



The Power to Surprise

Emergency Rescue Guide Manual



OPTIMA HYBRID

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Document Purpose

The purpose of this document is to familiarize first responders and the towing/roadside assistance industry with the proper methods to handle the Optima Hybrid Electric Vehicle in an emergency situation. This guide gives a basic overview of key vehicle systems and instructions for dealing with the different types of emergencies encountered by first responders. The emergency response procedures for this vehicle will be somewhat similar to that of a conventional Optima, with additional information provided on dealing with the high voltage electrical system.

Within this Emergency Response Guide you will find *Notices, Cautions, Warnings* and *Dangers* which provide critical information and help you do your job safely and efficiently. Below are the definitions of these terms. When you see a *Notice, Caution, Warning* or *Danger*, be certain you understand the message before you attempt to perform any part of an emergency response procedure.

DANGER

A Notice alerts you to a situation which, if not avoided, could result in vehicle damage.

CAUTION

A Caution alerts you to a hazardous situation which, if not avoided, could result in minor or moderate injury.

WARNING

A Warning alerts you to a hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE

A Danger alerts you to a hazardous situation which, if not avoided will result in death or serious injury.

Vehicle Description

As with other HEV, the Kia Optima HEV uses the combination of a conventional gasoline powered internal combustion engine and a high voltage electric motor to propel the vehicle. This combination provides for improved gas mileage over a conventional Kia as well as an increase in power over the standard 4-cylinder engine. The high voltage electrical system is completely self-contained and does not need to be recharged by an external power source such as a charging station. The high voltage battery is recharged automatically while driving the vehicle. This is accomplished through the use of a generator that produces electricity while driving and braking.



General Vehicle Description

The Kia Optima Hybrid Electric Vehicle is built on the conventional Optima chassis and therefore the vehicle looks very similar to its conventional counterpart with a few notable exceptions. The safest method is to assume that any Optima you respond to is an Hybrid Electric Vehicle until proven otherwise. Using the information provided in this section, responders will be able to differentiate between the two.

Identifying a Kia Optima Hybrid Electric Vehicle

"Eco Hybrid" logo on trunk and side of vehicle

The Kia Optima Hybrid Electric Vehicle can be easily identified by the "Eco Hybrid" logo attached on the trunk lid and side of the vehicle, beside the passenger-side brake light.

⚠ DANGER **Electrocution Risk**

The hybrid logo can become hidden after a crash due to damage to the vehicle. Always be sure to utilize additional methods of identification before determining the vehicle is not a hybrid.



ECO hybrid

ECO hybrid



ECO hybrid

VIN number

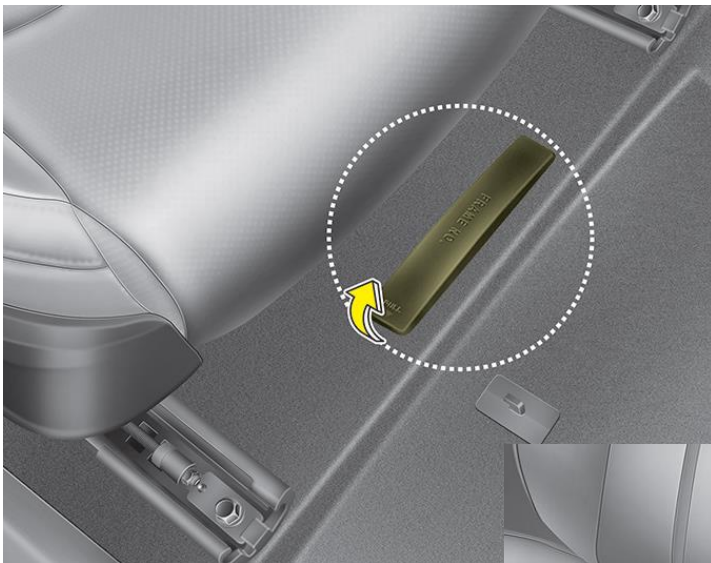
The VIN (Vehicle Identification Number) identifies the Hybrid Electric Vehicle with a "C" in the 8th digit, as shown below.

The VIN can be found:

- 1) Underneath the front passenger seat, and
- 2) On the vehicle certification label attached to the driver side center pillar.

XXXXXXXXCXXXXXXXXX

← 8th digit



Engine Room

An "Eco Hybrid" logo is also displayed on the engine cover under the hood. Also, the High Voltage cabling is orange as per SAE standard. Cables run from the bottom of the vehicle where they connect the High Voltage Battery to the Electric Power Control Unit, Motor, Inverter, and other High Voltage components in front of the vehicle.

The presence of orange cables under the hood identifies the vehicle as an Electric Vehicle.

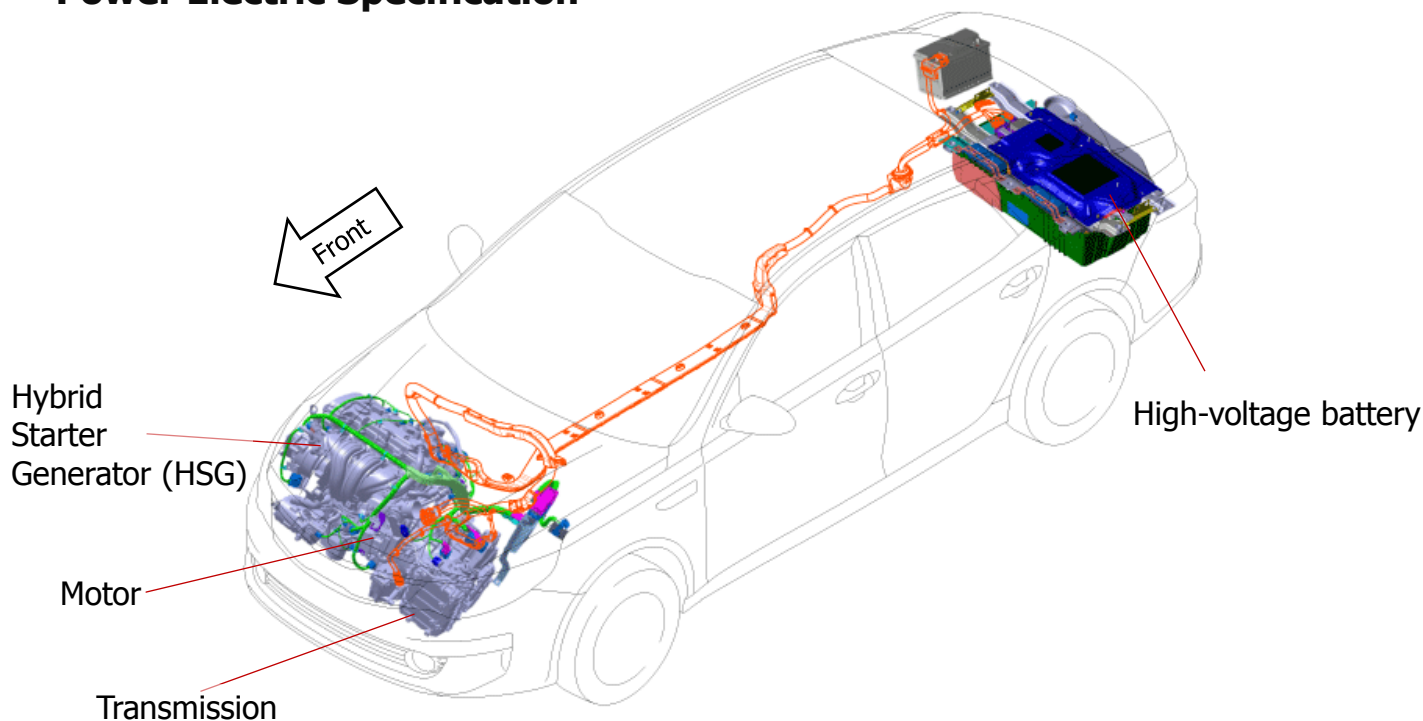


Hybrid Electric Vehicle Cluster Instrument Panel

The Hybrid Electric Vehicle Cluster Instrument Panel displays the HEV specific features that identify the Optima as a hybrid electric vehicle as in the circled areas below.



Power Electric Specification



Motor		Type	Permanent magnet synchronous motor
		Max. Output (kW)	38
		Max. Torque (Nm)	205
HPCU	Inverter	Input Voltage(V)	200 ~ 310
	LDC	Max. Output (kW)	1.8
High Voltage Battery		Type	Lithium-ion polymer
		Rated Voltage (V)	270
		Capacity (Ah) / Energy (kWh)	6.0 / 1.62
		Quantity per Pack (Cell / Module)	72 Cells / 9 Modules

Vehicle Components

12V Auxiliary Battery

The 12V auxiliary battery, located in the right hand side of the trunk, powers all of the vehicle's standard electronic systems such as radio and air conditioner. Also, it powers the HPCU (Hybrid Power Control Unit) which controls high voltage current to main electric systems like the motor.



12V Auxiliary Battery

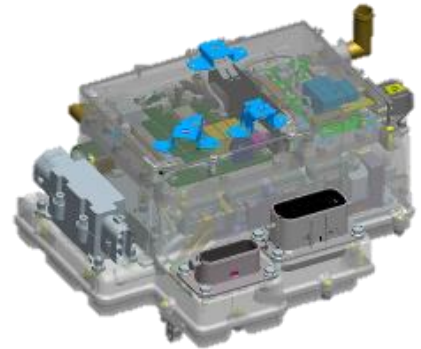
Motor

The motor of the HEV converts electrical energy into propelling energy with max. power of 38 kW and max. torque of 205 Nm.



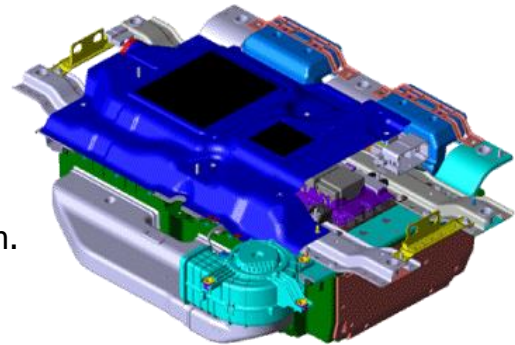
Hybrid Power Control Unit (HPCU)

The HPCU integrates an Inverter and LDC (Low Power DC-DC Converter) in one housing. The inverter converts DC to AC to supply electricity to the motor. It also converts AC to DC to charge the high voltage battery. The LDC converts high voltage electricity to 12V voltage to charge 12V auxiliary battery.



High Voltage Battery System

The High voltage battery system supplies and stores electrical energy to traction motor. It is a Lithium ion polymer battery with specifications, 270V / 6Ah / 1.62 kWh. It is located in the trunk of the Optima HEV.



Hybrid Starter Generator (HSG)

The HSG restarts the engine in HEV mode and also charges the high voltage battery – the generator for hybrid vehicle - while driving.



High Voltage Orange Cabling

The High Voltage cabling is orange as per SAE standard. Cables run under the floor of the vehicle and connect the High Voltage Battery to the HPCU, Motor, LDC, Inverter and other High Voltage components in front of the vehicle.

The presence of orange cables under the hood, on the under-floor battery compartment, or orange shielding under the car, identifies the vehicle as an electric vehicle.

⚠ DANGER High Voltage Cables

- *Never cut or disconnect the high voltage orange cabling and connectors without first disabling the system by removing the safety plug.*
- *Exposed cables or wires may be visible inside or outside the vehicle. Never touch the wires, cables, connectors, or any electric components before disabling the system, to prevent injury or death due to electrical shock.*

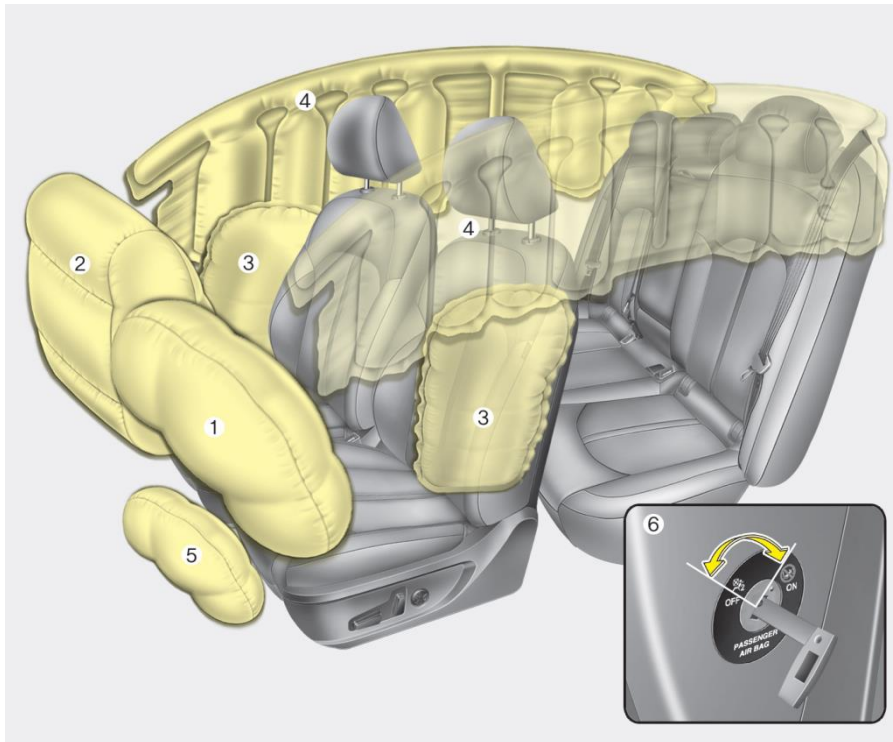
Failure to follow these instructions can lead to death by electrical shock.



Airbag system (SRS: Supplemental Restraint System)

Airbag

Seven airbags are installed in the Optima Hybrid Electric Vehicle, located in standard areas of the vehicle so that the first responder can find them immediately. Before emergency procedure, make sure that the vehicle ignition is switched off, and disconnect the negative cable from the 12V auxiliary battery to prevent accidental deployment of undeployed airbags.



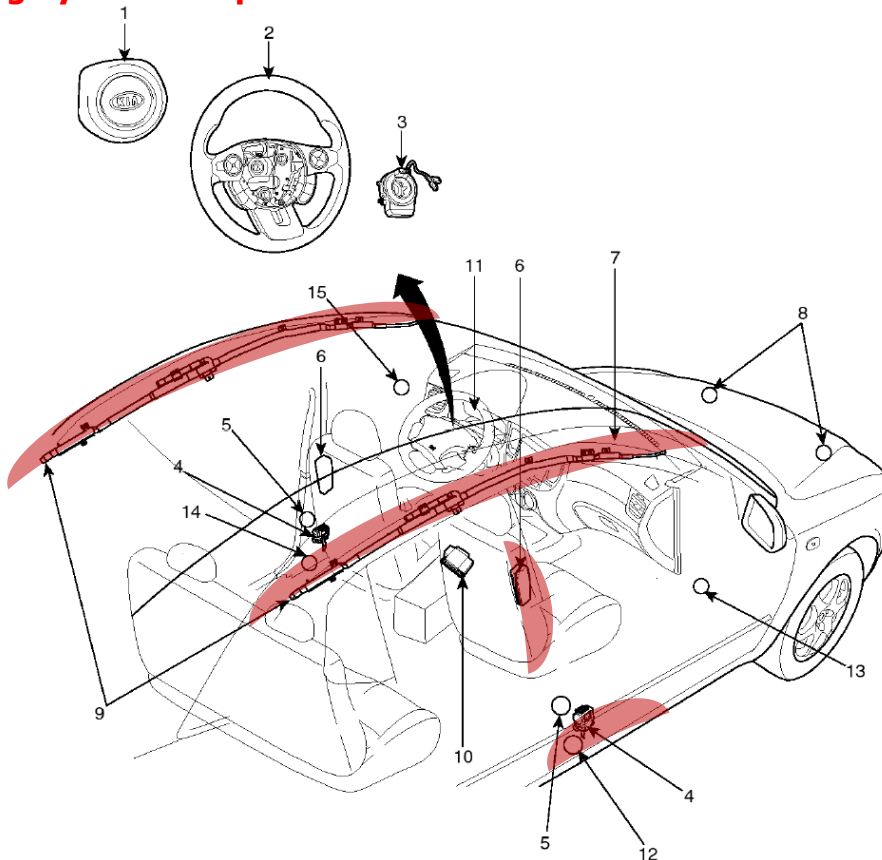
- (1) Driver side front airbag
 - (2) Passenger side front airbag
 - (3) Side airbag
 - (4) Curtain airbag
 - (5) Driver side knee airbag*
 - (5) Passenger side front airbag ON/OFF switch*
- * : if equipped

✱ The actual airbags and seats in the vehicle may differ from the illustration.

Seatbelt Pretensioner

The Optima Hybrid Electric Vehicle is equipped with driver side and front passenger side seatbelts with pretensioners. When the seatbelt pretensioners are activated in a collision, a loud noise may be heard and fine dust, which may appear to be smoke, may be visible in the passenger compartment. These are normal operating conditions and are not hazardous. The seatbelt pretensioner assembly mechanisms may become hot during activation, and may need several minutes to cool after they have been activated.

Airbag System Components



- | | |
|--------------------------------|--|
| 1. Driver Airbag (DAB) | 8. Front Impact Sensor (FIS) |
| 2. Steering Wheel | 9. Curtain Airbag (CAB) |
| 3. Clock Spring | 10. Supplemental Restraint System Control Module (SRSCM) |
| 4. Seatbelt Pretensioner (BPT) | 11. Airbag Warning Lamp |
| 5. Side Impact Sensor (SIS) | 12, 14. Emergency Fastening Device (EFD) |
| 6. Side Airbag (SAB) | 13, 15. Pressure Side Impact Sensor (PSIS) |
| 7. Passenger Airbag (PAB) | |

WARNING Undeployed Airbags

To avoid injuries caused by accidental deployment of undeployed airbags

- *Do not cut the red colored part on the above layout.*
- *Make sure the vehicle ignition switch is turned off, disconnect the negative cable from the 12V auxiliary battery, and wait 3 minutes or longer to allow the system to deactivate*

Failure to follow any of these instructions may result in serious injury or death from accidental deployment of the airbag system.

Initial Response: Identify, Immobilize and Disable

The following procedures should be used whenever you are dealing with an Optima Hybrid Electric Vehicle at an emergency scene. All other operations should be consistent with your department's standard operating procedures or guides. Hybrid electric vehicles damaged by a crash may have compromised high voltage safety systems and present a potential high voltage electrical shock hazard. Exercise caution and wear appropriate personal protective equipment (PPE) safety gear, including high voltage safety gloves and boots. Remove all metallic jewelry, including watches and rings.


Identify

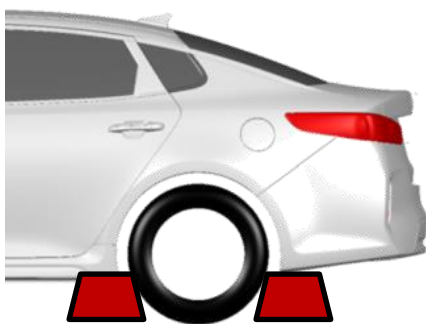
When dealing with an Optima at an emergency scene, emergency responders should always assume that it is a hybrid electric vehicle until it can be proven otherwise, using the identification clues outlined in this ERG. External logos will usually be the first clues but they can often be hidden from sight by damage caused in a crash. Always be sure to visually check all sides of the vehicle and use clues found under the hood and in the interior of the vehicle.



Immobilize

The next step is to immobilize the vehicle to prevent any accidental movement that can endanger response personnel and civilians alike. Although Optima Hybrid Electric Vehicle emits virtual sound of engine, if it is damaged from crash, there may be instances where the vehicle appears to be shut off due to no engine sound.

When  "READY" lamp is lit on the Cluster Instrument Panel, the vehicle can move silently using the electric motor. Responders should approach the vehicle from the sides and stay away from the front or rear as they are potential paths of travel. Immobilize the vehicle in the following procedure.



Chock the wheels.



Set the parking brake.




Park (P) the shift lever.

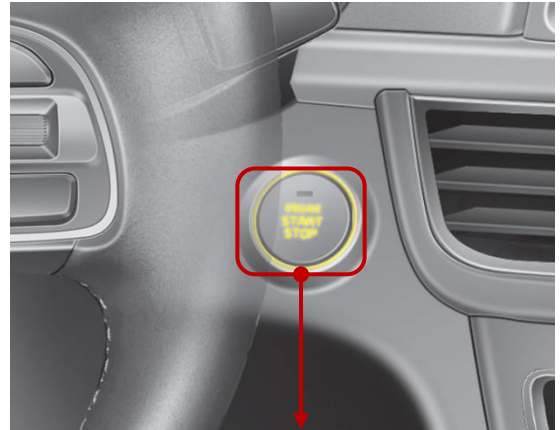
Disable

The final step of the initial response process, conducted after immobilizing the vehicle, is to disable the vehicle, its SRS components and the high voltage electrical system. To prevent current flowing through the system, use one of the following procedures to disable the vehicle.

I . Disabling the System – Smart Key System and “POWER” START/STOP Button

1. Check the status of the READY light on the instrument panel. If the  READY light is illuminated, the vehicle is on.

a) If the READY light is NOT illuminated, the vehicle is off. Do not push the “POWER” START/STOP button as this may start the vehicle.



“POWER” START/STOP Button

b) To turn off the system, Park (P) the shift lever and press the POWER button next to the shift lever.

With brake pedal released

Press POWER button	POWER button LED color	Vehicle condition
	Off	Off
One time	Amber	Electrical accessories are operational.
Two times	Reddish orange	The warning lights can be checked before the vehicle is started.
Three times	Off	Off

With brake pedal depressed and shift lever in P (Park)

Press POWER button	POWER button LED color	Vehicle condition
	Off	Off
One time	Off	Ready to drive

2. If necessary, lower the windows, unlock the doors and open the trunk as required, before disconnecting the 12V battery. Once the 12V battery is disconnected, power controls will not operate.

3. Before disconnecting 12V battery, move the Smart Key at least 2 meters away from the vehicle to prevent accidental restart.

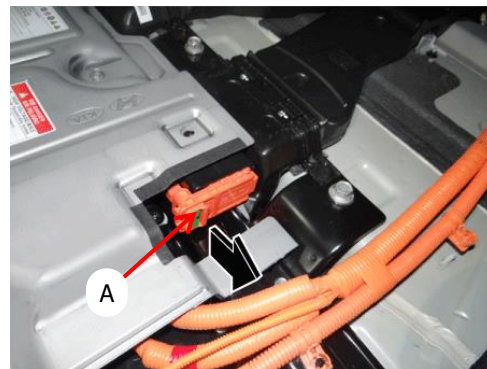
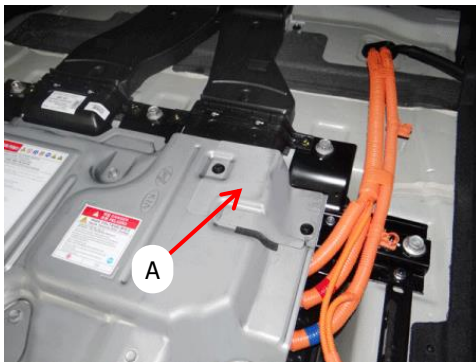


Smart key

4. Disconnect the negative (-) 12V battery cable, located in the trunk, to further prevent the risk of accidental restart.

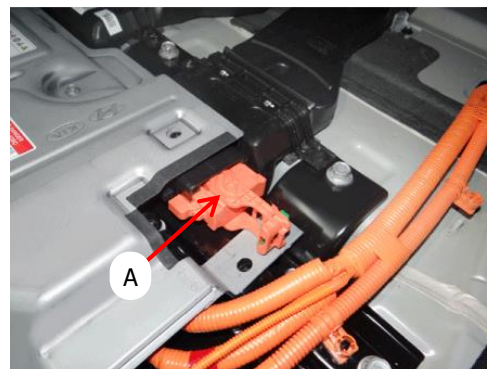
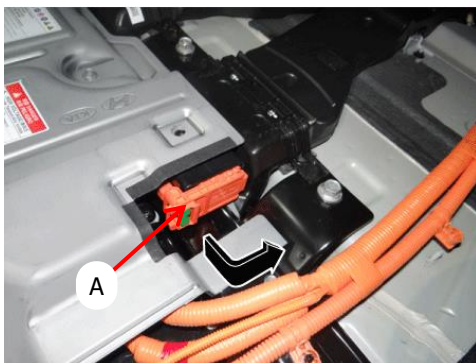
5. Remove the safety plug and disable the high voltage battery in the following procedure:

- a) Remove the luggage cover board and the side luggage foam in the trunk.
- b) Remove the safety plug cover (A).
- c) Unfasten the hook (A) in the direction of arrow.



d) Unfasten the lever (A) in the direction of arrow.

e) Remove the safety plug (A).



II. Disabling the System – IG Fuse Removal

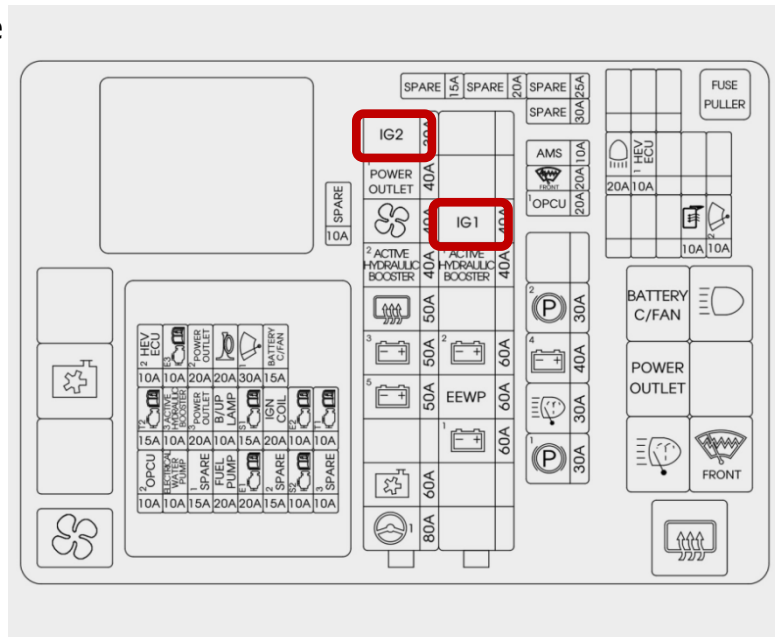
1. Open the hood.

2. Remove the engine room fuse box cover.



Engine room fuse box

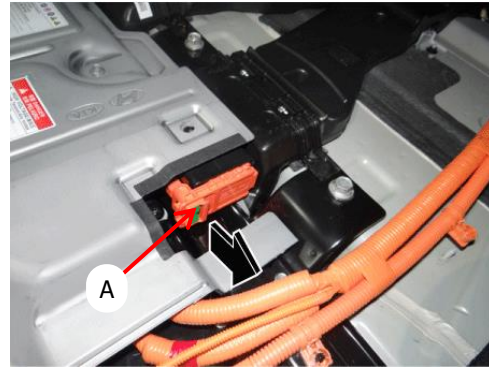
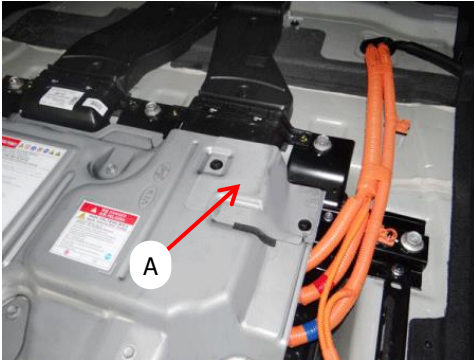
3. In the event the vehicle cannot be disabled using the “Power” START/STOP Button, pull the IG1, and IG2 fuses from the engine room fuse box. If the IG Relay cannot be located, pull out all the fuses and relays in the fuse box.



4. Disconnect the negative (-) 12V battery cable, located in the trunk, to further prevent the risk of accidental restart.

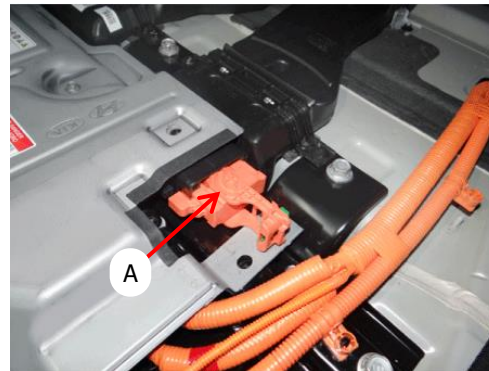
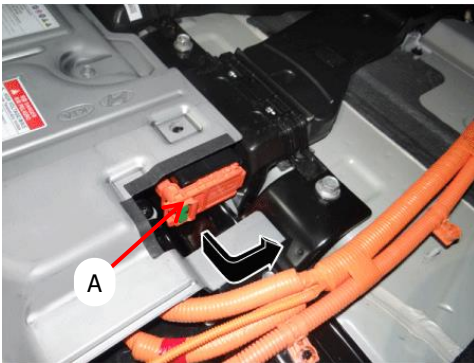
Before disconnecting the 12V battery (if needed), lower the windows, unlock the doors and open the trunk as required. Once the 12V battery is disconnected, power controls will not operate.

5. Remove the safety plug and disable the high voltage battery in the following procedure:
- Remove the luggage cover board and the side luggage foam in the trunk.
 - Remove the safety plug cover (A).
 - Unfasten the hook (A) in the direction of arrow.



- Unfasten the lever (A) in the direction of arrow.

- Remove the safety plug (A).



If the aforementioned two methods of disabling system are unsuccessful, the vehicle is not secured from accidental deployment of undeployed airbags and electric shock of high-voltage components.

⚠ DANGER Electrocutation Risk

- Before engaging in emergency response procedures, ensure the vehicle is disabled and wait 5 minutes to allow the capacitor in the high voltage system to discharge to avoid electrocution.*
- Exposed cables or wires may be visible inside or outside the vehicle. Never touch the wires or cables before disabling the system, to prevent injury or death due to electrical shock.*

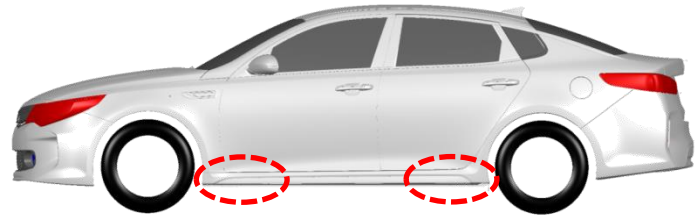
Failure to follow these instructions can lead to death by electrocution.

Extraction Operations

The extraction operations of Optima Hybrid Electric Vehicle is similar to that of the conventional gasoline or diesel fueled Optima. However, the first responder should pay special attention when they extract occupants in the car. Before extraction operations, the first responders should carry out "Initial Response: Identify, Immobilize and Disable" section in pages 15-20.

Vehicle Stabilization

Use standard stabilization (cribbing) points, as shown on right. 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.



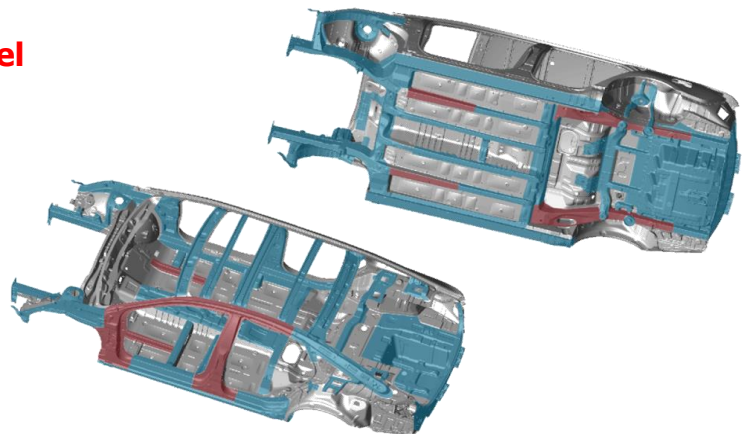
Extraction tools and procedure

When responding to an incident involving an Optima Hybrid Electric Vehicle, we recommend that the first responders follow their organization's standard operating procedures for assessing and dealing with vehicle emergencies.

When the first responders cut the vehicle, they should always pay special attention to airbag system, orange colored high voltage cables and other high voltage components due to the risk of explosion or electrocution from damaged parts.

Location of ultra-high strength steel

In the image, high strength steel is used in the blue colored areas and ultra-high strength steel is used in the red colored areas. Depending on the tools used, ultra high strength steel can be challenging or impossible to cut. If necessary, use a workaround technique.



- Mild steel
- High strength steel
- Ultra-high strength steel

Vehicle Fire

Kia motors recommends that firefighters follow standard firefighting practices.

- A burning or over-heated battery releases toxic vapors. These vapors include H₂SO₄, oxides of carbon, nickel, aluminum, lithium, copper and cobalt.
- Responders should wear full PPE (Personal Protective Equipment), including SCBA (Self-Contained Breathing Apparatus), and take appropriate measures to protect civilians downwind from the incident. Smoke from an Optima Hybrid Electric Vehicle fire is similar to that from a conventional vehicle fire.
- Even after a lithium-ion battery fire appears to have been extinguished, a renewed or delayed fire can occur.
- In the case of extinguishing a fire with water, **a powder extinguisher exclusive for an electric fire** or **large amount of water from a fire hydrant** (if available) must be used.

Do not extinguish fire with a small amount of water, due to the risk of electrocution.

There is no risk of electric shock from touching the car's body or framework; therefore, firefighters should not hesitate to pour large amount of water to the vehicle.

- If you must walk away from the vehicle, notify an appropriate responder or a rescue person of the fact that the vehicle is an electric car and contains a high voltage system and warn all people nearby.

Submerged or Partially Submerged Vehicles

In the event the vehicle is submerged or partially submerged, remove the vehicle from the water before attempting to disable the vehicle. Use one of the methods described in pages 15 to 18 to disable the vehicle once it has been removed from the water. There is no risk of electric shock from touching the car's body or framework — in or out of the water.

High Voltage Battery Damage and Fluid Leaks

If electrolyte solution leakage, or damage such as any problem with the Li-ion battery casing is observed, the first responders should attempt to neutralize the battery by pouring a large volume of water to the battery pack while wearing appropriate Personal Protective Equipment (PPE). The neutralization process helps stabilize the thermal condition of the battery pack without discharging the battery.

- Cease all smoke, spark, flame around the vehicle.
- Electrolyte solution is a skin irritant.
- Do not touch or step on the spilled electrolyte.
- If electrolyte leak occurs, wear appropriate solvent resistant PPE and use soil, sand, or a dry cloth to clean up the spilled electrolyte. Be sure to adequately ventilate the area.

WARNING Electrolyte Irritation

The high voltage battery contains electrolyte solution. To avoid exposure to electrolyte solution and serious personal injury, always wear appropriate solvent resistant PPE (Personal Protective Equipment) and SCBA (Self-Contained Breathing Apparatus).

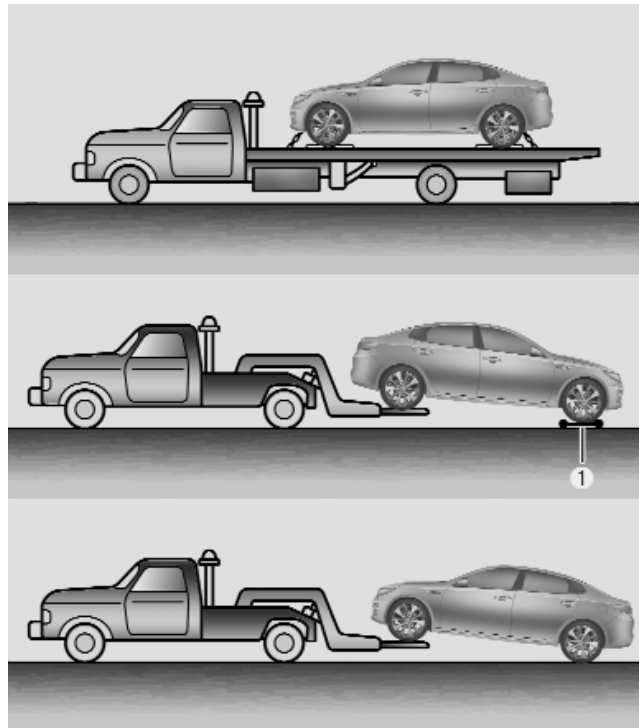
- *Electrolyte solution is an eye irritant – In the event of contact with eyes, rinse with plenty of water for 15 minutes.*
- *Electrolyte solution is a skin irritant. Therefore, in the event of contact with skin, wash off with a soap.*
- *Electrolyte liquid or fumes coming into contact with water will create vapors in the air from oxidization. These vapors may irritate skin and eyes. In the event of contact with vapors, rinse with plenty of water and consult a doctor immediately.*
- *Electrolyte fumes (when inhaled) can cause respiratory irritation and acute intoxication. Inhale fresh air and wash mouth with water. Consult a doctor immediately.*

Towing

In the event of an accident, the high voltage system must be disabled. The service plug must be removed from the high voltage battery according to one of the methods described in pages 17 to 20 to disable the vehicle.

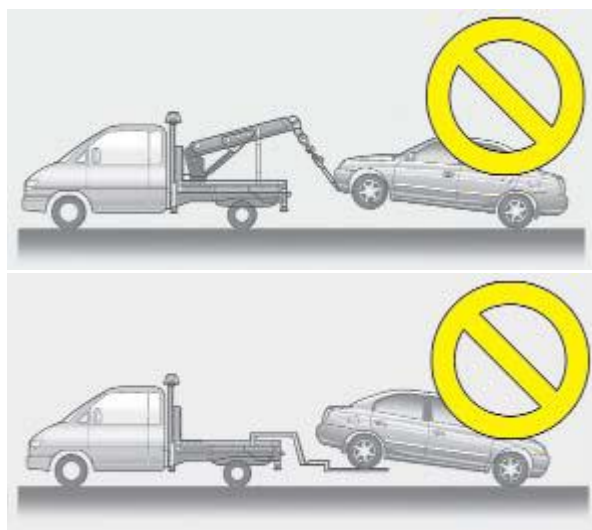
Towing Optima Hybrid Electric Vehicle is not different from towing conventional FWD vehicle with only exception that all wheels needs to be lifted off the road.

If emergency towing is necessary, we recommend having it done by an authorized Kia dealer or a commercial tow-truck service. Proper lifting and towing procedures are necessary to prevent damage to the vehicle. The use of wheel dollies or flatbed is recommended.



⚠ CAUTION

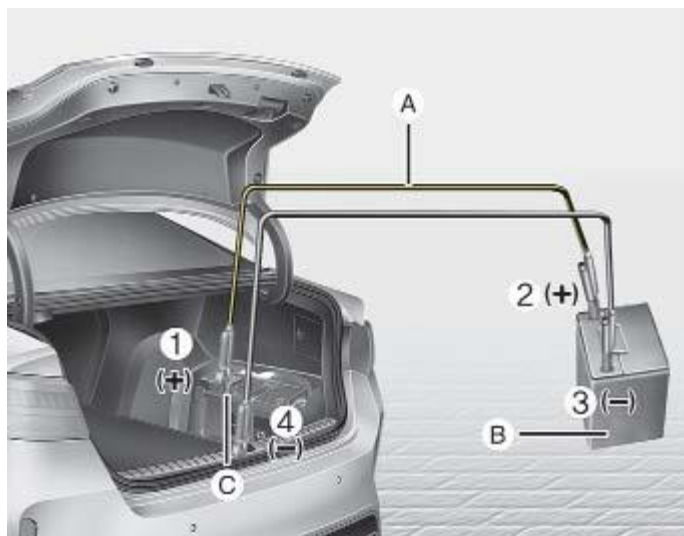
- *Do not tow the vehicle backwards with the front wheels on the ground as this may cause damage to the vehicle.*
- *Do not tow with sling-type equipment. Use wheel lift or flatbed equipment.*
- *Never tow the vehicle with the rear/front wheels on the ground (forward or backward), as this may cause fire or damage to the motor.*



To Jump Start the Car

Do not attempt to jump start the high voltage battery, as it cannot be jump started. In case the high voltage battery has been fully discharged, the vehicle must be towed in any of the methods mentioned on the previous page.

In case the 12V auxiliary battery is discharged, attach jumper cables or starting device to the 12V battery in the trunk as you would any 12V battery (see image). Refer to page 7-5 of the Kia Owner's Manual for additional information. Connect jumper cables in numerical order and disconnect in reverse order.



⚠ DANGER **Electrocution Risk**

Do not attempt to jump start the Optima HEV high voltage battery.