



The Power to Surprise

Emergency Rescue Guide Manual



OPTIMA

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

WARNING

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

CAUTION

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

NOTICE

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

Vehicle Description

As with other PHEV, the Kia Optima PHEV uses the combination of a conventional gasoline powered internal combustion engine and a High Voltage battery & 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.

Unlike HEV, Optima PHEV's High Voltage battery can be recharged through the charge port on the left fender. This increases fuel efficiency and EV mode driving range. The High Voltage battery is also automatically recharged while driving. This is accomplished through the engine and regenerative braking system that produces electricity while driving and braking.



General Vehicle Description

The Kia Optima Plug-in 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 a Plug-in 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 Plug-in Hybrid Electric Vehicle

“Eco plug-in” logo on trunk and side of vehicle

The Kia Optima Plug-in Hybrid Electric Vehicle can be easily identified by the “Eco plug-in” logo attached on the trunk lid and side of the vehicle.

⚠ DANGER **Electrocution Risk**

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



VIN number

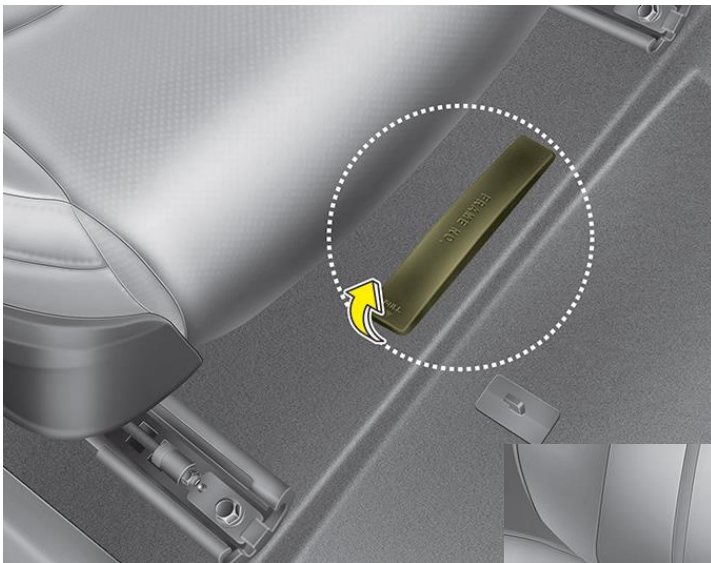
The VIN (Vehicle Identification Number) identifies the Plug-in Hybrid Electric Vehicle with a "D" in the 8th digit, as shown below.

The VIN can be found:

- 1) Underneath the front passenger seat (or driver seat).
- 2) On the vehicle certification label attached to the driver's side (or passenger) center pillar.

XXXXXXXXDXXXXXXXXX

← 8th digit



Engine Room

An "Eco Plug-in Hybrid" logo is also displayed on the engine cover under the hood. Also, the High Voltage cabling is orange per SAE standard. Orange cables run under the vehicle from the High Voltage Battery to the Hybrid Power Control Unit (HPCU), 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.



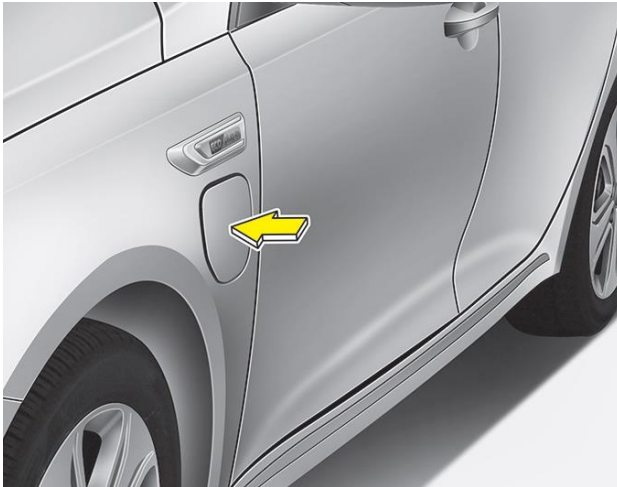
ECO plug-in

Charging Port

The charging port is located on the front left fender and it has one port for AC normal charging.

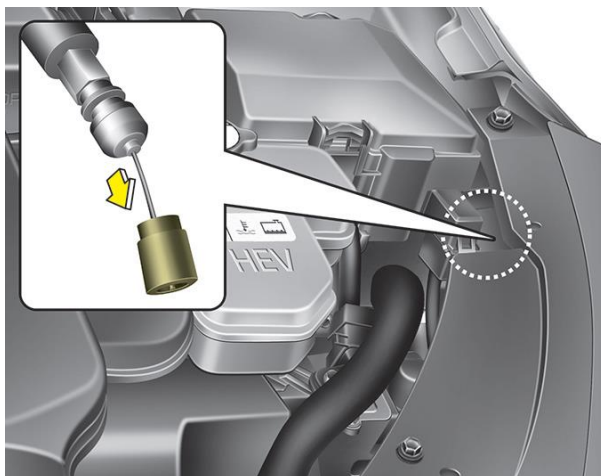
Note : The doors must be un-locked to open the charge port door.

How to open the charging port



1. Depress the brake pedal and apply the parking brake.
2. Turn OFF all switches, move the shift lever to P (Park) and turn off the vehicle.
3. Open the charging door by pressing it.

Unlock charging door in emergency



If the charging door does not open due to battery discharge, open the hood and slightly pull the emergency cable as shown left.

The charging door will then open.

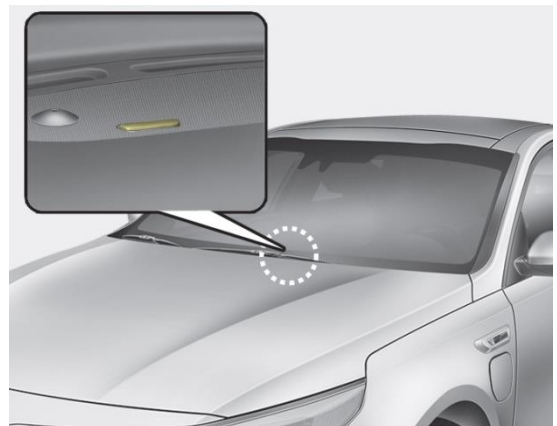
Plug-in Hybrid Electric Vehicle Instrument Cluster

The Plug-in Hybrid Electric Vehicle (PHEV) Instrument Cluster has specific features to identify the Optima as a PHEV. Those features are circled below in red.

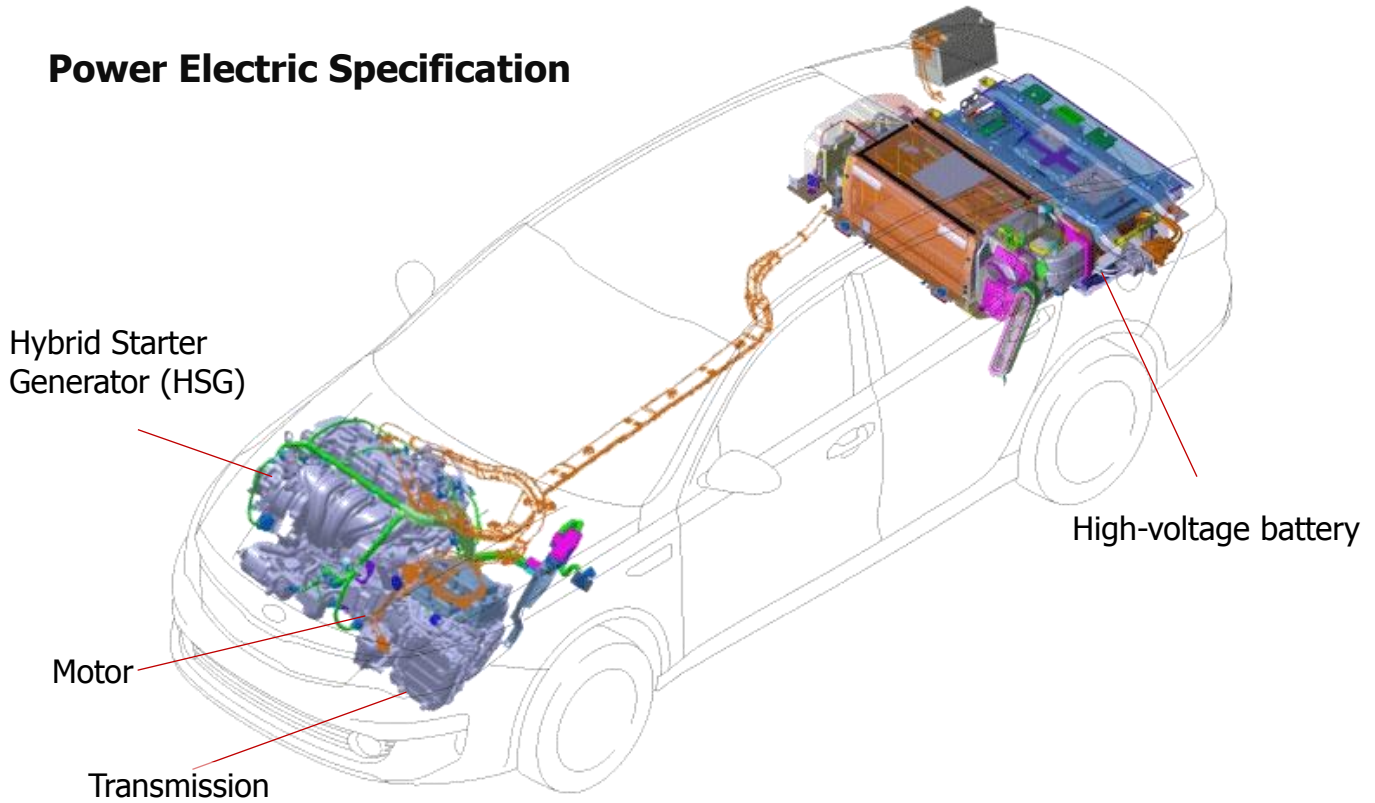


Charge Status Indicator

The High Voltage battery Charge Status Indicator is visible from outside the vehicle. It is seen through the windshield at the center of the crash pad and is illuminated when the vehicle is plugged-in and charging.



Power Electric Specification



Motor		Type	Permanent Magnet Synchronous Motor
		Max. Output HP(kW)	67 (50)
		Max. Torque lb-ft(Nm)	151 (205)
HPCU	Inverter	Input Voltage(V)	200 ~ 310
	LDC	Max. Output HP(kW)	2.4 (1.8)
High Voltage Battery		Type	Lithium-Ion Polymer
		Rated Voltage (V)	360
		Capacity (Ah) / Energy (kWh)	27.2 / 9.8
		Cells	96
		Power (kW)	68

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 (Plug-in Hybrid Power Control Unit) which controls high voltage current to main electric systems like the motor.



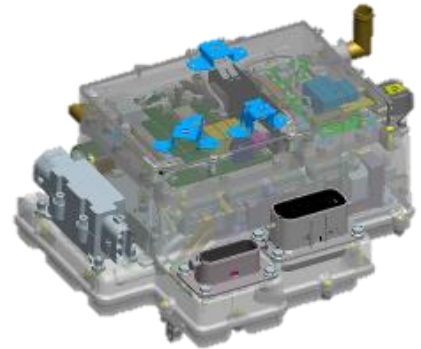
Motor

The electric motor drives the vehicle and produces 67HP (50 kW) and 151lb-ft (205 Nm) torque.



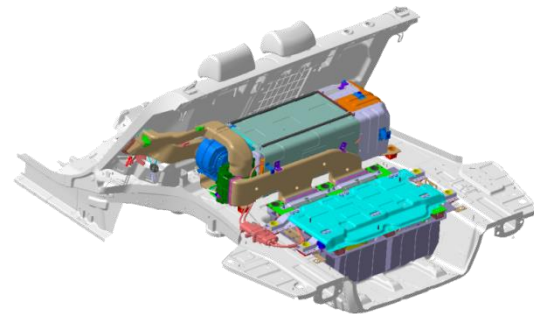
Hybrid Power Control Unit (HPCU)

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 AC electricity to Low Voltage DC to charge 12V auxiliary battery.



High Voltage Battery System

The High Voltage battery stores electricity and supplies it to the traction motor. It is a Lithium ion polymer battery with specifications, 360V / 27.2Ah / 9.8 kWh. It is located in the trunk of the Optima PHEV.



Hybrid Starter Generator (HSG)

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



On-Board Charger (OBC)

The OBC is the battery charging equipment that converts external AC to DC to charge the high voltage battery.



High Voltage Orange Cabling

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

Orange cables or Orange shielding underhood, under-floor or in the battery compartment identify the vehicle as an electric vehicle.

⚠ DANGER High Voltage Cables

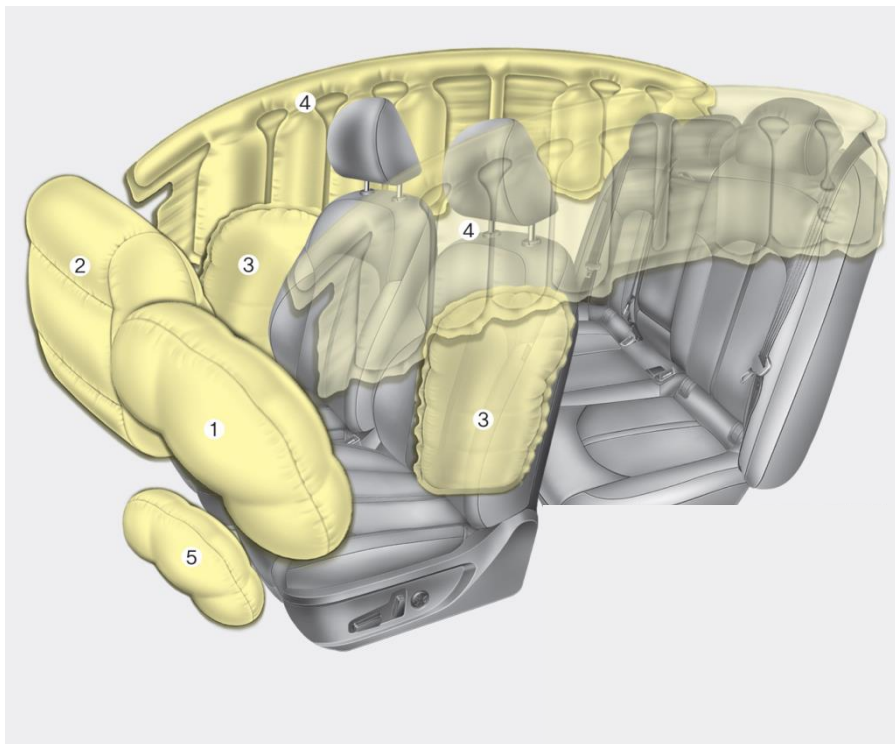
- *Never cut or disconnect the high voltage orange cabling and connectors without first disabling the system by removing the safety plug.*
- *Exposed cables or wires may be visible inside or outside the vehicle. Never touch the wires, cables, connectors, or any electric components before disabling the 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 standard areas of the Optima Plug-in Hybrid Electric Vehicle so first responders 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.



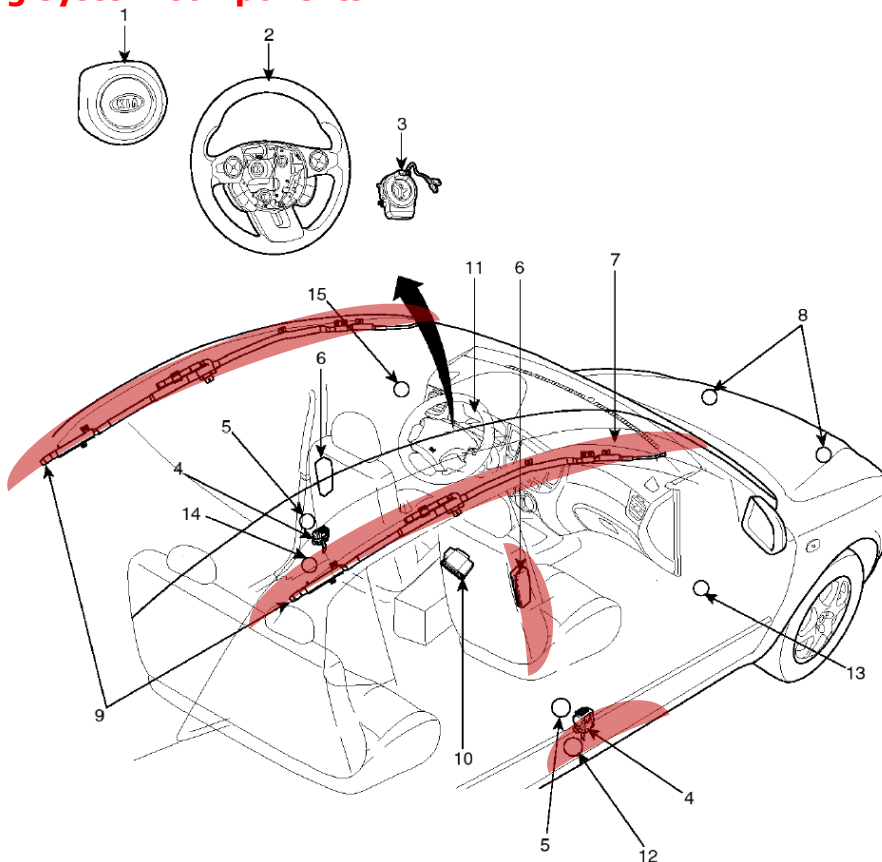
- (1) Driver side front airbag
- (2) Passenger side front airbag
- (3) Side airbag
- (4) Curtain airbag
- (5) Driver side knee airbag

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

Seatbelt Pretensioner

The Optima Plug-in 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 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 Plug-in Hybrid Electric Vehicle at an emergency scene. All other operations should be consistent with your department's standard operating procedures or guides. Plug-in 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

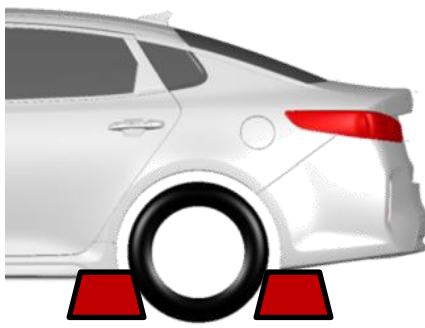
When dealing with an Optima at an emergency scene, emergency responders should always assume that it is a Plug-in Hybrid Electric Vehicle (PHEV) until it can be proven otherwise, using the identification clues outlined in this ERG. External logos will usually be the first clues but they can often be 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 the Optima Plug-in Hybrid Electric Vehicle emits a virtual engine sound, if it is damaged from crash, there may be instances where the vehicle appears to be shut off due to no engine sound.

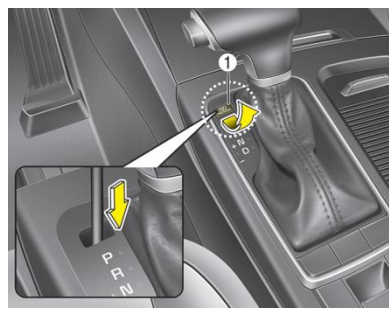
When  the "READY" lamp in the instrument cluster is illuminated, the vehicle can move silently using the electric motor. Responders should approach the vehicle from the sides and stay away from the front or rear as they are potential paths of travel. Immobilize the vehicle with the following procedure.



Chock the wheels.



Set the parking brake.




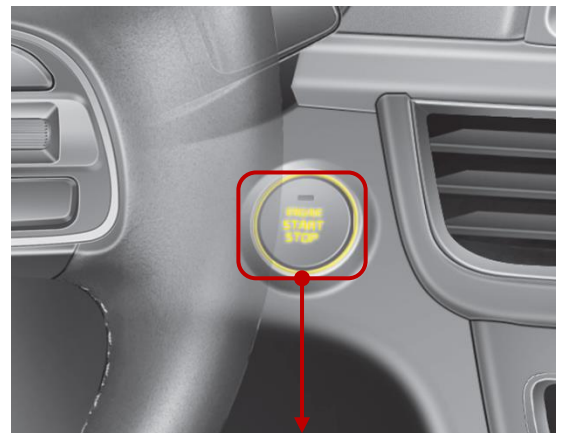
Shift lever in park "P".

Disable

After the vehicle is secured to prevent movement, the final step in the initial response process is to disable the vehicle, its SRS components and the high voltage electrical system. To prevent current flow 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, move the shift lever to Park "P" and press the POWER button.

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

While depressing the brake pedal while a shift lever is in the P (Park) position

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

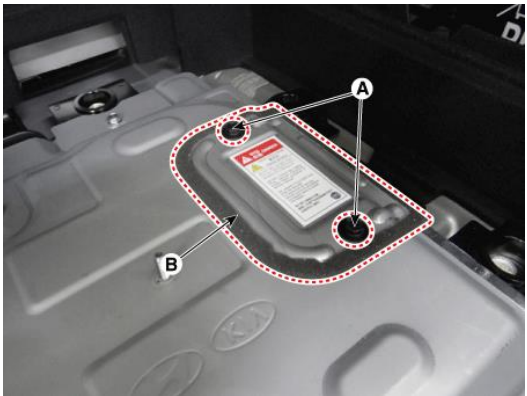
- 2. If necessary, lower the windows, unlock the doors and open the trunk as required, before disconnecting the 12V battery. Once the 12V battery is disconnected, power controls will not operate.
- 3. Before disconnecting 12V battery, move the Smart Key at least 2 meters away from the vehicle to prevent 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 (B) by loosening the mounting bolts (A).
- c) Unfasten the hook (A) to the direction of arrow.



d) Unfasten the lever (A).

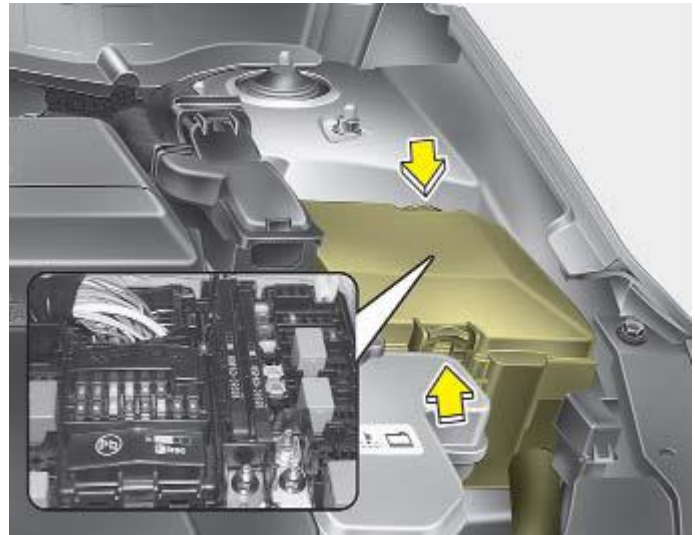


e) Remove the safety plug (A).

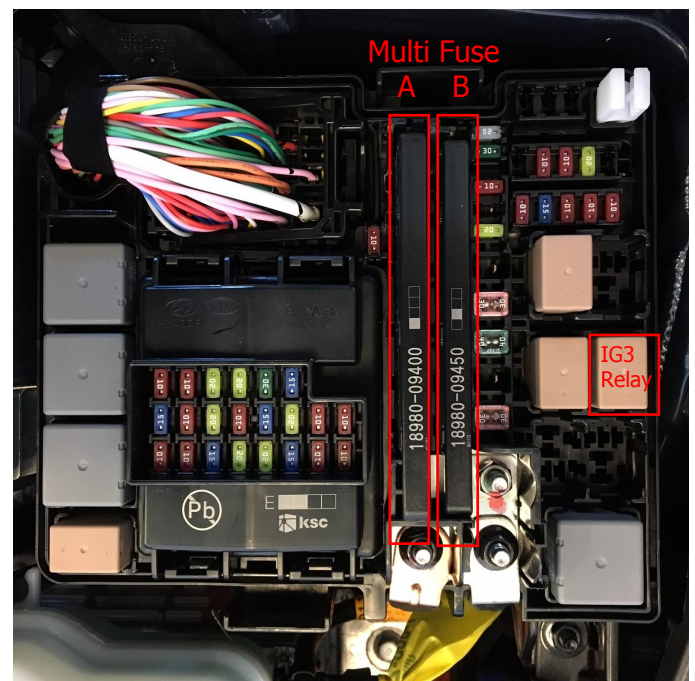


II. Disabling the System – IG (Ignition) Fuse Removal

1. Open the hood.
2. Remove the engine room fuse box cover.
3. 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.



4. In the event the vehicle cannot be disabled using the "Power" START/STOP Button, pull the Multi Fuse A and B along with IG3 Relay from the engine room fuse box. If the IG Relay cannot be located, pull out all the fuses and relays in the fuse box.



5. 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.

6. Remove the safety plug and disable the high voltage battery

(Refer to No.5 procedure in page 17)

If the above methods of disabling the 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.*

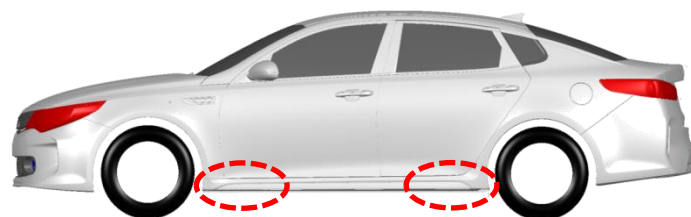
Failure to follow these instructions can lead to death by electrocution.

Extraction Operations

The Optima PHEV is an Eco-electric model (HEV/PHEV). Because of the high voltage components contained therein, first responders should pay special attention when they extract occupants in the car. Before extraction operations, the first responders should "Identify, Immobilize and Disable" the vehicle as discussed in sections on page 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.



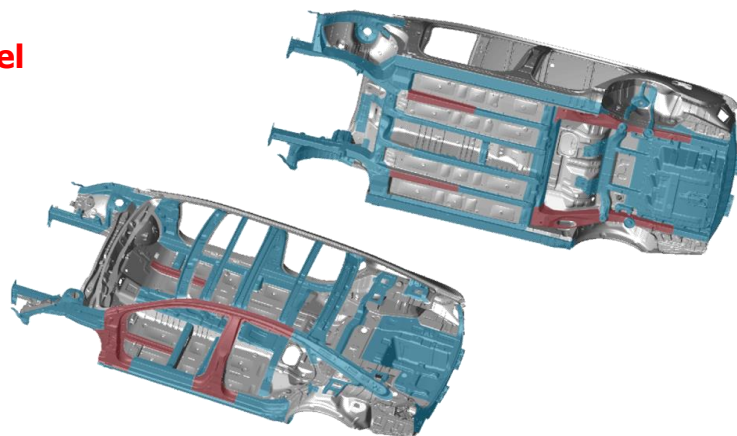
Extraction tools and procedure

When responding to an incident involving an Optima Plug-in 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 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 areas colored in blue 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.



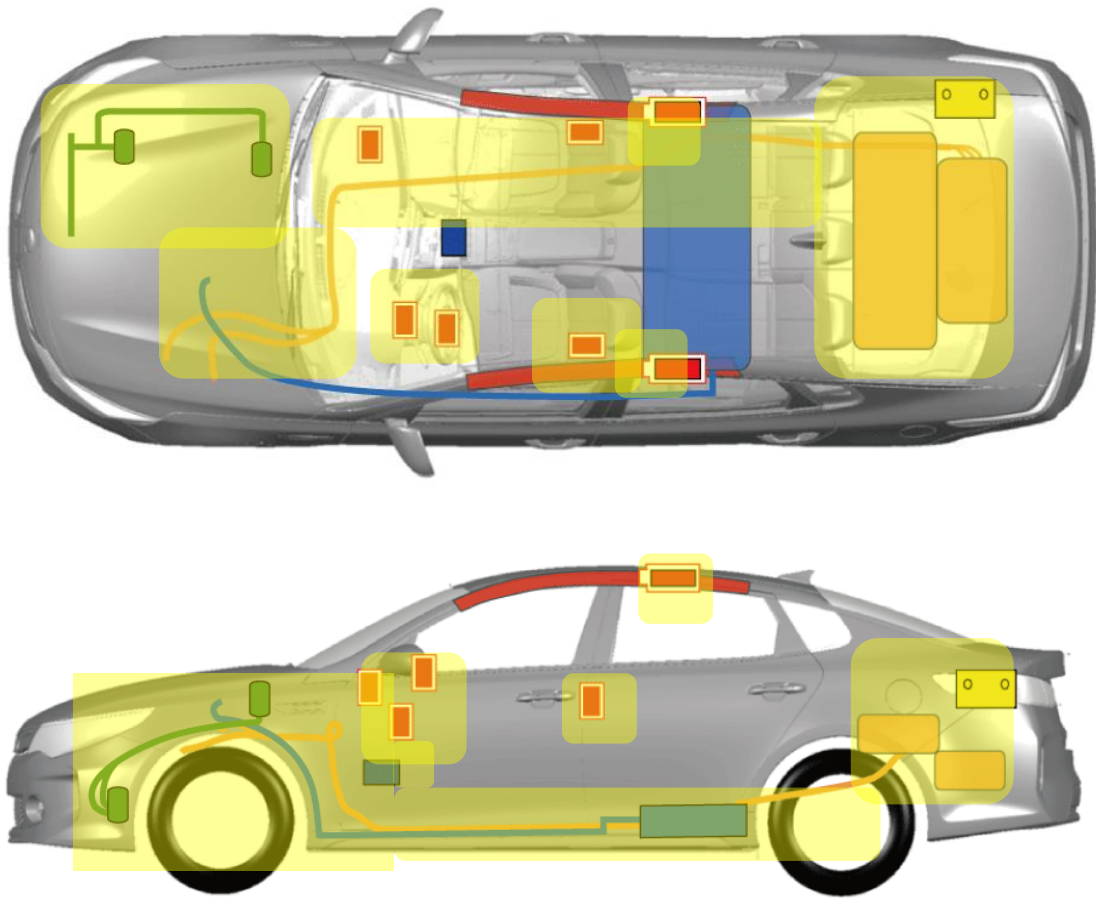
- Mild steel
- High strength steel
- Ultra-high strength steel

NO-CUT ZONES

The areas highlighted in yellow indicate "no-cut zones" that must not be cut during emergency procedures due to high voltage, gas inflators and airbag hazards.

⚠ DANGER

Do not attempt to enter the vehicle by cutting through the "no-cut zones" identified in the image below. Cutting through these zones can result in death by explosion or electrocution.



- Airbag&Gas inflators
- Airbag
- Gas inflators
- Supplemental Restraint System Control Module (SRSCM)
- 12V Battery
- High Voltage Battery & Cable
- Fuel system
- Refrigerant gas pipe

Vehicle Fire

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

Firefighting Operations

If the High Voltage battery is either involved in or at risk of being involved in a fire, strict cautions must be taken while conducting firefighting operations due to 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.
- Even after the high-voltage battery fire appears to have been extinguished, renewed or delayed fire can occur.
 - Use a thermal imaging camera to ensure the high voltage battery is completely cooled before leaving the incident.
 - Always advise second responders that there is a risk of the battery re-igniting.
 - In any case where fire, submersion or a collision has compromised the high voltage battery, always store it in an open area with no exposures within 50 feet.
- 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 with caution.

Extinguishers

- Small fires that exclude the High Voltage battery: Extinguish fires using a ABC extinguisher for an electric fire.
- If the high voltage battery is involved in a fire, or is heating internally: Extinguish fires using large and sustained amount of water to cool the High Voltage battery. Do not extinguish fire with a small amount of water. Firefighters should not hesitate to pour large amounts of water on the vehicle.

Submerged or Partially Submerged Vehicles

Some emergency responses can involve a submerged vehicle. An Optima PHEV that is submerged does not have high-voltage components on the vehicle's body or framework. It is safe to touch the vehicle's body or framework if there is no severe damage to the vehicle, whether it is in water or on land.

In the event of the vehicle is submerged or partially submerged, remove the vehicle from the water before attempting to disable the vehicle. Drain the water from the vehicle. Use one of the methods described in page 14-19 to disable the vehicle.

WARNING

- *If severe damage causes High Voltage components to become exposed, responders should take appropriate precautions and wear appropriate insulated Personal Protective Equipment (PPE).*
- *Do not attempt to remove the safety plug while the vehicle is in water.*

Failure to follow these instructions can lead to death or serious injury by electrocution.

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 High Voltage battery by applying a large volume of water on the High Voltage battery while wearing appropriate Personal Protective Equipment (PPE). The neutralization process helps stabilize the thermal condition of the High Voltage battery without discharging it.

- 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).

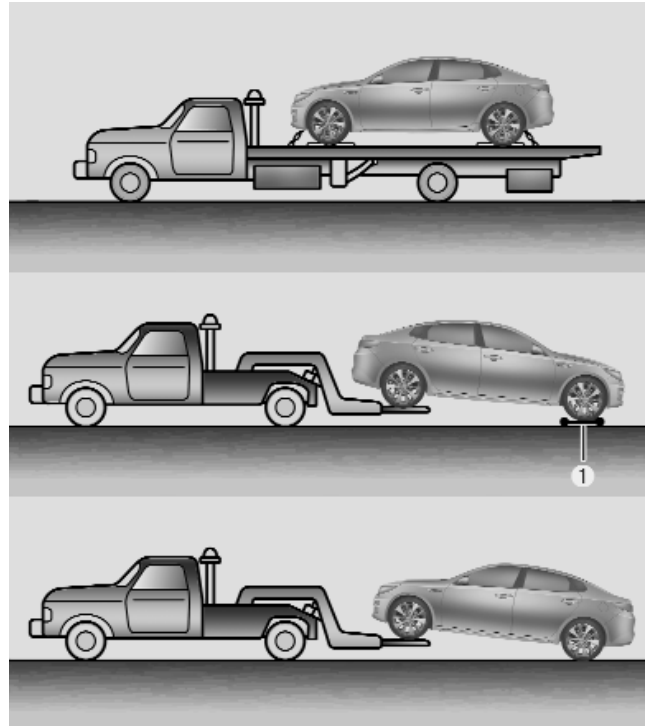
- *Electrolyte solution is an eye irritant – In the event of contact with eyes, rinse with plenty of water for 15 minutes.*
- *Electrolyte solution is a skin irritant. Therefore, in the event of contact with skin, wash off with a soap.*
- *Electrolyte liquid or fumes coming into contact with water will 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 safety plug must be removed from the high voltage battery according to one of the methods described in sections of page 17-20 to disable the vehicle.

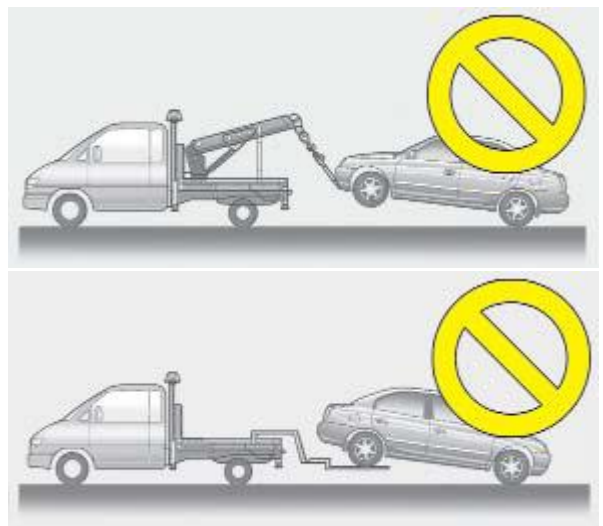
Towing the Optima Hybrid Electric Vehicle is not different from towing a conventional FWD vehicle with the exception that all wheels needs to be lifted off the road.

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.



NOTICE

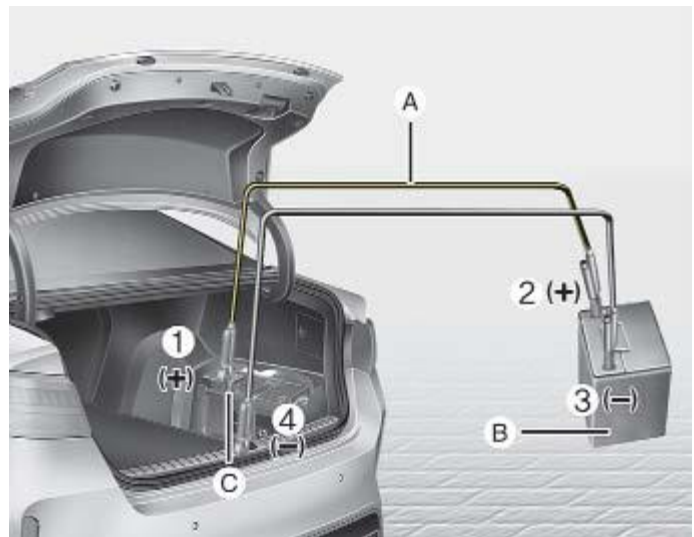
- *Do not tow the vehicle backwards with the front wheels on the ground as this may cause damage to the vehicle.*
- *Do not tow with sling-type equipment. Use wheel lift or flatbed equipment.*
- *Never tow the vehicle with the front wheels on the ground (forward or backward), as this may cause fire or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



To Jump Start the Car

Do not attempt to jump start the High Voltage battery. 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.

If the 12V auxiliary battery is discharged attach jumper cables or starting device to the 12V battery in the trunk (see image). Connect jumper cables in numerical order and disconnect in reverse order. Refer to "Emergency Starting" in Owner's Manual for additional information.



⚠ DANGER Electrocutation Risk

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