

# *Tucson Fuel Cell*

## Emergency Response Guide

Prepared for Fire Service, Law Enforcement, Emergency Medical,  
and Professional Towing Personnel.

NEW THINKING.  
NEW POSSIBILITIES.



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# Introduction

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## Forward

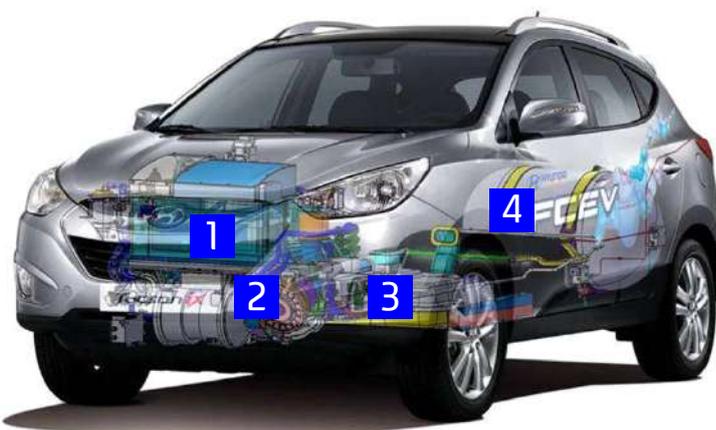
Hyundai has high standards and is dedicated to the safety of our customers and emergency responders alike. Hyundai is providing this fuel cell electric vehicle information as a result of our commitment to safety.

## 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 Tucson 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 Tucson with additional information provided on dealing with the hydrogen system and high-voltage electrical system.

## Vehicle Description

The Tucson hydrogen fuel cell vehicle is an electric vehicle that uses fuel cells to convert hydrogen and oxygen into electrical power. The body structure of the Tucson Fuel Cell is essentially the same as a conventional Tucson and both vehicles share many common parts. The Tucson Fuel Cell vehicle chassis and most components are made of steel and aluminum. Many of the interior components and the trim components are made of plastic. The electric motor and power train of the Tucson Fuel Cell are located in the engine compartment much like a conventional vehicle. The high voltage battery is located underneath the center of the vehicle.



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

# High Voltage Safety System in FCEV

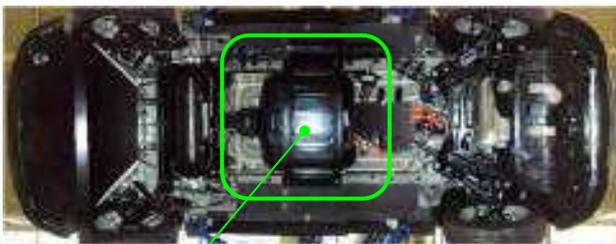
## Fuel Cell Stack

The main power source of the Tucson Hydrogen Fuel Cell electric vehicle comes from the fuel cell stack. The fuel cell stack contains layers of individual fuel cells that combine hydrogen and oxygen to produce a voltage. The cells are stacked together in series to multiply the voltage and generate electricity, which is used to drive the electric traction motor. The only by-products of this electrochemical process are heat and water. Some of the water is recirculated to the humidifier. Excess water is extracted out of the tailpipe. Because the fuel cell stack generates over 400V when operating, some precautions are required.

- 1) The fuel cell stack is located in the engine compartment, underneath the high voltage junction box and the fuel processing unit. The fuel cell stack is housed in a metal enclosure which is insulated from the rest of the vehicle.
- 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.

## High voltage battery system

The high voltage battery system is comprised of a lithium-ion polymer battery that operates at a nominal voltage of 180V. This battery stores power generated by the fuel cell stack and also by the traction motor during regenerative braking. The battery provides extra current to the traction motor during acceleration. The high voltage battery is located underneath the vehicle near the center of the vehicle and is stored in a protective steel enclosure.



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	106 lb (47 Kg )

# High Voltage Safety System in FCEV

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To ensure safety, the high voltage battery system cuts off the main relay when the ignition is off. The main relay is enclosed within the high voltage battery module assembly. An over-current protection circuit is used, and all high voltage cables are identified by distinctive orange coloring. A safety plug which houses the high voltage main fuse is also applied to isolate the high voltage from the rest of the vehicle.

## Safety of high voltage system

Direct contact with any electrically-charged high voltage component can cause serious injury or death. However, as long as certain precautions are taken, the risk of getting electrocuted is highly unlikely. The high voltage components of the Tucson hydrogen fuel cell vehicle are designed to provide reliable insulation resistance and protect against the occurrence of electrical shock. Most of the high voltage components are located within a protective enclosure. The enclosure is mounted to the chassis and is electrically grounded should there be a change in the insulation resistance between the high voltage component and the enclosure. All high voltage power cables are sufficiently insulated and can easily be identified (orange color). High voltage fuses protect devices from overheating and a Ground Fault Detector (GFD) circuit will shut off the high voltage relay if a current leak is detected. To disconnect the high voltage battery from the rest of the vehicle, a safety plug accessible from the rear of the vehicle inside the trunk can be easily removed. (Refer to page 22 for detailed instructions on how to remove the safety plug.)

# Safety Issues of Compressed Hydrogen

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## General Features of Hydrogen

Hydrogen is a gas at room temperature and is the lightest of all the elements and has the lowest density. It is non-toxic, odorless, tasteless, and colorless. It makes up about 75% of the mass of the universe since it is present in most organic compounds and in water. As a result, it is the most abundant element on earth. 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.

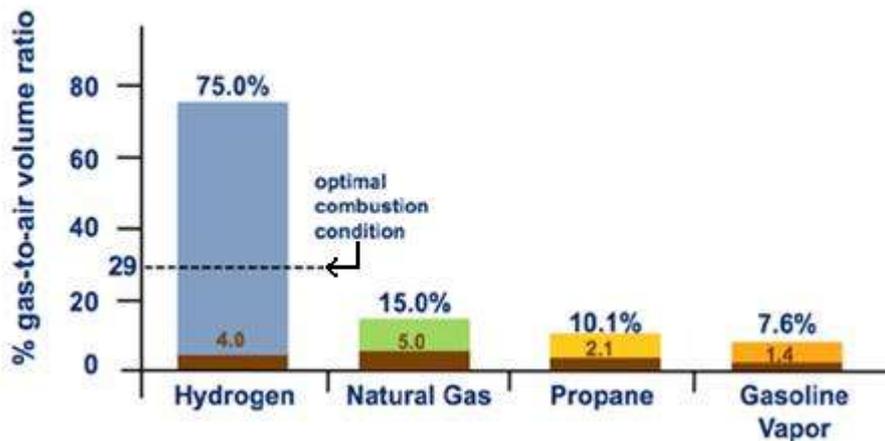
Because it is lighter than air and diffuses rapidly, hydrogen burns very quickly and radiates less heat than gasoline or other fuels. Pure hydrogen-oxygen flames emit ultraviolet light and are invisible to the naked eye. As such, the detection of burning hydrogen requires a flame detector.

## Facts About Hydrogen Gas

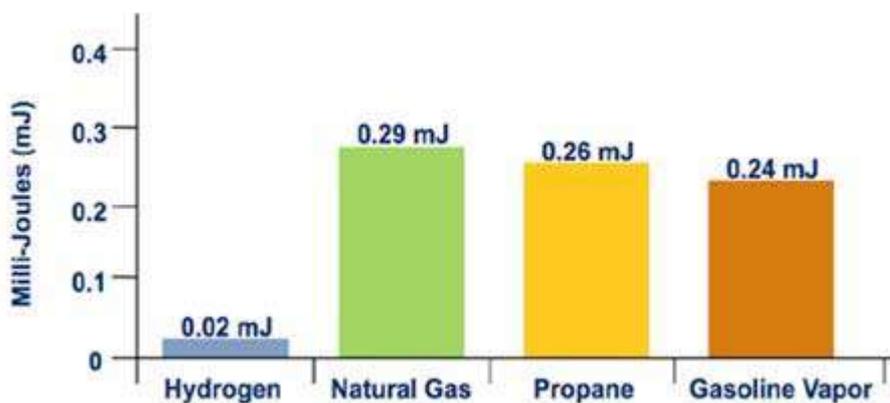
- Like gasoline or natural gas, hydrogen is a fuel that must be handled properly. It can be used safely as with other common fuels when simple guidelines are followed. Some key properties of hydrogen and some important facts are listed below:
- Hydrogen is the lightest and smallest element in the periodic table; it is two times lighter than helium
- Hydrogen is a colorless, odorless, tasteless, non-toxic, and non-poisonous gas at room temperature. It is also non-corrosive, but it can cause embrittlement in some metals
- Natural gas and propane are also odorless, but industry adds a sulfur-containing odorant so people can detect them. Currently, odorants are not used with hydrogen because there are no known odorants light enough to "travel with" hydrogen at the same dispersion rate. Current odorants also can contaminate the hydrogen fuel cell
- Hydrogen is about 57 times lighter than gasoline vapor, and 14 times lighter than air. This means that if it is released in an open environment, it will typically rise and disperse rapidly. This is a safety advantage in an outside environment.
- Hydrogen is a very small molecule with low viscosity; as a result it is prone to leakage
- Hydrogen gas is highly flammable and will burn in air at a very wide range of concentrations between 4% and 75% by volume; the mixture may be ignited by spark or heat
- Pure hydrogen-oxygen flames emit ultraviolet light. The flames are nearly invisible to the naked eye. A good example of this is the faint plume of the space shuttle main engine at full thrust (cryogenic liquid hydrogen) versus the highly visible plume of a space shuttle solid rocket booster (solid rocket propellant)

# Safety Issues of Compressed Hydrogen

- Impurities such as sodium from ocean air or other burning materials will introduce color to the hydrogen flame. In daylight, a hydrogen flame can be seen with thermal imaging. At night, a hydrogen flame is visible
- The destruction of the Hindenburg airship was an infamous example of hydrogen combustion; the cause is debated, but the visible orange flames were the result of a mixture of hydrogen to oxygen combined with carbon compounds from the airship skin



## Flammability Range



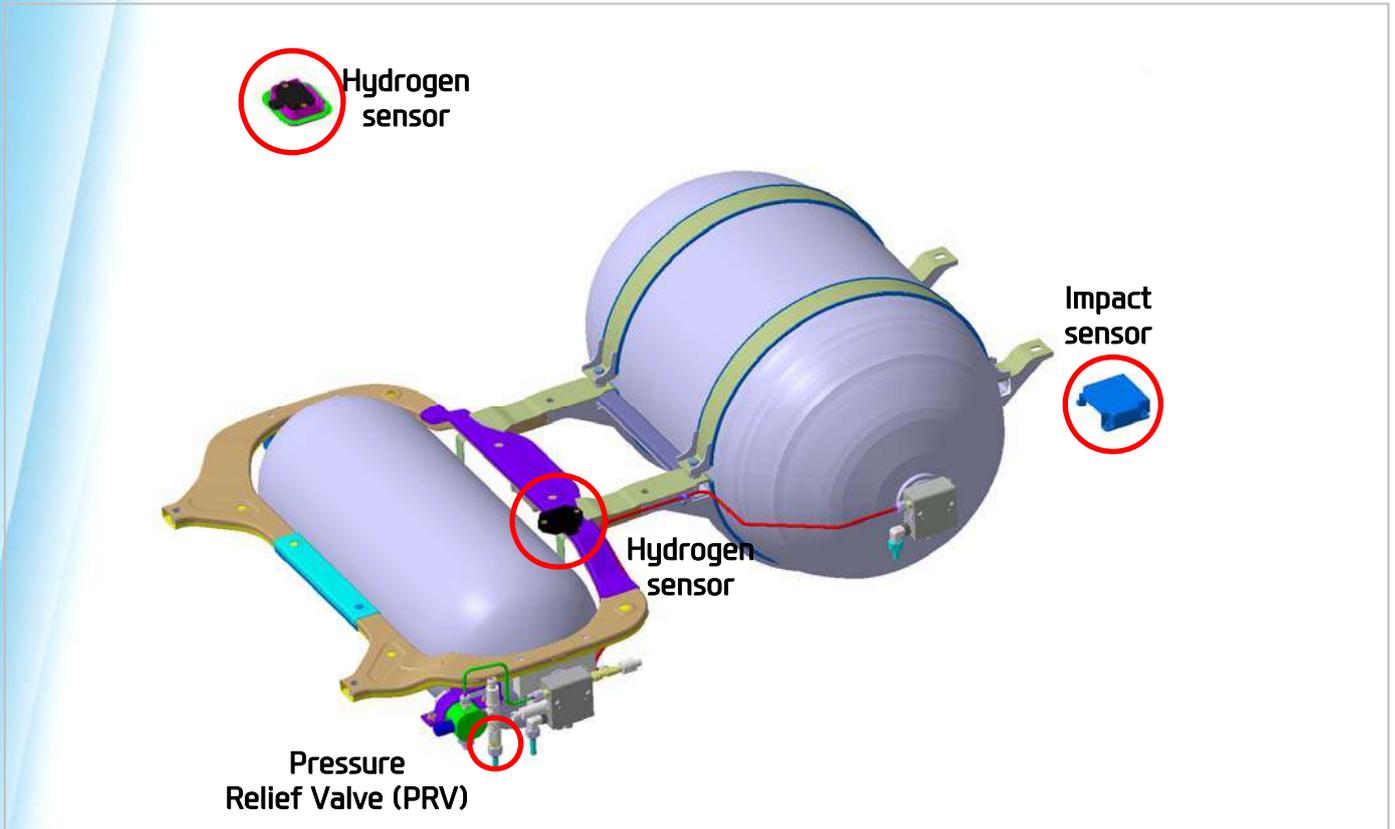
## Minimum Ignition Energy

### 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 Safety Devices

### In-Tank Solenoid Valve (ITS)

Solenoid valves are directly connected to each tank to control the flow of hydrogen. The solenoids are energized ON when the vehicle is operating (READY state), and OFF when the vehicle is turned off.

### Thermally-activated Pressure Relief Device (PRD)

The in-tank solenoid valve is also equipped with a Pressure Relief Device (PRD) that discharges the hydrogen in the tank if the gas temperature exceeds 110°C [230°F].

### Excess Flow Valve (EFV)

The in-tank solenoid valve includes an Excess Flow Valve (EFV) that functions as an overflow prevention mechanism and prevents excessive discharge of hydrogen from the fuel tank that might occur (for example, in the case of damage to the high pressure line).

### Pressure Relief Valve (PRV)

A Pressure Relief Valve is mounted to the Hydrogen Pressure Regulator and will vent hydrogen to atmosphere if the pressure in the line exceeds the regulated pressure.

## Front and Rear Impact Sensors

As part of the vehicle crash safety system, the front and rear impact sensors are installed on the front bumper and the rear floor member, respectively. In the event of a front end or rear end collision, the system controller will automatically shut off the flow of hydrogen to the vehicle and the vehicle will shut down.

# Safety precaution for FCEV

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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 Precautions with the Hydrogen Storage System]

### **⚠ 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 comprised of two separate tanks that are interconnected and filled with hydrogen gas. Each tank is made of aluminum cylinder wrapped in carbon fiber. The cylinders contain hydrogen gas under high pressure. Serious injury or death can result from improper installation, lack of maintenance, or over pressurization. Do not attempt to remove the fuel tanks or any of its fittings from the vehicle. The tanks may contain residual flammable gas under pressure which could cause fire or explosion.

## [Safety Precautions with the 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: Insulating Gloves, Safety Glasses, etc.)

# Tucson FCEV Identification

## General Vehicle Description

The Hyundai Tucson Hydrogen Fuel Cell vehicle is built on the conventional Tucson chassis and therefore looks very similar to its conventional counterpart. The information provided below will help to identify the Tucson Fuel Cell Vehicle for first responders and emergency personnel.

## [Exterior Visual Identification]

### 1. Badging

The Tucson Hydrogen Fuel Cell vehicle can be identified by unique badging found on the exterior of the vehicle.

1) On the rear tailgate on the right hand side there is a "Fuel Cell" badge. Just below the Fuel Cell badge is a blue-colored diamond sticker with the words "Compressed Hydrogen" in white letters. This is the standard marking for hydrogen fuel cell vehicles, as specified by SAE J2578 - Recommended Practice for Fuel Cell Vehicle Safety.

2) On the front grille is the Hyundai logo, a slanted, stylized 'H' with a blue background.

Note that after a vehicle crash, some of the identifying markings may become hidden from view. Always be sure to inspect all around the fuel Cell vehicle in order to fully.



# Tucson FCEV Identification

## 2. Vehicle Identification Number (VIN)

The Vehicle Identification Number (VIN) is a unique number that can be used to help identify the type of vehicle.

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

A sample VIN for the Tucson Hydrogen Fuel Cell vehicle is shown below. The number "6" in the 8th digit identifies the vehicle as a Tucson Hydrogen Fuel Cell vehicle.

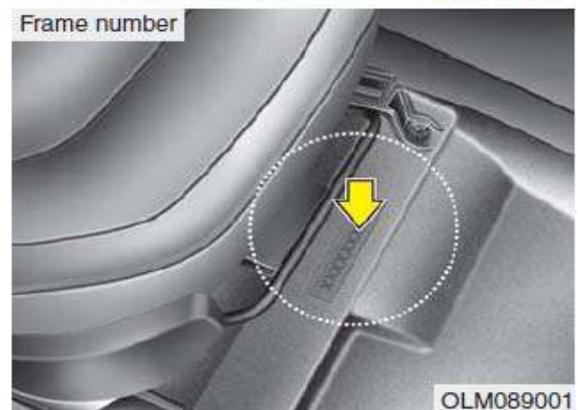
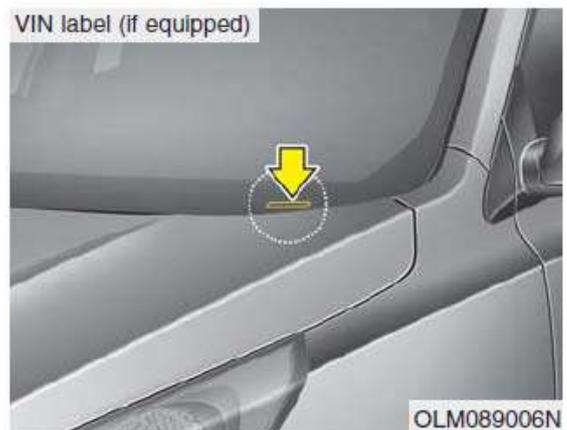
KM8JU3A**6**7EUxxxxxx (8th position)

(xxxxxx represents the vehicle serial no.)

## 3. Fuel cell module compartment

The FCEV version has a High junction box cover with "*Tucson Fuel Cell*" clearly shown on it.

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

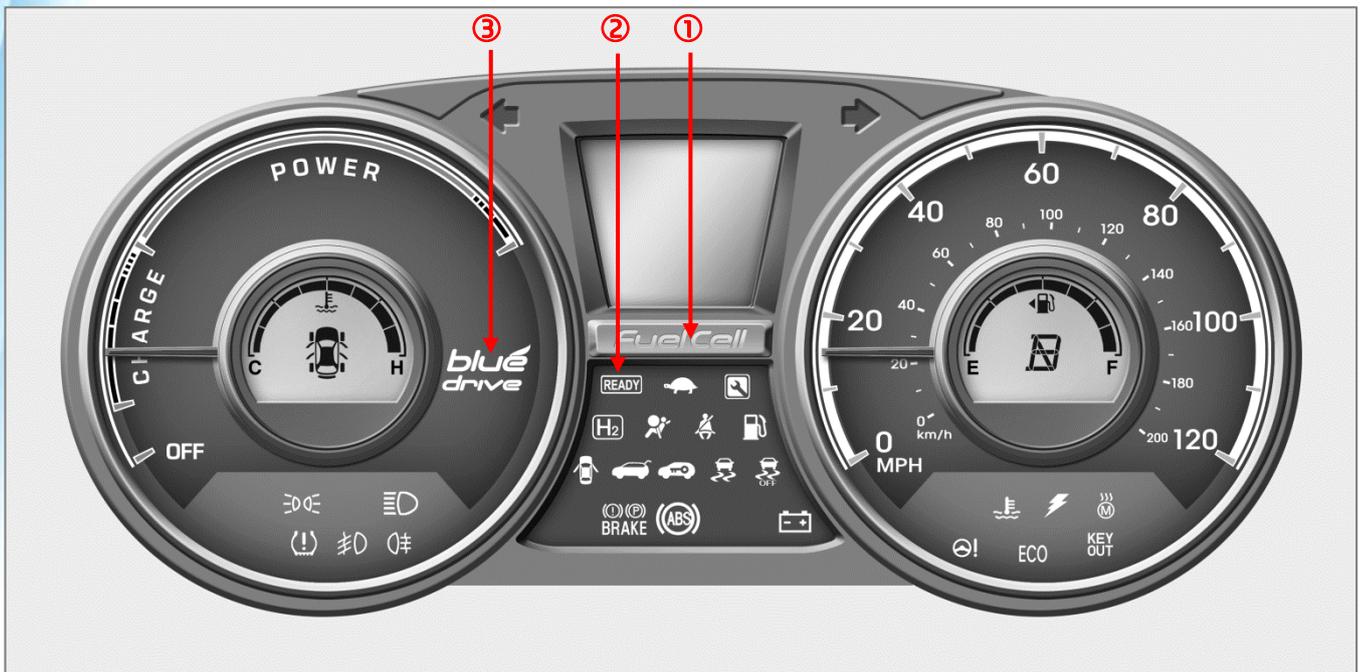


# Tucson FCEV Identification

## [Interior Visual Identification]

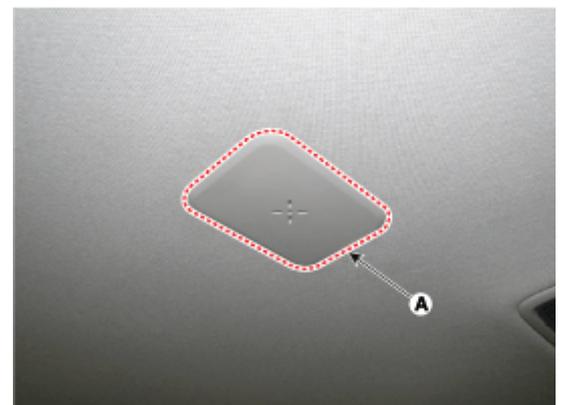
### 1. Cluster

The Tucson FCEV instrument cluster contains several unique components that are not found on a conventional Tucson. 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.

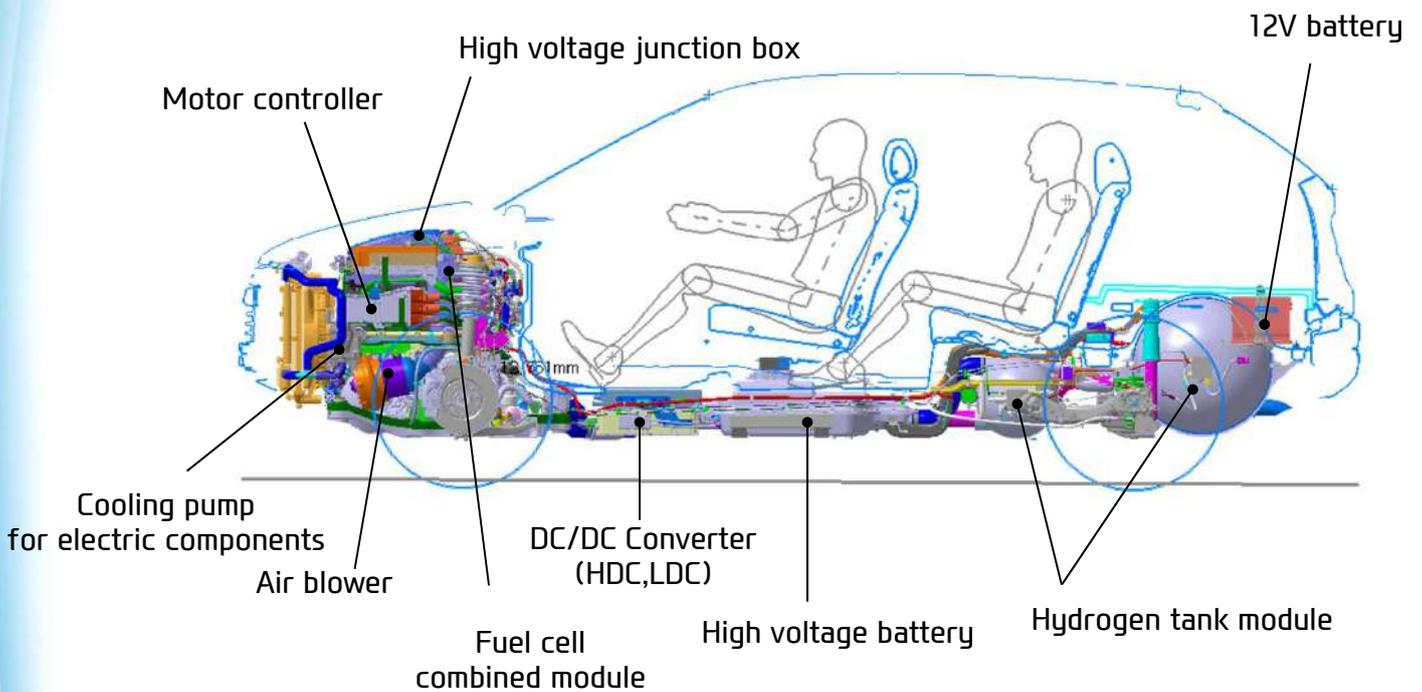
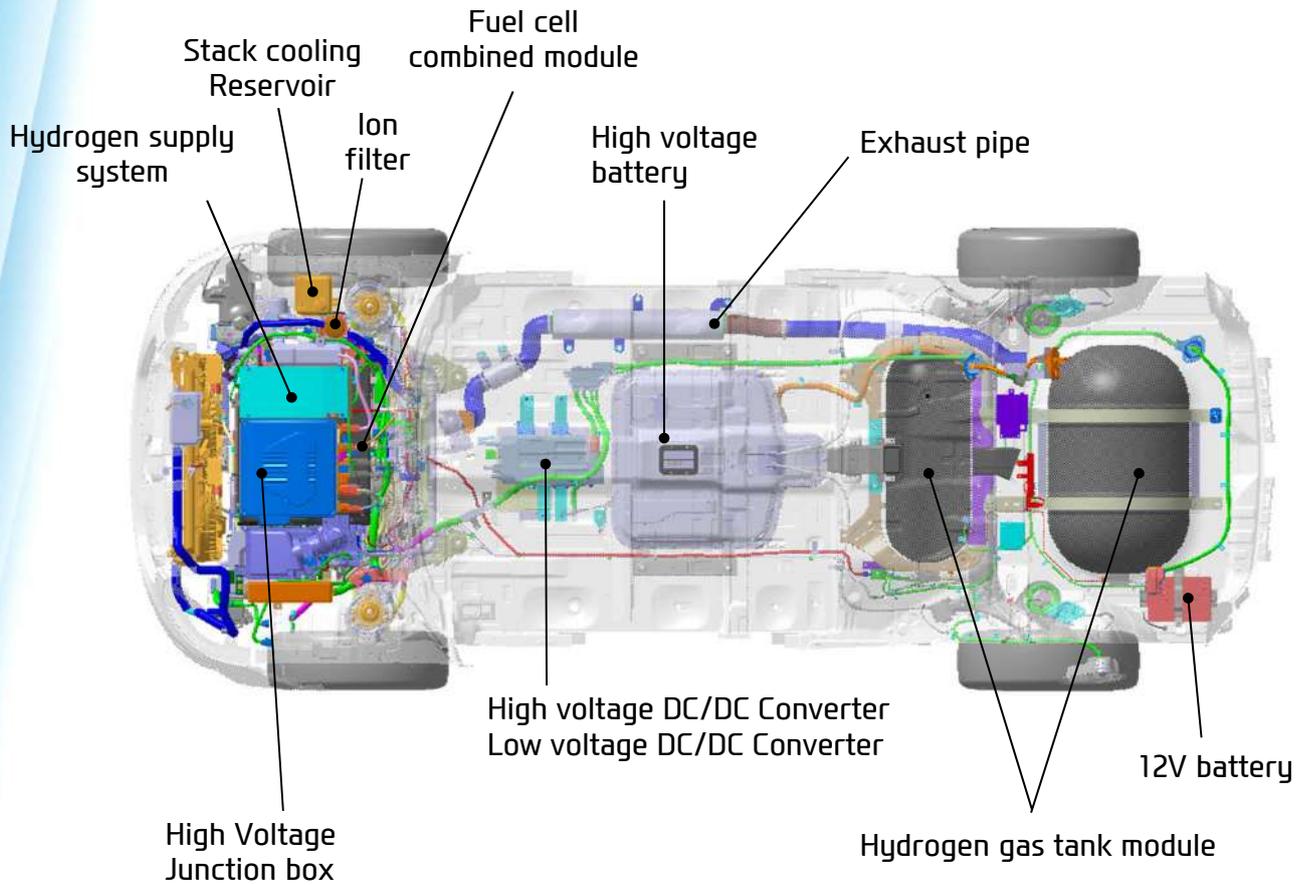


### 2. Roof

In the interior of the vehicle there is a hydrogen sensor (A) on the cabin headliner. If the hydrogen concentration increases in the cabin as a result of a hydrogen leak, the system controller shuts down the fuel cell and the driver will be alerted with a warning lamp in the instrument cluster. If this occurs, the vehicle will revert to “EV mode”, which will allow the vehicle to be driven solely on the high voltage battery system.



# FCEV Main Components



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

# FCEV Systems Overview

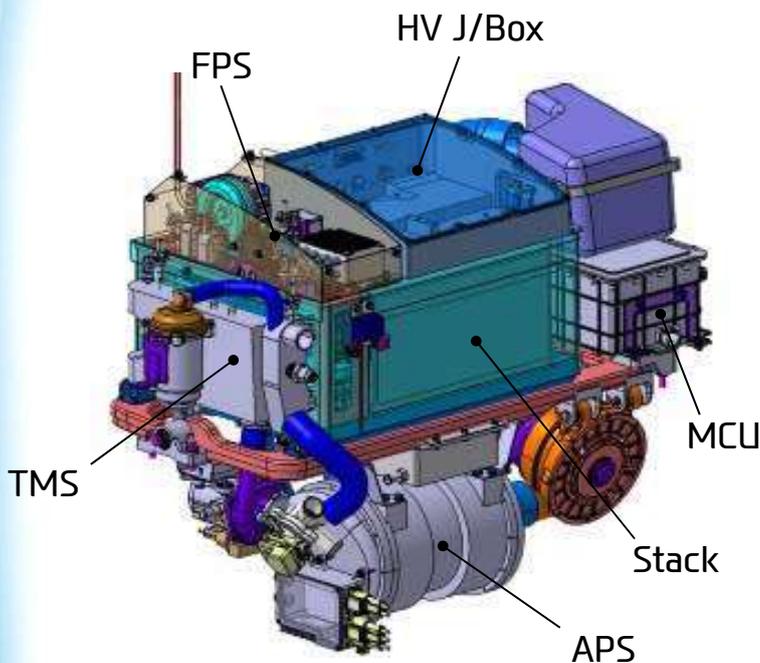
## Features of the Tucson hydrogen fuel cell vehicle

The Tucson Hydrogen Fuel Cell vehicle is an electric vehicle that generates electricity from the hydrogen fuel cell system. The Tucson Fuel Cell is manufactured on the same platform as a conventional Tucson. The primary difference between both vehicles is the powertrain.

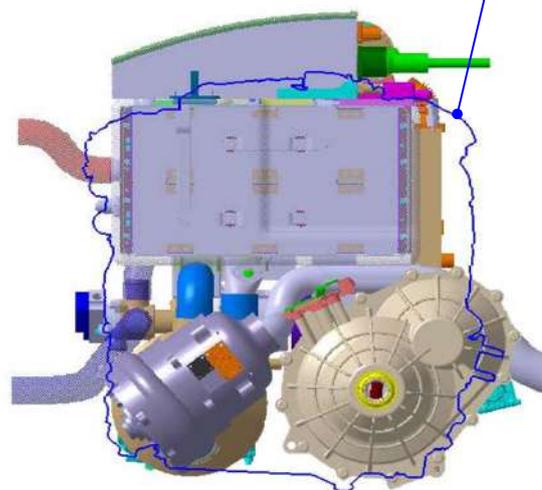
As shown in the figure, the powertrain including the Fuel Cell stack of the Tucson Fuel Cell vehicle is in the engine room compartment. An AC electric drive traction motor is also located in the engine room and provides the motive force to move the vehicle. Although slightly heavier than the conventional Tucson powertrain, the fuel cell power module is similar in size and takes up about the same amount of space in the engine room compartment.



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



Outline of conventional Tucson engine and transmission in the engine room



[Engine Vs FCEV Module Comparison]

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

# FCEV Systems Overview

The Tucson Hydrogen Fuel Cell vehicle is comprised of four major systems:

- 1) The Fuel Cell system which combines hydrogen and oxygen to generate electrical power
- 2) The Electrical Power System which provides the motive force using an electric motor
- 3) The Hydrogen Storage System which provides the fuel source for the vehicle
- 4) Components of the Auxiliary Power Supply System, which provides energy storage and battery management, are located in the engine compartment and underneath the center of the vehicle.

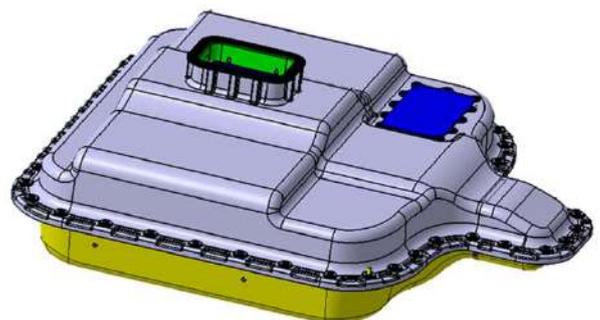
## 1. Fuel Cell Stack

The hydrogen fuel cell stack is the power generation module that generates electrical power for traction motor and the high voltage battery system. A hydrogen fuel cell is a device that converts the chemical energy from hydrogen into electricity through a chemical reaction with hydrogen and oxygen.

Fuel cells are different from batteries in that they require a continuous source of fuel and oxygen or air to sustain the chemical reaction. Hydrogen fuel cells can produce electricity continuously provided there is a sufficient amount of hydrogen and air being supplied to the vehicle.

## 2. High voltage battery

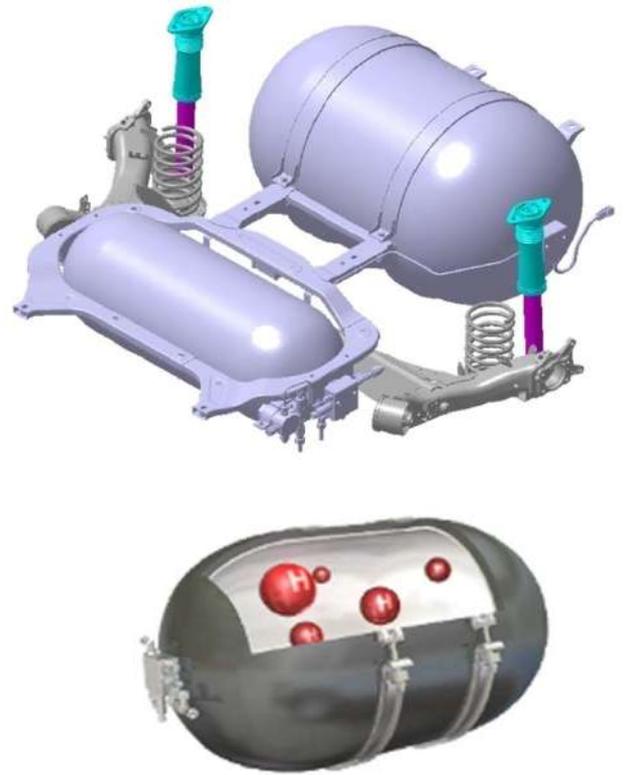
The Tucson Hydrogen Fuel Cell includes a high voltage battery system which is connected to the fuel cell stack. The battery stores electrical energy which comes from both the fuel cell stack and from the electric traction motor when the vehicle is decelerating. Electrical energy is recovered through a process called regenerative braking.



# FCEV Systems Overview

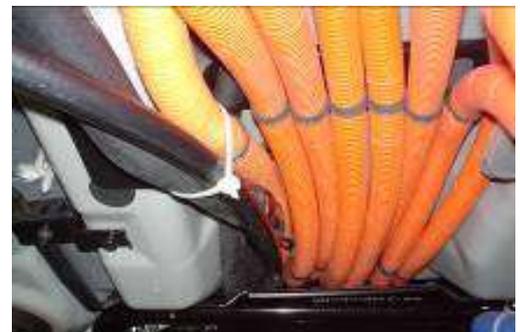
## 3. Hydrogen Storage Tank System

The hydrogen storage system is comprised of two separate tanks that are interconnected and filled with hydrogen gas. The tanks contain hydrogen gas under high pressure. When the tanks are full the corresponding tank pressure is approximately 10,000 psi (700 bar, 70 MPa). Each tank is made of an aluminum inner liner wrapped in carbon fiber. Temperatures inside the tank can range from  $-40^{\circ}\text{C}$  up to  $+85^{\circ}\text{C}$  [ $-40^{\circ}\text{F}$  to  $185^{\circ}\text{F}$ ]. A pressure regulator located near the front (smaller) tank in the vehicle reduces the line pressure to approximately 145 psi (10 bar, 1000 kPa).



## 4. High Voltage Cables

The high voltage which is generated from the fuel cell stack and stored in the high voltage battery system is distributed to various components through high voltage cables. Most of the high voltage cables are routed near the bulkhead in the engine room and underneath the vehicle. These high voltage cables are sufficiently insulated and can easily be identified by their bright orange color. Special precautions must be taken before handling the high voltage cables.



## 5. 12V Battery

A conventional 12V battery is located in the rear compartment on the driver side of the vehicle (underneath the plastic cover). The auxiliary battery power is used to initiate the fuel cell stack during startup (prior to "READY" mode). The auxiliary battery is also used to supply power to the headlamps, the audio system, and other low voltage electrical components in the vehicle.



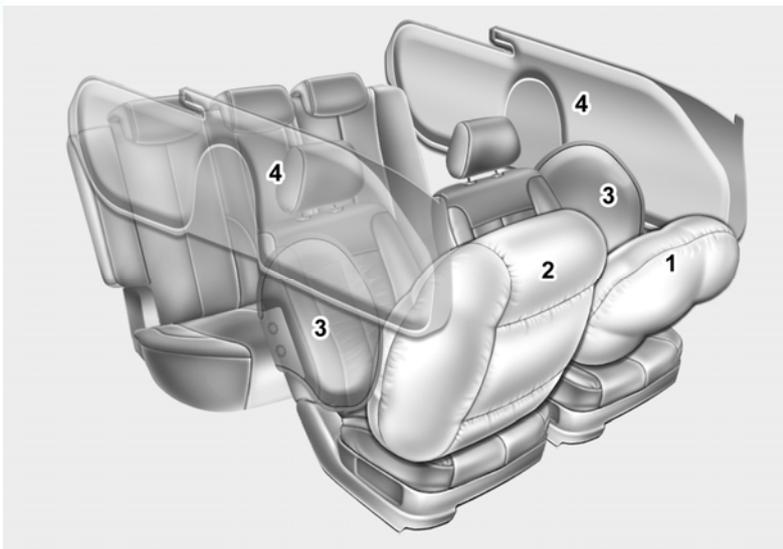
# FCEV Systems Overview

## 6. Supplemental Restraint System (SRS)

### 1) Air bag

The Tucson hydrogen fuel cell vehicle is equipped with a total of six airbags for passenger protection. These airbags are located in standard areas of the vehicle. Precaution should always be taken to disconnect the 12V auxiliary battery power from the vehicle before any emergency extrication operation or before emergency personnel enter the vehicle. This will disable the Supplemental Restraint System and prevent accidental deployment.

#### <Airbag Types and Locations>



1. Driver's front Air Bag
2. Passenger's front Air Bag
3. Side impact Air Bag
4. Curtain Air Bag

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

# FCEV Systems Overview

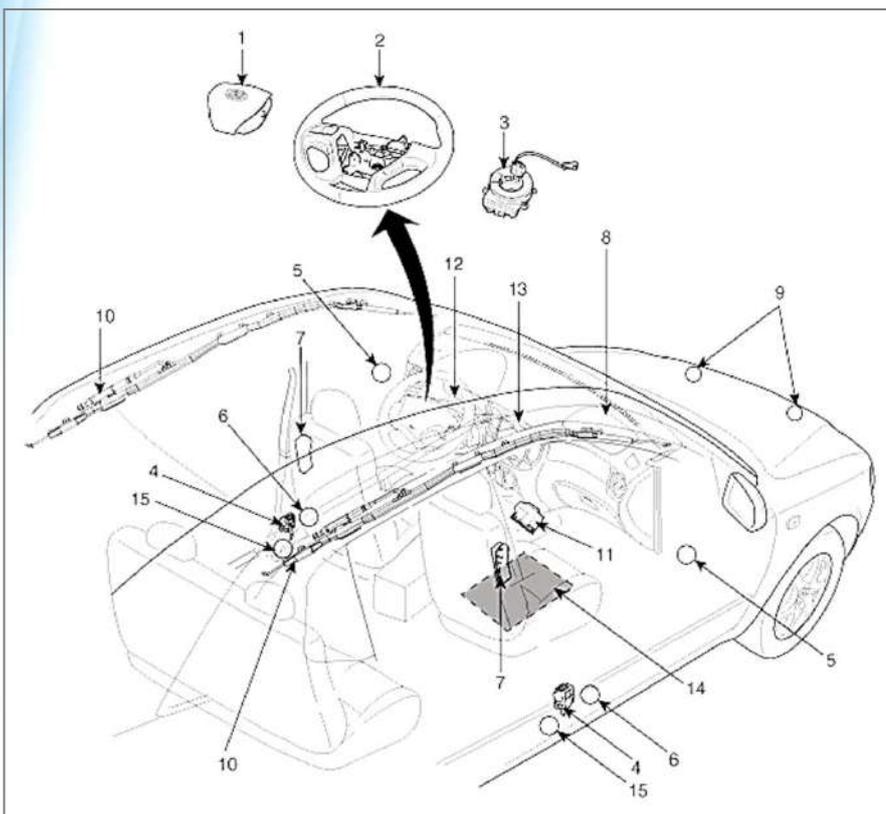
## 2) Seatbelt Pretensioners

The Tucson hydrogen fuel cell vehicle 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.

## 3) 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. Pressure Side Impact Sensor (P-SIS)
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 Control Module (SRSCM)
12. Airbag Warning Lamp
13. Telltale Lamp
14. Passenger Occupant Detecting System (PODS)
15. Anchor Pretensioner (APT)

### **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	mph	100
0 - 60 Acceleration Time	sec	12.5 (0-62mph)
Driving range (Approx.)	miles	About 250
Maximum torque	lb-ft	221 at 1,000 rpm
Drive train power	kW (hp)	100 (134) at 5,000 rpm
No. of Passengers	-	Up to 5 passengers
Ambient temperature limits vehicle operation	min °F	-4~104 °F
	max °F	
Maximum hydrogen storage capacity of the vehicle	lb of H <sub>2</sub>	12.4 lb. at 10,000 psi
High Voltage Battery Energy	kWh	0.95
Power output battery	kW	24



# Warning Lamps on Cluster



## Power Down Warning Lamp



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 while driving, this indicates that there may be a malfunction with the fuel cell stack. If this occurs, have the vehicle inspected by an authorized Tucson fuel cell dealer.

## Hydrogen Gas Leak Warning Lamp



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 while driving, this indicates that there may be hydrogen leakage. If this occurs, turn off the vehicle and have the vehicle inspected by an authorized Tucson fuel cell dealer.

There are four hydrogen gas detectors located in the vehicle. When the sensor is triggered, the hydrogen fuel cell system will be shut down. At that time, the vehicle will revert to "EV mode", which will allow the vehicle to be driven solely on the high voltage battery system. EV mode is limited to only about 1 mile of driving range, therefore it is important to pull over to the side of the road as soon as it is reasonably safe to do so. When the vehicle has stopped, turn OFF the ignition and contact an authorized Hyundai Tucson Fuel Cell dealer immediately.

## Motor Overheat Warning Lamp



This warning light illuminates:

- When the motor or inverter is overheated. Do not continue driving with an overheated motor or inverter. Have the vehicle inspected by an authorized Tucson fuel cell dealer.

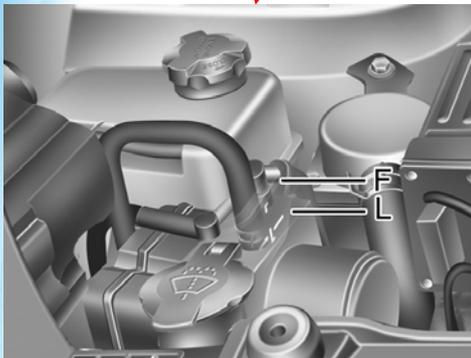
## Service Lamp



This warning light illuminates:

- When the fuel cell electric vehicle control system is not working properly. If the warning light continuously remains on, have the vehicle inspected by an authorized Tucson fuel cell dealer.

# Fuse Box Position and Engine Room Layout



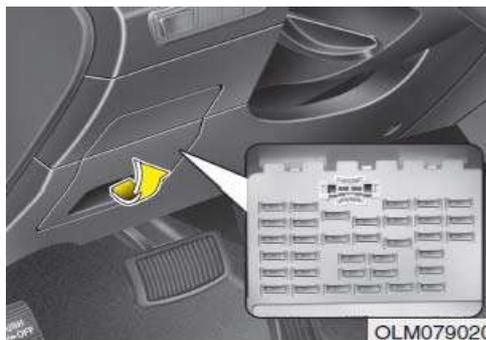
Fuel cell coolant reservoir



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 Tucson Hydrogen Fuel Cell vehicle at an emergency scene. All other operations should be consistent with your department's Standard Operating Procedure.

## 1. Identify

When working with a Tucson at an accident scene, emergency responders should always assume that it is a Tucson Hydrogen Fuel Cell vehicle 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 Tucson hydrogen fuel cell vehicle is essentially an electric vehicle, there is little or no sound from the electric motor that is generated when the vehicle moves. When the vehicle is in the "READY" state, as indicated in the cluster, the vehicle can move if the accelerator is depressed. 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.



# 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 the fuel cell and the 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.

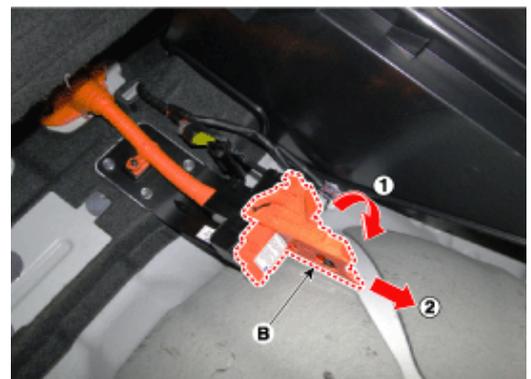
## NOTICE

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 plug 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.

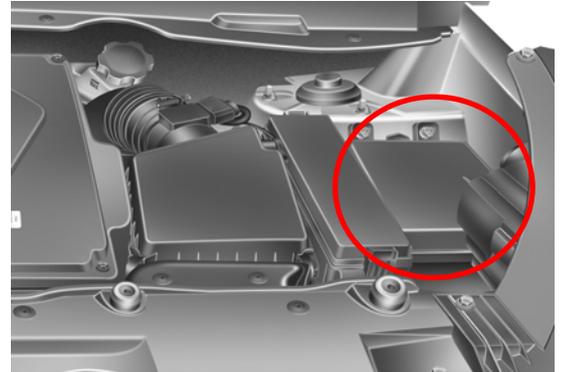


# Emergency Procedures – Initial Response

## II. Secondary Method

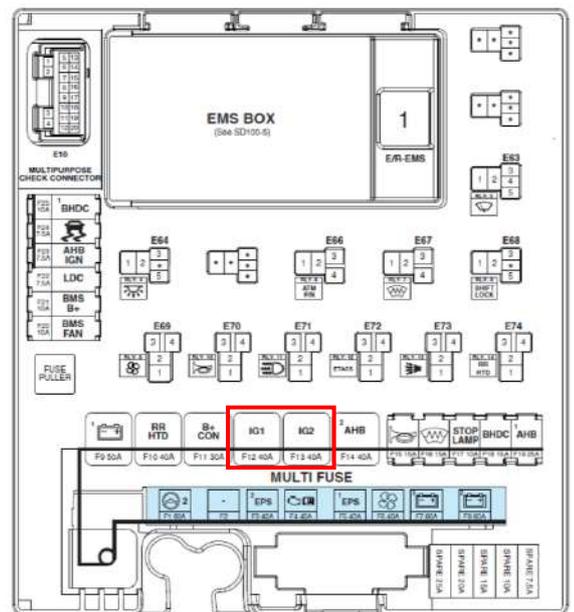
- ① Remove the fuses      ② Disconnect the 12V Auxiliary Battery      ③ Remove the service plug

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

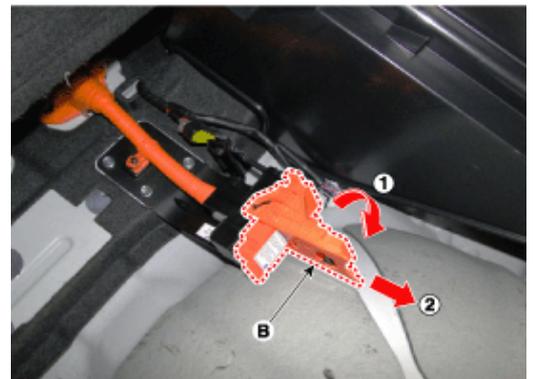
Before disconnecting the 12V battery (-) cable , if necessary, lower the windows and unlock the doors. Once the 12V battery (-) cable is disconnected, the window and door lock controls will not operate.



# 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 Tucson hydrogen fuel cell vehicle in an emergency, the following sections will address specific types of emergencies.

## Extrication

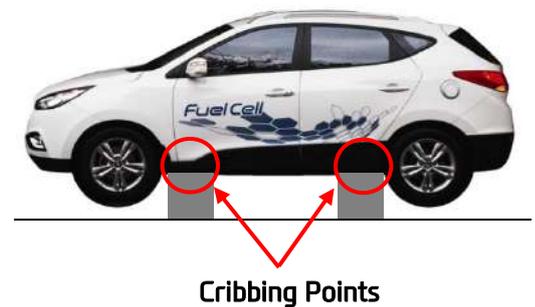
Extrication operations for the Tucson hydrogen fuel cell vehicle is almost the same as for a conventional vehicle, but

with some exceptions. Utilize the “Identify, Immobilize, and Disable” model described in the previous pages prior to engaging in emergency 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.



## Tire Deflation

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 Tucson hydrogen fuel cell vehicle specific details that are covered in this guide.

## 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 enough away from the vehicle to protect yourself from fire or explosion. Once in a safe location, call the fire department to report the incident. Inform any first responders that the vehicle is a hydrogen fuel cell vehicle.

### [For firefighters]

If the Tucson hydrogen fuel cell vehicle is involved in a fire, follow standard fire fighting procedures, but follow these precautions:

- Keep away from the rear of the vehicle until the fire is completely out.
- If the temperature inside either of the hydrogen tanks exceed 110°C [290°F], the hydrogen in the tank will be released through a pressure relief device located on each solenoid mounted to the tank. You may hear a hissing sound as the hydrogen gas escapes.
- Do not attempt to put out a hydrogen gas fire. Instead, allow the fire to burn until the hydrogen gas is depleted (about 5 minutes). Note that pure hydrogen flames are nearly invisible; you may see colored flames if other parts of the vehicle are burning.

## 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

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If the high voltage battery module located underneath the center of the vehicle is either involved in fire or at risk of catching fire, certain additional precautions must be taken in regards to the high voltage battery system. Note the following when conducting fire fighting operations on a Tucson hydrogen fuel cell vehicle:

- Lithium-ion Polymer batteries contain gel electrolyte that can vent, ignite, and produce sparks when subjected to temperatures above 300°F.
- The lithium-ion polymer batteries may burn rapidly with a flare burning effect.
- A burning battery may release hydrogen fluoride, carbon monoxide, and carbon dioxide gases. Be sure to have adequate full face protection with a self-contained breathing apparatus and full protective gear.

## Extinguishers

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

- Dry chemical
- CO<sub>2</sub>
- Large amounts of water
- Regular foam

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

- Large amounts of water
- Fog
- Regular foam

# Emergency Procedures – Specific types Response

## Overhaul Operations

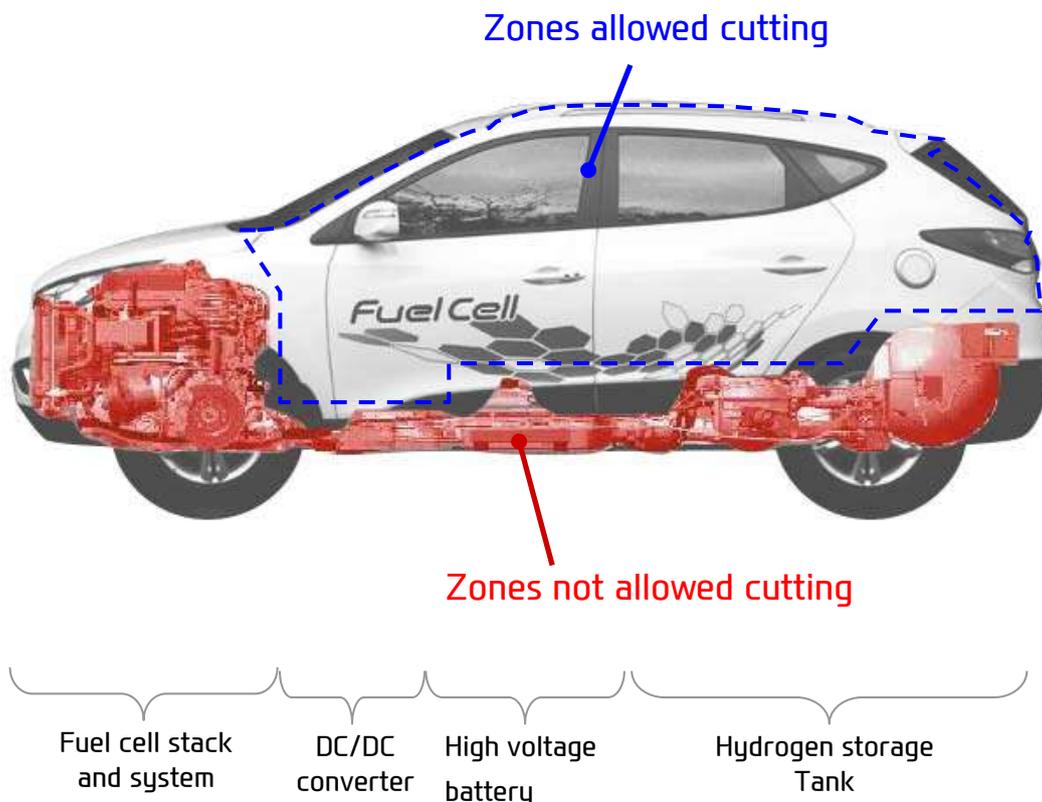
During overhaul operations it is important for responders to remember the dangers that are still present, even after a fire has been extinguished.

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 Electrocutation

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 cutting of the vehicle is required to extricate passengers, follow the "Identify, Immobilize, and Disable" procedure outlined in the previous section to disable the electrical systems prior to extrication.

# Emergency Procedures – Specific types Response

## Submersion in Water

In the case of an incident involving a submerged or partially submerged Tucson hydrogen fuel cell vehicle, follow the procedures outlined below.

### [Procedure]

1. Remove the vehicle from water.
2. Drain the water from the vehicle.
3. Disable the vehicle by using the method described in the "Identify, Immobilize, and Disable" procedure outlined in the previous 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 electrically charged. The high voltage electrical system remains isolated from the water that had been in contact with the vehicle.

# Emergency Procedures – Specific types Response

## High-Voltage Battery Damage/Spills

The high voltage battery module is enclosed in a sturdy metal case that is rigidly mounted to structural components of the vehicle. This construction helps prevent damage to the high voltage battery module even in severe crashes. This section provides emergency responders with information regarding how to mitigate the severity of a damaged high voltage battery 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 high voltage 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**

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

# Emergency Procedures – Specific types Response

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## First Aid for Electrolyte Exposure

The Tucson Hydrogen Fuel Cell battery module is a self-contained, sealed unit and poses no electrolyte contamination hazards under normal conditions. It is only under the rare instance of 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.

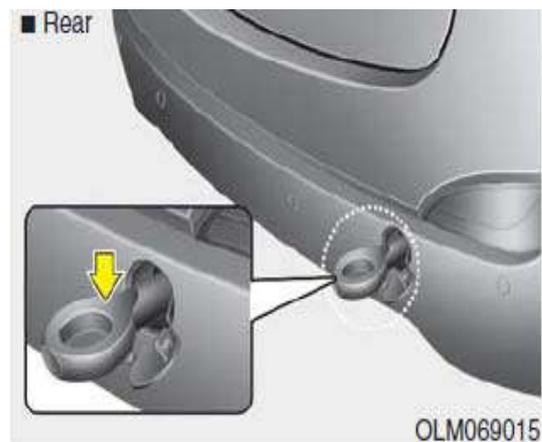
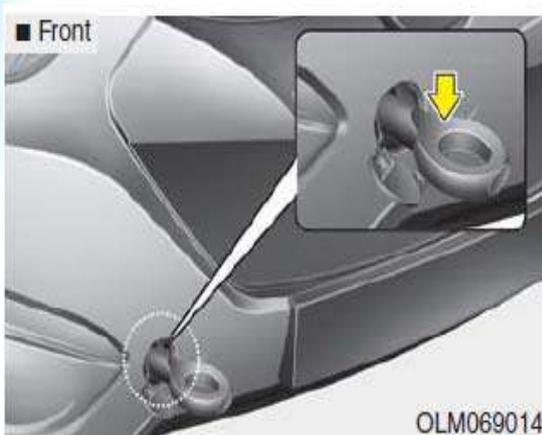
### **[Ingestion]**

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

# Emergency towing

## Emergency towing

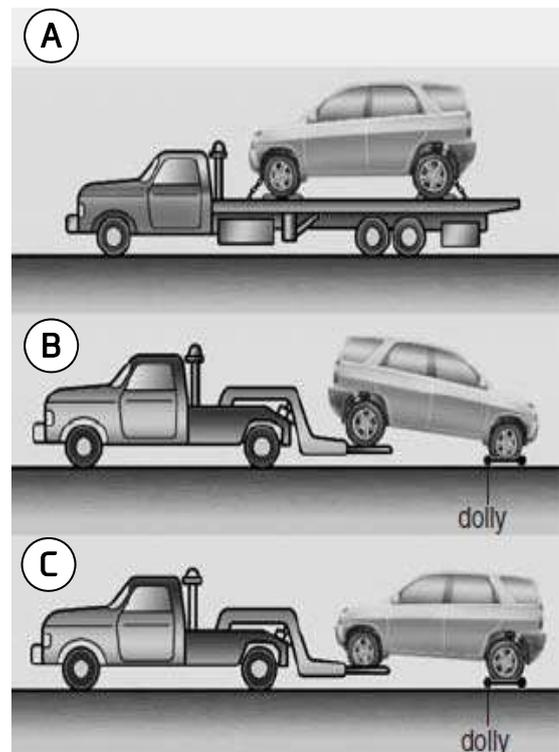
The Tucson Hydrogen Fuel Cell vehicle is no different from a conventionally powered gasoline engine vehicle with regard to towing. If emergency towing is necessary, Hyundai recommends having it done by an authorized Hyundai dealer. Proper lifting and towing procedures are necessary to prevent damage 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 Tucson 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.

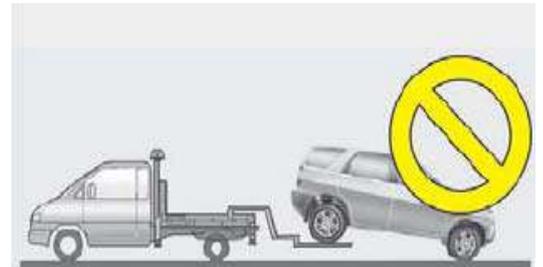
C. The vehicle can be towed with the front wheels supported by the lifting equipment in most cases that do not involve damage to wheel, tire, or suspension components.



# 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.



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## 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.
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 the cables 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, 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 or Hyundai Motor America.



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