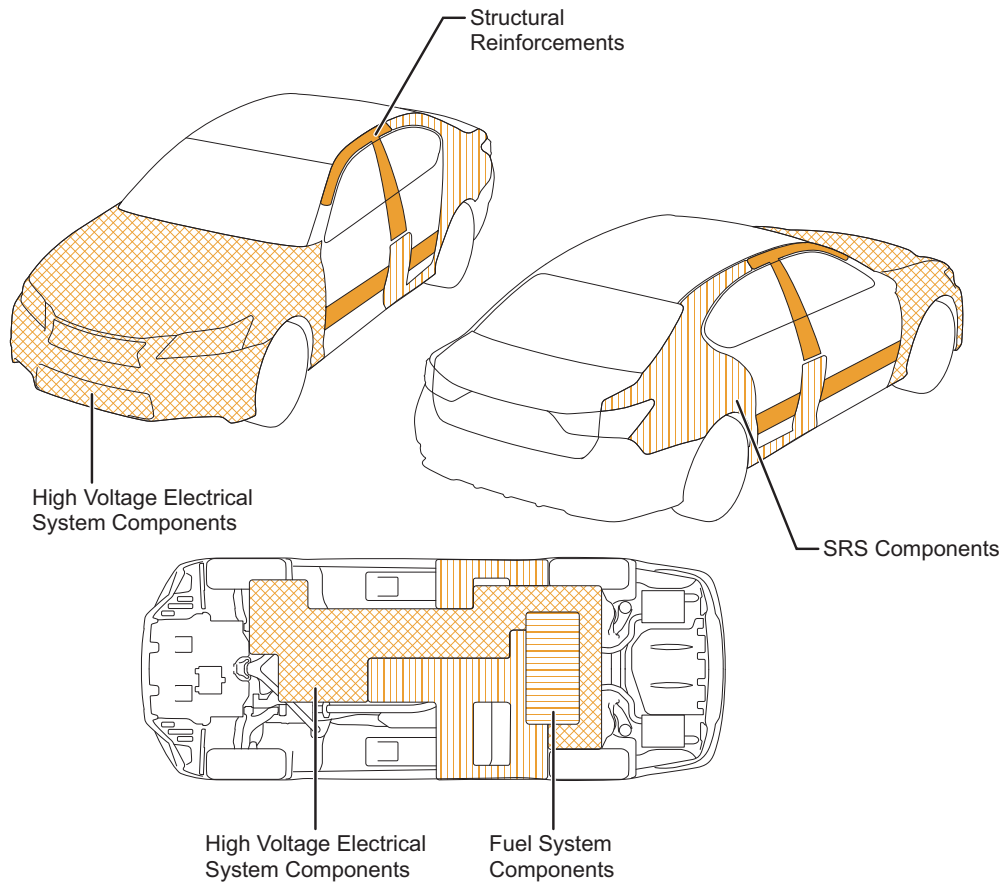


- Hydrogen gas is colorless, odorless and flammable.
- Compared to gasoline or natural gas, hydrogen gas can ignite in a wide range of concentrations (4 to 74.5%). If the sound of hydrogen leaking (a loud hissing sound) can be heard when working on the vehicle, or if the hydrogen concentration around the vehicle exceeds 4% when measured with a hydrogen concentration detector, immediately step away from the vehicle as there is a chance that the hydrogen gas may ignite.
- Even after the vehicle is stopped (refer to P64), hydrogen remains inside the FC stack, hydrogen tanks and other hydrogen-related parts, as well as inside the hydrogen pipe. In order to avoid fires and explosions, never cut or damage these hydrogen-related parts or the hydrogen pipe.
- If there is any hydrogen leakage, do not use any electrical or rescue equipment that may produce static electricity, as this may ignite the hydrogen.

Access Patients

Cut Vehicle

- Pay special attention to the location of structural reinforcements, fuel system, SRS and high voltage electrical system components when cutting a vehicle.
- Refer to the Quick Reference Sheet (QRS) for each model for model specific information such as component locations, etc.



- To prevent serious injury from a fire caused by sparks, use a hydraulic cutter or other tools that do not generate sparks when cutting the vehicle.



- If the SRS airbag, seatbelt pretensioner, pop up hood or active headrest has already been activated, the inflator can be cut.

Fire

- During the initial attack on a fire, extinguish the fire with copious amounts of water. This will also cool down the vehicle.



- Plastic and other components will generate toxic gases when they melt. Wear appropriate protective equipment such as a protective mask when extinguishing a fire.

Fire Extinguisher

- Water has been proven to be a suitable extinguishing agent.
- Also use a fire extinguisher suitable for flammable liquid fires (burning of gasoline, grease, oil, etc.) and electrical fires (burning of electrical wiring, electric devices, etc.) as well as general fires (burning of solid objects, etc.).

Vehicle with High Voltage Battery

- Hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) and fuel cell vehicles (FCV) are equipped with a high voltage battery.
- Extinguish the fire with copious amounts of water to cool down the high voltage battery.
- Refer to the Quick Reference Sheet (QRS) for each model for the high voltage battery location.



- To avoid serious injury or death from severe burns or electric shock, never breach or remove the high voltage battery assembly cover under any circumstances, including fire.
- If only a small amount of water is used to extinguish a fire, a short circuit may occur in the high voltage battery, causing the fire to reignite.



- It is recommended to allow the high voltage battery to burn itself out if it is judged that it is difficult to apply copious amounts of water to the high voltage battery.

Vehicle with Lithium ion (Li-ion) Battery



- Burning Li-ion batteries may irritate the eyes, nose or throat. In case of contact with the vapor from the electrolyte, it may irritate the nose or throat. To avoid injury by coming in contact with the electrolyte or vapor, wear appropriate protective equipment such as rubber gloves, safety goggles, protective mask or SCBA when there is a risk of touching electrolyte.

Vehicle with Urea Solution

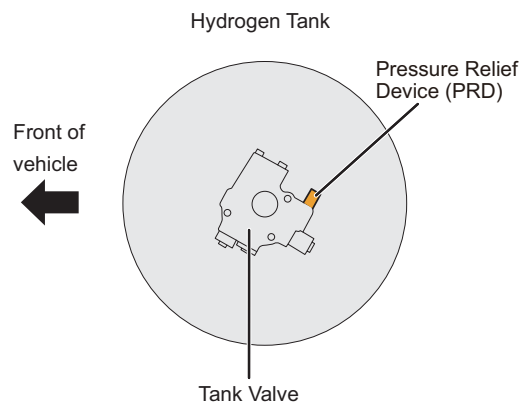
- Urea solution equipped vehicles have a urea tank that stores urea solution.



- The urea solution is noncombustible. However, if the urea solution is heated due to a fire, etc., it breaks down and may emit a harmful gas. If you come in contact with smoke or vapor from a burning urea tank, it may irritate the eyes, nose or throat.
- To avoid injury by coming in contact with the smoke or vapor from a burning urea tank, wear appropriate protective equipment such as rubber gloves, safety goggles, a protective mask or SCBA when there is a risk of contacting the smoke or vapor.

Vehicle with Hydrogen Gas

- Fuel cell vehicles (FCV) carry compressed hydrogen gas.
- When dousing the vehicle, keep a distance in case of hydrogen igniting.
- Use larger amounts of water particularly on the vehicle's rear underfloor to cool the area where the hydrogen tanks are located.
- If the hydrogen is on fire, extinguishing the hydrogen flame completely could cause unburned hydrogen to accumulate and lead to a secondary explosion. Therefore, spray water to prevent the flame from spreading to surrounding areas, then wait for the hydrogen flame to naturally die down (burn itself out).
- In order to prevent an explosion when the temperature of the hydrogen reaches abnormal levels in case of a vehicle fire, the pressure relief devices (PRD) installed on the hydrogen tanks open when they exceed approximately 110°C (230°F), and the hydrogen inside the tank is released outside of the vehicle.
- A pure hydrogen fire is colorless and is not visible. However, in a vehicle fire, other flammable materials will also burn, allowing the fire to be visible.
- The temperature of a hydrogen fire itself is very high, but the amount of heat that radiates from the flame is small. It is unique in that it is difficult to feel the heat even in close proximity.



- Hydrogen gas is colorless, odorless and flammable.
- Compared to gasoline or natural gas, hydrogen gas can ignite in a wide range of concentrations (4 to 74.5%). If the sound of hydrogen leaking (a loud hissing sound) can be heard when working on the vehicle, or if the hydrogen concentration around the vehicle exceeds 4% when measured with a hydrogen concentration detector, immediately step away from the vehicle as there is a chance that the hydrogen gas may ignite.

Submersion

- Pull the vehicle out of water as much as possible. Immobilize the vehicle (see page 61) and disable the vehicle (see page 64) before starting any operation.



- A short circuit due to electrical corrosion (wiring and circuit boards become corroded due to an electrochemical reaction with water) may cause a vehicle fire after some time has elapsed.
- To prevent a vehicle fire, avoid turning the ignition switch or power switch of a submerged vehicle to ACC or ON.

Vehicle with High Voltage Battery

- A partially or fully submerged hybrid vehicle (HV), plug-in hybrid vehicles (PHV), electric vehicle (EV) or fuel cell vehicle (FCV) does not have high voltage potential on the metal vehicle body, and is safe to touch.
- It is safe to enter the water as the vehicle and water have the same electrical potential.



- Touching exposed orange high voltage power cables or high voltage components such as the high voltage battery may cause electrical shock due to a change in electrical potential.
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or a high voltage components.

Spills

- Vehicles contain various fluids such as gasoline, coolant, engine oil, transmission oil, brake fluid, power steering fluid, window washer fluid and 12 V battery electrolyte.

Coolant

- Long Life Coolant (LLC) that is used to cool the engine and inverter contains ethylene glycol for freezing temperature control and anticorrosion additives for preventing metal components from corroding.

Lubrication Oil

- Engine oil, transmission oil and gear oil are used for lubrication and contain mineral oils and synthetic oils.

Brake Fluid

- Brake fluid contains several types of glycol-ether and anticorrosion additives for preventing metal components from corroding.



NOTICE

- Brake fluid contains ingredients that damage painted surfaces. If any comes in contact with the vehicle body, the paint may come off.

Power Steering Fluid

- Power steering fluid contain mineral oils and synthetic oils.

Window Washer Fluid

- Window washer fluid contains alcohol for freezing temperature control.

12 V Battery Electrolyte

- 12 V battery electrolyte contains dilute sulfuric acid.



WARNING

- Dilute sulfuric acid may cause irritation of the skin if contacted. Wear appropriate protective equipment such as rubber gloves and safety goggles when there is a risk of touching electrolyte.



NOTICE

- 12 V battery electrolyte contains ingredients that damage painted surfaces. If any comes in contact with the vehicle body, discoloration or other damage may occur.

Vehicle with High Voltage Battery

- There are 2 types of high voltage battery; the nickel-metal hydride type and the lithium ion type.

1. Nickel-metal hydride (Ni-MH) battery

- The Ni-MH battery contains a strong alkaline electrolyte (pH 13.5). The electrolyte is absorbed in the cell plates, but it may leak in case of damages to the high voltage battery. However, it would not be a large amount.
- Electrolyte leakage from the HV battery pack is unlikely considering the battery construction and the amount of electrolyte inside the module.
- Any spillage would not warrant a declaration as a hazardous material incident.



- Strong alkaline electrolyte (pH 13.5) is harmful to the human body. To avoid injury by coming in contact with the electrolyte, wear appropriate protective equipment such as rubber gloves and safety goggles when there is a risk of touching electrolyte.

2. Lithium ion (Li-ion) battery

- The Li-ion battery electrolyte, mainly consisted of carbonate ester, is a flammable organic electrolyte. The electrolyte is absorbed into the electrodes and the separators. It may leak in case of damages to the high voltage battery, but it would not be a large amount.
- Electrolyte will quickly evaporate if leaked from the battery cell.



- The flammable organic electrolyte which primarily contains carbonate ester is harmful to the human body. In case of contact with the electrolyte, it may irritate the eyes, nose, throat and skin. In case of contact with the smoke or vapor from leaked electrolyte or a burning battery, it may irritate the eyes, nose or throat. To avoid injury caused by coming in contact with the electrolyte or the vapor, wear appropriate protective equipment such as rubber gloves, safety goggles, protective mask or SCBA when there is a risk of touching electrolyte.
- If the electrolyte is spilled, keep it away from fire and ensure the area is well ventilated. Absorb the electrolyte with a piece of cloth or equivalent absorbent material, and keep it in an airtight container for proper disposal.

Vehicle with Urea Solution

- Urea solution equipped vehicles have a urea tank that stores urea solution.
- The urea solution is a harmless noncombustible liquid. However, if the urea solution is heated due to a fire, etc., it breaks down and may emit a harmful gas.



- If you come in contact with smoke or vapor from a burning urea tank, it may irritate the eyes, nose or throat. To avoid injury by coming in contact with the smoke or vapor from a burning urea tank, wear appropriate protective equipment such as rubber gloves, safety goggles, a protective mask or SCBA when there is a risk of contacting the smoke or vapor.

Vehicle with Hydrogen Gas

- The FC stack coolant used to cool the FC stack, etc. is colorless and transparent and contains ethylene glycol in order to lower the freezing point.

Gas Leaks

- There are various types of gas used in vehicles. For example, there is nitrogen (N₂) gas used in gas filled dampers, refrigerant gas for air conditioners, and CNG, LPG and hydrogen gas.

Nitrogen (N₂) Gas

- Nitrogen (N₂) is used in gas filled dampers.
- The gas is colorless, odorless, and harmless.

Refrigerant Gas

- The refrigerant gas used in air conditioner is R-134a or R-1234yf.
- The gas is containing carbon and fluorine.
- The gas is colorless, odorless, and harmless.

Vehicle with CNG

- Compressed Natural Gas (CNG) is a flammable gas that mainly contains methane.
- The gas is colorless and harmless.
- The gas is infused with a smell so that a leak can be quickly detected.



- If the sound of natural gas leaking (a loud hissing sound) can be heard when working on the vehicle, or if the smell of natural gas is present, immediately step away from the vehicle as there is a chance that the natural gas may ignite.

Vehicle with LPG

- Liquefied Petroleum Gas (LPG) is a flammable gas that mainly contains propane and butane.
- The gas is colorless and harmless.
- The gas is infused with a smell so that a leak can be quickly detected.



- If the sound of LPG leaking (a loud hissing sound) can be heard when working on the vehicle, or if the smell of LPG is present, immediately step away from the vehicle as there is a chance that the LPG may ignite.

Gas Leaks

Vehicle with Hydrogen Gas

- Hydrogen gas is a flammable gas.
- The gas is colorless, odorless, and harmless.



- If the sound of hydrogen leaking (a loud hissing sound) can be heard when working on the vehicle, or if the hydrogen concentration around the vehicle exceeds 4% when measured with a hydrogen concentration detector, immediately step away from the vehicle as there is a chance that the hydrogen gas may ignite.

Damaged Vehicle Handling Key Points

■ Points to be noted when handling damaged vehicles are provided in this section.

Towing Damaged Vehicle

- Loading a vehicle onto a car carrier (flat bed trailer) is the preferred method of towing.
- Only the FF (Front-engine Front-wheel drive) vehicles are available to tow with rear wheels on the ground.
- If towing the vehicle with all four wheels on the ground is unavoidable, release the parking lock, move the shift lever to neutral (N), and unlock the steering wheel first. The vehicle can then be towed at a low speed (below 30 km/h) for a distance of up to 80 km in a forward direction. (*Except vehicles with a high voltage battery. See page 88 for details.)
- Refer to the illustrations on the following page for correct and incorrect methods of towing FF (Front-engine Front-wheel drive), FR (Front-engine Rear-wheel drive), MR (Mid-engine Rear-wheel drive) and 4WD (Four Wheel Drive) vehicles.



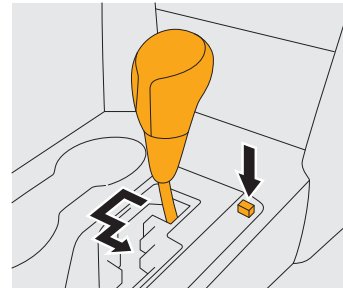
- When towing a vehicle with all four wheels on the ground, make sure the vehicle is in “Ignition-On” mode. If in “Off” mode, the steering wheel may lock, making the steering inoperative.



- Exceeding the towing distance or speed limit when towing a vehicle with all four wheels on the ground or towing a vehicle with the vehicle facing backwards, may damage the transmission or transaxle.
- When the vehicle is equipped with a stop and start system, towing the vehicle with all four wheels on the ground may damage the system.

Parking Lock

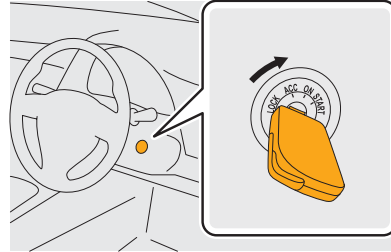
- The parking lock can be released by moving the shift lever from park (P) to neutral (N) while pushing and holding the “lock release button” on the shift gate.



- For hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) or fuel cell vehicles (FCV) that are equipped with an electronic shift switch (P position switch), the parking lock cannot be released if the negative (-) terminal of the 12 V battery is disconnected. Use wheel dollies or similar equipment when moving the vehicle.

Steering Wheel Lock

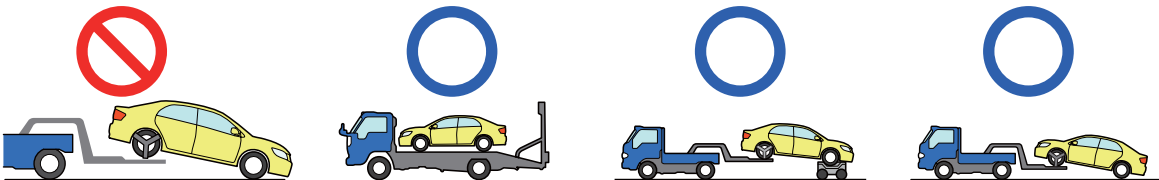
- The steering wheel can be unlocked by pushing the engine/power switch until “Ignition-On” mode, or turning the ignition switch to any position other than “LOCK”.
- When it is difficult to release the lock, turn the steering wheel in either direction while pushing the engine/power switch or turning the key.



- When a vehicle is equipped with the electrical key transmitter system, the steering wheel cannot be unlocked if the negative (-) terminal of the 12 V battery is disconnected. Use wheel dollies or similar equipment when moving the vehicle.

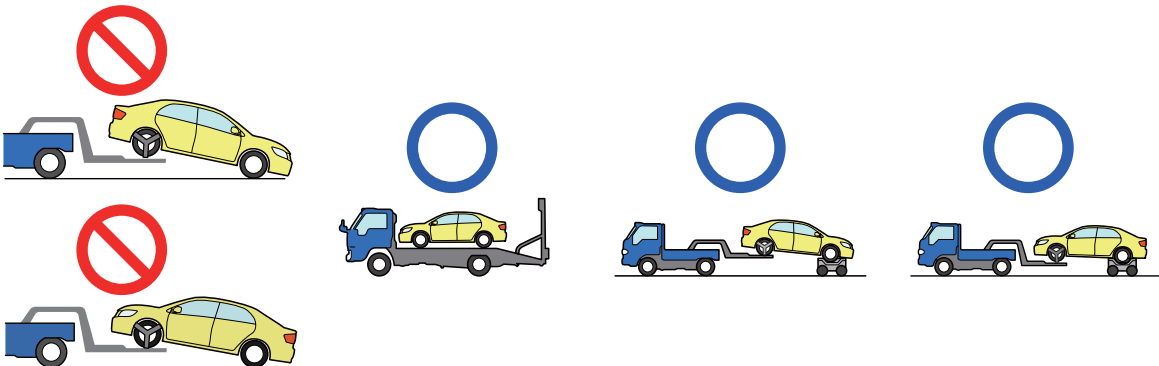
Precautions for FF (Front-engine Front-wheel drive) vehicle

- Tow the vehicle with the front wheels or all four wheels off the ground.



Precautions for FR (Front-engine Rear-wheel drive), MR (Mid-engine Rear-wheel drive) and 4WD (Four Wheel Drive) vehicles

- Tow the vehicle with all four wheels off the ground.



Vehicle with High Voltage Battery

- Make sure the negative (-) terminal of the 12 V battery is disconnected, then load the vehicle onto a car carrier (flat bed trailer).
- If towing the vehicle with all four wheels on the ground is unavoidable, only tow it for a short distance (such as to a car carrier (flat bed trailer)) in a forward direction at a low speed (below 5 km/h (3 mph)).
- Refer to the above illustrations for correct and incorrect methods of towing FF, FR and 4WD vehicles.



- Hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) and fuel cell vehicles (FCV) are equipped with a high voltage electrical system (over 144 V, up to 650 V).
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.



- If hybrid vehicles (HV), plug-in hybrid vehicles (PHV), electric vehicles (EV) or fuel cell vehicles (FCV) are towed with the drive wheels on the ground, it could have adverse effects on the high voltage system and damage it.

Storing a Damaged Vehicle

- Drain gasoline, oil and other fluids, then disconnect the negative (-) terminal of the 12 V battery before storing a damaged vehicle.

Submerged Vehicle

- In addition to the normal procedures, remove the water from the vehicle.



- A vehicle that has been submerged in water poses a threat of vehicle fire after some time for possible short circuits due to electrical corrosion (wiring and circuit boards to corrode in an electrochemical reaction with water). To store a vehicle that has been submerged in water, choose a well-ventilated place at least 15 meters (49.2 feet) away from other objects.
- To prevent a vehicle fire, avoid turning the ignition switch or power switch of a submerged vehicle to ACC or ON.

Vehicle with High Voltage Battery

- In addition to the normal procedures, remove the service plug from the high voltage battery before storing a damaged vehicle.



- The service plug is a high voltage component. Touching it without appropriate protective equipment may result in serious injury or death from severe burns and electric shock from the high voltage electrical system. Wear appropriate protective equipment such as insulated gloves when touching the service plug.
- The high voltage battery is still charged with high voltage electricity even after the vehicle is shut off, disabled (see page 64) and the service plug is removed from the high voltage battery.
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.
- When the person(s) in charge of handling the damaged vehicle is away from the vehicle, other person(s) may accidentally touch the vehicle and be electrocuted, resulting in severe injury or death. To avoid this danger, display a "HIGH VOLTAGE DO NOT TOUCH" sign to warn others (print and use page 21 of this guide).



- A high voltage battery may cause a vehicle fire after some time for possible short circuits inside due to the impact of collision or electrical corrosion. To store a vehicle equipped with a high voltage battery, choose a well-ventilated place at least 15 meters (49.2 feet) away from other objects.

Vehicle with Hydrogen Gas

- In addition to the normal procedures, remove the service plug from the FC stack before storing a damaged vehicle.



- The service plug is a high voltage component. Touching it without appropriate protective equipment may result in serious injury or death from severe burns and electric shock from the high voltage electrical system. Wear appropriate protective equipment such as insulated gloves when touching the service plug.
- To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or breaching any orange high voltage power cable or high voltage component. Wear appropriate protective equipment such as insulated gloves when there is a risk of touching high voltage power cables or high voltage components.
- When the person(s) in charge of handling the damaged vehicle are away from the vehicle and someone else accidentally approaches or touches the vehicle, death or serious injury may occur due to electrocution, a rupture, an explosion or fire. To avoid this danger, display “HIGH VOLTAGE DO NOT TOUCH” and “HIGH-PRESSURE GAS DO NOT TOUCH” signs to warn others (print and use page 21 and 32 of this guide).



- Vehicles that are equipped with hydrogen gas may leak due to damage incurred during an accident. The remaining hydrogen may ignite causing a fire or explosion. Therefore, when storing a vehicle equipped with hydrogen gas, place it in a well ventilated area 15 meters or more away from other items and leave the windows or doors open.

ix35 **FCEV**

Emergency Response Guide

NEW THINKING.
NEW POSSIBILITIES.



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Introduction

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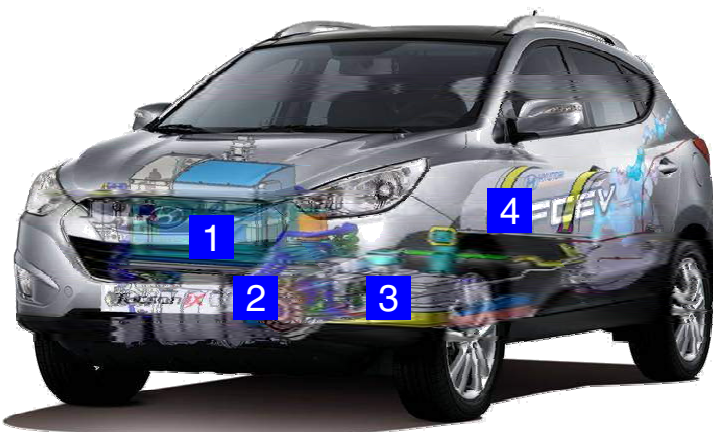
Hyundai has high standards and is dedicated to the safety of our customers and emergency responders alike. Hyundai is providing this fuel cell electric vehicle information as a result of our commitment to safety.

Document purpose

The purpose of this document is to familiarize emergency responders and the towing/roadside assistance industry with the proper methods to treat the Hyundai ix35 fuel cell electric vehicle in an emergency situation. This guide offers a basic overview of key vehicle systems and provides instructions for dealing with the different types of situations encountered by emergency responders. The emergency response procedures for this vehicle are somewhat similar to a conventional ix35 FCEV with additional information provided on dealing with the high-voltage electrical system.

Vehicle Description

ix35 fuel cell electric vehicle (FCEV) is an electric vehicle that generates an electrical energy by a fuel cell system. ix35 FCEV is manufactured with the same platform of conventional Tucson SUV. However, the power train system is totally different from the conventional vehicle; an internal combustion engine. As shown in Figure, the power train system of ix35 FCEV is placed in the engine room of conventional vehicle which means that its power train system has almost same size of conventional vehicle.



- 1. Fuel cell power module
- 2. Motor
- 3. High voltage battery
- 4. Hydrogen tank

High Voltage Safety System in FCEV

Fuel Cell Stack

Fuel Cell Electric Vehicle, unlike the regular internal combustion engine vehicle, use an high voltage electrical energy generated in the fuel cell stack as a power source. Owing to this high voltage electricity, it requires to handle with a care for the high voltage hazard. The followings are safety guideline of high voltage in fuel cell stack of ix35.

- 1) A metal chassis and electro-conductive enclosure is located in the fuel cell stack to prevent an electrical shock due to the direct or indirect contact of users. Fuel cell stack has a high protection degree of IPXXB.
 - 2) Live parts and high voltage buses which are generating over DC 400V in the fuel cell stack are designed to maintain a reliable insulation resistance with an electro-conductive enclosure. When the insulation resistance is lower than the regulated value, it is alarmed to the user and limited the output current of fuel cell stack.
- Direct contact: the contact of persons with live parts
 - Indirect contact: the contact of persons with conductive parts which can be touched, and which becomes electrically energized under isolation failure conditions.

High voltage battery system

This system supplies the energy which can be applied vehicle's acceleration phase. The system also is being used to store the energy generated during regeneration braking phase.



Battery system
→ underneath the vehicle(center)

High voltage battery system	
Battery pack voltage	180 Volts (Max 206V)
Battery type	LI-POLYMER
Number of cells	48 Cells
Battery system total weight	47 Kg

- 1) High voltage system is located underneath the floor and protected with a steel case.
- 2) The system consists of 48 cells. Each cell is sealed with an aluminum case to protect an electrolyte spillage. There is rare possibility to spill the electrolyte in the cell even if a battery module is cracked.

High Voltage Safety System in FCEV

- 3) For safety, an over-current protection and ceramic coating isolation layer are used.
- 4) Non-flammable material electrolyte is applied to prevent explosions or fire in an emergency case such as a car accident.
- 5) High voltage cable (orange color) is connected to the battery system with DC converter.
- 6) There is a high voltage regulator to control the high voltage line. In addition, there are a high voltage fuse and safety plug to separate the electrical sources in the system for safety.

Safety of high voltage system

The followings are safety guideline to prevent an electric shock caused by a high voltage system of ix35.

- 1) High voltage components of FCEV such as solid insulator, insulation distance and etc. are designed to maintain a reliable insulation resistance with a metal chassis of vehicle as ground over vehicle service life.
- 2) All of live parts of high voltage components are covered with an enclosure to prevent a direct contact. These are not possible to be disassembled without special tools.
- 3) There is a high risk of electrical shock due to an indirect contact when an insulation resistance between a high voltage component and electro-conductive enclosure rapidly decreases. All of electro-conductive enclosure maintains an electrical continuity with a chassis of vehicle as ground.
- 4) Ground Fault Detector (GFD) detects a current leak over permissible level at the electrical conductive chassis parts. In addition, it shut down the current from high voltage relay immediately when there is the current leak.
- 5) All power supply cables are insulated from metal chassis parts. There is no possibility to get a electric shock at contacting the chassis parts.
- 6) High voltage fuse are a protective device against overheating due to an excessive current.
- 7) Safety plug of high voltage battery is located in the inside of the battery system case.

Safety Issues of Compressed Hydrogen

General Features of Hydrogen

Hydrogen is a unique gaseous element and possessing the lowest molecular weight of any gas. It is a colorless, odorless, tasteless, non-corrosive, flammable and high volatile. Hydrogen therefore is necessary to be handled with care due to its gaseous properties. However, it is no more dangerous and it is rather less dangerous than other commonly used fuels in some respects. Hydrogen is much lower density which gives it a comparative advantage from a safety point of view. Owing to this, hydrogen gas tends not to mix with the air and disperses upwards in the air. This means that the concentration levels of hydrogen necessary for ignition or detonation are unlikely to be achieved.

Hydrogen Gas Features

A hydrogen gas leak should be prevented for hazard of ignition or detonation for a safety point of view.

The followings are properties of gaseous hydrogen.

- It has the lowest molecular weight, and is the smallest molecules of any elements.
- It has the lowest density and the highest buoyancy of any element.
- It can cause brittleness in some materials, including metals (but materials chosen for hydrogen applications are not susceptible to brittleness).
- It is colorless, odorless and tasteless.
- It burns invisibly and without smoke.
- It has the lowest ignition energy of any fuel (less than one-tenth that of other fuels).
- It has a wide flammability concentration range of 4% to 75%

The Velocity Ratio of Diffusion and Flow in the air

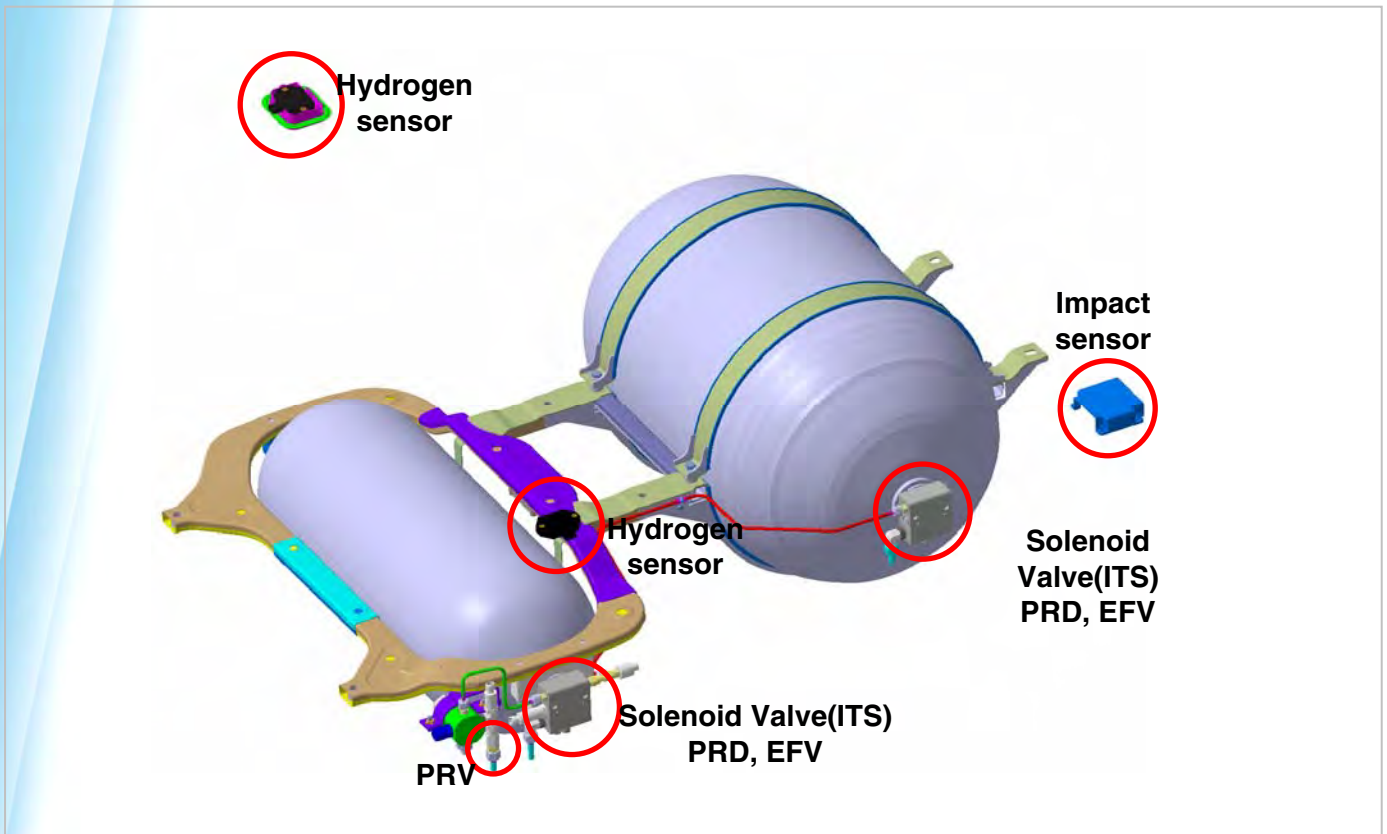
Gas	CH ₄	C ₃ H ₈	H ₂
Diffusion	1.0	0.63	3.8
Turbulent Flow	1.0	0.6	2.83

Hydrogen Gas Leak Detection System

Hydrogen gas detection sensor detects a hydrogen leak. If there is a hydrogen leak, a hydrogen storage system and electrical systems will be shut down. Sensors typically start to trigger a warning alarm at concentrations below the minimum flammability limit of hydrogen.

Sensors are installed at the fuel cell stack, fuel processing system (FPS), in-between hydrogen storage tank ceiling of vehicle. These sensors prevent a hydrogen leak in an emergency.

Hydrogen Safety System



Hydrogen Gas Ventilation

FCEV releases low concentration hydrogen while operating FCEV. The released gas is diluted through a ventilation system equipped in the vehicle before the gas gets into the inside of vehicle and the diluted gas releases to the surroundings.

Hydrogen Safety Devices

- In-Tank Solenoid valve (ITS)
: It supplies hydrogen at a normal operating condition. In an emergency, it has a role to shut off hydrogen safely.
- Pressure Relief Device (PRD)
: It detects temperature of the hydrogen tank and vent hydrogen to the surrounding atmosphere in case of fire.
- Excessive Flow Valve (EFV)
: It detects an excessive hydrogen flow and then shut off hydrogen safely in case of high pressure tubes damaged.
- Pressure Relief Valve (PRV)
: It is installed on the regulator and it vent hydrogen to the surrounding atmosphere in case of regulator failure.

Front, Rear Impact Sensors

The sensors are installed on the front bumper and the rear floor. They are remote sensors that detect acceleration due to a collision. In addition, the rear impact sensor shuts off supplying hydrogen, and helps not to cause the secondary damage.

Safety precaution for FCEV

This Fuel Cell Electric Vehicle (FCEV) uses approximately DC 180 ~ 400 voltage and high pressure hydrogen gas. Be sure to follow safety instructions below. Failure to follow safety instructions may result in serious injury or electrocution.

[Safety precaution for Hydrogen system]

NOTICE

A hydrogen gas leak should be prevented for hazard of ignition or detonation for a safety point of view.

The followings are properties of gaseous hydrogen.

- It has the lowest molecular weight, and has the smallest molecules of any elements.
- It has the lowest density and the highest buoyancy of any element.
- It can cause brittleness in some materials, including metals (but materials chosen for hydrogen applications are not susceptible to brittleness).
- It burns invisibly and without smoke.
- It has the lowest ignition energy of any fuel (less than one-tenth that of other fuels).
- It has a wide flammability concentration range of 4% to 75%

⚠ WARNING

- There must be no ignition sources around the vehicle. For example, exposed flame, sparks, electrostatic discharge or hot surfaces that could cause hydrogen gas to ignite.
- Caution labels for hydrogen are attached to the hydrogen storage system components. The hydrogen storage system is composed of two cylinders which are filled with Hydrogen gas. Each tank is made of aluminum and covered additionally with carbon fiber which makes the storage tank sustain high pressures. This cylinder contains flammable gas under high pressure. Serious injury or death can result from improper installation, lack of maintenance or overfilling. Do not attempt to remove this cylinder or any of its fittings from this vehicle. It may contain residual gases under pressure, which could cause fire or explosion.

[Safety precaution for High voltage system]

⚠ WARNING

- Warning labels for high voltage are attached to the high voltage components. The color of the high voltage cables and connectors are orange. Do not touch any of these high voltage components, cables, and connectors without proper Personal Protection Equipment (PPE).

ix35 FCEV Identification

General Vehicle Description

The Hyundai ix35 FCEV is built on a conventional ix35 chassis and therefore it looks very similar to its conventional counterpart. The best approach is to assume that all ix35 are FCEV until proven otherwise. Using the information provided in this section, responders will be able to differentiate between the two.

Exterior Visual Identification

Badging or Symbols

The ix35S FCEV can be identified by unique badging found on the exterior of the vehicle.

- ① On the front of the vehicle is the Hyundai logo, a slanted, stylized 'H' with a blue background.
- ② there is a **Fuel Cell** stickers on each of the front doors.
- ③ on the passenger side of the tail gate there is a **Fuel Cell** badge.

Badging may become hidden after a crash due to damage to the vehicle. Always be sure to inspect all sides of the vehicle before determining whether or not a badge is present.



ix35 FCEV Identification

Vehicle Identification Number (VIN)

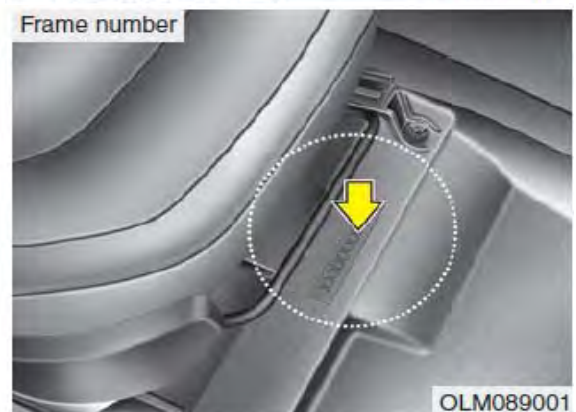
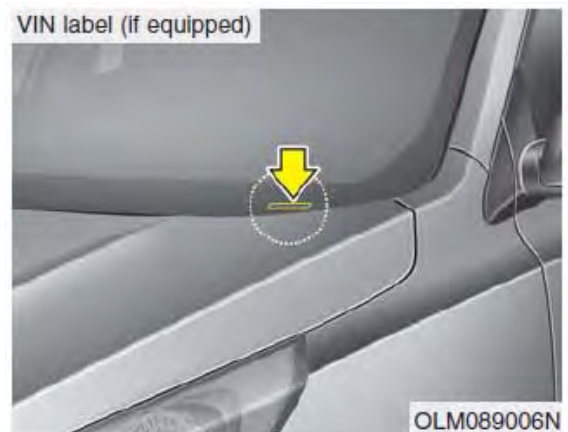
The Vehicle Identification Number (VIN) is used to determine whether a vehicle is conventional or FCEV.

The VIN is located on the driver's side windshield cowl and under the passenger's seat.

The number 6 in the 8th character of the VIN indicates that it is a FCEV.

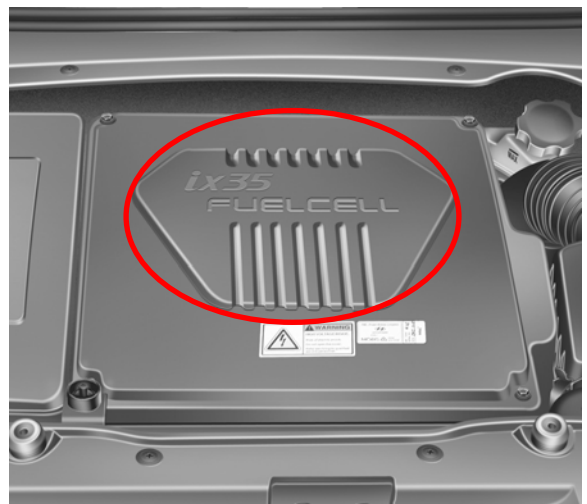
XXXXXXXX**6**XXXXXXXXXX

(8th position)



Fuel cell module compartment

Unlike the conventionally powered ix35, the FCEV version has a High junction box cover with "**ix35 Fuel Cell**" clearly shown on it.



Additionally, there are orange colored high-voltage electrical cables in the fuel cell module compartment.

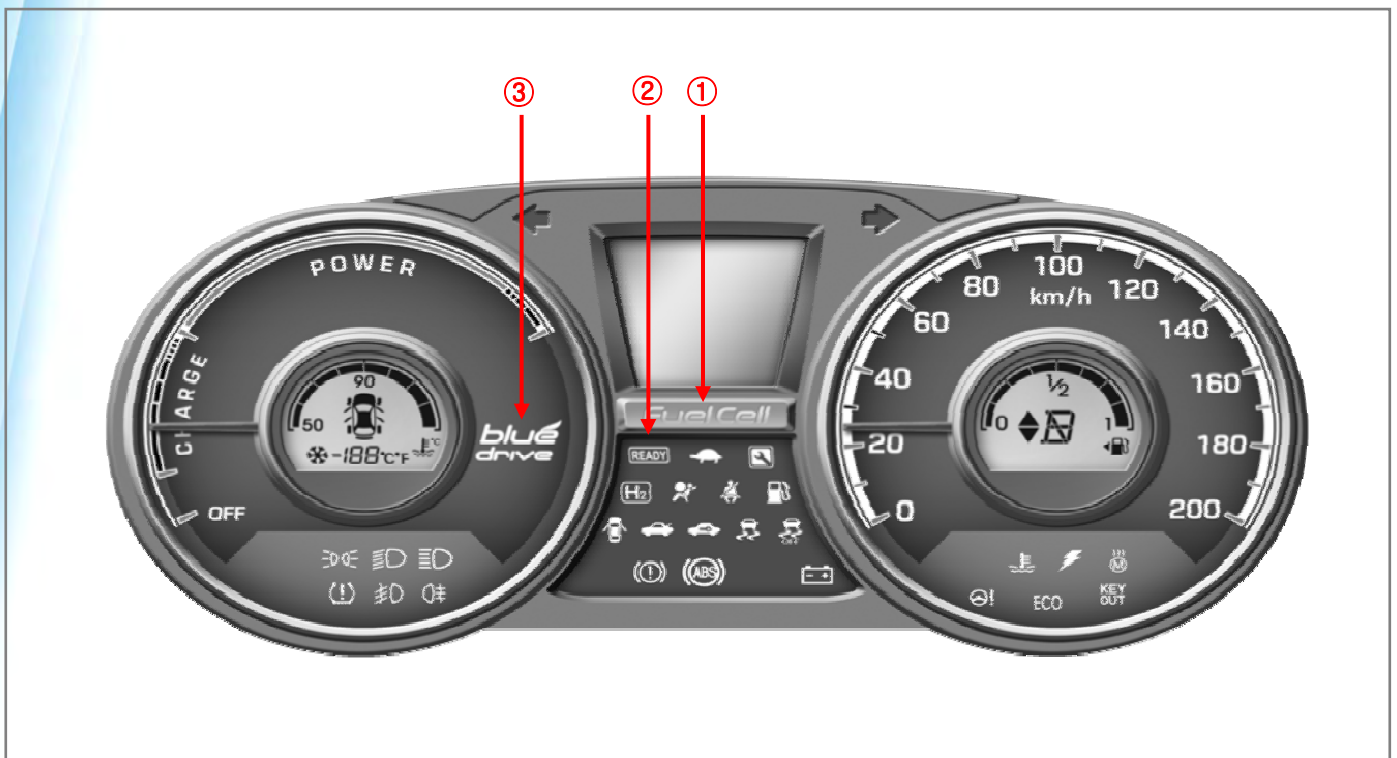


ix35 FCEV Identification

Interior Visual Identification

Cluster

The ix35 FCEV instrument cluster contains several unique components that are not found on a conventional ix35. The “① **Fuel Cell**” logo is the most easily recognizable item in the instrument cluster. It is visible no matter what the powertrain or ignition status may be. The ② **READY** Indicator and ③ **blue drive** indicator are visible when the power button is ON.

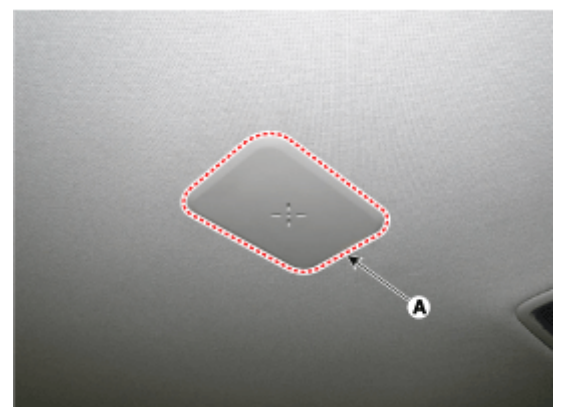


Roof

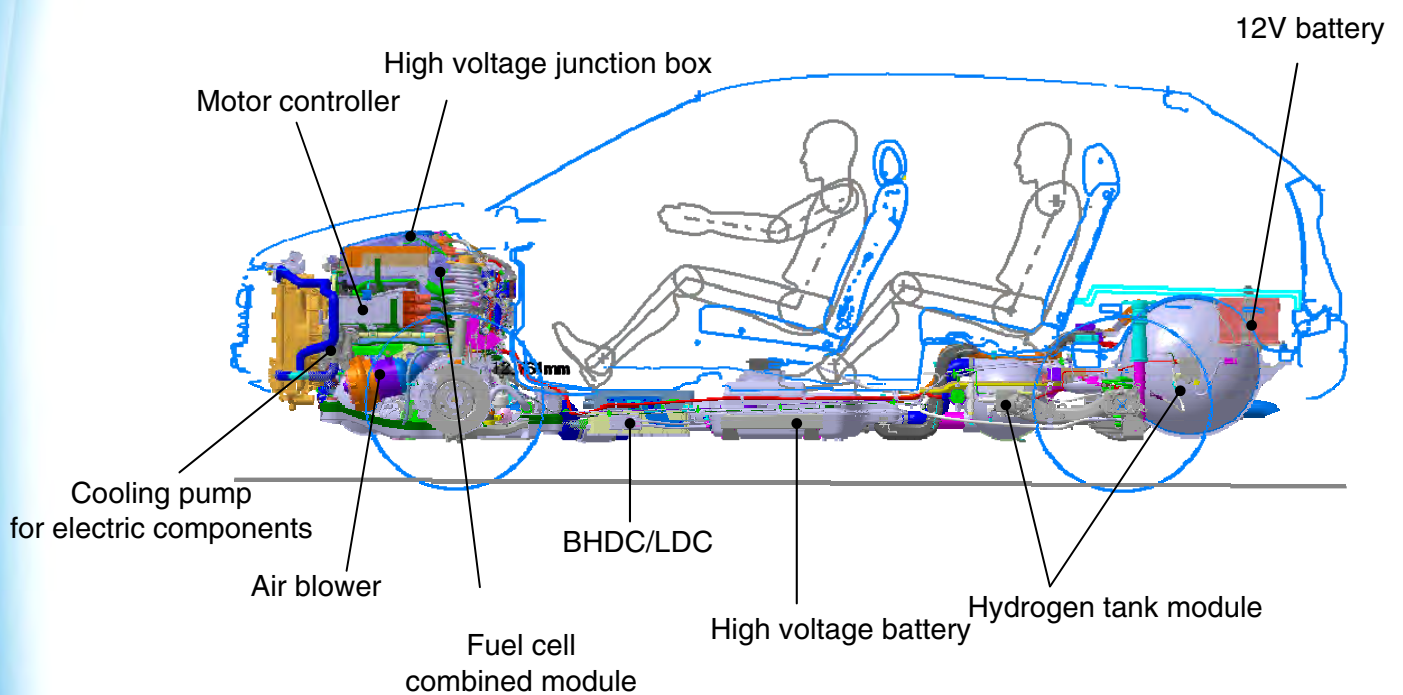
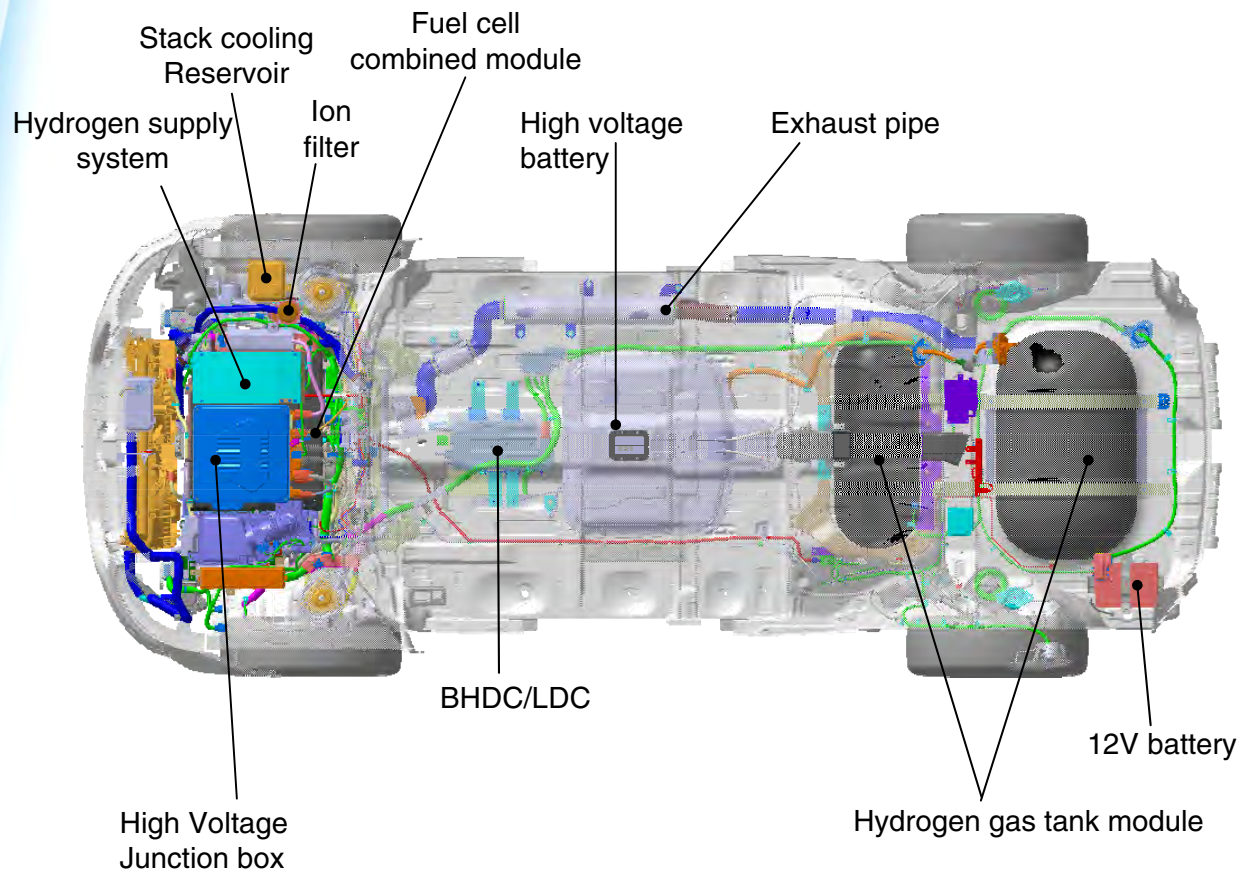
There is a hydrogen sensor (A) on the cabin roof .

If hydrogen content increases due to a hydrogen leak, the FCU stops the fuel cell system or the vehicle.

In most cases, the Fuel cell Control Unit stops the fuel cell system and switches the driving mode to EV mode, in which the vehicle is powered only by the high voltage battery.



Main Components



※ BHDC : Bidirectional High voltage DC-DC Converter
LDC : Low voltage DC-DC Converter

FCEV Systems Overview

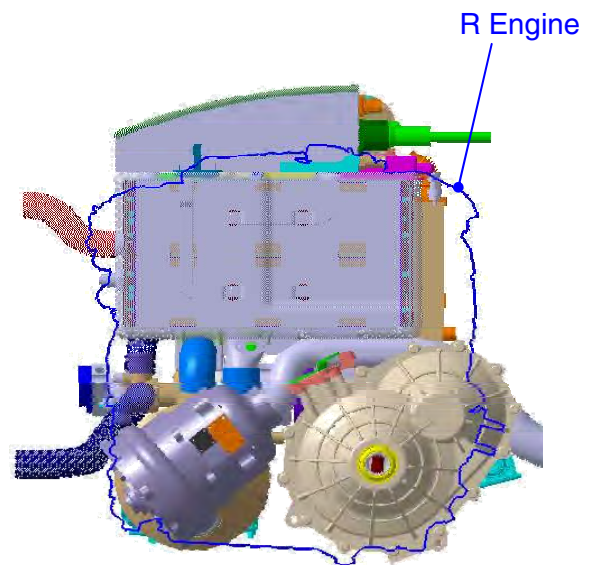
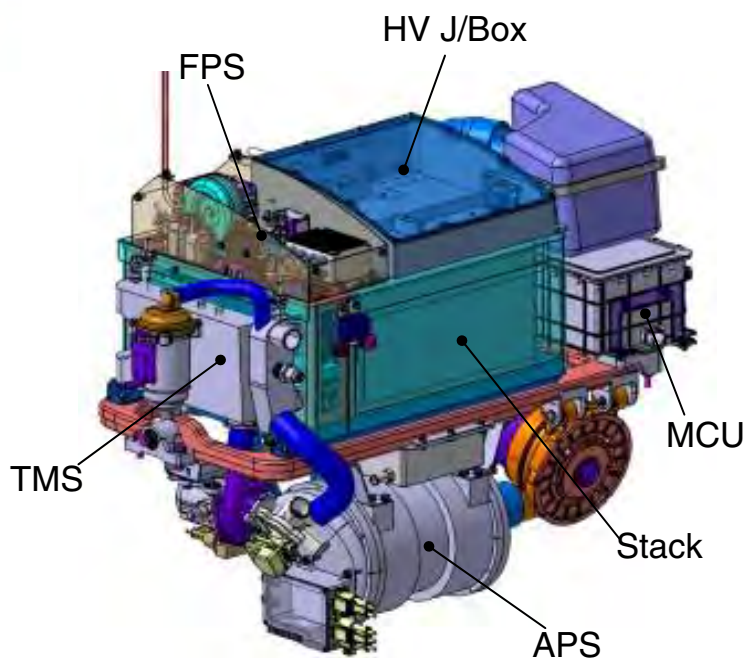


1. Fuel cell power module
2. Motor
3. High voltage battery
4. Hydrogen tank

Features of Fuel Cell Electric Vehicle

ix35 fuel cell electric vehicle (FCEV) is an electric vehicle that generates an electrical energy by a fuel cell system. ix35 FCEV is manufactured with the same platform of conventional Tucson SUV. However, the power train system is totally different from the conventional vehicle; an internal combustion engine.

As shown in Figure, the power train system of ix35 FCEV is placed in the engine room of conventional vehicle which means that its power train system has almost same size of conventional vehicle.



[Engine Vs Module Comparison]

※ **FPS** : Fuel Processing System, **TMS** : Thermal Management System
APS : Air Processing System, **HV J/BOX** : High Voltage Junction Box

※ Stack and BOP parts integrated into modules
: Stack + {APS+FPS+TMS} + HV J/BOX + Inverter

FCEV Systems Overview

Fuel cell vehicle mainly comprises four items.

- 1) Fuel cell system which is generating electric power,
- 2) Electric power system which is making driving-force,
- 3) Hydrogen storage tank system which is installed under the luggage space of the vehicle,
- 4) Auxiliary power supply system which is to support the power or to storage the energy regenerated.

Additionally it includes a lot of controllers, voltage converters and distributors.

These components are installed in engine room or underneath the vehicle

Fuel Cell Stack

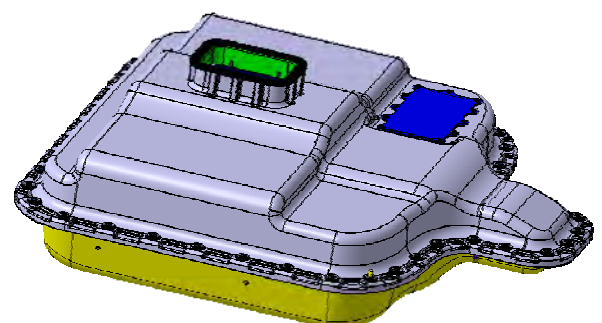
Fuel cell stack is an energy source which can be generated by the chemical reaction using oxygen and hydrogen. It drives the vehicle with electric motor power as an conventional vehicle does.

Batteries are either primary or secondary. Primary batteries are used only once because the chemical reactions that supply the electrical current are irreversible. Secondary batteries can be used, charged, and reused. In these batteries, the chemical reactions that supply electrical current are readily reversed so that the battery is charged.

Generally, fuel cell could be considered that it is not a battery because it is more likely to be closer to a kind of generators, which is using the energy by combining hydrogen and oxygen.

High voltage battery

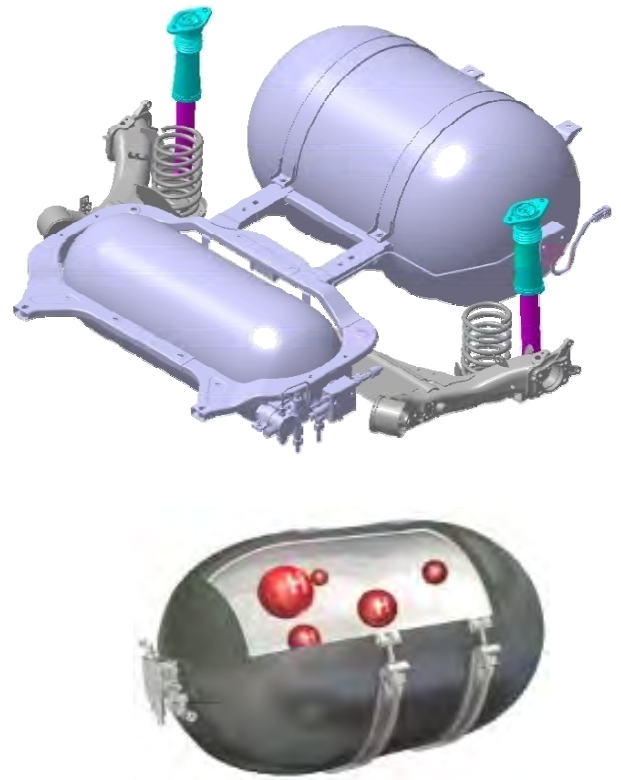
FCEV has a high voltage battery which is directly connected to fuel cell stack through DC/DC converter. This battery stores the electric energy, which comes from the fuel cell stack or the vehicle's regeneration braking system.



FCEV Systems Overview

High pressure hydrogen storage tanks

Compressed hydrogen tank system is composed of two tanks which are filled with Hydrogen gas in a gas station. Each tank is made of aluminum and covered additionally with carbon fiber which makes the storage tank sustain high pressures. There are magnetic valves, pressure regulators and pressure sensors in the vicinity of the cylinder's inlet. The hydrogen in the tanks comes into the pressure regulator which has a pressure sensor. The manual valve located between the regulator and hydrogen vent socket is used to control the flow amount during Hydrogen vent. The compressed hydrogen system is designed using pressure of 70MPa, temperature range -40°C ~ 85°C . Maximum allowable pressure is limited to 87.5MPa (12,691psi) @ 85°C .



High Voltage Cables

The electric energy which is generated from fuel cell system or high voltage battery module is distributed to the various components. Most of the cables are located in the inside or bottom of the components. These cables use orange colored cover to distinguish from other lines. It is required to handle the cables with care.



12V Battery

Conventional 12V battery is located in the luggage room (under the luggage room cover). The battery supplies the power to head lamps, audio, and other electric components. This battery is also being used to drive fuel cell system at Initial stage after start.



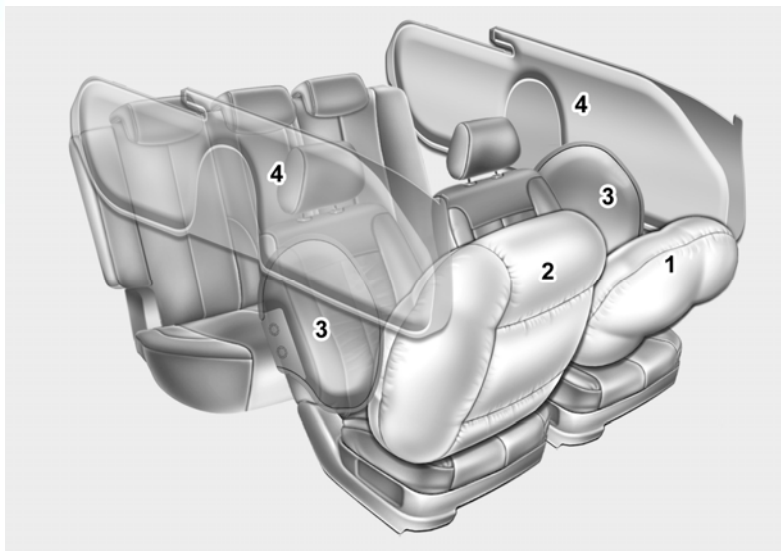
FCEV Systems Overview

Supplemental Restraint System (SRS)

Air bag

The ix35 FCEV is equipped with a total of six airbags for passenger protection. These airbags are located in standard areas of the vehicle where emergency responders are accustomed to finding them. Care should always be taken to secure any 12V power sources in the vehicle before extrication operations are initiated or emergency response personnel enter the vehicle. This is critical in order to prevent any accidental deployment of the supplemental restraints.

Airbag Types and Locations



1. Driver's Frontal

2. Passenger Frontal

3. Side Impact Thorax

4. Side Impact Curtain

Type	Location
Frontal	Driver Side
Frontal	Passenger Side
Side Impact Thorax	Driver Side
Side Impact Thorax	Passenger Side
Side Impact Curtain	Driver Side
Side Impact Curtain	Passenger Side

FCEV Systems Overview

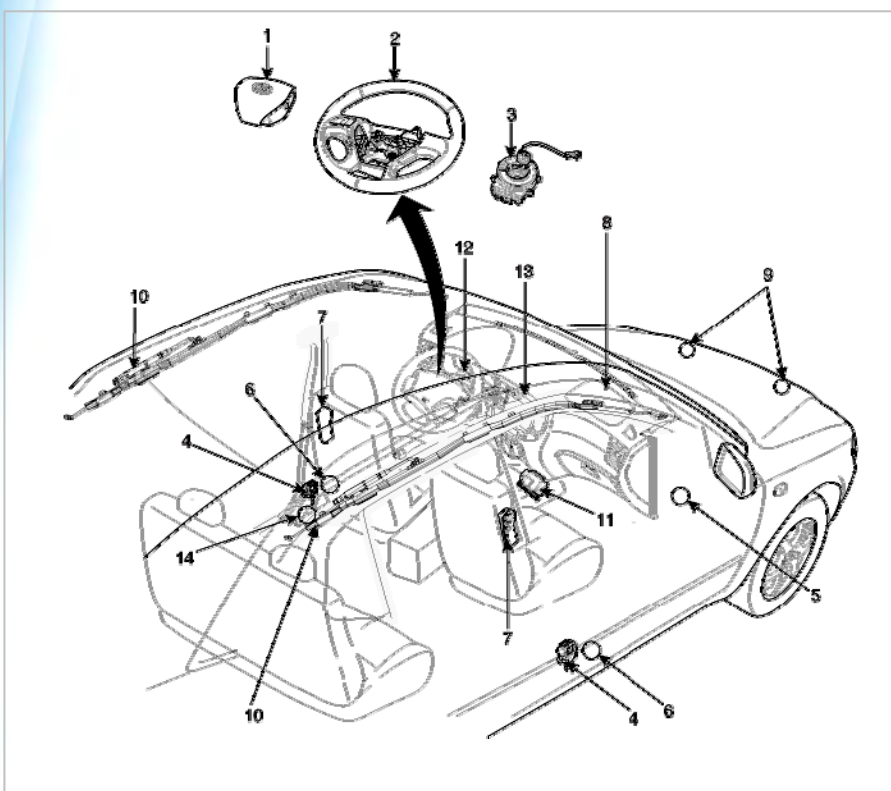
Seatbelt Pretensioners

The ix35 FCEV has a total of four seatbelt pretensioners. Two are located in the Driver's Side B-pillar, one is a Belt Pretensioner (BPT) and the other is an Anchor Pretensioner (APT). The other two are located in the Passenger's Side B-pillar. They also consist of a BPT and an APT.

Sensor and Control Module Locations

The airbags and pretensioners are managed by the SRS Control Module, or SRSCM, which is located below the front of the center console. In addition, there are four side impact sensors: two conventional accelerometer sensors in the B-pillars, and two pressure sensing sensors inside of the front door modules. Their locations are illustrated in the image below.

SRS Component Locations



1. Driver Airbag (DAB)
2. Steering Wheel
3. Clock Spring
4. Seat Belt Pretensioner (BPT)
5. PAB ON/OFF Switch
6. Side Impact Sensor (SIS)
7. Side Airbag (SAB)
8. Passenger Airbag (PAB)
9. Front Impact Sensor (FIS)
10. Curtain Airbag (CAB)
11. Supplemental Restraint System (SRS) Control Module
12. Airbag Warning Lamp
13. PAB ON/OFF Lamp
14. Anchor Pretensioner

⚠ WARNING

- Unintentional deployment of SRS components can result in serious injury or death. Do not cut through any SRS component.
- SRS components can remain powered and active for up to 3 minutes after the 12V electrical system is shut off or disabled.

Vehicle Specifications

Items	Unit	Specification
Maximum speed	km/h	160
Acceleration & elasticity	s	12.5 (0-100km/h)
Driving range (NEDC)	km	594
Maximum torque engine	Nm	300
Drive train power	kW	100
Payload	kg	5 passengers
Ambient temperature limits vehicle operation	min °C	-20~40°C
	max °C	
Maximum hydrogen storage capacity of the vehicle	kg of H ₂	5.64
Energy density of the hydrogen storage	wt%	Type III
	kg per liter	3.32 (70 MPa)
Battery Energy	kWh	0.95
Power output battery	kW	24
Vehicle efficiency (NEDC)	kgH ₂ / 100 km	0.95 kgH ₂ /100 km
Fuel consumption (NEDC)	km/L	Gasoline equivalent: 27.8 km/L



Warning Lamps on Cluster



Power Down Warning Light



This warning light illuminates:

- When the vehicle power should be limited due to a malfunction with fuel cell stack. If the warning light continuously remains on when the vehicle is in "READY" state, or comes on during driving, this indicates that there may be a malfunction with the fuel cell stack. If this occurs, we recommend that you have the vehicle inspected by an authorized HYUNDAI dealer.

Hydrogen Gas Leak Warning Light



This warning light illuminates:

- When the hydrogen leakage is detected in the vehicle. If the warning light continuously remains on when the vehicle is in "READY" state, or comes on during driving, this indicates that there may be hydrogen leakage. If this occurs, we recommend that you turn off the vehicle and have the vehicle inspected by an authorized HYUNDAI dealer.

Motor Overheat Warning Light



This warning light illuminates:

- When the motor or inverter is overheated. Do not continue driving with an overheated motor or inverter. If your vehicle remains overheated, we recommend that you have the vehicle inspected by an authorized HYUNDAI dealer.

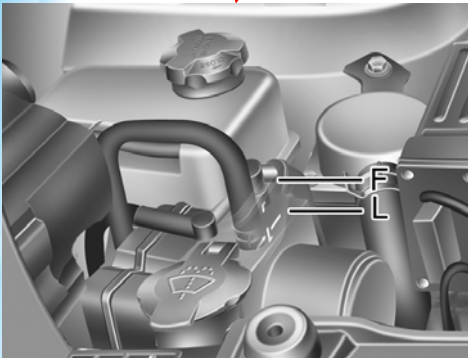
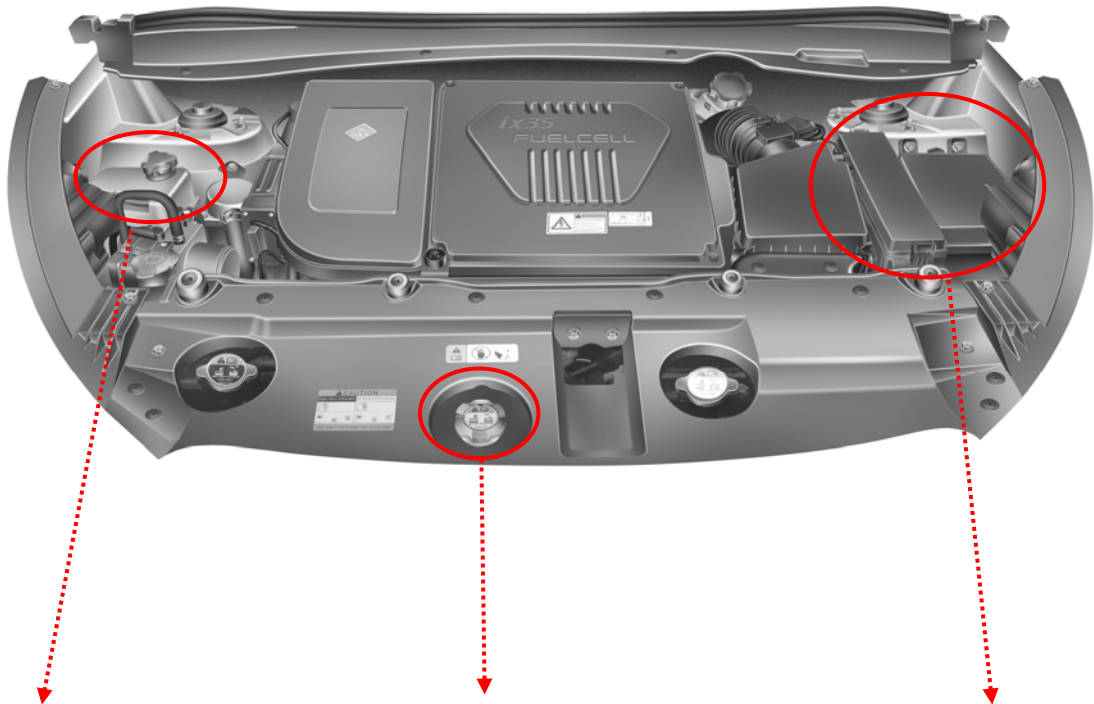
Service Lamp



This warning light illuminates:

- When the fuel cell electric vehicle control system is not working properly. When the warning light continuously remains on, we recommend that you have the vehicle inspected by an authorized HYUNDAI dealer.

Fuse Box Position and Engine Room Layout



Fuel cell coolant reservoir



Electric coolant reservoir



**[Left]
Fuel cell system fuse and relay
[Right]
Conventional system fuse and relay**



**Conventional vehicle system related
fuses and relays**

Emergency Procedures - Initial Response

The following procedures should be utilized when working with a ix35 FCEV at an emergency scene. All other operations should be consistent with your department's Standard Operating Procedure.

1. Identify

When working with a ix35 at an accident scene, emergency responders should always assume that it is a FCEV model until it can be proven otherwise using the identification features outlined at the beginning of this Emergency Response Guide (ERG). External stickers and badging will usually be the first indicator, but it often can be hidden by damage caused in a crash. Responders must always be sure to inspect all sides of the vehicle, as well as using the identifiers found under the hood and in the interior of the vehicle.

2. Immobilize

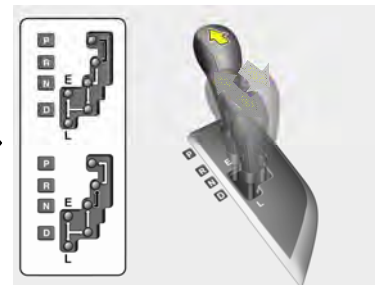
The next step is to immobilize the vehicle to prevent any accidental movement that can endanger the emergency response personnel and any crash victims. Since the ix35 FCEV has the fuel cell system and the motor, there will be instances where the vehicle appears to be off because of the absence of engine noise. When in its "ready" mode, the vehicle can move almost silently using the electric motor alone. Responders should approach the vehicle from the sides and stay away from the front or rear as they are both potential paths of travel. Instructions for immobilizing the vehicle are shown below.



Chock the Wheels



Engage Parking Brake



Place Vehicle in Park

Emergency Procedures - Initial Response

3. Disable

After the vehicle has been secured to prevent movement, the final step in the initial response process is to disable the vehicle, its SRS components, and its fuel cell & high-voltage electrical system. This can be accomplished in one of two ways:

I . Primary Method

- ① Turn the vehicle off ② Disconnect the 12V Battery (-) cable ③ Remove the service plug

1. Determine if the vehicle is on or off by looking at the indicators on the instrument cluster
 - a. If the vehicle is off move to step #2.
 - b. If the instrument cluster lights indicate the vehicle is on push the “Power button” located at the right of the steering column according to the conditions in the tables below.



Brake Pedal Not Applied

Press Power button	LED Color on Power button	State of Vehicle
-	OFF	OFF
1st time	Red	ACCESSORY
2nd time	BLUE	ON
3rd time	OFF	OFF

Brake Pedal Applied and Transmission in Park

Press Power button	LED Color on Power button	State of Vehicle
-	OFF	OFF
1st time	BLUE	START

2. If possible remove the proximity key from the vehicle.

Keep the key a minimum of 6 feet away to prevent accidental restarting of the vehicle until the 12V Auxiliary Battery is disconnected.



Emergency Procedures - Initial Response

3. Disconnect the 12V battery (-) cable (A) which is located in the trunk.

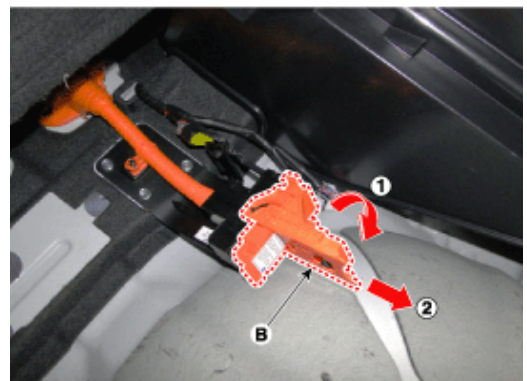
NOTICE

Before disconnecting the 12V battery (-) cable , if necessary, lower the windows and unlock the doors. Once the 12V battery (-) cable is disconnected, the window and door lock controls will not operate.



4. If possible, remove the service cover in the trunk.

- 1) Lift the locking hook (A) in the direction of the arrow.
- 2) Remove the safety plug after pulling the lever (B) 90 degrees in the direction of the arrow.

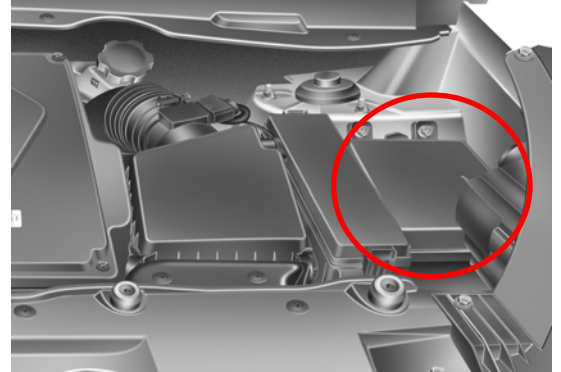


Emergency Procedures - Initial Response

II. Secondary Method

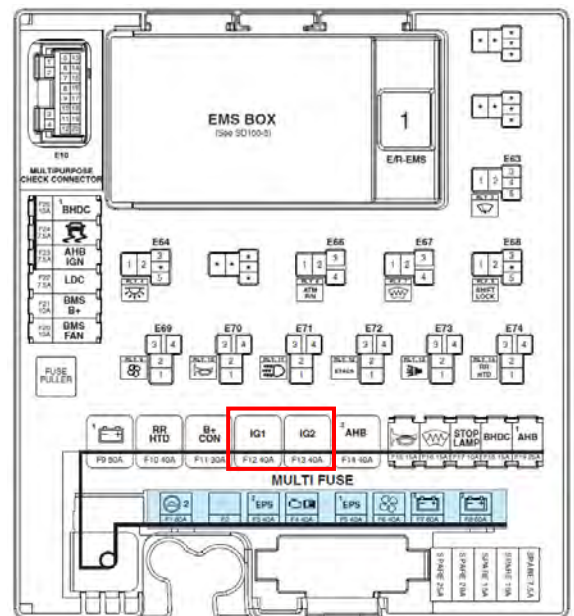
- ① Remove the fuses ② Disconnect the 12V Auxiliary Battery ③ Remove the service plug

1. Open the hood.
2. Remove the engine compartment fuse box cover.



3. Remove the IG1, IG2 fuses. Refer to the illustration for fuse location.

If the correct relay cannot be recognized, pull all of the fuses and relays from the fuse box.



4. Disconnect the 12V battery (-) cable (A) which is located in the trunk.

NOTICE

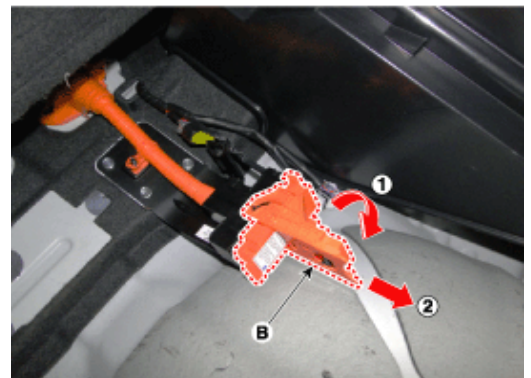
Before disconnecting the 12V battery (-) cable , if necessary, lower the windows and unlock the doors. Once the 12V battery (-) cable is disconnected, the window and door lock controls will not operate.



Emergency Procedures - Initial Response

5. If possible, remove the service cover in the trunk.

- 1) Lift the locking hook (A) in the direction of the arrow.
- 2) Remove the safety plug after pulling the lever (B) 90 degrees in the direction of the arrow.



If neither of the preceding methods can be completed, emergency responders must be aware of the potential for accidental SRS activation as well as understand that there is no guarantee that the high-voltage system has been shut down.

⚠ WARNING High voltage!

- Before any type of emergency service is performed on this vehicle the high-voltage system must be shut down. Wait 5-10 minutes after shut down to allow high-voltage capacitors to discharge sufficiently.
- Even after the high-voltage system has been shut down and discharged, all high-voltage components should be treated as if they are still energized.
- Failure to shut down and disable the high-voltage system prior to emergency operations can result in serious injury or death.

⚠ WARNING Explosive!

- SRS Components can be unintentionally deployed.
- To avoid unintentional deployment, the 12V electrical system must be shut down. Wait 3 minutes after the system is shut down or disabled to allow the voltage to discharge sufficiently. Do not cut through any SRS Component.
- Failure to shut down and disable the SRS system prior to emergency operations or cutting through SRS Components can result in serious injury or death.

Emergency Procedures - Specific types Response

Having addressed the general initial response procedures for handling the ix35 FCEV in an emergency, the following sections will address specific types of emergencies.

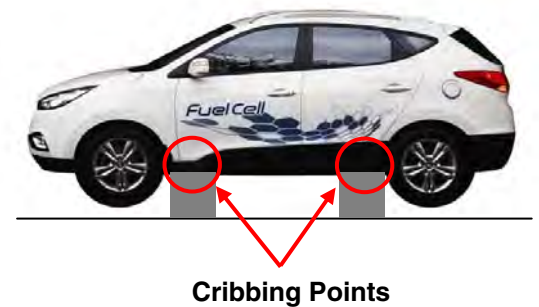
Extrication

Extrication operations for the ix35 FCEV is almost the same as for a conventional vehicle, but with some notable exceptions. Utilize the Identify, Immobilize, and Disable model described in the previous pages prior to engaging in extrication operations.

Vehicle Stabilization

Use standard stabilization (cribbing) points.

Always be sure to connect to a structural member of the vehicle, and avoid placing cribbing under high-voltage cables, fuel lines, and other areas not normally considered acceptable.



Vehicle Stabilization

In some instances responders may determine the need to deflate the tires to stabilize the vehicle. In this case, note that this vehicle uses a Tire Pressure Monitoring System. The sensors in the tires are mounted by means of a metal valve stem. To rapidly deflate the tires it might be necessary to snap off the valve stem with pliers or remove the valve cap and Schrader valve.



Extrication Equipment and Techniques

Standard extrication equipment can be employed on this vehicle, and normal techniques and the dispatching unit's Standard Operating Procedures (SOPs) and Standard Operating Guidelines (SOGs) should be followed. There are no high-voltage cables or components in areas that are considered standard cut points. Extrication personnel should always visually inspect the area being cut to ensure no SRS or high-voltage components are compromised.

Emergency Procedures - Specific types Response

Firefighting

After Initial Emergency Response Procedures have been applied, Firefighting Procedures may begin. Hyundai recommends that each response team follow their own department's standard operating procedures for fighting vehicle fires in combination with the ix35 FCEV specific details that are covered in this section.

Firefighting Operations

[For non-firefighters]

- If the fire is extinguishable, it is recommended to use the CO2 fire extinguisher. If you are not able to find one, use water or other types of fire extinguishers.
- If the fire is not extinguishable, move far away from the vehicle to the place where you can conceal yourself. And then call the fire department to report a FECV vehicle is on fire.
Never go near the vehicle before the fire is extinguished.

[For firefighters]

- If the fire does not spread until the hydrogen tanks which are installed to rear floor of ix35 FCEV, extinguish a fire.
- If the fire spreads until the hydrogen tanks which are installed to rear floor of ix35 FCEV, you should not extinguish a fire. And wait until the vehicle to be burned at the place where you can conceal yourself.

Emergency venting of hydrogen gas

If the temperature near the safety valve located at the rear under vehicle is over 110°C caused by a fire or other reasons, the safety valve will open to vent hydrogen gas. Venting the hydrogen gas makes a loud noise because the venting speed is very fast. Stay well away from the vehicle. This jet stream of hydrogen gas could ignite.



Hydrogen venting position

Emergency Procedures - Specific types Response

- If the high-voltage battery pack is either involved in or at risk of being involved in a fire in a ix35 FCEV, strict cautions must be taken while conducting firefighting operations because of the following reasons:

- Lithium-ion Polymer batteries contain gel electrolyte that can vent, ignite, and produce sparks when subjected to temperatures above 300°F.
- May burn rapidly with a flare-burning effect.
- A burning battery could release hydrogen fluoride, carbon monoxide, and carbon dioxide gasses. Use NIOSH/MSHA approved full-face self-contained breathing apparatus (SCBA) with full protective gear.

Even if the high-voltage battery pack is not directly involved in a vehicle fire, approach the vehicle very carefully.

Extinguishers

To extinguish a small fire, the following techniques can be used:

- Dry chemical
- CO₂
- Large amounts of water
- Regular foam

For a large fire, use these types of extinguishing methods:

- Large amounts of water
- Fog
- Regular foam

Placing Water on High-voltage Electricity

When approaching a vehicle fire on a ix35 FCEV, firefighters should not hesitate to extinguish the fire with water. The vehicle's high-voltage electrical system is well insulated and unlike the 12V electrical system, it is not part of the vehicle's chassis.

Emergency Procedures - Specific types Response

Overhaul Operations

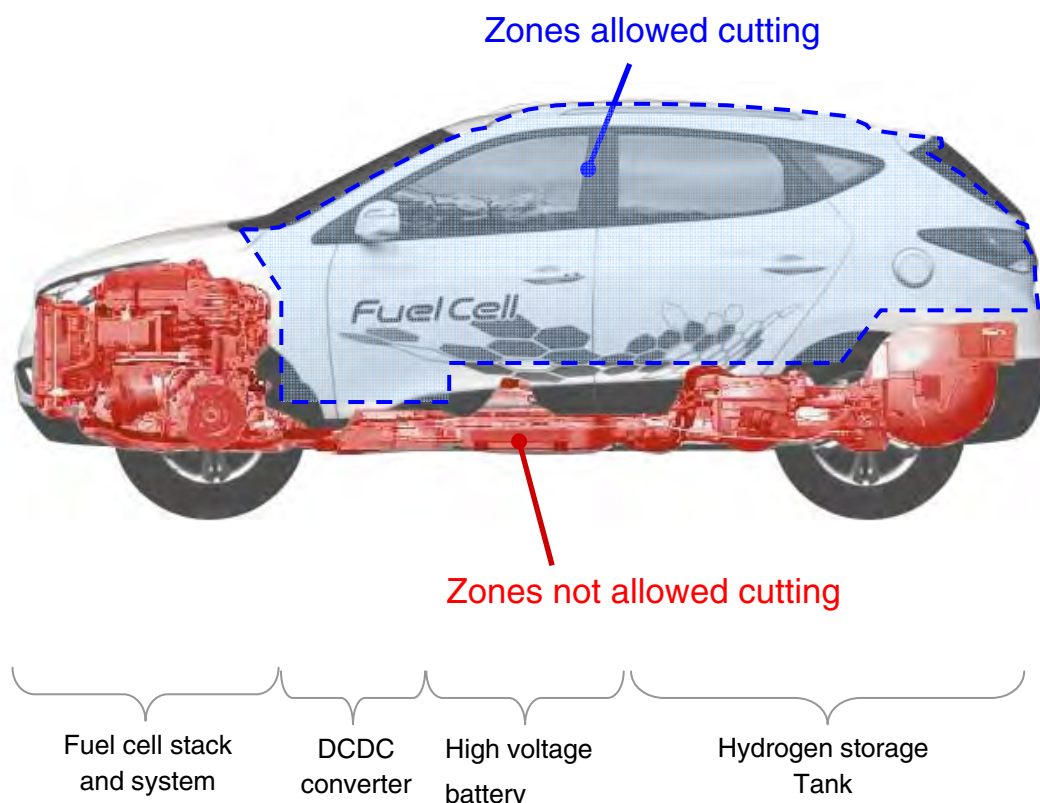
During overhaul operations it is important for responders to remember the dangers that are still present, even after a fire has been extinguished.

Just as during a fire, the same dangers exist. They include, but are not limited to:

- Harmful gasses
- Reignition of fire
- Electrical Burns, Shock, or Electrocution

To protect oneself and others, and to minimize potential risk, responders should use appropriate Personal Protective Equipment (PPE) defined by the department's SOP's and ensure the vehicle's high-voltage electrical system has been disabled. The methods described at the beginning of the Emergency Response Procedures should be followed.

Vehicle's Cutting Area for Emergency Escape



⚠ WARNING

If a vehicle cutting is required to evacuate passengers in emergency case like a car accident, it is entirely required that all high voltage systems and hydrogen supply system should be blocked.

Emergency Procedures - Specific types Response

⚠ WARNING

- It is a safe way to remove the battery safety plug, and disconnect (-) terminal of battery.
In addition to these, it is recommended to shut off the 12 V power supply. It is requested to be handled with care when cutting the orange-colored cables because it is high voltage supply lines.
- Hydrogen supply lines are installed in the underneath the floor. For preventing an accidental damage of hydrogen supply lines, it is handled with care.
- Electrical shock may occur when high or low voltage supplies are not shut off properly.

Submersion

Some emergency responses can involve a submerged vehicle. A ix35 FCEV that is submerged does not have high-voltage potential on the vehicle's body or framework and is safe to touch, whether it is in water or on land.

[Procedure]

1. Remove the vehicle from water.
2. Drain the water from the vehicle.
3. Disable the vehicle by using the methods described at the beginning of the Emergency Response Procedures section.



NOTICE

Once the vehicle has been removed from the water and drained completely, the drained water that is surrounding the area will not be energized.

This is a benefit of the design of the ix35 FCEV's high-voltage electrical system. It is designed to maintain its isolation from the vehicle's chassis and the surrounding area.

Emergency Procedures - Specific types Response

High-Voltage Battery Damage/Spills

The HV Battery assembly is enclosed in a sturdy metal case that is rigidly mounted to structural components of the vehicle. This construction helps prevent damage to the HV Battery assembly even in severe crashes. This section provides emergency responders with information regarding how to mitigate the severity of a damaged HV Battery assembly or gel electrolyte spill, however unlikely that might be.

Mitigation Procedures

For a gel electrolyte spill or leak:

- Eliminate all ignition sources (no smoking, flares, sparks, or flames) in the immediate area.
- Do not touch or walk through spilled material.
- Absorb electrolyte with earth, sand, or other non-combustible material.
- Place leaking battery (if removed from a vehicle) and contaminated absorbant material in metal containers.

WARNING **Irritant!**

- Internal components of HV Batteries are irritants and sensitizers.
- To avoid contact with these irritants and sensitizers wear positive pressure self- contained breathing apparatus (SCBA) and other personal protective equipment (PPE) designed for use with these types of hazards.
- Failure to wear proper SCBA and PPE can result in serious injury or death

Information

HV Battery Manufacturer Contact Information: HL Green Power, Ltd. 47, Gieopdosi 1-ro, Daesowon-myeon, Chungju-si, Chungbuk-do, 380-870 Korea	Emergency Phone Number: Bong kyu Hwang (Manager) - TEL : +82-43-841-6789 - M.P : +82-10-8943-7139
Disposal of Damaged HV Battery Pack	Contact a local authorized Hyundai dealer.

Emergency Procedures - Specific types Response

First Aid for Electrolyte Exposure

The ix35 FCEV HV battery pack is a self-contained, sealed unit and poses no electrolyte contamination hazards under normal conditions. It is only under the rare instance of HV battery damage that the gel electrolyte would be exposed and a person could come in contact with it.

Follow these guidelines for electrolyte exposure.

If a victim has been exposed to electrolyte, complete these steps first:

- Move victim to fresh air.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- Ensure that other emergency responders are aware of the materials involved and take precautions to protect themselves.

Then treat the victim according to his/her path of exposure:

[Absorption]

- Eye Contact: Rinse eyes with water for 15 minutes.
- Skin Contact: Wash area thoroughly with soap and water.

[Inhalation]

- Remove the victim and leave the area immediately to avoid further exposure.

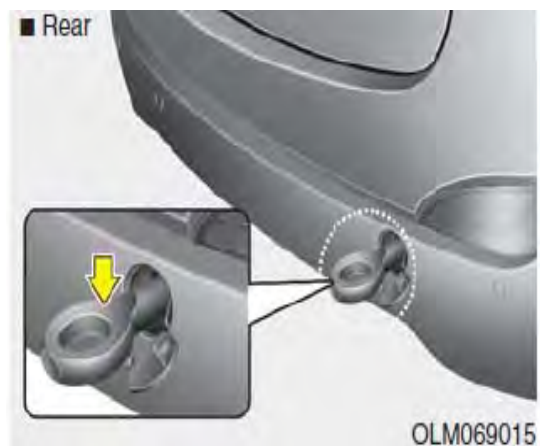
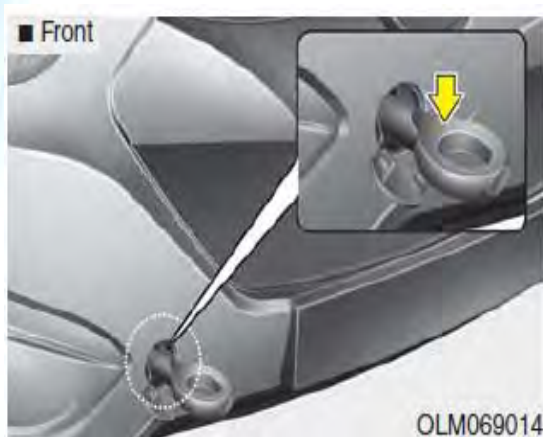
[Ingestion]

- Compel the victim to drink milk or water and induce vomiting.

Emergency towing

Emergency towing

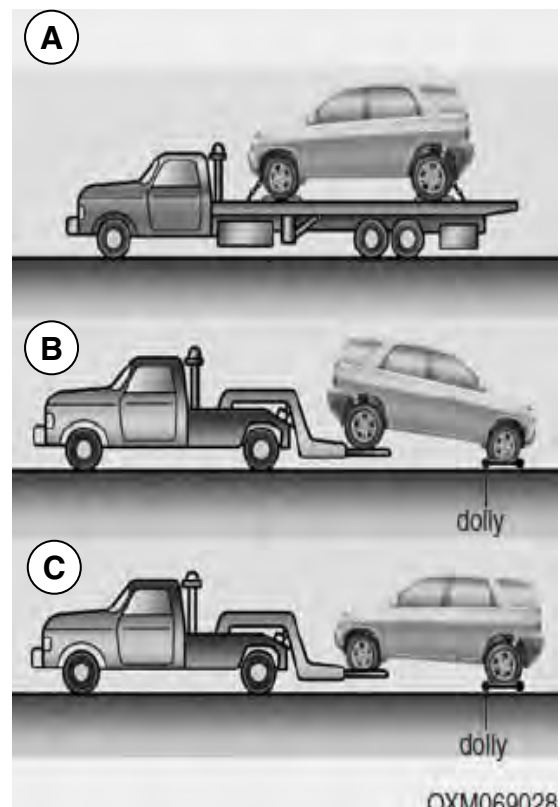
The ix35 FCEV is no different from a conventionally powered gasoline engine vehicle with regard to towing. If emergency towing is necessary, Hyundai recommends having it done by an authorized Hyundai dealer or a professional tow-truck service. Proper lifting and towing procedures are necessary to prevent damage to the vehicle. Because the vehicle has a front wheel drive powertrain, using a flatbed or wheel dollies is recommended, specific towing guidelines are described below.



A. Towing via flatbed is the recommended method for transporting a ix35 FCEV.

B. If any of the loaded wheels or suspension components are damaged or the vehicle is being towed with the rear wheels off the ground, use a towing dolly under the front wheels.

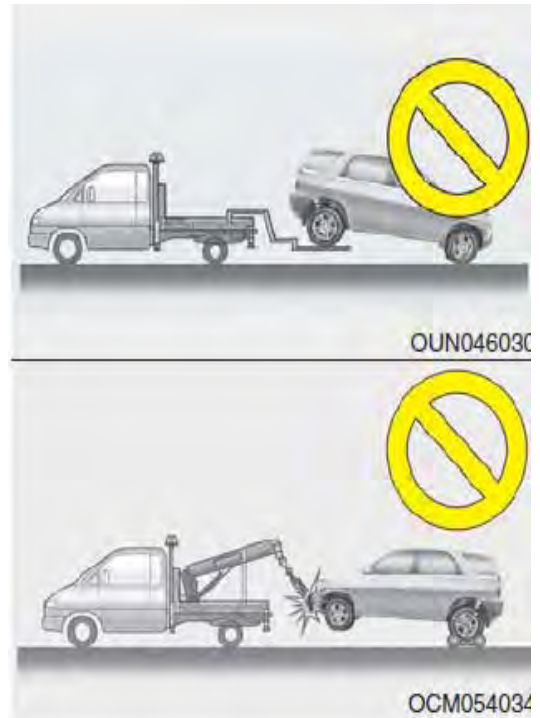
C. The vehicle can be towed with the front wheels supported by the lifting equipment in most cases that do not involve damage to wheel, tire, or suspension components.



Emergency towing

⚠ CAUTION

- Towing with sling-type equipment or with the front wheels on the ground are not correct methods for towing this vehicle.
- To prevent damage to the vehicle always use wheel lift or flatbed equipment.
- Failure to use the proper towing methods will cause damage to the vehicle.



Emergency towing precautions

- Turn the POWER button to ACC so the steering wheel isn't locked.
- Place the shift lever in N (Neutral).
- Release the parking brake.
- Press the brake pedal with more force than normal since you will have reduced brake performance.
- More steering effort will be required because the power steering system will be disabled.
- If you are driving down a long hill, the brakes may overheat and brake performance will be reduced. Stop often and let the brakes cool off.

Jump Starting

Jump starting procedure

1. Make sure the booster battery is 12-volt and that its negative terminal is grounded.
2. If the booster battery is in another vehicle, do not allow the vehicles to touch.
3. Turn off all unnecessary electrical loads.
4. First connect one end of a jumper cable to the positive terminal of the discharged battery in the luggage room, then connect the other end to the positive terminal on the booster battery.

Proceed to connect one end of the other jumper cable to the negative terminal of the booster battery, then the other end to a solid, stationary, metallic point away from the battery (for example, the tailgate latch).

⚠ CAUTION

Do not connect it to or near any part that moves when the vehicle is started.
Do not allow the jumper cables to contact anything except the correct battery terminals or the correct ground.
Do not lean over the battery when making connections.

5. Start the vehicle with the booster battery and let it run at 2,000 rpm, then start the vehicle with the discharged battery.
6. After a few minutes, turn off both of the vehicles.
7. Remove the negative terminal cable first, and then remove the positive terminal cable. If the cause of your battery discharging is not apparent, we recommend that the system be checked by an authorized HYUNDAI dealer.



Check the luminous intensity





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HONDA

Emergency Response Guide

Honda Fuel Cell Vehicle

FCX
CLARITY

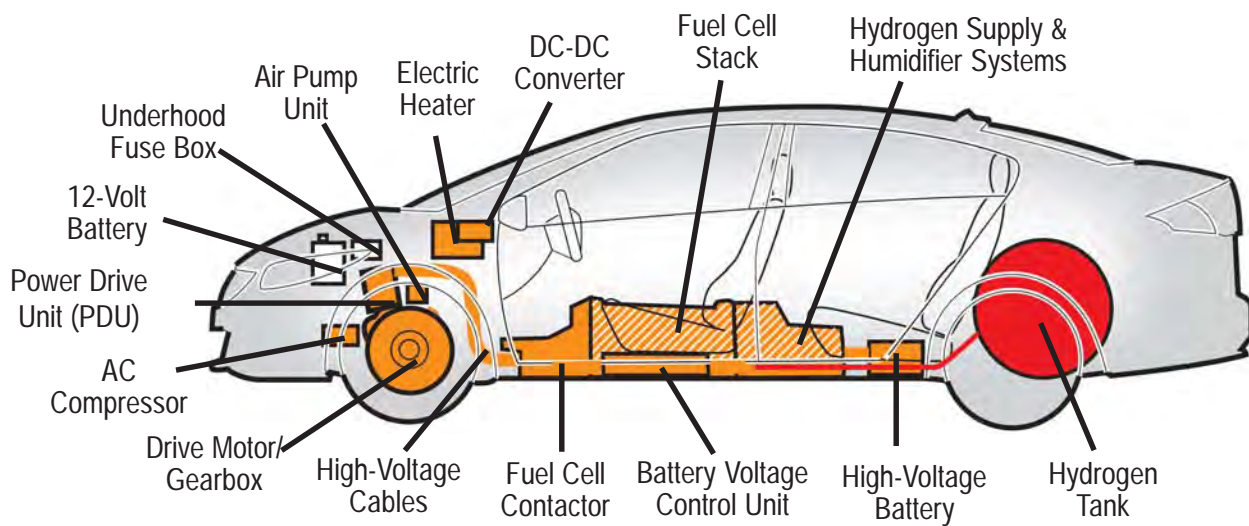
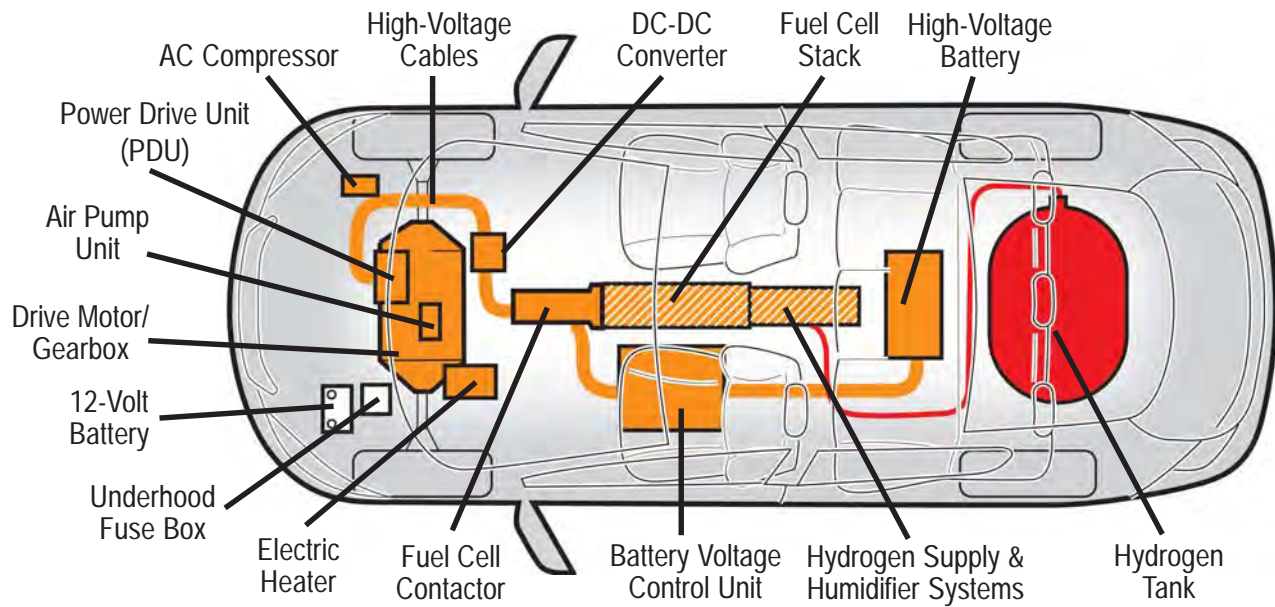


Prepared for Fire Service, Law Enforcement, Emergency Medical, and Professional
Towing Personnel by American Honda Motor Co., Inc.

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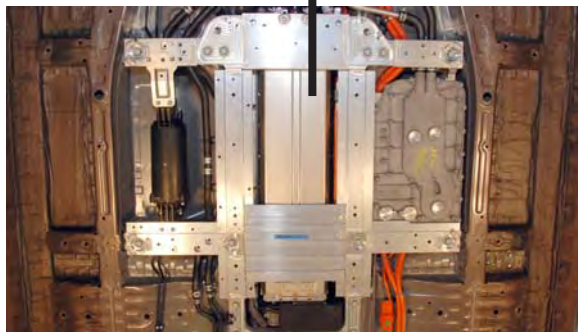
Key Components



Vehicle Description



Fuel Cell Stack



The fuel cell stack is well protected in the lower center of the vehicle, shown here with the underbody covers removed.

Vehicle Type, Size, and Materials

The Honda FCX Clarity is a 4-door, 4-passenger sedan that uses fuel cells to convert hydrogen and oxygen into electrical power. The chassis and most components are made of steel and aluminum. Some parts are made of plastic.

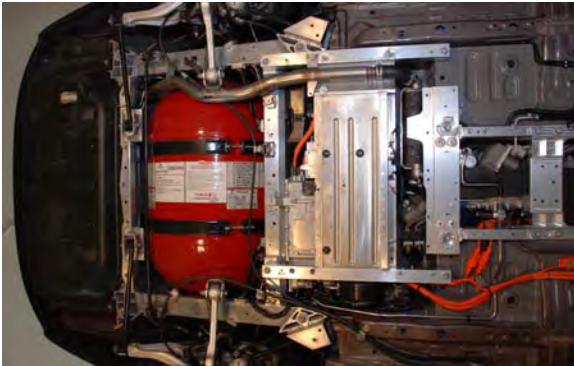
Identifying the FCX Clarity

The Clarity can be identified by the logo containing the words "FCX" and "Clarity" located on the lower part of both rear passenger doors, and to the left of the license plate on the rear of the vehicle.

Fuel Cell Stack

The FCX Clarity's main power source is a fuel cell stack housed in a metal box in the lower center of the vehicle. The stack contains layers of individual fuel cells that combine hydrogen from an onboard tank with oxygen brought into the vehicle from air intakes to produce electricity. The only by-products of this process are heat and water. Some of the water is used by the humidifier, and excess water is vented through the exhaust pipe.

Vehicle Description



The hydrogen tank is securely strapped to the FCX Clarity's frame.

Hydrogen Tank

The hydrogen used to generate electricity is compressed to 5,000 psi and stored in a strong, refillable tank located behind the rear seats. The tank is made of nonflammable materials, and has passed the same rigid impact tests for tanks in cars fueled by compressed natural gas (CNG). Tank capacity is 171 liters.



Removing the underbody covers that protect components from dirt and damage reveals the drive motor, located between the front wheels.

High-Voltage Electric Motors

Electricity generated by the fuel cell stack powers the drive motor, an air pump motor, and an air conditioning motor—all located under the hood. Other high-voltage components include a fuel cell contactor, forward of the fuel cell stack; a battery voltage control unit, under the driver's seat; a DC-DC converter; a power drive unit; and an electric heater. (See page 2 for component locations.)

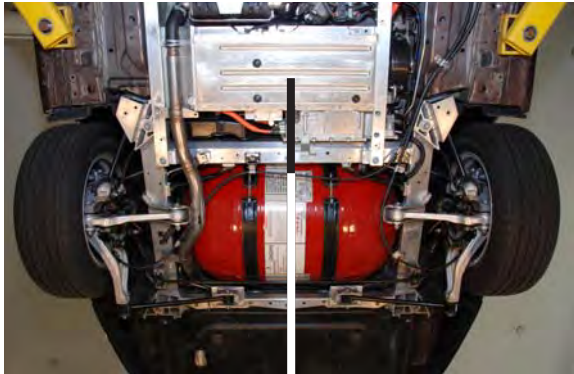


The Power Drive Unit (PDU) is located under other components and can be reached only by their removal.

Power Drive Unit

The power drive unit (PDU) controls the high-voltage electric motor power. While the PDU contains high-voltage components, it is located out of sight and reach, under other components.

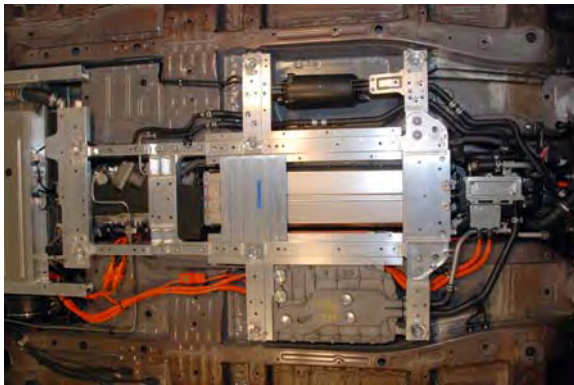
Vehicle Description



High-Voltage Battery Location

High-Voltage Battery

A lithium-ion battery stores power generated by the fuel cells and regenerated by the drive motor. It provides extra current when needed, such as during acceleration. The battery is housed under the rear seat and just forward of the hydrogen tank. Its voltage is nominally 288 volts.



The distinctive orange color makes it easy to identify the location of high-voltage cables, shown here with the underbody covers removed.

High-Voltage Cables

Electricity from the fuel cell stack and the high-voltage battery is delivered to the motors through a number of cables. Most are located inside or behind enclosed high-voltage components. Those located underneath the vehicle are protected by the underbody covers. Any that might be visible under the hood can be easily identified by distinctive orange protective covers.



12 Volt Battery

12-Volt Battery

A conventional 12-volt battery is located under the hood on the driver's side. This battery powers the lights, the audio system, and other standard electrical components. It is also used to start the drive system.

Vehicle Description

Occupant Protection Equipment

The FCX Clarity has lap/shoulder belts in all seating positions, dual front airbags, side airbags in front, and side curtain airbags. The front seats are equipped with pyrotechnically activated seat belt pretensioners. As with conventional automobiles, it takes about 3 minutes for the airbags and pretensioners to be disabled after the ignition switch is turned off or the 12-volt negative battery cable is cut.

Built-In Safety Features

The FCX Clarity is designed with a number of built-in features to protect users, bystanders and emergency responders.

Crash Detection System

The vehicle is equipped with sensors that can detect a serious impact to the vehicle. *If the impact is severe enough to deploy any airbag, the system controller will automatically shut off the flow of hydrogen and electric current.* While the hydrogen flow stops immediately, it takes about 3 minutes before the high-voltage system is completely shut down.

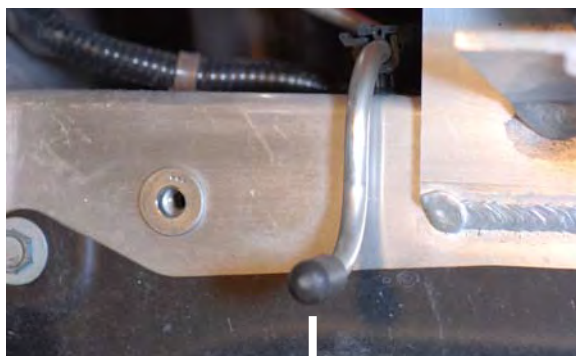
Hydrogen Tank Safety Valves

The hydrogen tank contains an internal solenoid valve with three safety valves. One prevents backflow during refueling. Another stops the flow of hydrogen when signaled by the system controller. The third is a pressure relief valve that releases hydrogen if temperature inside the tank exceeds about 226°F (108°C).

If the pressure relief valve opens, hydrogen will be routed through a metal line and out a pressure relief tube under the trunk on the passenger side of the vehicle. The hydrogen will make a hissing noise as it escapes, and it will continue releasing and dissipating up into the atmosphere until the tank is empty. It could take up to 5 minutes if the tank is full.



Hydrogen Pressure Relief Tube Location



Hydrogen Pressure Relief Outlet

Built-In Safety Features

Hydrogen Detectors

In addition to the safety valves, several hydrogen sensors are located throughout the vehicle. If a potentially hazardous leak is detected, the system controller will automatically stop the flow of hydrogen from the tank.

Potential Hazards

The FCX Clarity does not appear to present any greater hazards than a conventional gasoline-powered, hybrid, or electric car. The vehicle performed well in all standard crash tests, with no damage to the high-voltage or hydrogen components.

Flammable Fluid

The only flammable fluid used by the FCX Clarity is transmission oil. The capacity is 1.2 liters.

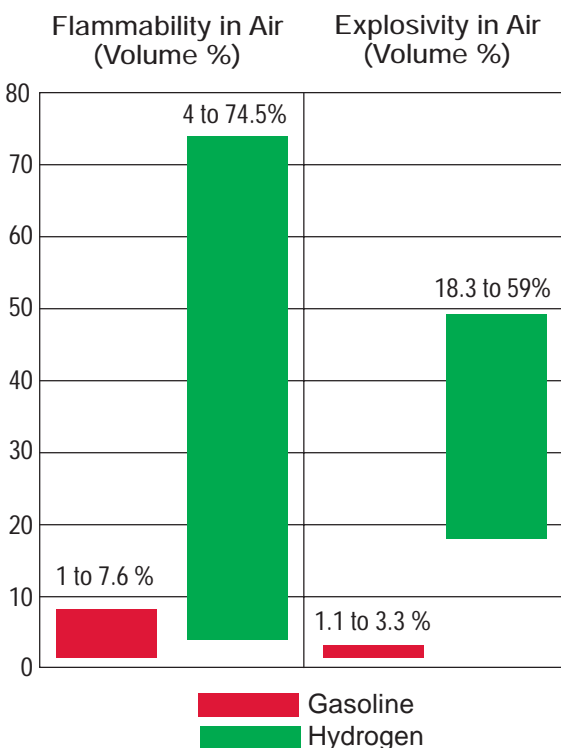
Hydrogen Properties and Potential Hazards

The hydrogen used in the FCX Clarity is a nontoxic and odorless gas. Unlike gasoline and oil, it cannot spill and it cannot harm humans, wildlife, or the environment.

However, like other fuels, **hydrogen is flammable and explosive**. Compared to gasoline, for example, when mixed with air, hydrogen has a much larger range of flammability, and its explosive range is also much larger.

Emergency responders should also know that **hydrogen flames are invisible**. In addition, hydrogen burns very quickly and radiates less heat than gasoline or other fuels.

To limit the chance of a hydrogen leak, the FCX Clarity has many built-in safety features (see pages 7-8). And, since hydrogen is 14 times lighter than air, a leak occurring outdoors would quickly dissipate into the atmosphere.



Electric Shock Potential

Unprotected contact with any electrically charged or “hot” high-voltage component can cause serious injury or death. However, *receiving an electric shock is highly unlikely* due to these facts:

- Following the instructions on pages 13-15 after an incident will shut down the high-voltage system (in about 3 minutes).
- All high-voltage components are insulated from the rest of the vehicle, so touching the body or other vehicle parts cannot result in an electric shock.
- Contact with high-voltage components (shown in orange in the illustrations on page 2) can occur only if these items are damaged and someone deliberately touches the contents.
- Contact with any of the high-voltage motors or other components can occur only after one or more components are removed, or the vehicle is cut outside the cut zone shown on page 16.

High-Voltage Battery Contents

The lithium-ion battery is contained in a strong metal box and should present no hazard in normal circumstances. Also, if the box is engulfed in flames or temperatures above 212°F (100°C), a pressure relief valve will open and release pressure, so the battery should not explode.

However, the contents of the battery are flammable and will burn if the box is broken open, giving off gases that can cause irritation if inhaled. To extinguish a burning battery, the manufacturer recommends CO₂ or an abundance of water.

The electrolyte in the battery is a non-aqueous liquid which is less hazardous than the electrolyte in the 12-volt battery. If the battery box is broken and the electrolyte leaks out, appropriate skin and eye protection are recommended.

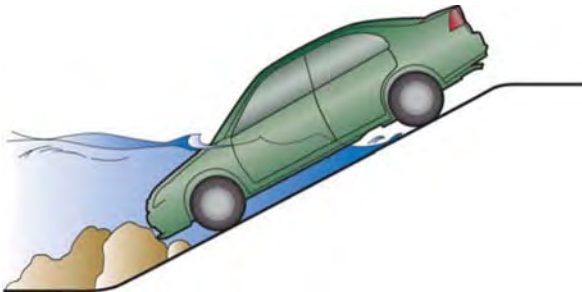
Emergency Procedures

Based on discussions with rescue professionals, we recommend that emergency response personnel follow standard procedures developed by their own organization for assessing situations and dealing with potential hazards. Given our knowledge of the FCX Clarity, we also recommend the procedures outlined in this section.

Incidents Involving Fire

If an FCX Clarity is involved in a fire, follow standard fire-fighting procedures, but with this reminder:

Keep away from the rear of the vehicle until the fire is completely out. If the temperature inside the hydrogen tank exceeds about 226°F (108°C), the gas in the tank will be released through a pressure relief tube at the right rear of the vehicle. You may hear a hissing sound as the hydrogen escapes, and it can take up to 5 minutes for a full tank to empty. Although pure hydrogen flames are invisible, you will see colored flames if other parts of the vehicle are burning.



Submerged or Partly Submerged Vehicle

Pull the vehicle out of the water, then proceed with the emergency procedures on the following pages.

Emergency Procedures

Shutting Down the High-Voltage, Hydrogen & Airbag Systems

If it becomes necessary to shut down the high-voltage, hydrogen and airbag systems (such as after the vehicle has been involved in a collision), follow one of the two procedures described below and on the following pages.

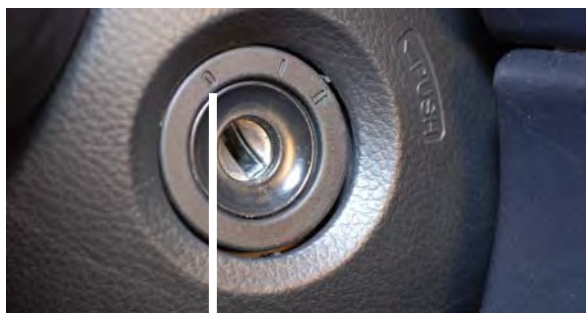
Preferred Method

This method is recommended for situations where the responder can safely reach the ignition key.

Turn the ignition key to the off (O) position and remove the key.

Turning the ignition switch off immediately shuts down the flow of hydrogen. In about three minutes, the high-voltage system and any undeployed airbags and front seat-belt pretensioners will also be shut down.

Removing the key prevents the high-voltage and occupant protection systems from restarting while you assist the vehicle's occupants.



Ignition Switch Off (O) Position

Emergency Procedures

Alternate Method

This method is recommended for situations in which responders cannot reach the ignition key but can reach under the hood and have access to a Phillips screwdriver.

Remove the 120 amp main fuse from the underhood fuse box, THEN cut the negative 12-volt battery cable.

Removing the main fuse shuts down the high-voltage and hydrogen systems, and cutting the negative 12-volt battery cable shuts down power to the airbags and pretensioners. (Remember, it will take about 3 minutes for these systems to shut down.)

To use this method:

1. Raise the hood and locate the underhood fuse box and the 12-volt battery.



Underhood
Fuse Box

12-Volt
Battery

Emergency Procedures



120 Main Fuse Screws

2. Remove the underhood fuse box lid and locate the 120 amp main fuse.
3. Using a Phillips screwdriver, unscrew and remove the main fuse assembly.



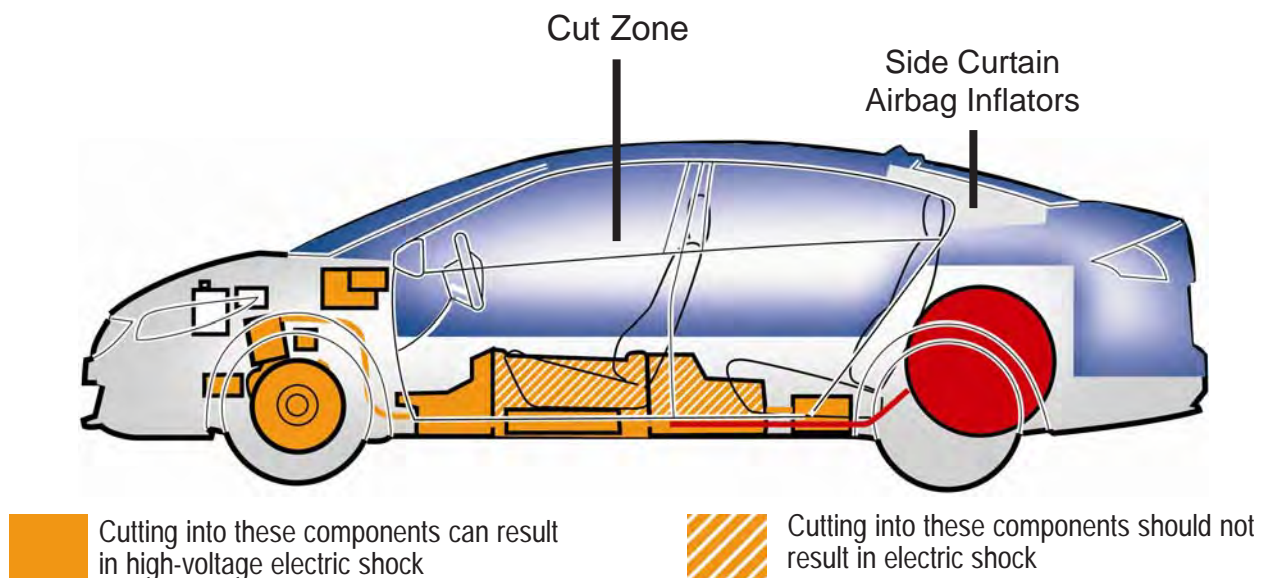
Negative 12-Volt Battery Cable

4. Cut the negative 12-volt battery cable.

Emergency Procedures

Extricating Occupants

If you need to cut into the body, or use other Jaws of Life type of equipment to remove occupants, be sure to stay within the cut zone indicated in the illustration below.



Emergency Towing

If a damaged or disabled FCX Clarity needs to be moved a short distance, such as to the side of the road, and the car can still roll on the ground, shift the transmission to neutral, then manually push the car. If the vehicle needs to be towed away from the area, the preferred method is by flatbed truck.

Chevrolet Equinox Fuel Cell

Emergency Response Guide



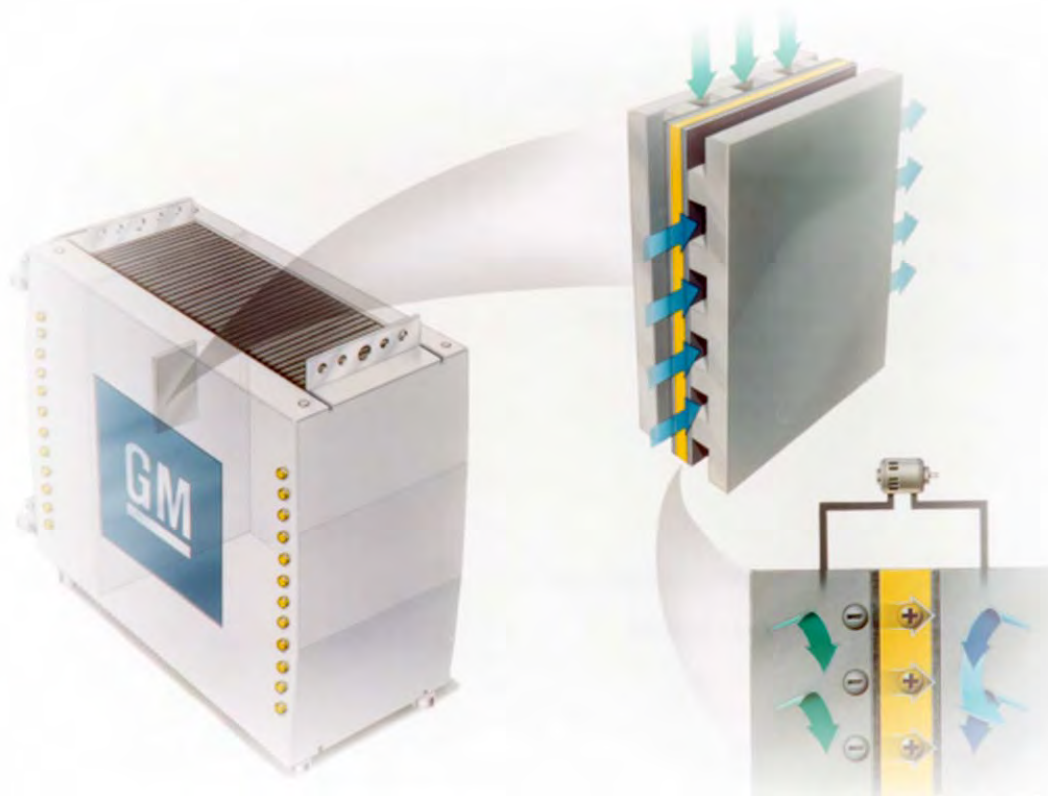


This guide specifically addresses the Chevrolet Equinox Fuel Cell.

While a majority of the systems installed on these vehicles are common to traditional GM vehicles, some components are different and may affect how a rescue procedure is performed.

We will note those differences as well as highlight ways to easily distinguish the Equinox Fuel Cell from its conventional counterparts.

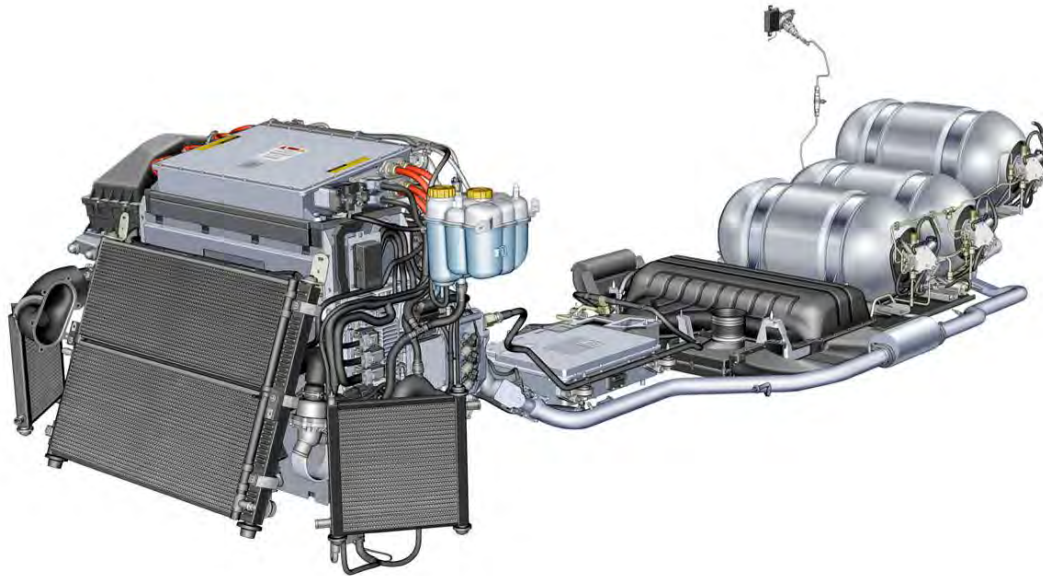
Finally, we will illustrate where the Do NOT Cut Zones exist to help you safely extricate occupants from the Equinox Fuel Cell.



System Operation

The Equinox Fuel Cell is a hydrogen fuel cell electric vehicle that uses both high voltage and low voltage electrical systems. This vehicle is being initially launched as a controlled market test to compile consumer feedback.

Instead of traditional propulsion through an internal combustion engine, the Equinox Fuel Cell uses electrical output from hundreds of stacked fuel cells, which use hydrogen that is converted to energy for vehicle propulsion. The Equinox fuel cell is a zero emission vehicle. It does not have a conventional internal combustion engine.



Hydrogen Properties

The fuel consumed in an Equinox Fuel Cell is hydrogen gas. Hydrogen rises two times faster than helium, and nearly 10 times faster than natural gas. Because hydrogen is much lighter than air, it will disperse quickly from an area.

While hydrogen and gasoline have similar characteristics, they also have many differences. Hydrogen and gasoline can both be used as fuel; however, gasoline is a liquid as dispensed, and hydrogen fuel may be dispensed as a gas or liquid. Equinox Fuel Cells are fueled only with gaseous hydrogen.

A difference between hydrogen gas and gasoline is that they autoignite at different temperatures. Autoignition is the temperature at which a substance will spontaneously ignite without an external spark or flame. Depending on octane ratings, gasoline will autoignite between 450°F to 900°F (230°C to 480°C). Hydrogen has an autoignition temperature of 1058°F (570°C) making it less likely to spontaneously ignite.

Hydrogen minimum ignition energy, or the lowest possible energy resulting in the ignition of a flammable mixture by an electrical discharge, is lower than that of gasoline. This means that sparks from static electricity or electrical circuits discharges can more easily ignite hydrogen / air mixtures than gasoline vapor / air mixtures. Hydrogen gas typically burns with a flame that is only visible at night.

Vehicle Identification

The Equinox Fuel Cell can be identified by the graphics and badging on the vehicle exterior.



Graphics displayed are typical of what you will see on vehicles, but can vary by vehicle.

Vehicle Identification (cont.)

A special trim cover on the Fuel Cell System, located under the hood, helps to identify an Equinox Fuel Cell.



Voltage Classifications

The Equinox Fuel Cell uses a high voltage system, similar to hybrid vehicles, and **MUST** be approached with caution.



Voltage Classifications (cont.)

Electricity wiring is categorized as either low, intermediate, or high voltage.

- Low voltage – from 0 to 30 volts DC / 0 to 15 volts AC
- Intermediate voltage – from 30 volts to 60 volts DC / 15 volts to 30 volts AC
- High voltage – any voltage greater than 60 volts DC / 30 volts AC

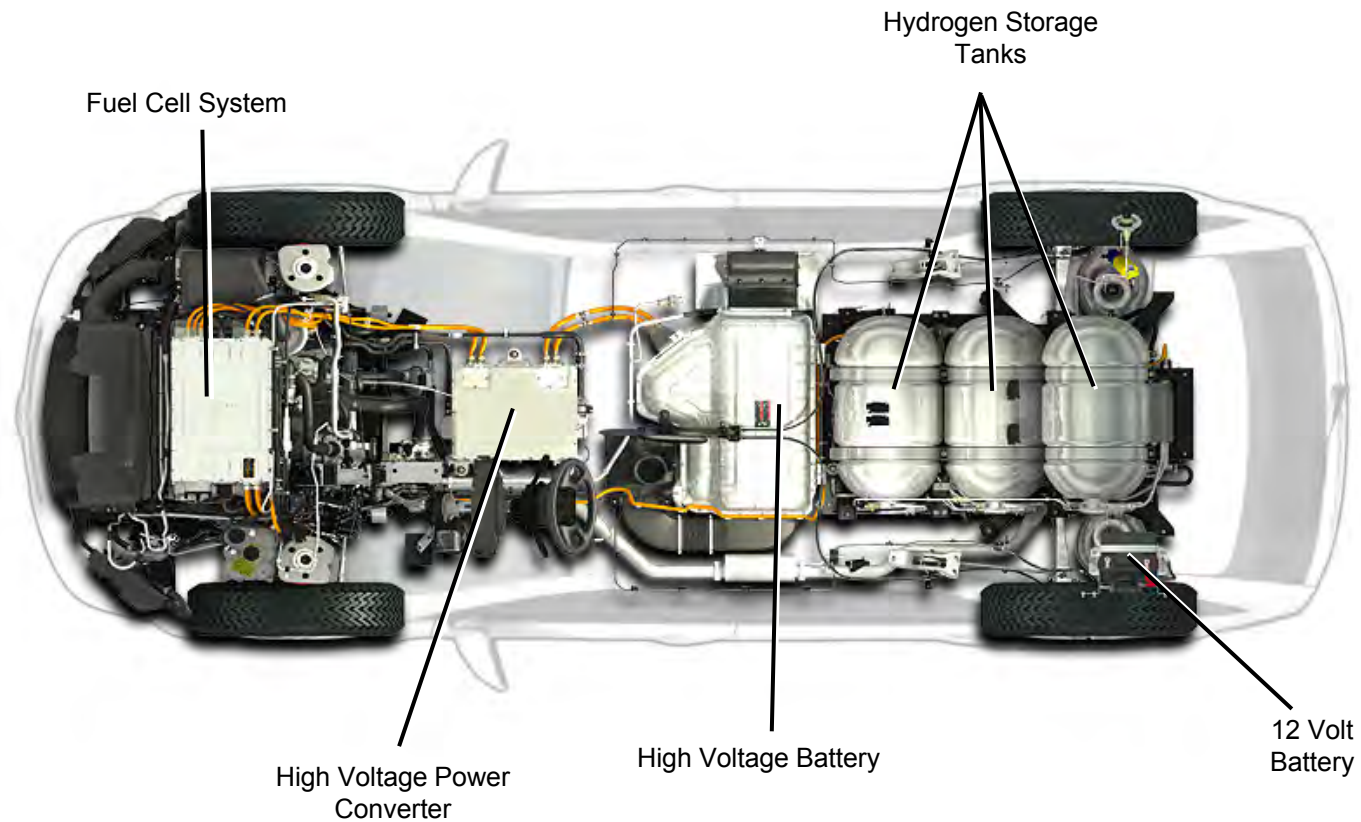
Color coding is used to identify the wiring with different levels of voltage. Orange represents high voltage.

Classification	Low Voltage (No color code)	Intermediate Voltage (Blue)	High Voltage (Orange)
Voltage Ranges	$DC \leq 30v$ $AC \leq 15v^{RMS}$	$DC: 30 - 60v$ $AC: 15 - 30v^{RMS}$	$DC > 60v$ $AC > 30v^{RMS}$

Note: Intermediate voltage is not used on this vehicle. Only low voltage and high voltage are used on the Equinox Fuel Cell.

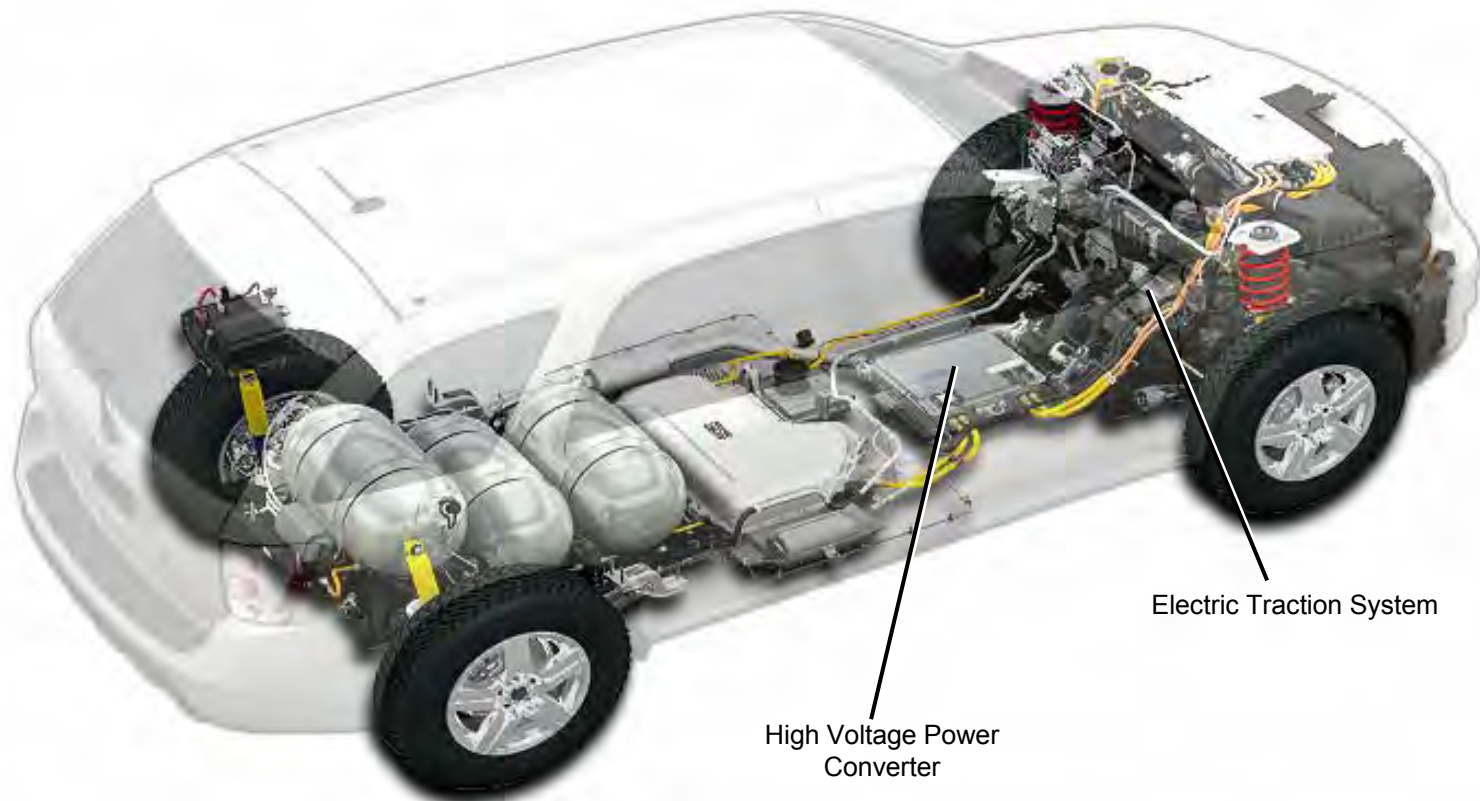
Equinox Fuel Cell Component Location

This illustration shows the location of the main Equinox Fuel Cell components from a top view of the vehicle.



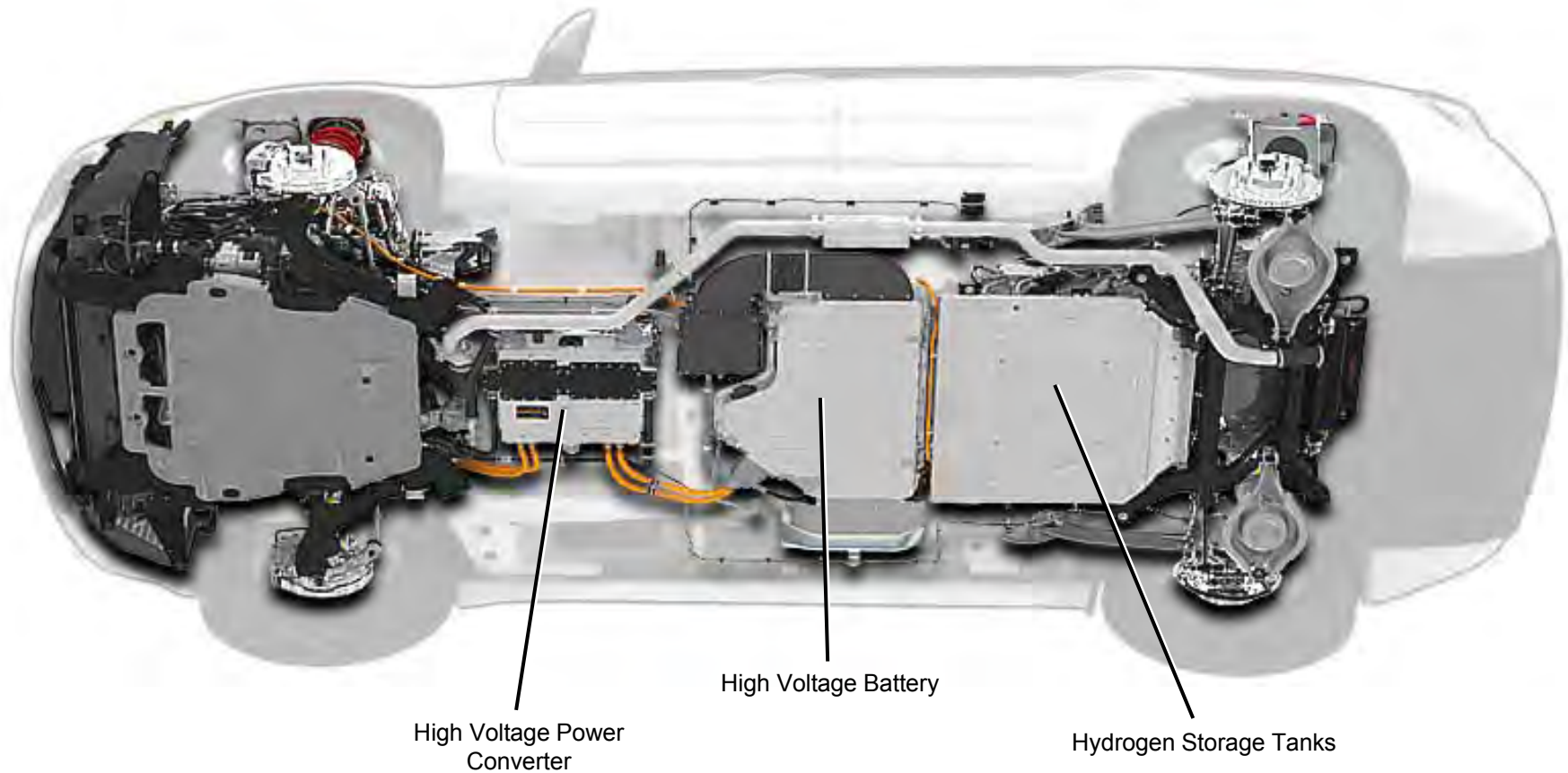
Equinox Fuel Cell Component Location (cont.)

This illustration shows the locations of the main Equinox Fuel Cell components from the passenger side of the vehicle.



Equinox Fuel Cell Component Location (cont.)

This illustration shows the locations of the main Equinox Fuel Cell components from the underside of the vehicle.

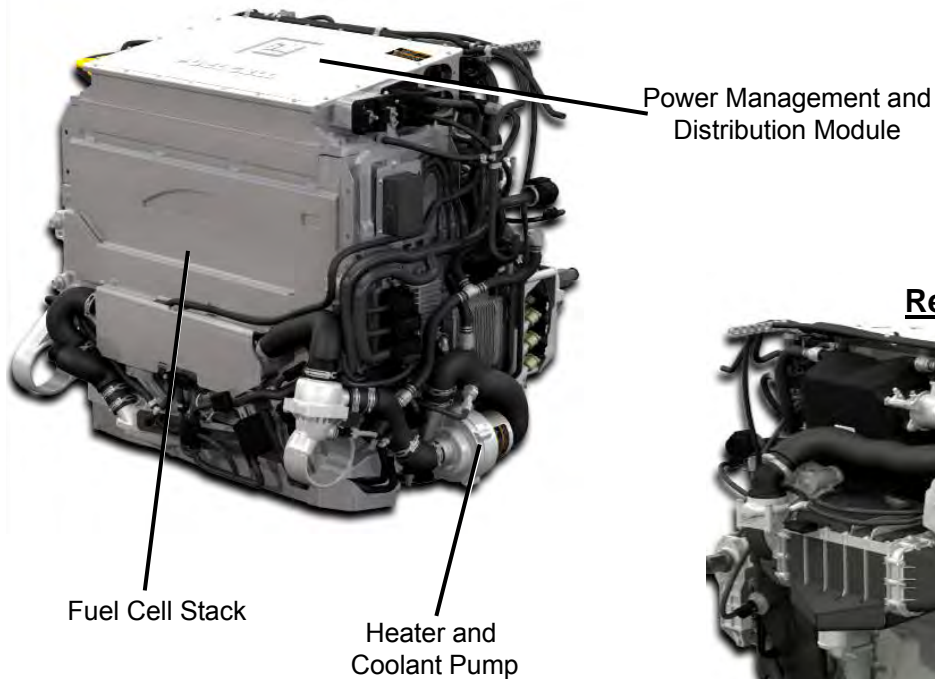


Equinox Fuel Cell Components

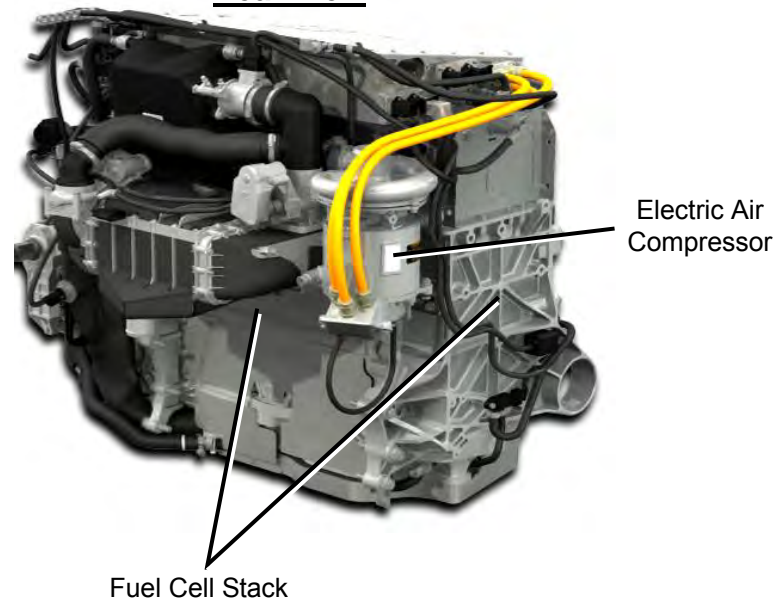
The Fuel Cell System provides power from the Fuel Cell Stack to the high voltage components. The Fuel Cell System contains:

- Fuel Cell Stack
- Power Management and Distribution Module
- Electric Air Compressor
- Heater and Coolant Pump

Front View

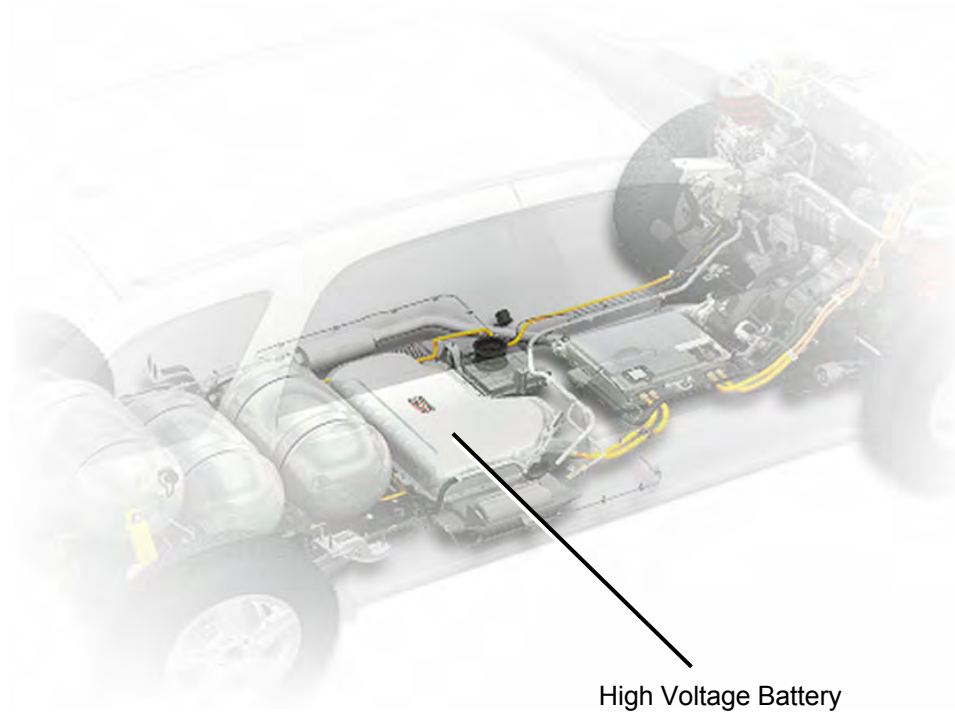


Rear View



Equinox Fuel Cell Components (cont.)

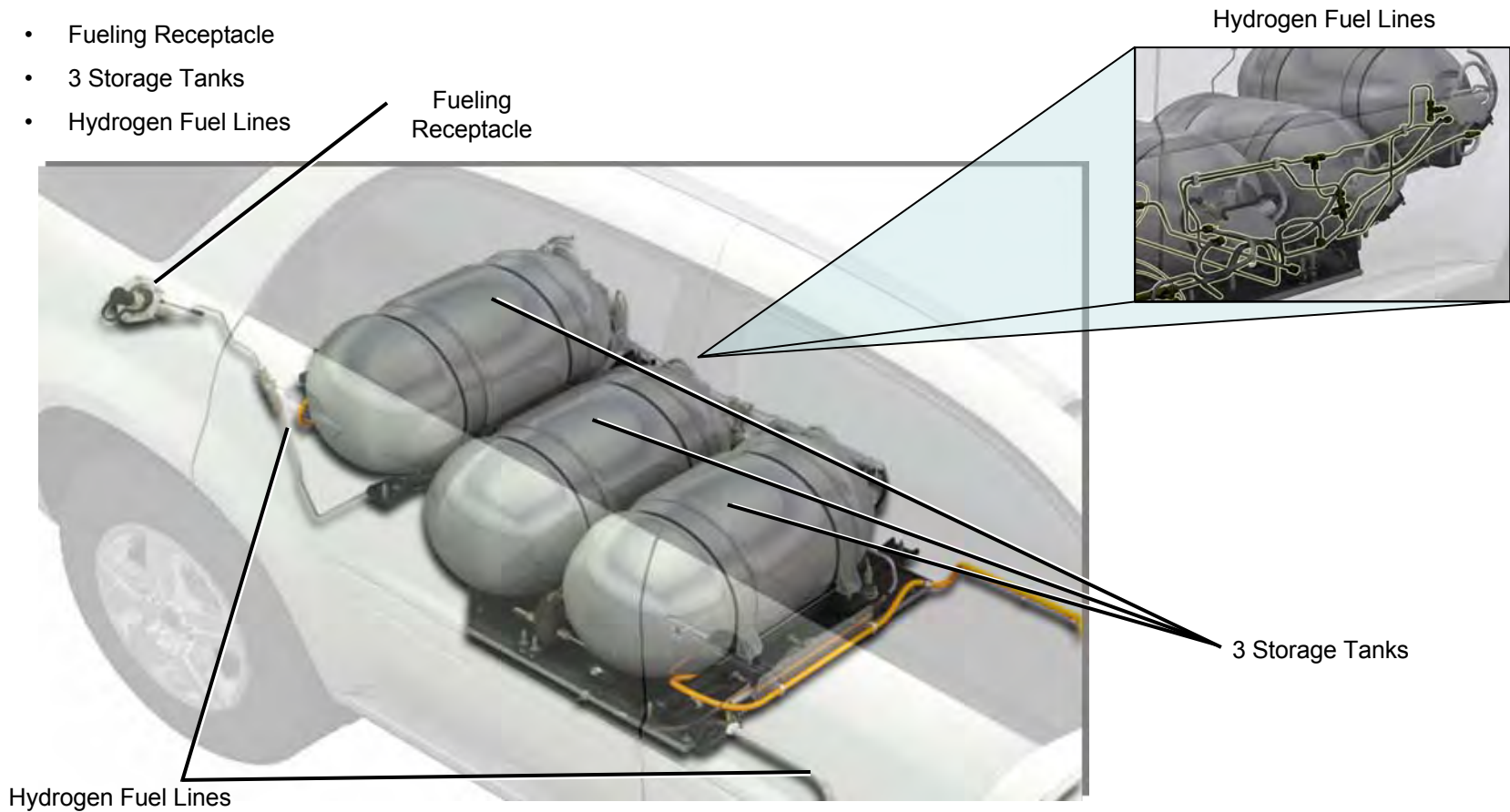
The High Voltage Battery stores energy generated from braking and/or the Fuel Cell System.



Equinox Fuel Cell Components (cont.)

The Hydrogen Storage System, located in the rear underbody area, stores compressed hydrogen for use in the Fuel Cell Stack. This system consists of:

- Fueling Receptacle
- 3 Storage Tanks
- Hydrogen Fuel Lines



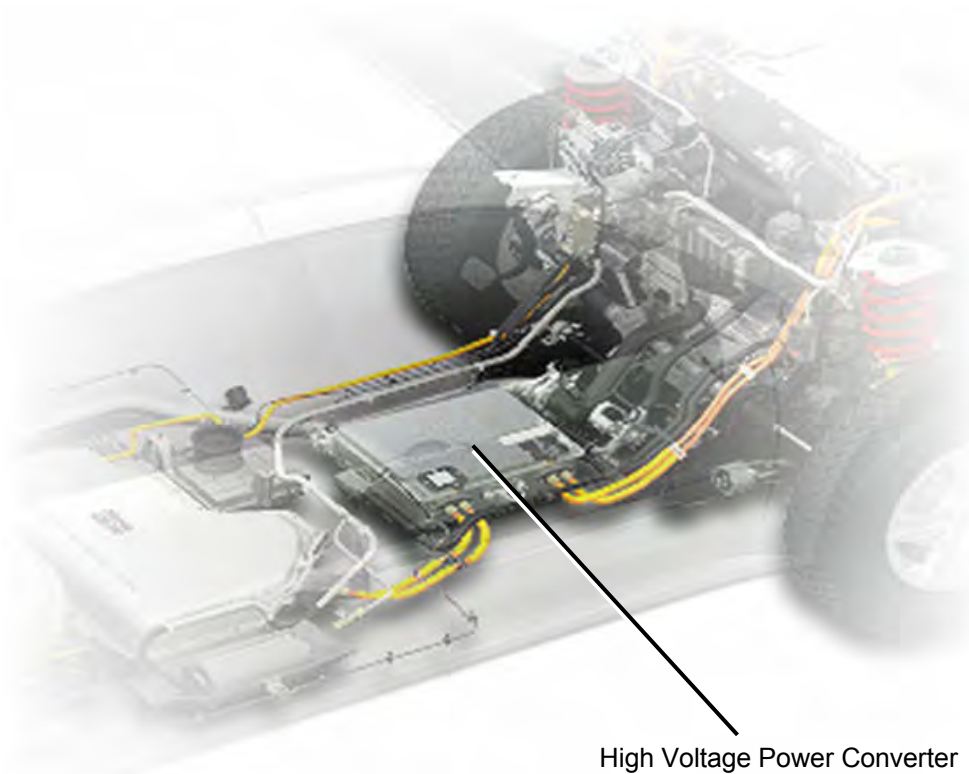
Equinox Fuel Cell Components (cont.)

The 12 Volt Battery is located in the rear of the vehicle, on the driver side, under a trim panel. The 12 Volt Battery powers all accessories when the Equinox Fuel Cell is NOT running.



Equinox Fuel Cell Components (cont.)

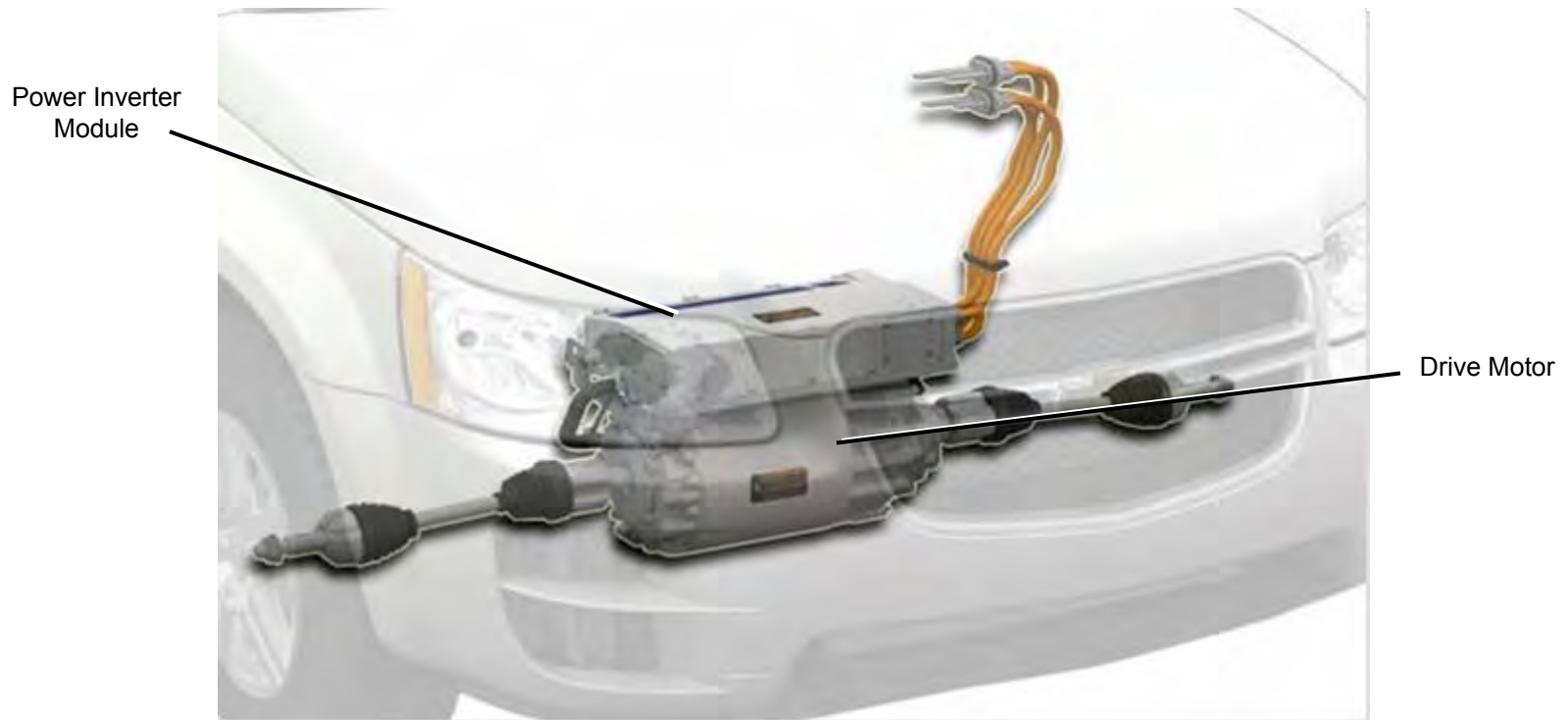
The main function of the High Voltage Power Converter is to control the flow of energy between the Fuel Cell Stack and the High Voltage Battery.



Equinox Fuel Cell Components (cont.)

The Electric Traction System contains the Power Inverter Module and the Drive Motor. The Drive Motor is the only propulsion motor on the vehicle. It propels the vehicle using power from both the Fuel Cell System and the High Voltage Battery. The Electric Traction System also provides regenerative energy from deceleration to recharge the High Voltage Battery.

The main function of the Power Inverter Module is to convert direct current (DC) from the Fuel Cell System into 3-phase alternating current (AC) for the Electric Traction System. The Power Inverter Module also converts alternating current (AC), captured from braking by the drive motor, into DC power that recharges the High Voltage Battery.



Hydrogen Sensors

There are a total of 7 hydrogen sensors located on the Equinox Fuel Cell:

- 2 sensors under hood
- 2 sensors mounted above headliner in passenger compartment
- 2 sensors near hydrogen storage tanks
- 1 sensor inside exhaust system

During fueling and when the ignition is ON, hydrogen sensors are active.

If hydrogen is detected, the H₂ icon on the instrument panel lights, an audible beep will continuously sound, and a “HYDROGEN DETECTED” message will appear (as shown below). The hydrogen flow to the fuel cell will be shut off, and the vehicle will have reduced power from the battery to move to the roadside.

If hydrogen does not dissipate within 60 seconds, the HYDROGEN IS DETECTED EVACUATE VEHICLE” message will appear.



H₂ Icon

Approaching the Vehicle

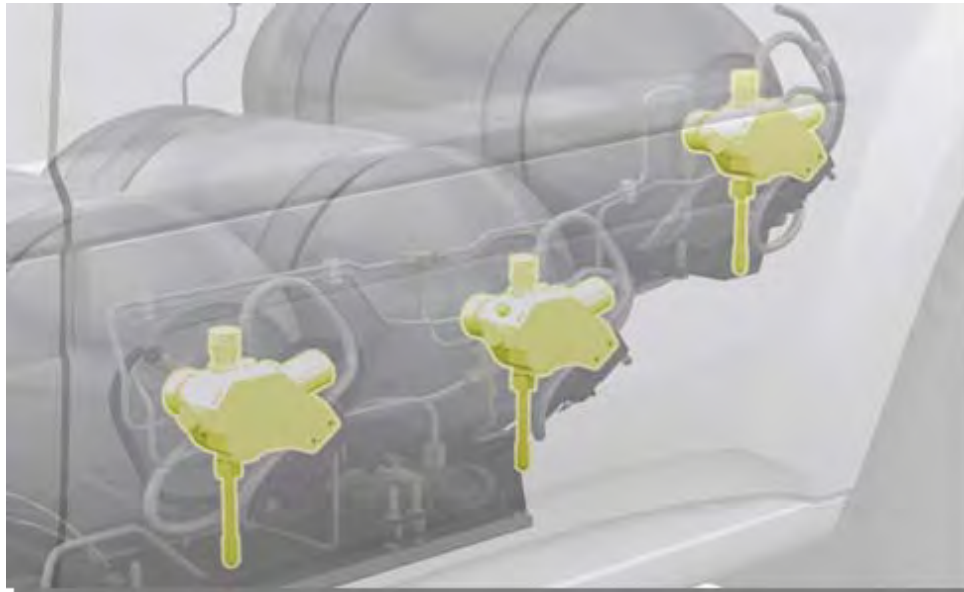
The Equinox Fuel Cell has a Pressure Relief Device (PRD) on each of the three hydrogen storage tanks. PRDs open when exposed to fire to vent hydrogen and prevent over-pressurization. A loud hissing noise is emitted from the rear during a hydrogen release.

The tanks release hydrogen independently depending on their exposure to fire. Release by different tanks can be separated by several minutes. All of the tanks may not release if they are not similarly exposed to fire. A release of one tank may last several minutes. The venting hydrogen will disperse quickly. It will likely ignite and burn if a fire or ignition source is present.

These potential occurrences should be considered in timing an occupant extraction. PRDs are located underneath the rear driver's side of the vehicle.

The fire fighter should use common fire fighting strategies for managing a vehicle fire, which includes extinguishing a vehicle fire.

Note: Hydrogen gas typically burns with a flame that is only visible at night.

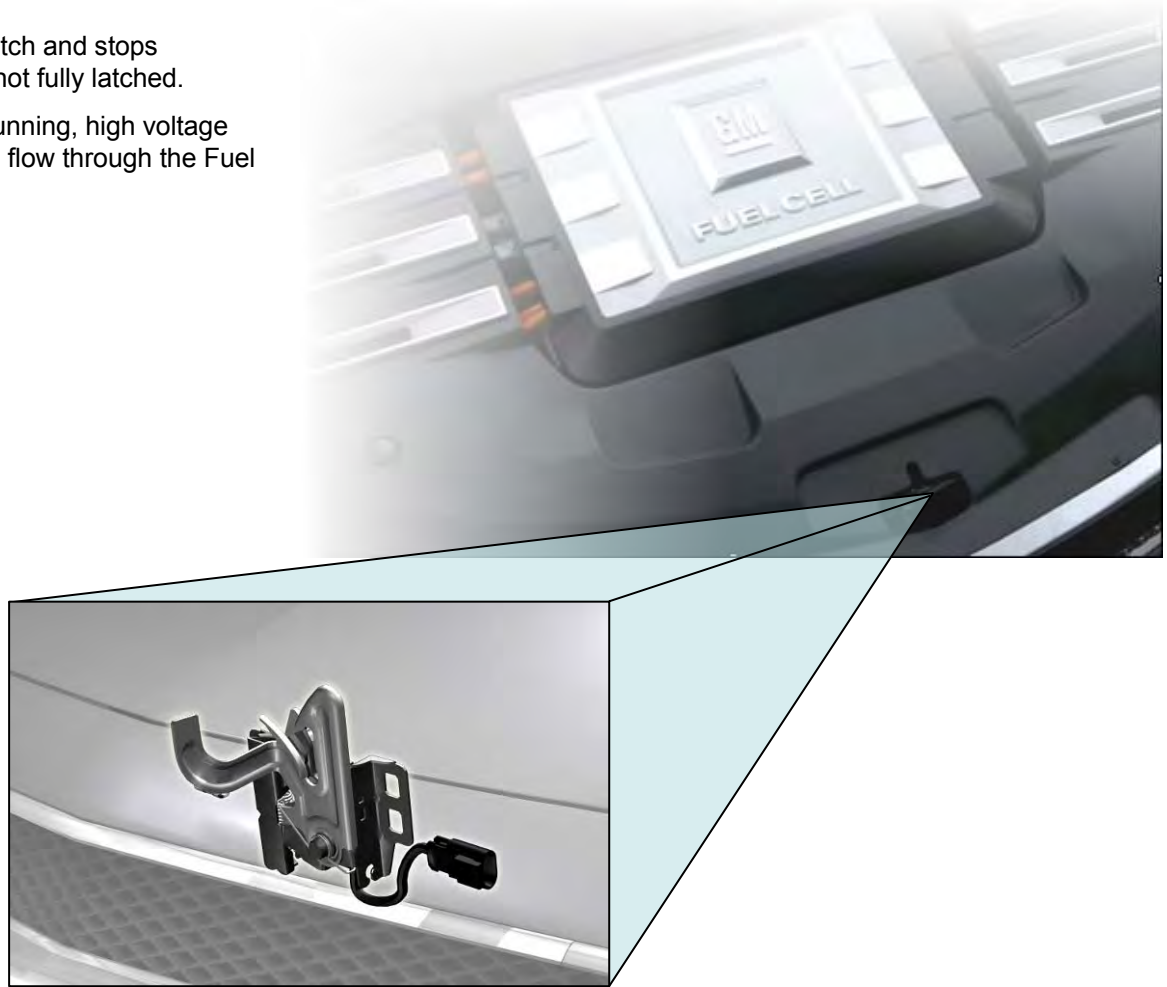


Driver's Side View

Disabling Propulsion System

A hood switch is mounted near the hood latch and stops hydrogen flow if the hood of the vehicle is not fully latched.

If the hood is opened while the vehicle is running, high voltage current flow will be disabled, and hydrogen flow through the Fuel Cell System will shut down.



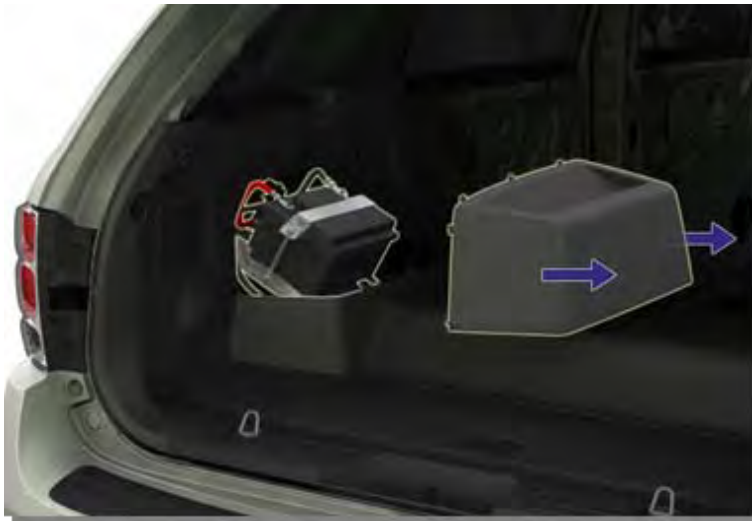
Air Bag Deployment*

Upon rear impact, or if one or more air bags deploy, contactors inside the high voltage battery open to isolate high voltage within the High Voltage Battery. In addition, the automatic shut off valves on the hydrogen tanks close to stop the flow of hydrogen fuel out of the tanks.

To ensure personal safety, it is essential to disable 12 volt power if one or more of the air bags remains undeployed. Refer to the Disabling Power section to review this procedure.



*For more information on air bags, refer to the Emergency Personnel Information link at www.gmstc.com



After disabling 12 volt power, WAIT a minimum of 10 seconds to allow any undeployed air bag reserve energy and high voltage energy to dissipate before cutting into the vehicle.

Disabling Power

Perform each of the following steps to disable the High and Low Voltage electrical systems. This includes power to the air bag system.

1. Turn the ignition key to the OFF position.
2. Pull the hood release latch. This interrupts the normal Fuel Cell System shutdown procedure, disconnects the high voltage power supply, and stops hydrogen flow to the propulsion system.
3. Remove the 12 volt battery cover and disconnect or cut the 12 volt negative battery cable.
4. WAIT a minimum of 10 seconds to allow any undeployed air bag reserve energy and high voltage energy to dissipate before cutting into the vehicle.



High Voltage Electrical System

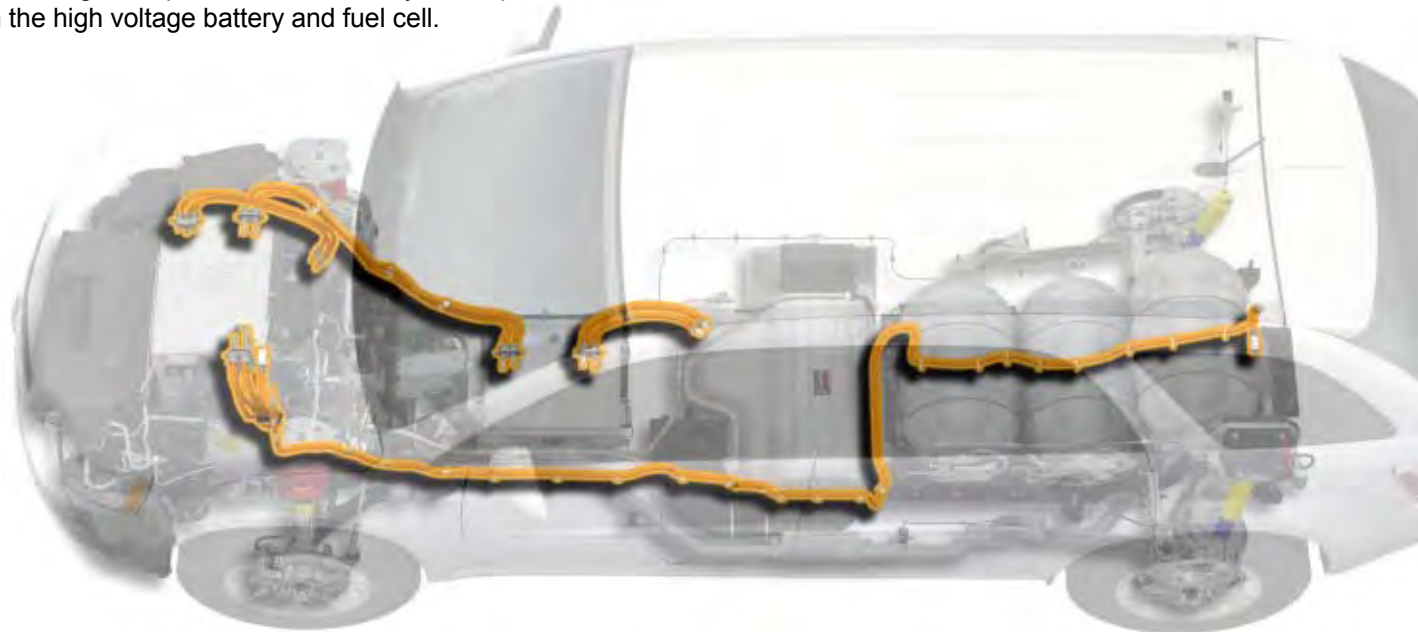
There are three sources of high voltage power on the vehicle: the battery, the fuel cell and the regenerative braking system (the Electric Drive Motor). Regenerative power is not generated when the vehicle has stopped moving.

The high voltage is shut off immediately when an air bag deploys, the hood is opened or the rear crash sensor is activated. When the ignition is turned OFF, the fuel cell shuts down and its high voltage power dissipates within minutes.

Disconnecting the 12 volt battery removes power from undeployed air bags and provides a secondary interruption of power from the high voltage battery and fuel cell.

WARNING: Even though high voltage current flow stops when the power is interrupted, Do NOT cut the orange high voltage cables and/or the High Voltage Power Converter.

If an orange cable and/or the High Voltage Power Converter is cut, residual static charge may cause an electrical arc discharge and/or personal injury.



Do NOT Cut Zones

DANGER: Do NOT cut the orange high voltage cables. Cutting these cables can result in serious injury or death.

Caution: No matter what disable method you perform, Do NOT cut the high voltage cables.



No Cut Zones

- Hydrogen Tanks
- Engine Compartment
- Beneath the Passenger Cabin Floor

Note: Disconnect the 12v Battery prior to cutting the rear roof pillar and allow any undeployed airbag reserve energy to dissipate.

WARNING: Do NOT cut the fuel lines – cutting fuel lines will release hydrogen in the fuel lines.



Note: An Equinox Fuel Cell First Responder **Quick Reference Sheet** is available for download and printing from <http://www.gmstc.com>. Click on the First Responder link and select the Chevrolet Equinox Fuel Cell First Responder Quick Reference Sheet.

Conclusion

Automotive propulsion technology advancements are changing the way vehicles are being built. Awareness of new technology and changes in vehicle systems will assist First Responders in their job. The information in this Equinox Fuel Cell Emergency Response Guide will help First Responders prepare for rescue situations. In this guide we have made you aware of Equinox Fuel Cell:

- Identification
- Component operation & location
- Potential risks & dangers
- Air bag safety
- Disabling procedures
- Do NOT Cut zones

We are confident this guide will contribute positively toward attaining this goal.

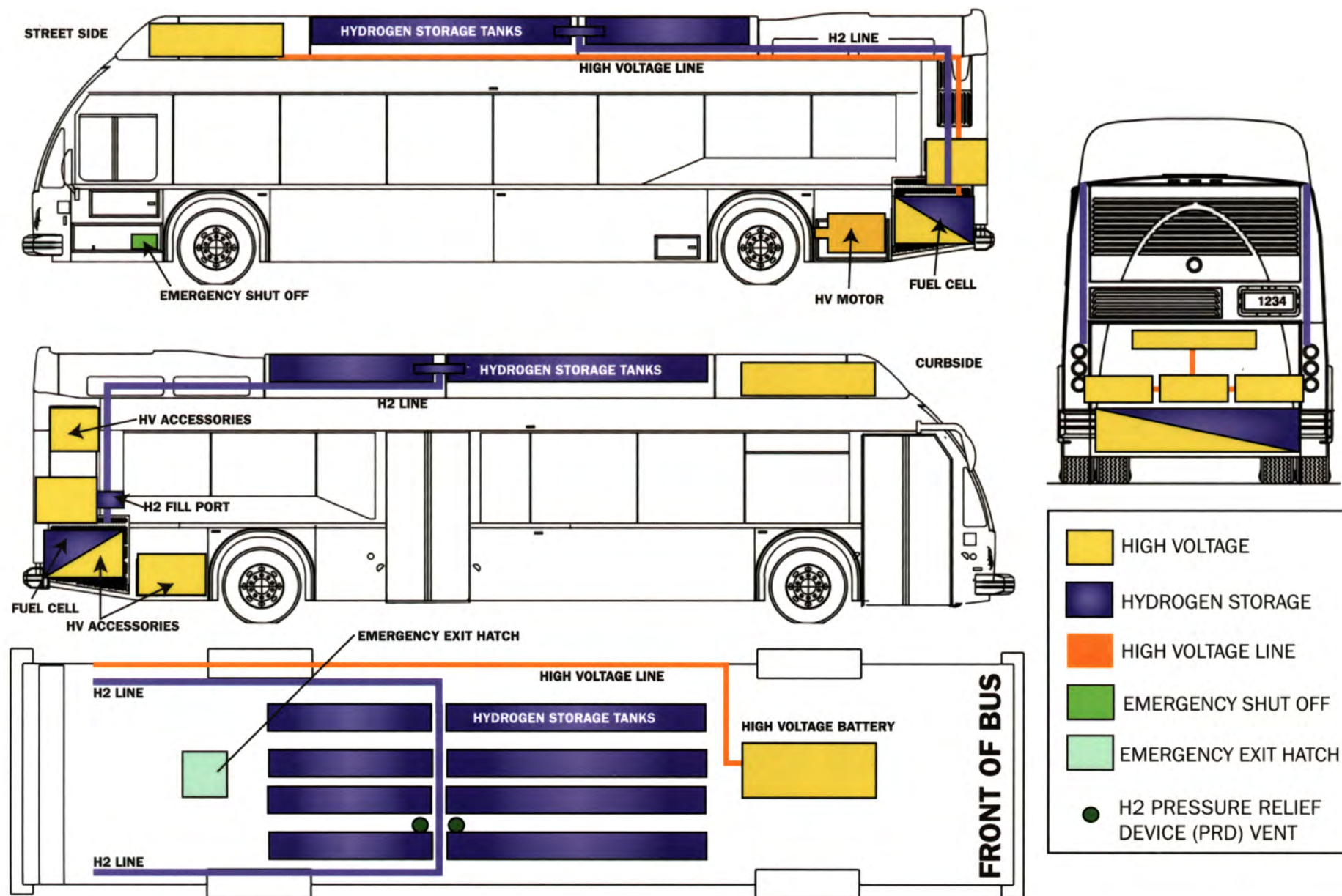
Note: Like many other GM vehicles, the Equinox Fuel Cell is equipped with OnStar, which may notify your area's Public Safety Answering Points ("9-1-1" call center) if a crash occurs.

FUEL CELL BUS RESPONSE GUIDE

BAE SYSTEMS

INSPIRED WORK

Warning: Yellow and purple denotes high voltage and high pressure hydrogen. Never cut for any reason or personal injury may result.



FUEL CELL BUS RESPONSE GUIDE

To shut down electrical and hydrogen systems

1. Set parking brake by pulling the handle up then
2. Turn master run switch to “OFF” position or
3. Turn master 24-volt switch to “OFF” position

