ix35 FCEV

Emergency Response Guide

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Introduction

Forward

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

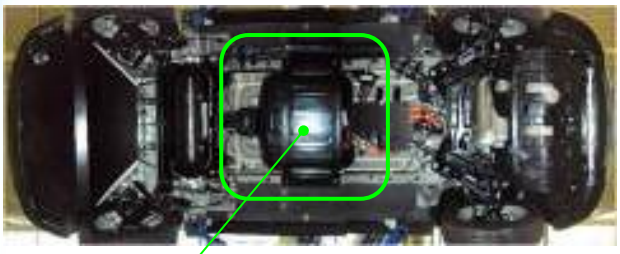
Fuel Cell Electric Vehicle, unlike the regular internal combustion engine vehicle, use an high voltage electrical energy generated in the fuel cell stack as a power source. Owing to this high voltage electricity, it requires to handle with a care for the high voltage hazard. The followings are safety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

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 dissembled without special tools.
3) There is a high risk of electrical shock due to a 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

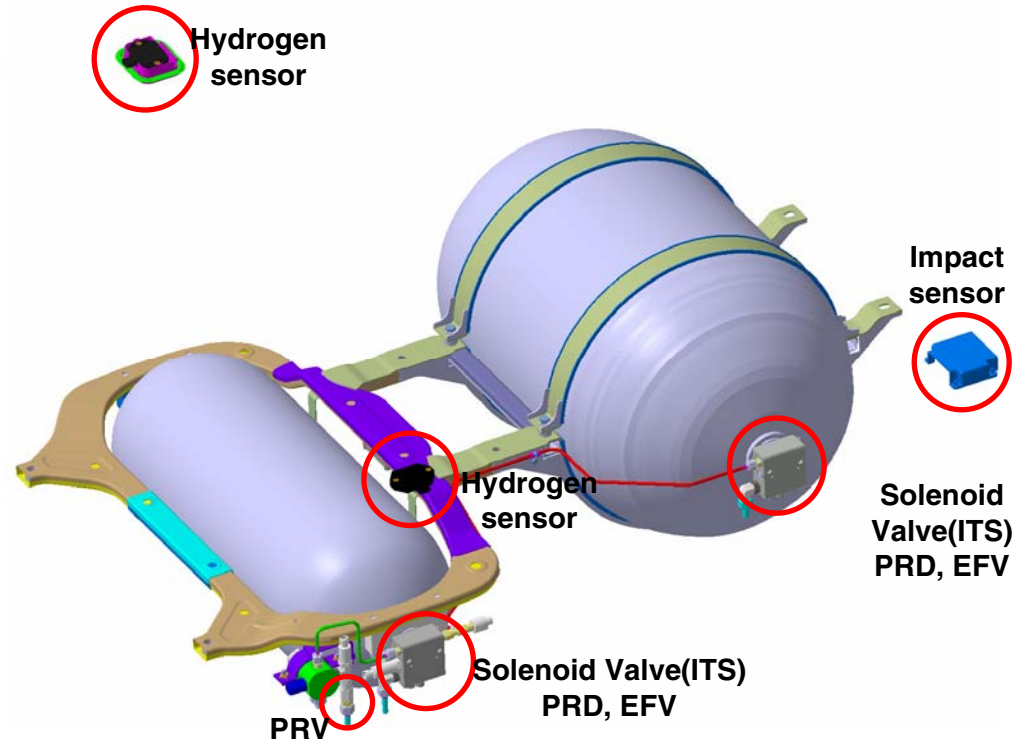
Gas	CH_4	C_3H_8	H_2
Diffusion	1.0	0.63	3.8
Turbulent Flow	1.0	0.6	2.83

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 additon, 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 hyd rogen gas. Be sure to follow safety instructions below. Failure to follow safety instructions may result in s erious 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.

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- 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 volt age 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 c onventional 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

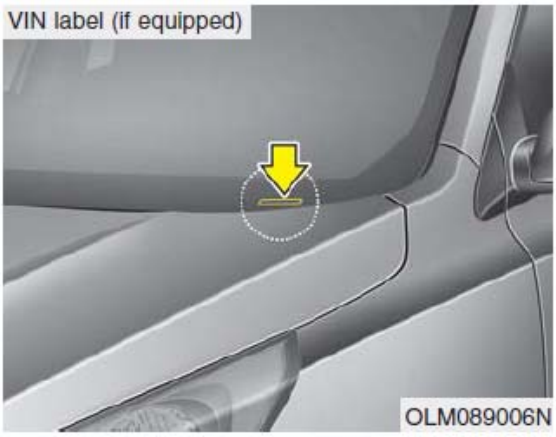
Vehicle Identification Number (VIN)

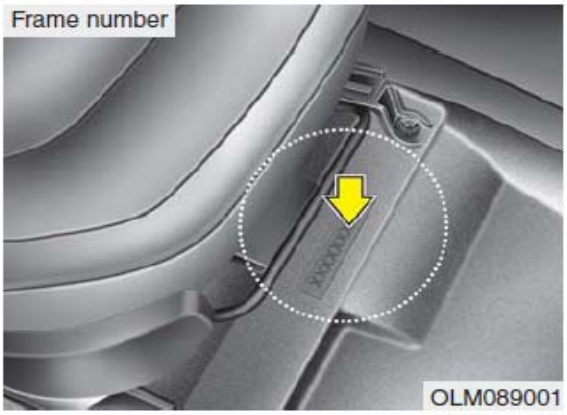
The Vehicle Identification Number (VIN) is used to determine whether a vehicle is conventional or FCEV.

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.

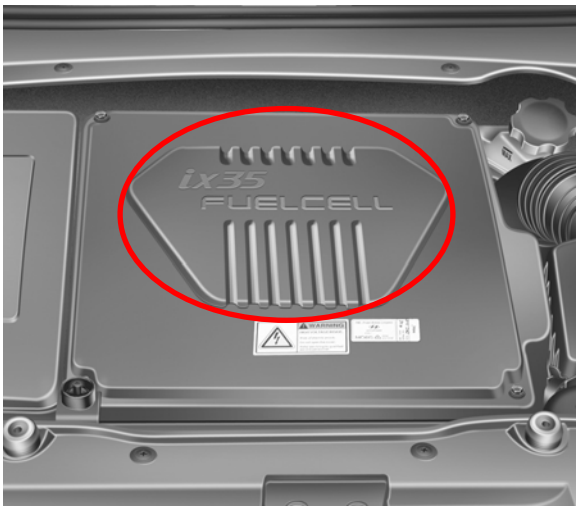
XXXXXXX6XXXXXXXXX (8th position)





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.

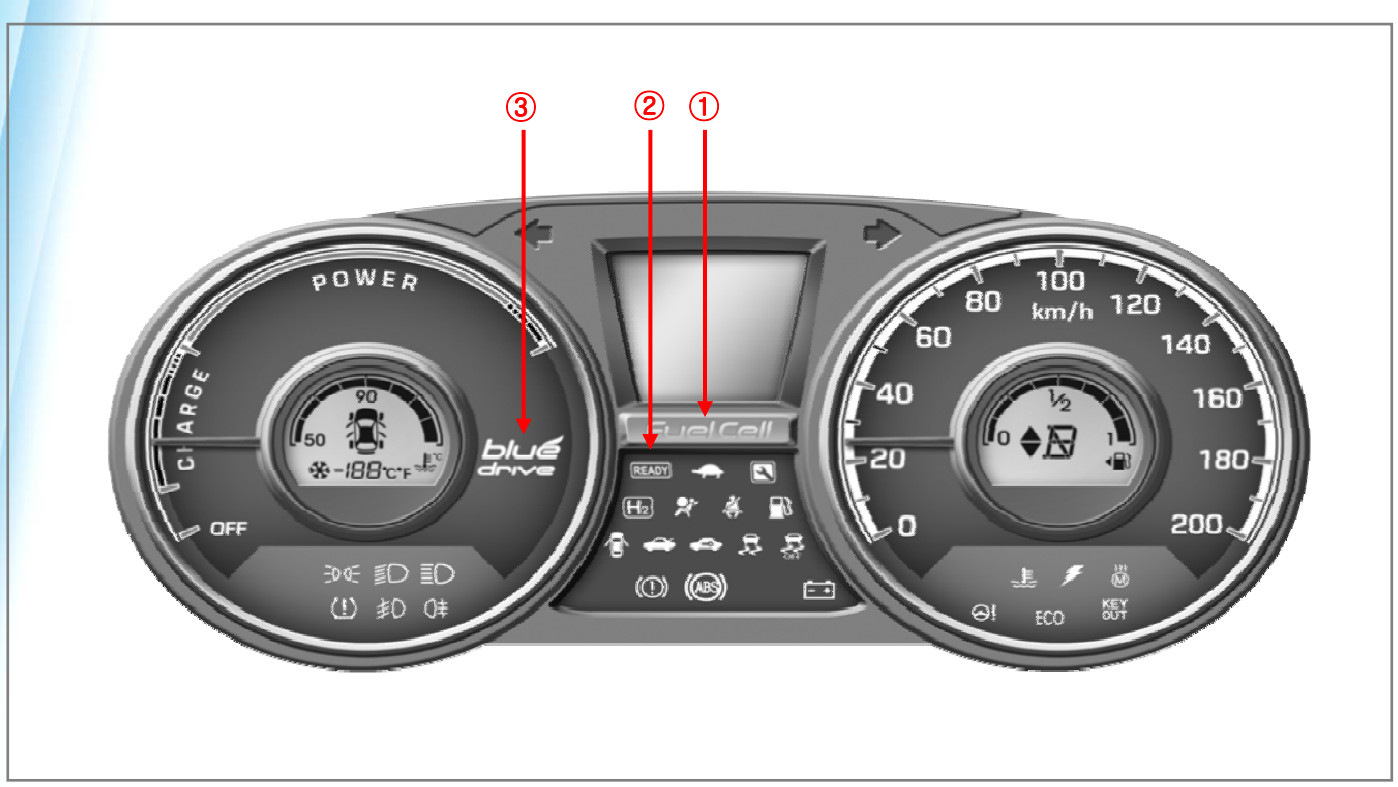


Additionally, there are orange colored high-voltage electrical cables in the fuel cell module compartment.

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.

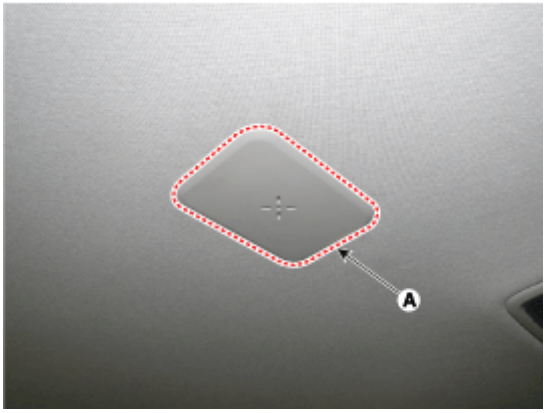


Roof

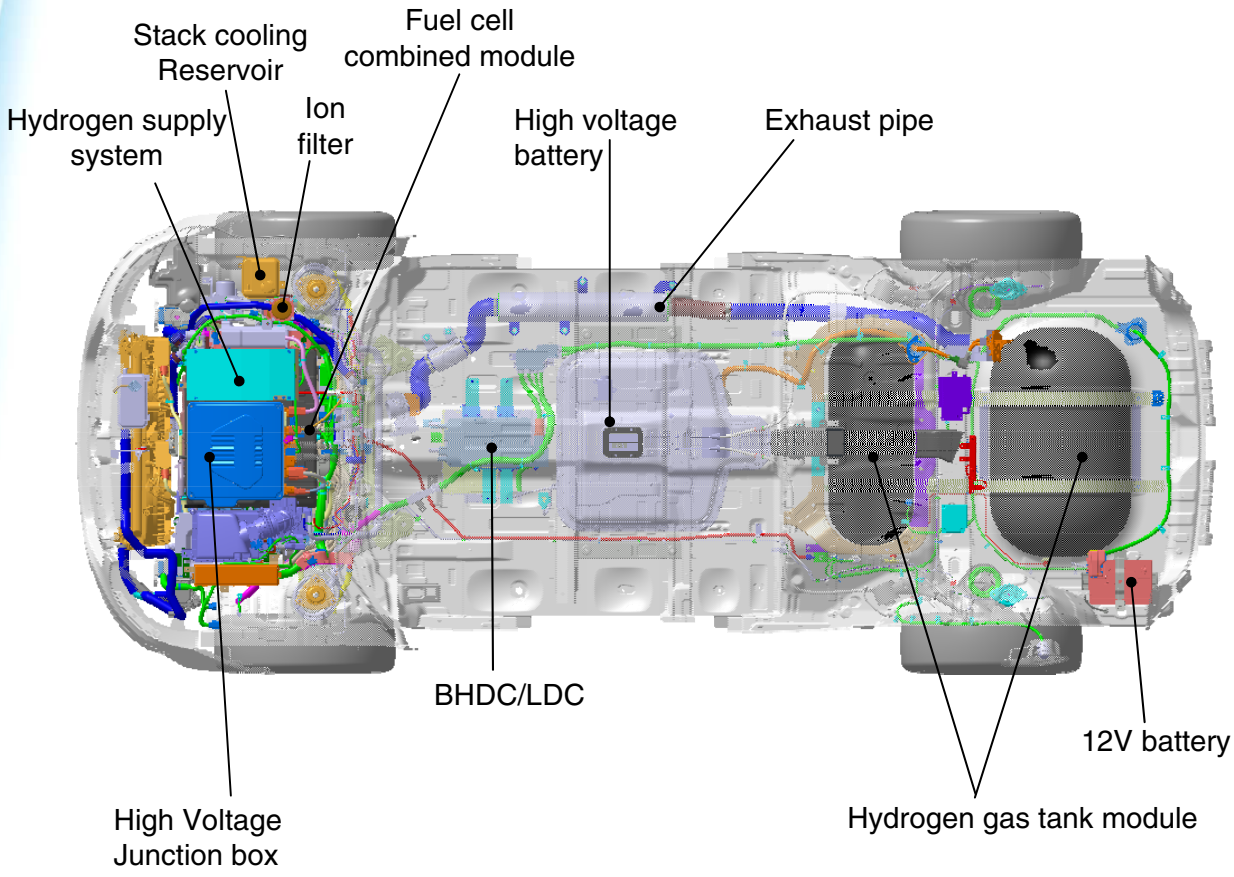
There is a hydrogen sensor (A) on the cabin roof .

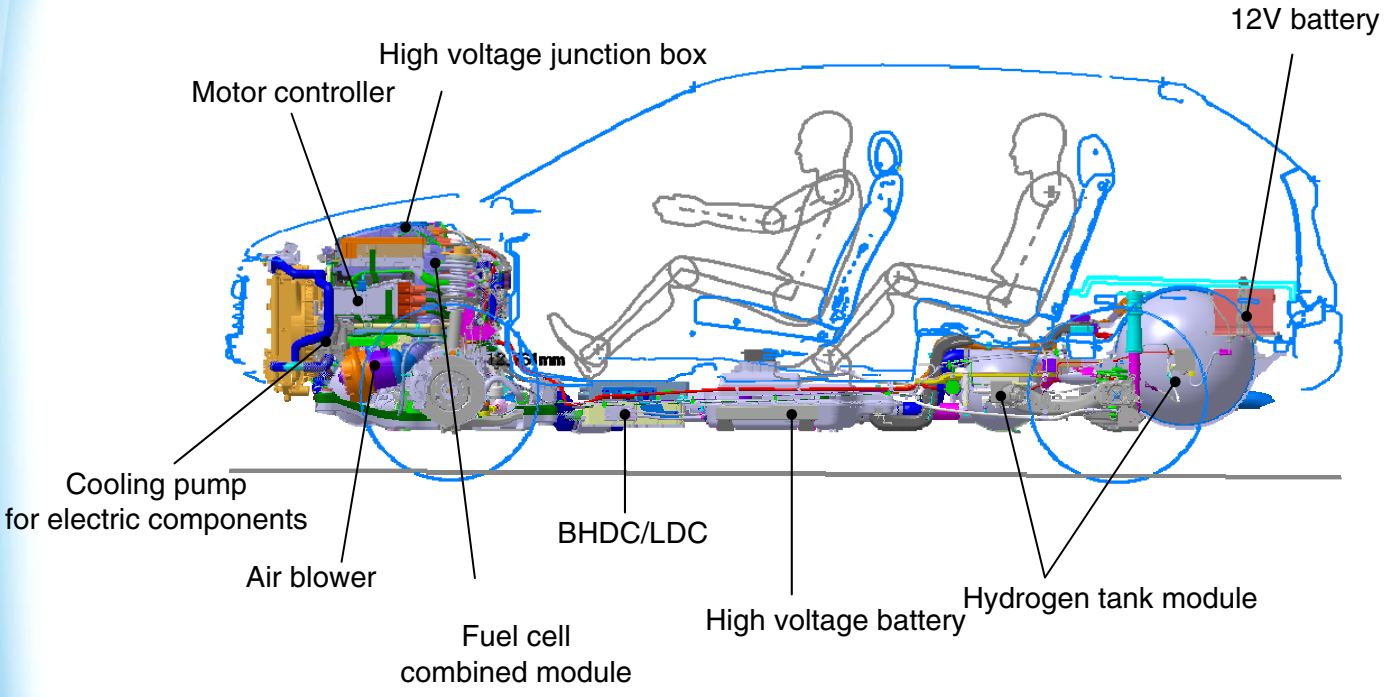
If hydrogen content increases due to a hydrogen leak, the FCU stops the fuel cell system or the vehicle.

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

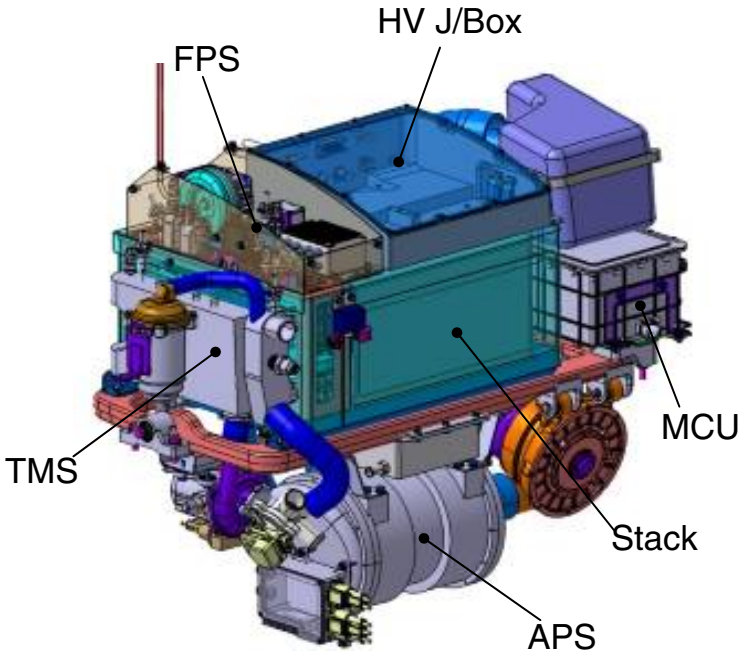
FCEV Systems Overview

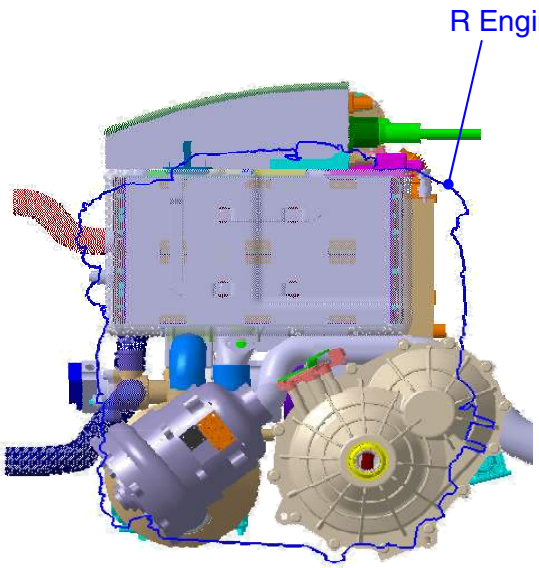
1. Fuel cell power module
2. Motor
3. High voltage battery
4. Hydrogen tank

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.

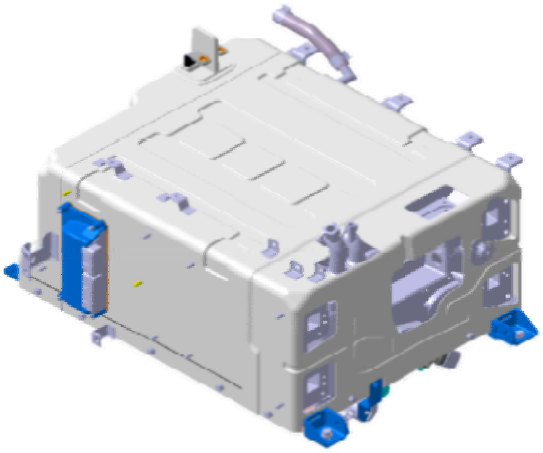
These components are installed in engine room or underneath the vehicle

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.

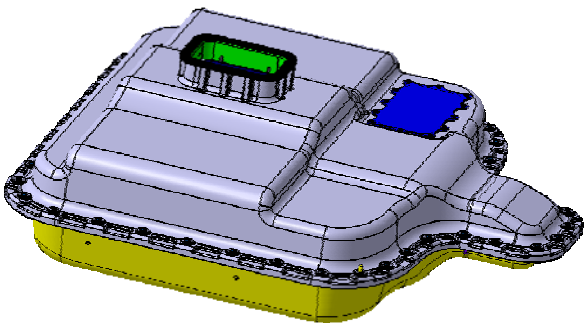
Batteries are either primary or secondary. Primary batteries are used only once because the chemical reactions that supply the electrical current are irreversible. Secondary batteries can be used, charged, and reused. In these batteries, the chemical reactions that supply electrical current are readily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



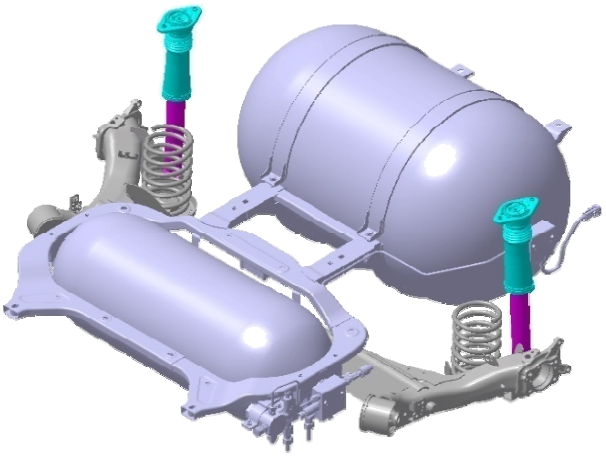
High voltage battery

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℃~85℃. Maximum allowable pressure is limited to 87.5MPa (12,691psi) @ 85℃.

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

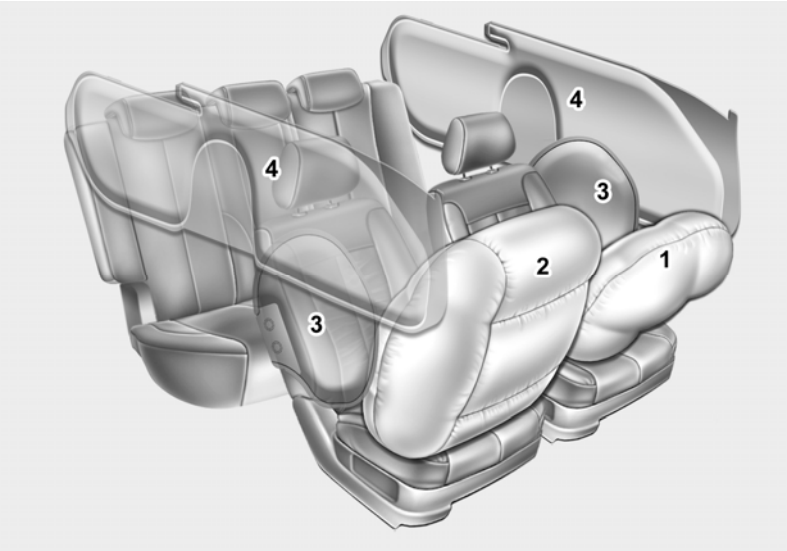
Conventional 12V battery is located in the luggage room(under the luggage room cover). The battery supplies the power to head lamps, audio, and other electric components. This battery is also being used to drive fuel cell system at Initial stage after start.

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

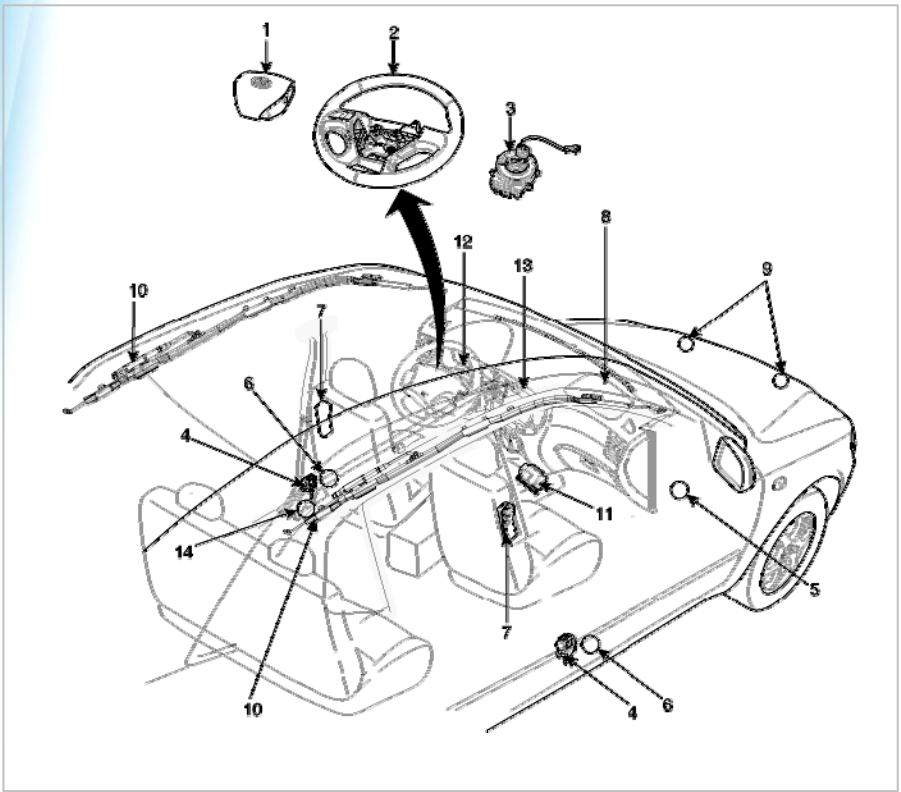
Seatbelt Pretensioners

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)	kgH2 / 100 km	0.95 kgH2/100 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 duringdriving, 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:

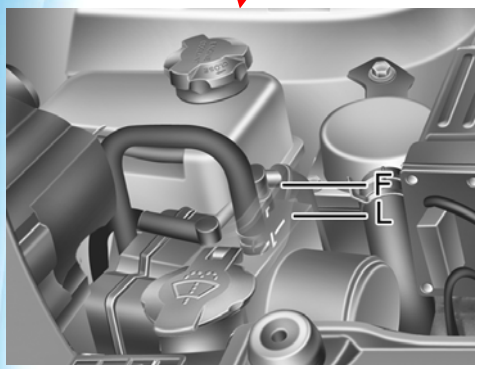
• When the motor or inverter is overheated. Do not continue driving with an overheated motor or inverter. If your vehicle remains overheated, we recommend that you have the vehicle inspected by an authorized HYUNDAI dealer.

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.

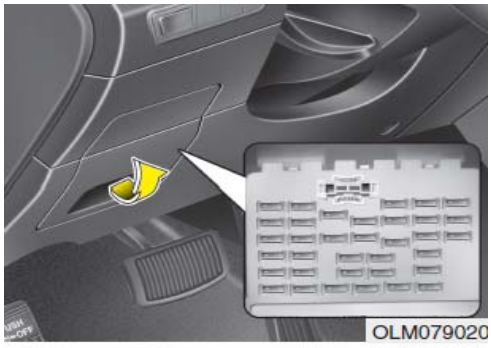
Fuse Box Position and Engine Room Layout



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

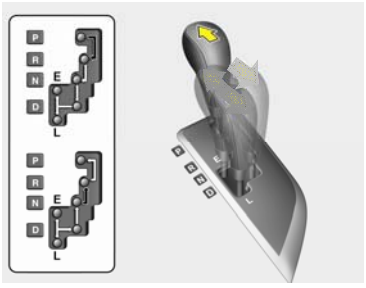
When working with a ix35 at an accident scene, emergency responders should always assume that it is a FCEV model until it can be proven otherwise using the identification features outlined at the beginning of this Emergency Response Guide (ERG). External stickers and badging will usually be the first 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

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.

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

NOTICE

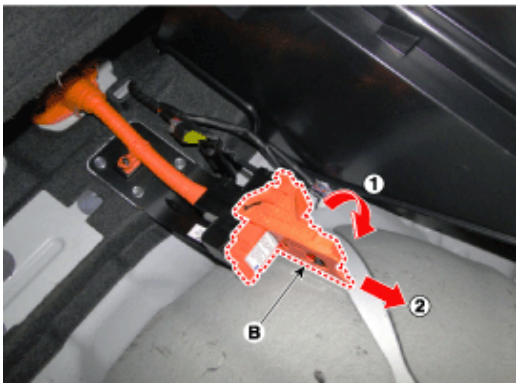
Before disconnecting the 12V battery (-) cable ,

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.

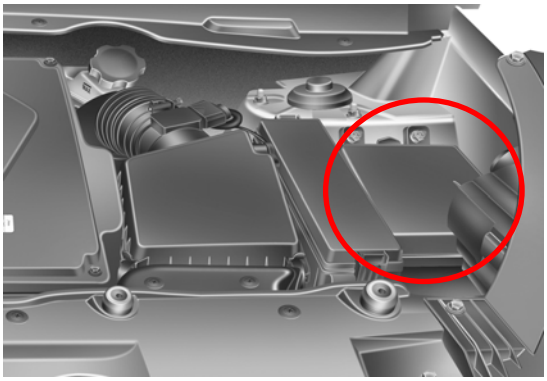
2) Remove the safety plug after pulling the lever (B) 90 degrees in the direction of the arrow.



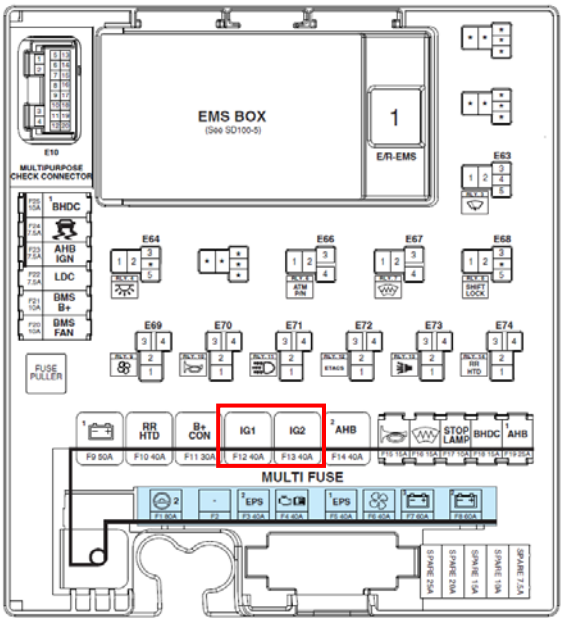
Ⅱ. Secondary Method

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.

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

1) Lift the locking hook (A) in the direction of the arrow.

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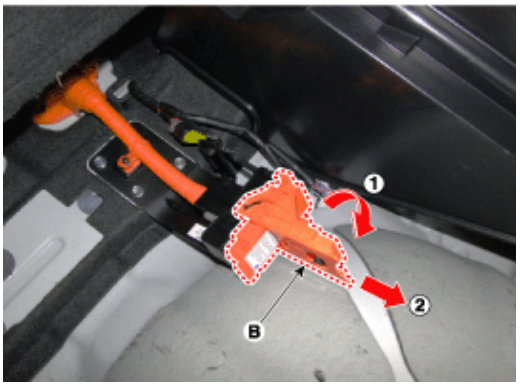


If neither of the preceding methods can be completed, emergency responders must be aware of the potential for accidental SRS activation as well as understand that there is no guarantee that the high-voltage system has been shut down.

⚠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.

Cribbing Points

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.

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

• 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

• CO_2

• 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.

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:

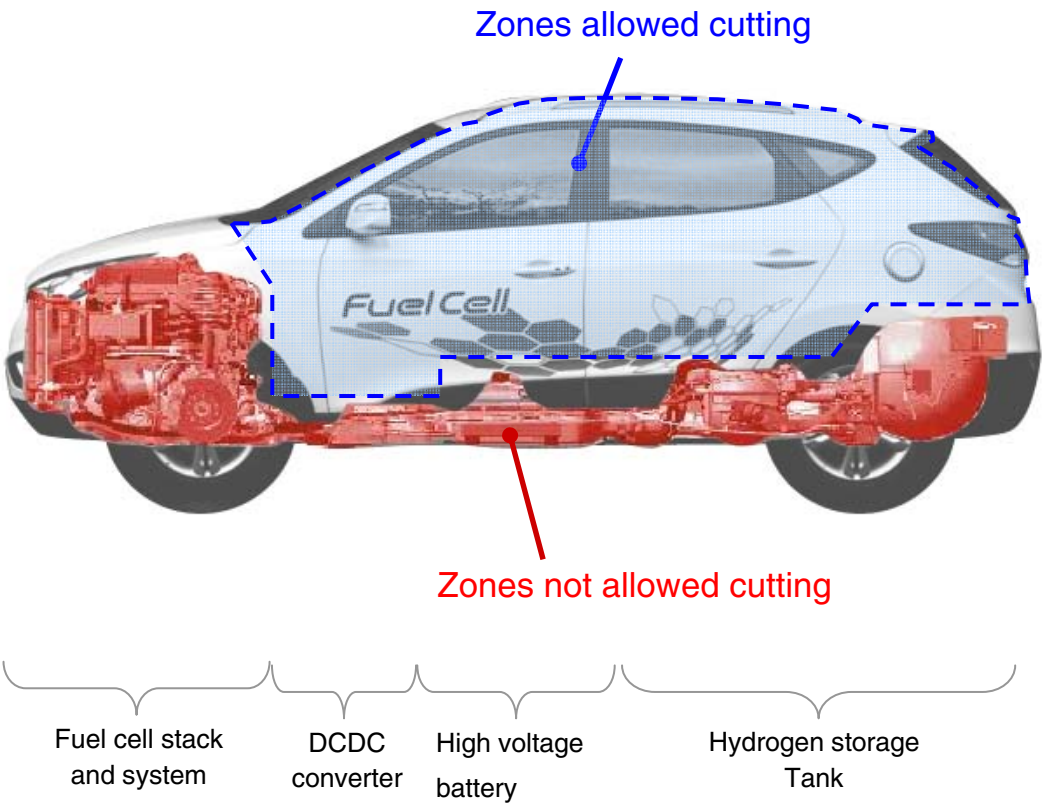
• Harmful gasses

• 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.

⚠ 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.

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.

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.

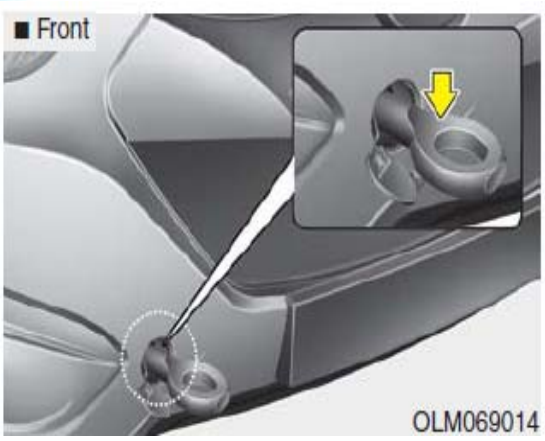
[Ingestion]

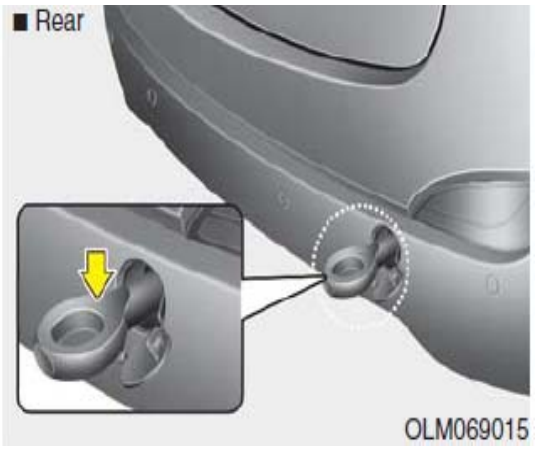
- Compel the victim to drink milk or water and induce vomiting.

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.

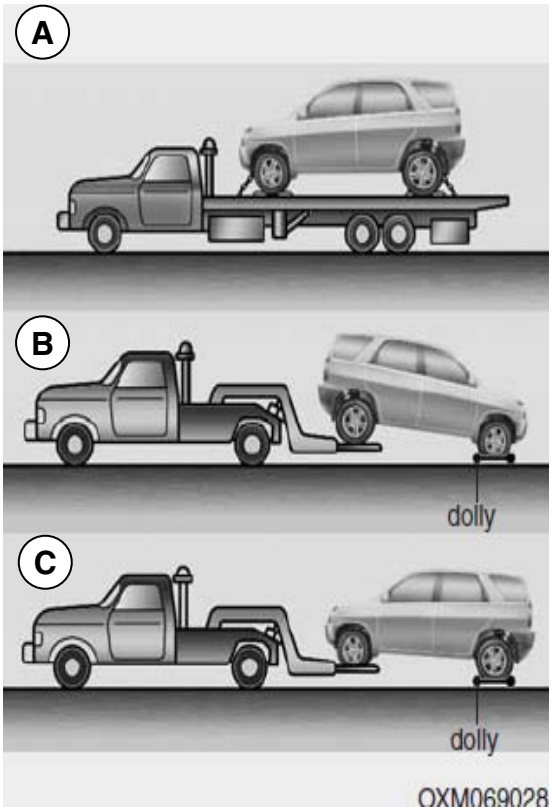




A. Towing via flatbed is the recommended method for transporting a ix35 FCEV.

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.

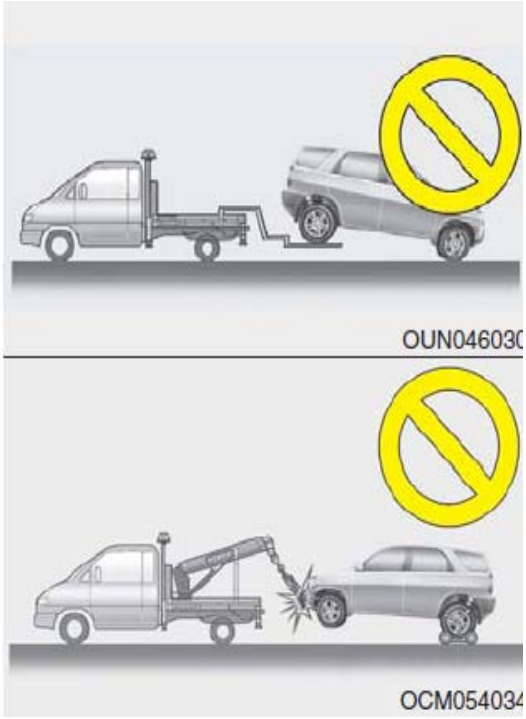
C. The vehicle can be towed with the front wheels supported by the lifting equipment in most cases that do not involve damage to wheel, tire, or suspension components.



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).

Check the luminous intensity

⚠ 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.