MIGHTY Electric.

Emergency Response Guide.

Vehicle shown fitted with additional cost accessories.

Hyundai Truck Roadside Support.
1800 388 782.

WARNING

- If severe damage causes high-voltage components to become exposed, emergency responders should take appropriate precautions and wear appropriate insulated personal protective equipment.
- Do not attempt to remove the safety plug while standing in the water.
- 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 any of these instructions may result in serious injury or death by electrocution.

- Do not cut through any component of the Airbag (SRS) system (Supplementary Restraint System)
- SRS components may remain powered and active for up to 3 minutes after the 12V electrical system is shut off or disabled.

Disconnect the battery negative cable and wait for at least 3 minutes before beginning work.
Failure to follow any of these instructions may result in serious injury or death from accidental deployment of the airbag system.

HYUNDAI

Contents

1. Introduction.

Document Purpose

The purpose of this document is to familiarise emergency responders and the towing/roadside assistance industry with the proper methods to handle the Hyundai MIGHTY Electric truck 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 vehicle with additional information provided on dealing with the high-voltage electrical system.

Vehicle Description

Recognising the environment and humanity as its utmost value, Hyundai has developed a medium-sized eco-friendly electric commercial truck in line with the growing global logistics market and the increasing demand for eco-friendly electric vehicles in general. With zero exhaust gas and noise, and remarkable energy efficiency and performance – the MIGHTY Electric model is the electric commercial truck that will lead eco-friendly urban logistics markets around the world and increase customer business value.

1. Introduction.

High-voltage Battery System

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

1. High-voltage system is located behind the cabin area and protected with a steel case.
2. The system consists of battery cells. Each cell is sealed with an aluminum case to protect from an electrolyte spillage. There is rare possibility that electrolyte could occur in the cell if a battery module is compromised.
3. For safety, an over-current protection and ceramic coating isolation layer are used.
4. Anti-flammable material electrolyte is applied to prevent explosions or fire in an emergency case such as a car accident.
5. The high-voltage wiring (housed in orange conduit) is connected to the battery system with DC converter.
6. There is a high-voltage regulator to control the high-voltage system. In addition, there is a high-voltage fuse and safety plug to separate the electrical sources in the system for safety.

The battery, of the highest watertightness grade of IP68, is positioned 240 mm above the ground surface to prevent water contact and any associated failures.

Increased Ground Clearance of High-voltage Battery

Watertightness Grade IP68
Advanced watertightness that prevents any entry of dust and moisture, of a level that keeps the battery usable even when submerged in water

240 mm when empty;
215 mm when full

The MIGHTY Electric's High-voltage battery sits higher off the ground for reduced risk of battery damage from road surface conditions.

1. Introduction.

Definition and safe operation of high-voltage systems for electric vehicles.

High-voltage System Definition

NOTICE

High-voltage system voltage (power battery system):

- 427V < DC ≤ 624V (95.25kw/h)
- 390V < DC ≤ 569V (114.52kw/h)

High-voltage signs and markings:

- The high-voltage wiring harness uses orange high-voltage cables, and the grounding wire uses woven mesh grounding wire.
- Install high-pressure warning signs on the surface of high-pressure components, as shown in the below figure.

Increased Ground Clearance of High-voltage Battery

1. Introduction.

Maintenance Operation Safety

WARNING

- Operators are required to have strong electric operation qualifications certified by the national certification authority, and pass the company's internal high-voltage safety training and examination personnel.
- The operator shall not wear metal ornaments (such as watches, rings, etc.) during operation, and shall not have metal objects (such as keys, metal pens, mobile phones, coins, etc.) in the pocket of the work clothes.
- The operator should carry out the operation when the person's body is dry.
- Before performing operations, check that the safety tools are in good condition.
- When operating under high-pressure, ensure that at least two people are present to prevent no first aid in the event of a safety accident and serve as a safety reminder.
- The maintenance switch must be installed on the BMS at the last step of the operation, and it is not allowed to touch the high-pressure parts on the vehicle during non-assembly or maintenance.
- Be familiar with the safe operation process of high-pressure system components and strictly follow the operation process.
- During commissioning, loading personnel are strictly prohibited from touching the vehicle; When loading the car, the debugging personnel are forbidden to debug.
- The electrician is responsible for the operation according to the new energy vehicle disassembly and assembly specifications.
- The operator should wear safety protection tools according to the operation requirements.
- Stop the vehicle in the permitted position, turn off the vehicle, and pull out the key.
- After parking the vehicle for 5 minutes, disconnect the negative electrode of the low-voltage 24V battery.
- Remove the high-voltage manual maintenance switch and disconnect the high-voltage cable harness from the high-voltage battery connector. Use a multimeter to check whether high-voltage cables exist between the terminals of the high-voltage connector on the high-voltage battery and the terminals of the high-voltage connector on the high-voltage cable harness. If the voltage is lower than 30V, remove the cables. (This operation is used to ensure that the negative high-voltage contactor of the high-voltage battery is disconnected, and the internal capacitor discharge of the all-in-one controller is completed).
- When installing and disassembling high-pressure components, strictly follow the assembly document and the requirements described in the document.
- After the high-voltage components are disassembled, it is necessary to check the assembly and connection of all high-voltage components before installing high-voltage cables to ensure safety and reliability.
- When the personnel are electrocuted, the rescuer should first immediately disconnect the nearby power supply (unplug, disconnect the maintenance switch), use insulation hooks, electrical insulation and other insulation tools or materials to open the electric shock or pick the wire to make it out of the power supply. Do not directly contact the electric shock personnel and wires with hands or metal materials and wet objects to prevent the rescue personnel from being electrocuted again.
- After the electric shock person is removed from the power supply, if the electric shock person is conscious, but some flustered, limbs numb, and the whole body weak, the electric shock person should rest quietly, do not move, and be sent to the hospital in time for diagnosis and treatment.
- If the electrocuted person has lost consciousness but is still breathing, put the electrocuted person down in a place with fresh air, unbuckle the clothes and belt that hinder breathing, maintain body temperature if the weather is cold, and promptly ask a doctor (or call emergency number) to arrive at the scene for diagnosis and treatment.
- If the electrocuted person has lost consciousness and stopped breathing, but the heart is still beating, put the electrocuted person on their back flat as soon as possible for artificial respiration and chest cardiac compression.

2. Electric Truck Identification.

General Vehicle Description

Modern BEV trucks are built on chassis developed for electric vehicles. Therefore, when we use BEV trucks, it is best for our safety to consider that the vehicle is using a high-pressure system. By using the information provided in this section, you will be able to identify BEV trucks.

Identifying a Hyundai BEV truck Electric Vehicle

“electric” badge on passenger front nose panel.

The Hyundai BEV truck can be easily identified by the “electric” badge located on front panel.

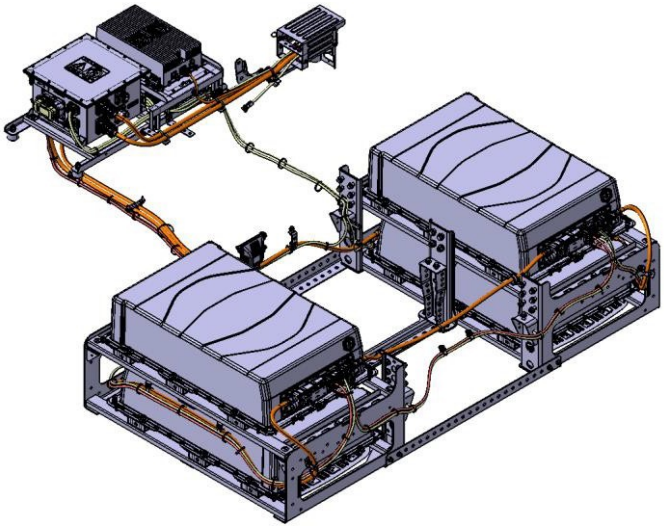
DANGER **Electrocution Risk!**

Badging can become hidden after a crash due to damage to the vehicle. Always be sure to utilise additional methods of identification before determining there is no badge present.

2. Electric Truck Identification.

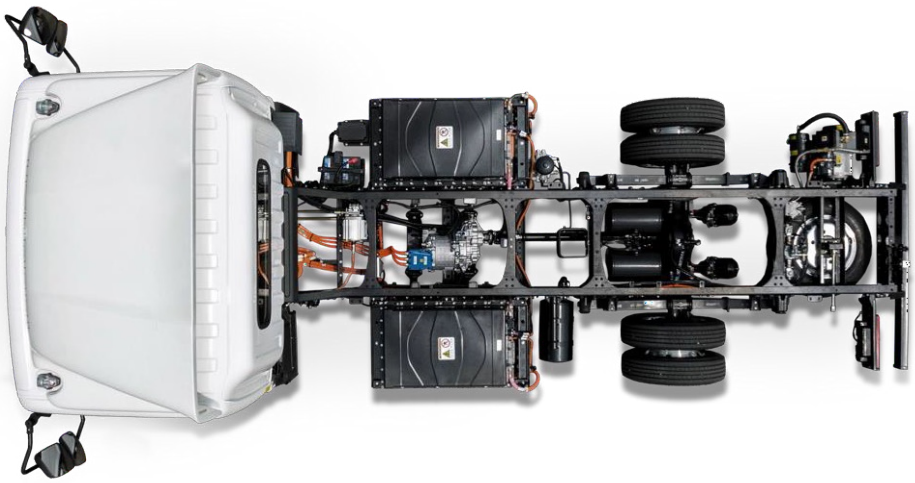
High-voltage Box

The BEV truck has a high-voltage box located in the center of the vehicle. In addition, there are orange high-voltage cables in the high-voltage box.



High-voltage Cable

Orange cables can also be seen at the bottom of the vehicle. The cable is connected from the high-voltage box to the power battery and motor.



2. Electric Truck Identification.

MIGHTY Electric Truck Cluster

Motor Power Gauge

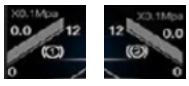
Main display

Speed Gauge

Main Display

Main display

Motor speed



Airtank pressure

3. Electric Truck Main System.

Calculated Performance		
Application Motor		TZ230XSIN101
Max. Speed	km/h	100
Max. Gradeability	Tan0	0.17
AER	Km	260 (actual road test in China, It may vary depending on actual road driving conditions)
	Km	370 (based on Chinese Electric Efficiency Regulation : 40kph Constant Speed Test)
Chassis Specifications		
Motor		
Model		TZ230XSIN101
Brand		Suzhou Inovance Technology Co.,Ltd
Type		PMSM
Power (ps)	Rated	60KW
	Max	120KW
Torque (N.m)	Rated	150
	Max	320
Battery Pack		
Brand		CATL (Contemporary Amperex Technology Co., Limited)
Type		LFP
Capacity(kW.h)		114.5
Energy density(W.h/kg)		159.79
Charge		
Onboard Charger OutPower(kW)		6.6
AC Socket		Type 2
DC Socket		CCS2
Charging Time (min)		71 (SOC :8% → 100%)

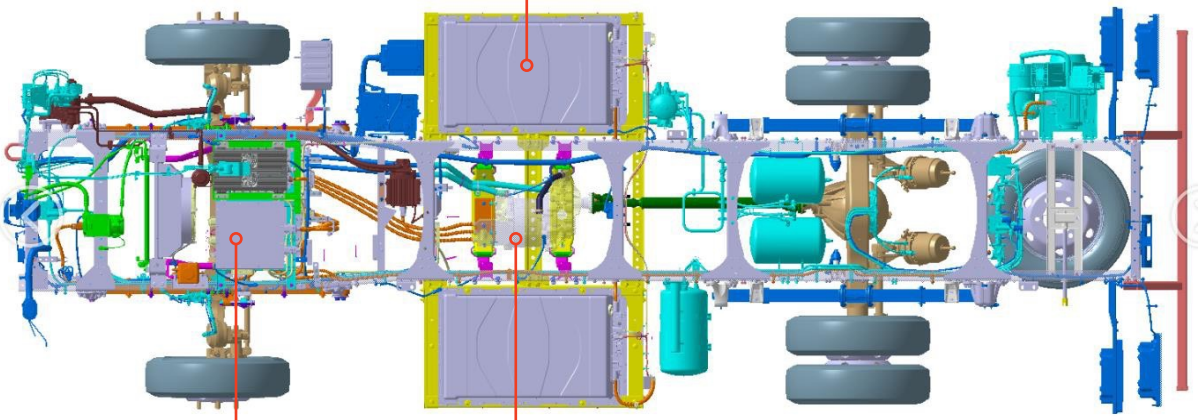
3. Electric Truck Main System.

Propellershaft		
Model		BJ130
Type		Tubular, Forged steel ends
Size (Diameter x Thickness)		Φ63.5×2.5t
Rear Axle		
Model		050C160295A
Type		Full Floating Type
Capacity	kg	5,000
	Type	Single reduction, Hypoid gear
Final Reduction Gear	G/Ratio	5.375
Gear Oil		API Gl-5,Sae85w/90 Synthetic Oil,3.5L
Front Axle		
Type		Reverse Elliott Type “I” Beam
Capacity	kg	2,300
Tire & Wheel		
Type		Single Front, Double Rear
Tire	Front / Rear	205/75R17.5-14PR
Wheel	Front / Rear	ST/AL: 17.5×6.00
Steering		
Type		Electro hydraulic power steering
Steering Wheel	Manual	-
Diameter (mm)	Power	400mm
Tilting Angle		-3.7°~+5.8°
Telescopic Stroke	mm	-30~+30mm
Overall Steering	Manual	-
Gear Ratio	Power	22.6
Turning Angle	Inner / Outer	38°/32°

3. Electric Truck Main System.

Vehicle Components Location

High-voltage Battery Assembly



High-voltage Junction Box

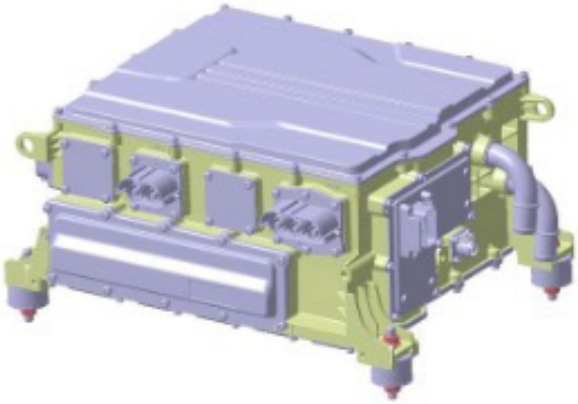
Motor

High-voltage Battery Assembly	Supplies electric energy to drive motor and stores generated electric energy.
High-voltage Junction Box	Supplies electricity from battery to the inverter, LOC, air conditioner compressor, etc.
Motor	When current flows through the coil, it generates a rotating magnetic field and generates motor torque.

3. Electric Truck Main System.

Motor Control Unit

The inverter coverts the direct current of the high-voltage battery to the alternative current and supplies the current to the driving motor and converts the alternative current of the regenerative current to the direct current to charge the high-voltage battery. The inverter is equipped with a Motor Control Unit (MCU) to control the motor torque. When dealing with the high-voltage related Items, stand by for about 5 to 10 minutes in order to discharge the high-voltage charged in the capacitor (condenser) located in the inverter.

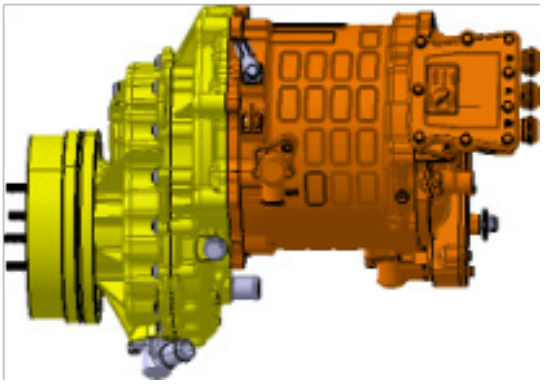


Electric Drive Motor

Mounted in power battery module compartment with the gear reduction unit, the Electric Drive Motor is used for vehicle propulslon. During deceleration or braking, it acts as an alternator and charges the high-voltage battery by converting the vehicle's kinetic energy into electrical energy.

Reducer

It is a reducer which fixes the speed ratio.
It is used to increase torque.



3. Electric Truck Main System.

High-voltage Cabling

The high-voltage cabling in the BEV truck is orange per the SAE standard. These cables run from the front of the vehicle where Motor control unit is located, through to both sides of the vehicle where both battery packs are located, and in between the two battery parks where electric motor is located.

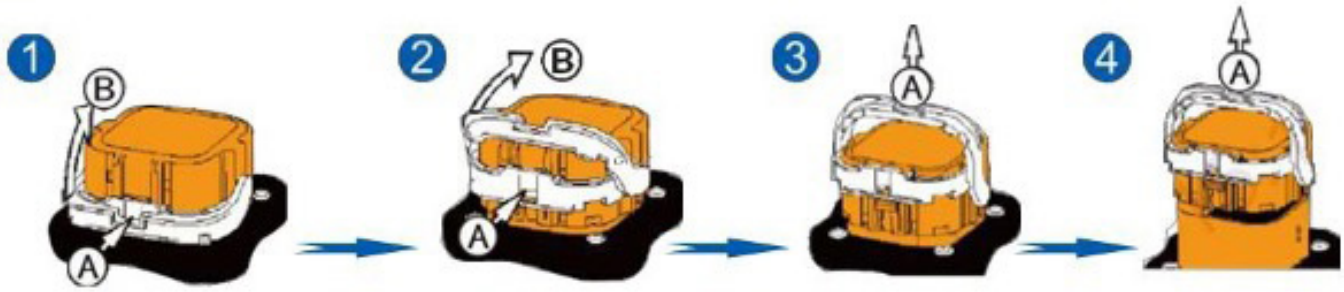
WARNING **Electrocution Risk!**

- 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, connecters, or any electric components before disabling the system, to prevent injury or death by shock.

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

Safety Plug

When dealing with high-voltage battery or components related to the high-voltage battery, make sure to remove the safety plug before commencing servicing. Even after the safety plug is removed, wait for about 5 to 10 minutes in order to discharge the high-voltage charged within the capacitor (condenser) located inside of the inverter.



4. Emergency Procedure.

Initial Response

The following procedures should be used whenever you are dealing with a MIGHTY Electric truck at an emergency scene. All other operations should be consistent with your department's standard operating procedure or guides. Hydrogen 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 jewellery, including watches and rings.

Identify

When dealing with a MIGHTY Electric truck at the scene of an accident, emergency responders should always assume that it is an electric model until it can be proven otherwise using the identification features outlined in this Emergency Response Guide. External badging will usually be the first clue, but it can often be hidden by damage caused in a crash. Always be sure to inspect multiple sides of the vehicle as well as using the clues found under the hood and in the interior of the vehicle.

Immobilise

The next step is to immobilise the vehicle to prevent any accidental movement that can endanger the emergency response personnel and any crash victims. Since the MIGHTY Electric truck doesn't have an engine, there will be instances where the vehicle may appear to be off because of the absence of engine noise. When it is in "ready" mode, the vehicle can move almost silently using the electric drive motor. Responders should approach the vehicle from the sides and away from the front or rear as they are both potential paths of travel. Instructions for immobilising the vehicle are shown on the next page.

Disable

The final step in the initial response process, conducted after the vehicle is secured to prevent movement, 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.

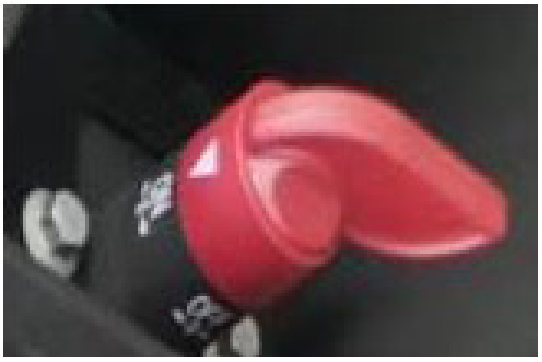
4. Emergency Procedure.

Disabling the System

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 rotate the ignition key because the vehicle may restart.
    b) To turn off the system, lift on the hand brake lever. Rotate the ignition key on the right side of the steering column cover. Wait for vehicle to power down. READY light should turn off.

2. Disconnect the negative (-) 24V battery cable to further prevent the risk of accidental restart.



NOTICE

Once the 24V battery is disconnected, power controls will not operate.

4. Emergency Procedure.

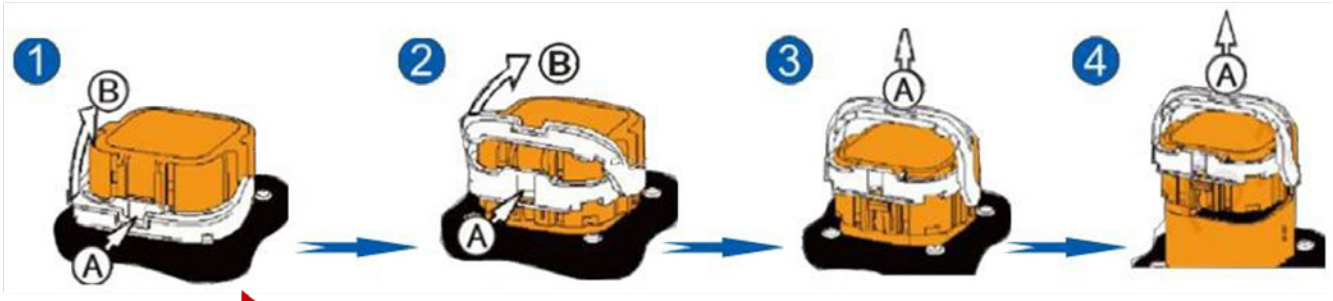
3. Use the following procedure to disable the high-voltage battery.

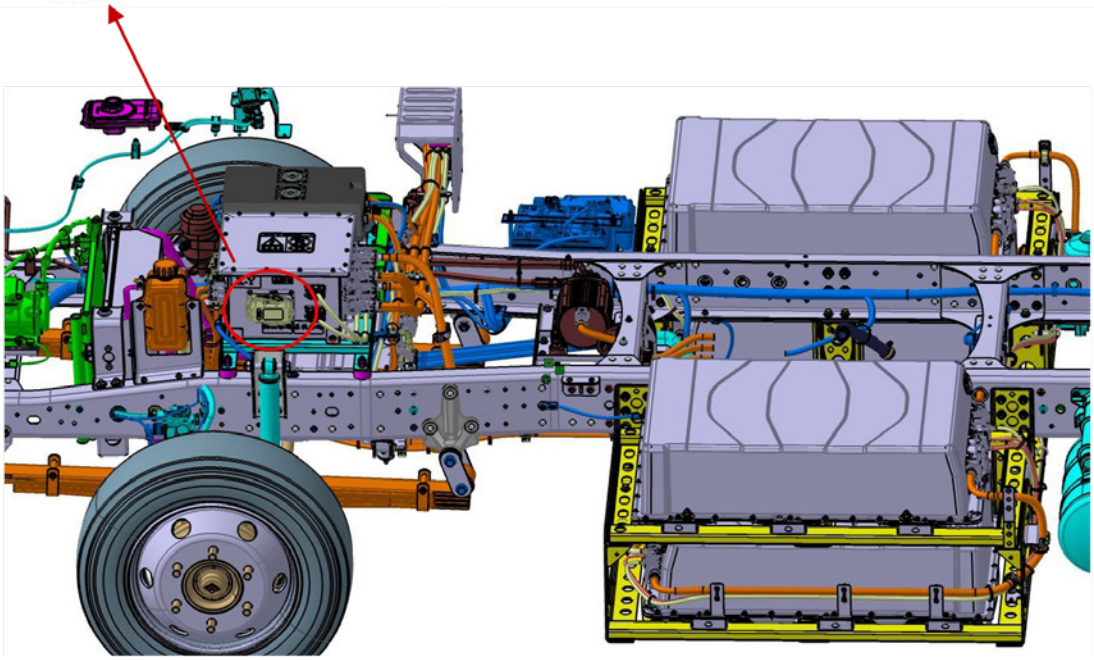
3.1. If the safety plug is accessible, remove the safety plug as shown.

a) Tilt the cap in accordance with the cap tilting procedure.
b) Remove the safety plug using the following procedure:
1: Unlock → 2: Release

WARNING

- Even after the safety plug is removed, wait for about 5 to 10 minutes in order to allow discharge of the high-voltage capacitor (condenser) located in the inverter.





4. Emergency Procedure.

Submersion

Some emergency responses can involve a submerged vehicle. A MIGHT Electric truck that is submerged does not have high-voltage component 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 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. Follow the method described on pages 16 and 17 to disable the vehicle.

DANGER

- If severe damage causes high-voltage components to become exposed, responders should take appropriate precautions and wear appropriate insulated personal protective equipment.
- Do not attempt to remove a safety plug while in the water. Failure to follow any of these instructions may result in serious injury or death by electrocution.

Vehicle Fire

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 MIGHTY Electric truck specific details that are covered in this section.

Firefighting Operations

If the high-voltage battery pack is either involved in or at risk of being involved in a fire in a MIGHTY Electric truck, strict cautions must be taken while conducting firefighting operations due to the following reasons:

- May burn rapidly with a flare-burning effect.
- Even after the high-voltage battery fire appears to have been extinguished, renewed or delayed.
  - 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.
  - Fire, submersion or a collision that 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.
- If the fire spreads to the hydrogen tanks (if equipped) which are installed to the rear floor of the MIGHTY Electric truck, you should not extinguish the fire. Wait for the vehicle to be completely consumed (burned). Insure all persons are a safe distance from the vehicle.

Even if the high-voltage battery pack is not directly involved in a vehicle fire, approach the vehicle with extreme caution.

Extinguishers

- In a fire where the high-voltage battery is not involved; extinguish the fire using an ABC fire extinguisher rated for an electric fire.
- In fires where the high-voltage battery is involved, or the high-voltage battery is heating:
  - 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.

4. Emergency Procedure.

High-voltage Battery Damage and Fluid Leaks

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

- Cease all smoke, spark, flame activity 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 oil, sand, or a dry cloth to clean up the spilled electrolyte. Be sure to adequately ventilate the area.

DANGER **Irritant Substance Risk !**

- Internal components of HV Batteries are irritants and sensitisers.
- To avoid contact with these irritants and sensitisers, 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.

- Electrolyte solution is an eye irritant. If contact with eyes, rinse with plenty of water for 15 minutes.
- Electrolyte solution is a skin irritant. Therefore, if there is contact with skin, wash off with soap.
- Electrolyte liquid or fumes that have come into contact with water vapors in the air will create an oxidised substance. This substance may irritate skin and eyes. In these cases, rinse with plenty of water and see a doctor immediately.
- Electrolyte fumes (when inhaled) can cause respiratory irritation and acute intoxication. Move to a well ventilated location for fresh air and wash mouth with water. See a doctor immediately.

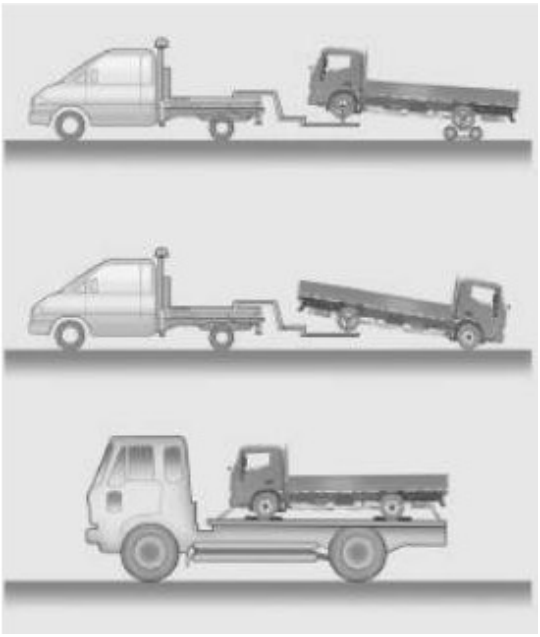
5. Truck Roadside Support.

Towing

Towing the MIGHTY Electric truck is not very different from towing the existing vehicles with internal combustion engine. If emergency towing is necessary, we recommend having it done by an authorised Hyundai Electric truck dealer or a commercial tow-truck service. Proper lifting and towing procedures are necessary to prevent damage to the vehicle. The best way to tow the vehicle is to lift the whole vehicle using the tow truck. However, to tow the vehicle using the wheels, use the flatbed or wheel dollies and lift the rear tyres as the vehicle is equipped with the rear wheel drive motor.

CAUTION

- Your vehicle can be damaged if towed incorrectly.
- Be sure the transmission is in neutral.
- When the vehicle will not start, be sure the steering is unlocked by placing the Ignition Key in the 'ACC' position.
- When towing the vehicle, take care not to cause damage to the bumper or underbody of the vehicle.
- Never tow the vehicle with the rear wheels on the ground, as this may cause a fire and/or damage the electric motor system.
- If the vehicle has to be towed with front wheels lifted, the use of wheel dollies or a flatbed is recommended.



5. Truck Roadside Support.

To Jump-start the Vehicle

1. Make sure the booster battery is 24 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 jumper cable to the positive (+) battery terminal of the discharged battery andconnect the other end to the positive (+) battery terminal for the jump-start.

Connect the second jumper cable to the negative (-) battery terminal for the jump-start and connect the other end to an unpainted robust fixed metal (i.e., hood latch striker), away from the battery.

CAUTION

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

Hyundai Truck Roadside Support.
1800 388 782.

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