

Gasoline-Electric Hybrid Synergy Drive





NHP10 Series

Foreword

This guide was developed to educate and assist dismantlers in the safe handling of Toyota Prius c gasoline-electric hybrid vehicles. Prius c dismantling procedures are similar to other non-hybrid Toyota vehicles with the exception of the high voltage electrical system. It is important to recognize and understand the high voltage electrical system features and specifications of the Toyota Prius c hybrid, as they may not be familiar to dismantlers.

High voltage electricity powers the A/C compressor, electric motor, generator, and inverter/converter. All other conventional automotive electrical devices such as the headlights, radio, and gauges are powered from a separate 12 Volt auxiliary battery. Numerous safeguards have been designed into the Prius c to help ensure the high voltage, approximately 144 Volt, Nickel Metal Hydride (NiMH) Hybrid Vehicle (HV) battery pack is kept safe and secure in an accident.

The NiMH HV battery pack contains sealed batteries that are similar to rechargeable batteries used in some battery operated power tools and other consumer products. The electrolyte is absorbed in the cell plates and will not normally leak out even if the battery is cracked. In the unlikely event the electrolyte does leak, it can be easily neutralized with a dilute boric acid solution or vinegar.

High voltage cables, identifiable by orange insulation and connectors, are isolated from the metal chassis of the vehicle.

Additional topics contained in the guide include:

- Toyota Prius c identification.
- Major hybrid component locations and descriptions.

By following the information in this guide, dismantlers will be able to handle Prius c-electric vehicles as safely as the dismantling of a conventional non-hybrid automobile.

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About the Prius c

The Prius c hatchback joins the PRIUS, CAMRY hybrid and HIGHLANDER hybrid as a hybrid model for Toyota. *Hybrid Synergy Drive* means that the vehicle contains a gasoline engine and an electric motor for power. The two hybrid power sources are stored on board the vehicle:

- 1. Gasoline stored in the fuel tank for the gasoline engine.
- 2. Electricity stored in a high voltage Hybrid Vehicle (HV) battery pack for the electric motor.

The result of combining these two power sources is improved fuel economy and reduced emissions. The gasoline engine also powers an electric generator to recharge the battery pack; unlike a pure all electric vehicle, the Prius c never needs to be recharged from an external electric power source.

Depending on the driving conditions one or both sources are used to power the vehicle. The following illustration demonstrates how the Prius c operates in various driving modes.

• During light acceleration at low speeds, the vehicle is powered by the electric motor. The gasoline engine is shut off.

• During normal driving, the vehicle is powered mainly by the gasoline engine. The gasoline engine also powers the generator to charge the battery pack and to drive the electric motor.

• During full acceleration, such as climbing a hill, both the gasoline engine and the electric motor power the vehicle.

• During deceleration, such as when braking, the vehicle regenerates the kinetic energy from the wheels to produce electricity that recharges the battery pack.

• While the vehicle is stopped, the gasoline engine and electric motor are off, however the vehicle remains on and operational.

• Starting

Over a straight of the stra

Acceleration

Deceleration

G Stopping

Electricity

Electricity and gasoline

Electricity and gasoline (additional electricity extracted from batteries) Charging batteries

Engine automatically stopped

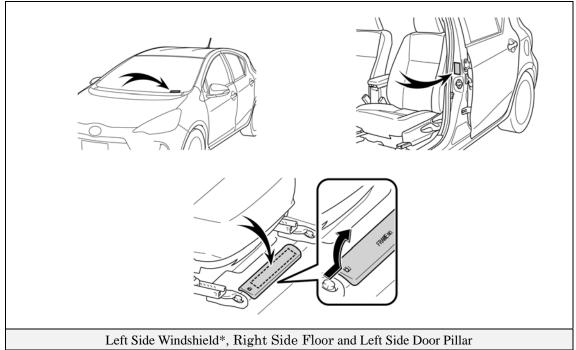
Prius c Identification

In appearance, the 2012 model Prius c is a 5-door hatchback. Exterior, interior, and engine compartment illustrations are provided to assist in identification.

The alphanumeric 17 character Vehicle Identification Number (VIN) is provided in the front windshield cowl*, right side floor and on the left side B pillar. *: Models for U.S.A. and Canada

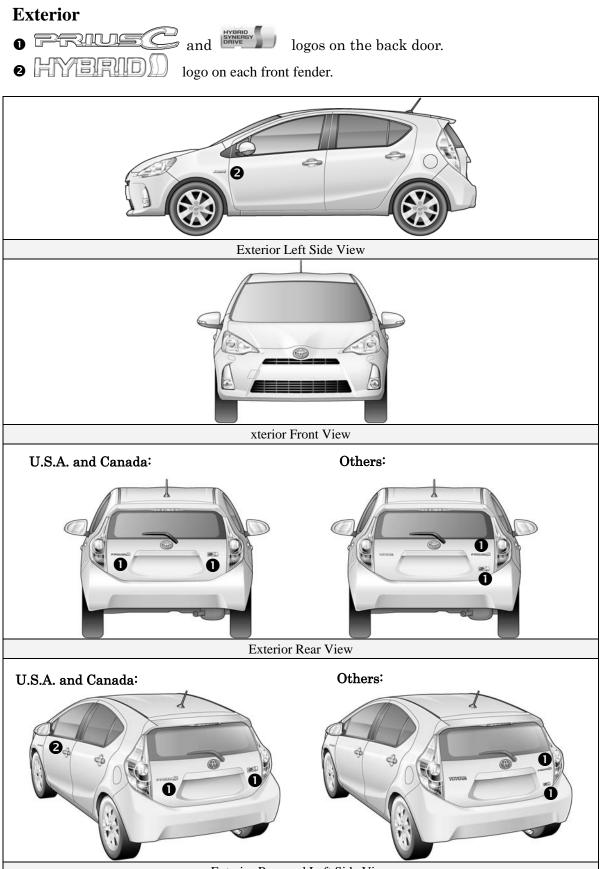
Example VIN: <u>JTDKDTB3</u>0C3000101 (U.S.A., Canada) <u>JTDKD3B3</u>0C3000101 (Others)

A Prius c is identified by the first 8 alphanumeric characters JTDKDTB3 or JTDKD3B3.



*: Models for U.S.A. and Canada

Prius c Identification (Continued)



Exterior Rear and Left Side View

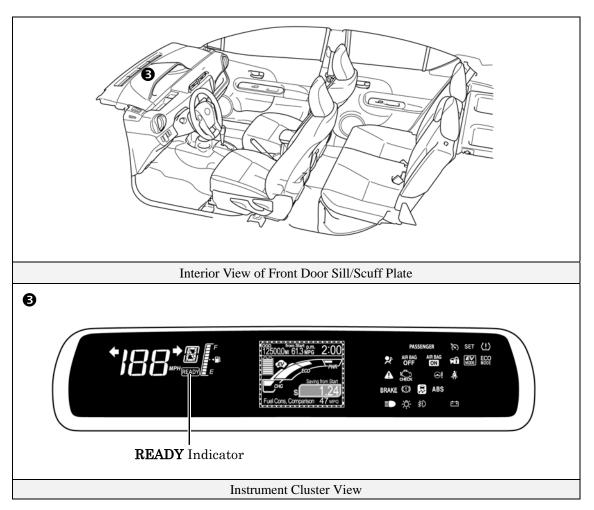
Prius c Identification (Continued)

Interior

S Instrument cluster (speedometer, **READY** light, shift state indicators, warning lights) located in center of the dash and near the base of the windshield.

Hint:

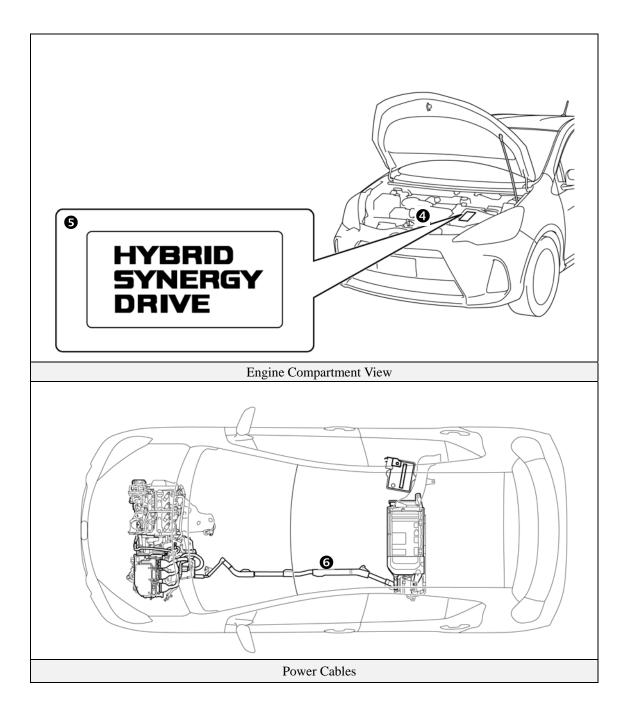
If the vehicle is shut off, the instrument cluster gauges will be "blacked out", not illuminated.



Prius c Identification (Continued)

Engine Compartment

- **4** 1.8-liter aluminum alloy gasoline engine.
- **S** Logo on the plastic engine cover.
- Orange colored high voltage power cables.



Hybrid Component Locations & Descriptions

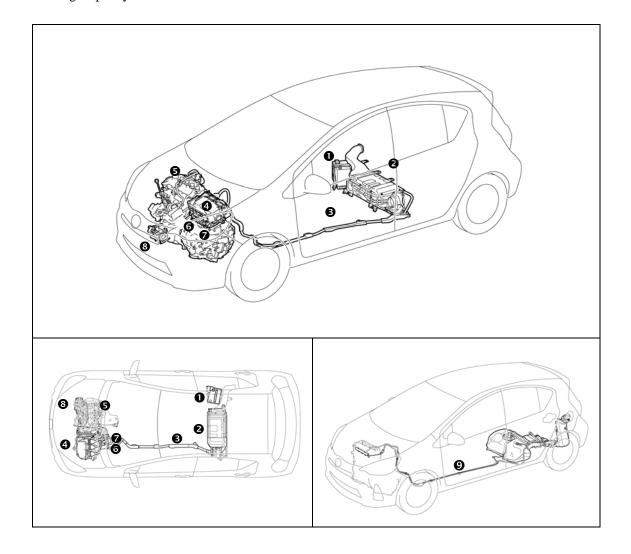
Component	Location	Description
12 Volt O Auxiliary Battery	Under Right Side Rear Seat	A lead-acid battery that supplies power to the low voltage devices.
Hybrid 2 Vehicle (HV) Battery Pack	Mounted to Cross Member Under Rear Seat	144 Volt Nickel Metal Hydride (NiMH) battery pack consisting of 20 low voltage (7.2 Volt) modules connected in series.
Power S Cables	Undercarriage and Engine Compartment	Orange colored power cables carry high voltage Direct Current (DC) between the HV battery pack, inverter/converter, and A/C compressor. These cables also carry 3-phase Alternating Current (AC) between the inverter/converter, electric motor, and generator.
Inverter/ Converter 4	Engine Compartment	Boosts and inverts the high voltage electricity from the HV battery pack to 3-phase AC electricity that drives the electric motors. The inverter/converter also converts AC electricity from the electric generator and electric motors (regenerative braking) to DC that recharges the HV battery pack.
Gasoline G Engine	Engine Compartment	 Provides two functions: 1) Powers vehicle. 2) Powers generator to recharge the HV battery pack. The engine is started and stopped under control of the vehicle computer.
Electric © Motor	Engine Compartment	3-phase high voltage AC permanent magnet electric motor contained in the front transaxle. It is used to power the front wheels.
Electric Ø Generator	Engine Compartment	3-phase high voltage AC generator that is contained in the transaxle and recharges the HV battery pack.
A/C Compressor (with Inverter) 3	Engine Compartment	3-phase high voltage AC electrically driven motor compressor.
Fuel Tank and Fuel Line 9	Undercarriage and Center	The fuel tank provides gasoline via a fuel line to the engine. The fuel line is routed under the center of vehicle.

*Numbers in the component column apply to the illustrations on the following page.

Hybrid Component Locations & Descriptions (Continued)

Specifications

Gasoline Engine:	73 hp (54 kW), 1.5-liter Aluminum Alloy Engine	
Electric Motors	60 hp (45 kW), Permanent Magnet Motor	
Transmission:	Automatic Only (electrically controlled continuously variable transaxle)	
HV Battery:	144 Volt Sealed NiMH-Battery	
Curb Weight:	2,500 lbs/1,132 kg	
Fuel Tank:	9.5 gals/36.0 liters	
Frame Material:	Steel Unibody	
Body Material:	Steel Panels	
Seating Capacity:	5 standard	



Hybrid Synergy Drive Operation

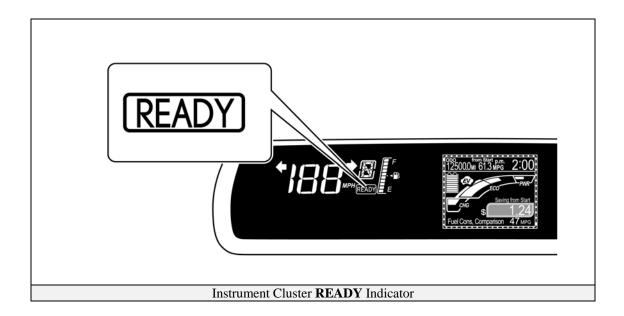
Once the **READY** indicator is illuminated in the instrument cluster, the vehicle may be driven. However, the gasoline engine does not idle like a typical automobile and will start and stop automatically. It is important to recognize and understand the **READY** indicator provided in the instrument cluster. When illuminated, it informs the driver that the vehicle is on and operational even though the gasoline engine may be off and the engine compartment is silent.

Vehicle Operation

- With the Prius c, the gasoline engine may stop and start at any time while the **READY** indicator is on.
- Never assume that the vehicle is shut off just because the engine is off. Always look for the **READY** indicator status. The vehicle is shut off when the **READY** indicator is off.

The vehicle may be powered by:

- 1. The electric motor only.
- 2. A combination of both the electric motor and the gasoline engine.



Hybrid Vehicle (HV) Battery Pack and Auxiliary Battery

The Prius c features a high voltage Hybrid Vehicle (HV) battery pack that contains sealed Nickel Metal Hydride (NiMH) battery modules.

HV Battery Pack

- The HV battery assembly is enclosed in a metal case and is rigidly mounted under the rear seat. The metal case is isolated from high voltage.
- The HV battery pack consists of 20 low voltage (7.2 Volt) NiMH battery modules connected in series to produce approximately 144 Volts. Each NiMH battery module is non-spillable and in a sealed case.
- The electrolyte used in the NiMH battery module is an alkaline mixture of potassium and sodium hydroxide. The electrolyte is absorbed into the battery cell plates and will not normally leak, even in a collision.

HV Battery Pack		
Battery pack voltage	144 V	
Number of NiMH battery modules in pack	20	
NiMH battery module voltage	7.2 V	
NiMH battery module dimensions	5 x 1 x 11 in (118 x 20 x 276 mm)	
NiMH module weight	2.3 lbs (1.04 kg)	
NiMH battery pack dimensions	15 x 40 x 9 in (387 x 1011 x 225 mm)	
NiMH battery pack weight	68 lbs (31 kg)	

Components Powered by the HV Battery Pack

- Electric Motor
- Inverter/Converter Motor
- A/C Compressor
- Power Cables Electric Generator

9

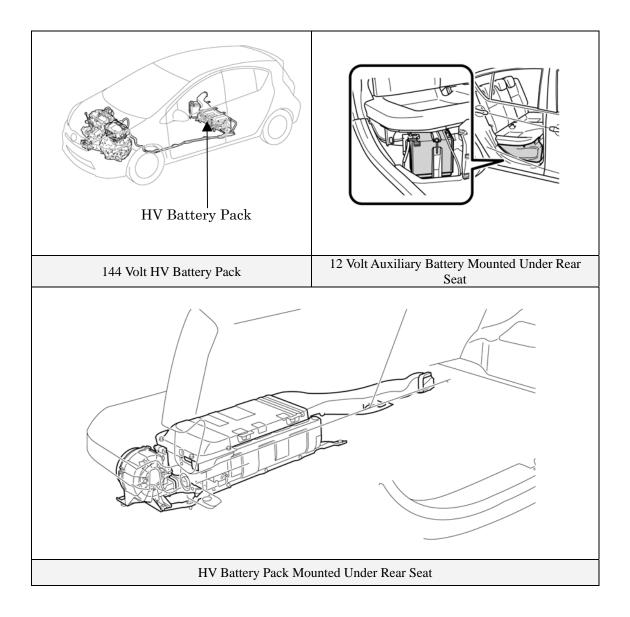
Hybrid Vehicle (HV) Battery Pack and Auxiliary Battery (Continued)

HV Battery Pack Recycling

• The HV battery pack is recyclable. Contact either your Toyota Distributor as mentioned on HV battery Caution Label (see page 26) or the nearest Toyota dealer.

Auxiliary Battery

- The Prius c also contains a lead-acid 12 Volt battery. This 12 Volt auxiliary battery powers the vehicle electrical system similar to a conventional vehicle. As with other conventional vehicles, the auxiliary battery is grounded to the metal chassis of the vehicle.
- The auxiliary battery is located under the rear seat. It is concealed by the floor cover.



High Voltage Safety

The HV battery pack powers the high voltage electrical system with DC electricity. Positive and negative orange colored high voltage power cables are routed from the battery pack, under the vehicle floor pan, to the inverter/converter. The inverter/converter contains a circuit that boosts the HV battery voltage from 144 to 520 Volts DC. The inverter/converter creates 3-phase AC to power the motors. Power cables are routed from the inverter/converter to each high voltage motor (electric motor, electric generator, and A/C compressor). The following systems are intended to help keep occupants in the vehicle and emergency responders safe from high voltage electricity:

High Voltage Safety System

- A high voltage fuse **0*** provides short circuit protection in the HV battery pack.
- Positive and negative high voltage power cables 2* connected to the HV battery pack are controlled by 12 Volt normally open relays 3*. When the vehicle is shut off, the relays stop electricity flow from leaving the HV battery pack.

WARNING:

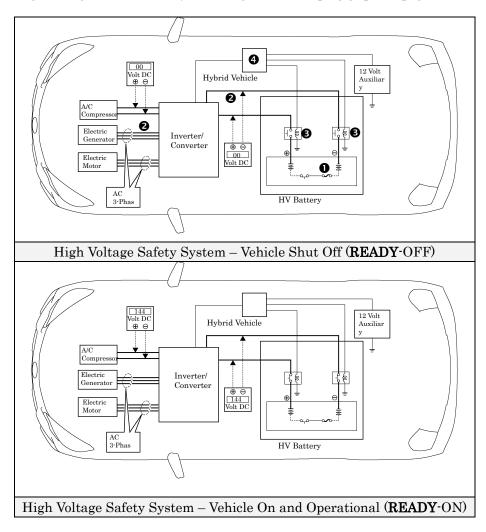
- The high voltage system may remain powered for up to 10 minutes after the vehicle is shut off or disabled. To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or opening any orange high voltage power cable or high voltage component.
- Both positive and negative power cables **2*** are insulated from the metal chassis, so there is no possibility of electric shock when touching the metal chassis.
- A ground-fault monitor continuously monitors for high voltage leakage to the metal chassis while the vehicle is running. If a malfunction is detected, the hybrid vehicle computer **4*** will illuminate the master warning light **1** in the instrument cluster and indicate "CHECK HYBRID SYSTEM" on the multi-information display.
- The HV battery pack relays will automatically open to stop electricity flow in a collision sufficient to activate the SRS.

*Numbers apply to the illustration on the following page.

High Voltage Safety (Continued)

Service Plug Grip

• The high-voltage circuit is cut by removing the service plug grip (see page 15).



Precaution to be observed when dismantling the vehicle

MARNING:

 The high voltage system may remain powered for up to 10 minutes after the vehicle is shut off or disabled. To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or opening any orange high voltage power cable or high voltage component.

Necessary Items

- Protective clothing such as insulated gloves (electrically insulated), rubber gloves, safety goggles, and safety shoes.
- Insulating tape such as electrical tape that has a suitable electrical insulation rating.
- Before wearing insulated gloves, make sure that they are not cracked, ruptured, torn, or damaged in any way. Do not wear wet insulated gloves.
- An electrical tester that is capable of measuring DC 750 Volts or more.

Spills

The Prius c contains the same common automotive fluids used in other non-hybrid Toyota vehicles, with the exception of the NiMH electrolyte used in the HV battery pack. The NiMH battery electrolyte is a caustic alkaline (pH 13.5) that is damaging to human tissues. The electrolyte, however, is absorbed in the cell plates and will not normally spill or leak out even if a battery module is cracked. A catastrophic crash that would breach both the metal battery pack case and a metal battery module would be a rare occurrence.

A caustic alkaline is at the opposite end of the pH scale from a strong acid. A safe (neutral) substance is approximately in the middle of this scale. Adding a weak acidic mixture, such as a dilute boric acid solution or vinegar, to the caustic alkaline electrolyte will cause the electrolyte to be neutralized. This is similar but opposite to the use of baking soda to neutralize a lead-acid battery electrolyte spill.

A Toyota Material Safety Data Sheets (MSDS) is attached to this document.

- Handle NiMH electrolyte spills using the following Personal Protective Equipment (PPE):
 - Splash shield or safety goggles. A fold down face shield is not acceptable for acid or electrolyte spills.
 - Rubber, latex or nitrile gloves.
 - Apron suitable for alkaline.
 - Rubber boots.
- Neutralize NiMH electrolyte.
 - Use a boric acid solution or vinegar.
 - Boric acid solution 800 grams boric acid to 20 liters water or 5.5 ounces boric acid to 1 gallon of water.

Dismantling the vehicle

The following 2 pages contain general instructions for use when working on a Prius c. Read these instructions before proceeding to the HV battery removal instructions on page 18.

MARNING:

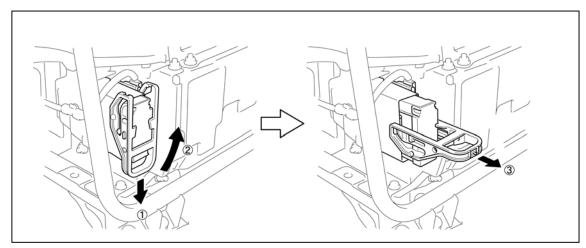
- The high voltage system may remain powered for up to 10 minutes after the vehicle is shut off or disabled. To prevent serious injury or death from severe burns or electric shock, avoid touching, cutting, or opening any orange high voltage power cable or any high voltage component.
- 2. Shut off the ignition (**READY** indicator is off). Then disconnect the cable from the auxiliary battery negative (-) terminal.
 - (1) Remove the front floor cover RH.
 - (2) Disconnect the battery negative terminal.

3. Remove the service plug grip.

Caution:

Wear insulated gloves for the following 3 steps.

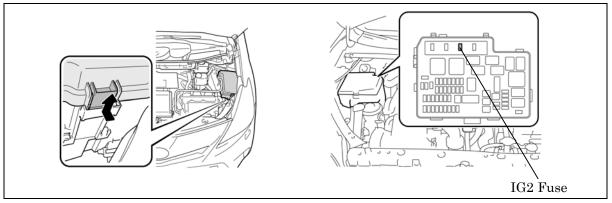
- (1) Slide the handle of the service plug grip to the right.
- (2) Raise the release handle of the service plug grip
- (3) Remove the service plug grip.
- (4) Apply insulating tape to the socket of the service plug grip to insulate it.



- 4. Carry the removed service plug grip in your pocket to prevent other staff from accidentally reinstalling it while you are dismantling the vehicle.
- 5. Make other staff aware that a high-voltage system is being dismantled by using the following sign: CAUTION: HIGH-VOLTAGE. DO NOT TOUCH (see page 17).
- 6. If the service plug grip cannot be removed due to damage to the vehicle, remove the **IG2** fuse (15A).

Caution:

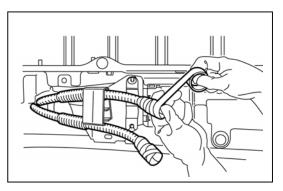
This operation shuts off the HV system. Be sure to wear insulated gloves because high voltage is not shut off inside the HV battery. When it is possible to remove the service plug grip, remove it and continue the procedure.



- After disconnecting or exposing a high-voltage connector or terminal, insulate it immediately using insulating tape. Before disconnecting or touching a bare high-voltage terminal, wear insulated gloves.
- 8. Check the HV battery and nearby area for leakage. If you find any liquid, it may be strong alkaline electrolyte. Wear rubber

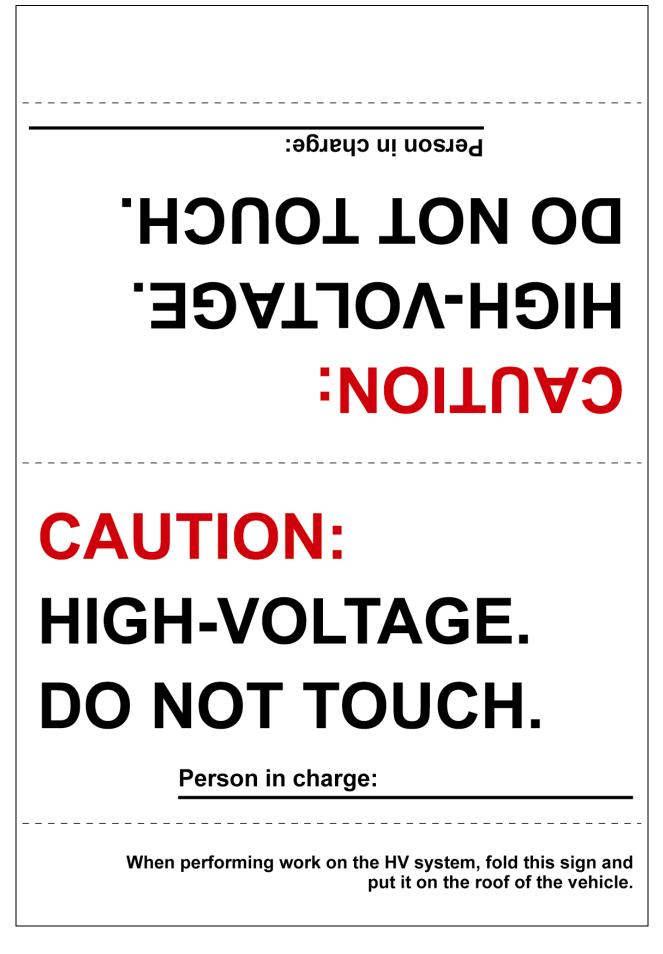
gloves and goggles and neutralize the liquid using a saturated boric acid solution or vinegar. Then wipe up the liquid using waste rags etc.

 If the electrolyte comes into contact with your skin, wash the skin immediately using a saturated boric acid solution or a large amount of water. If the electrolyte

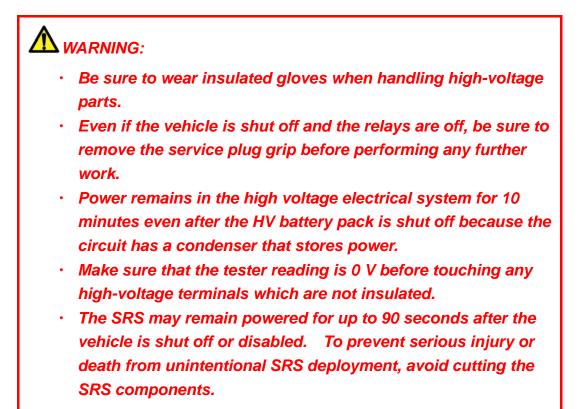


adheres to any article of clothing, take the clothing off immediately.

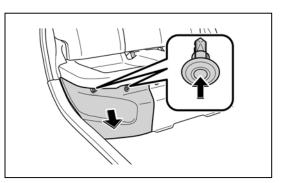
- If the electrolyte comes into contact with your eye(s), call out loudly for help. Do not rub your eye(s). Instead, wash the eye(s) with a dilute boric acid solution or a large amount of water and seek medical care.
- With the exception of the HV battery, remove parts by following procedures which are similar to conventional Toyota vehicles. For the removal of the HV battery, refer to the following pages.



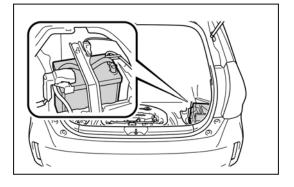
Removal of HV battery



- 1. SHUT OFF IGINITION (READY indicator is off)
- 2. REMOVE 12 V AUXILIARY BATTERY
 - (1) Remove the front floor cover RH.



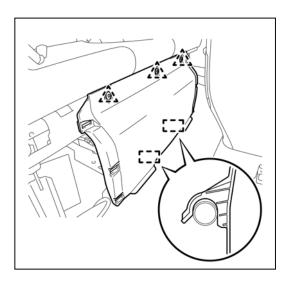
- (2) Disconnect the cable from the auxiliary battery negative (-) terminal.
- (3) Disconnect the cable from the auxiliary battery positive (+) terminal.
- (4) Remove the 12volt auxiliary battery.

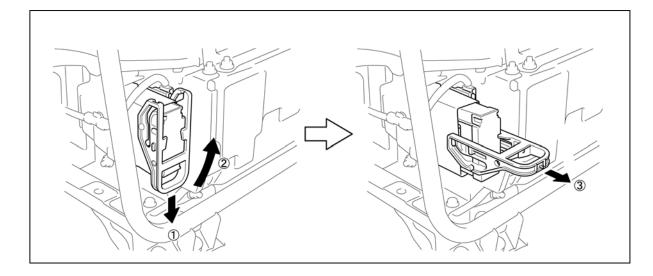


3. REMOVE SERVICE PLUG GRIP Caution:

Wear insulated gloves for the following 3 steps.

- (1) Remove the front floor cover LH and front center floor cover.
- (2) Raise the release handle of the service plug grip as shown in the illustration below.
- (3) Remove the service plug grip.
- (4) Apply insulating tape to the socket of the service plug grip to insulate it.





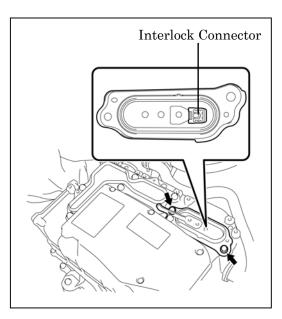
4. REMOVE INVERTER TERMINAL COVER Caution:

Wear insulated gloves.

(1) Remove the 2 bolts and inverter terminal cover.

Caution:

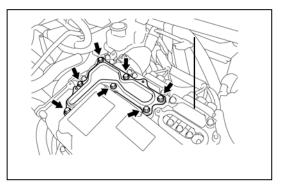
An interlock connector is installed to the inverter terminal cover. Make sure to remove the inverter terminal cover before removing the inverter cover.



5. REMOVE INVERTER COVER Caution:

Wear insulated gloves.

(1) Remove the 7 bolts and inverter cover.



6. CHECK TERMINAL VOLTAGE

(1) Check voltage at the terminals in inspection point in the power control unit.

Caution:

Wear insulated gloves.

To prevent serious injury or death, do not proceed with dismantling of the HV system until the voltage at the terminals in the inspection point is 0 V.

Standard voltage: 0 V

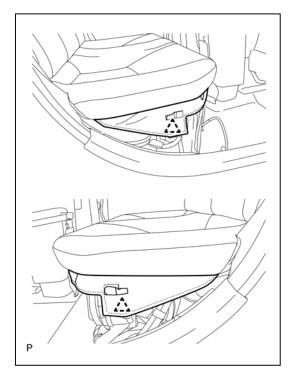
Hint:

Set the tester to DC 750 Volts measure the voltage.

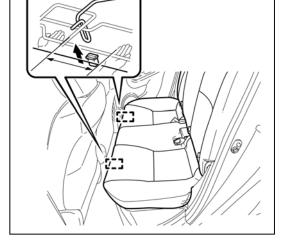
This inspection is performed to verify that it is safe to remove the HV battery.

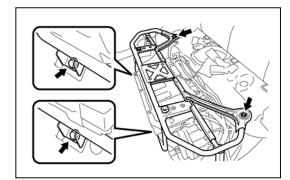
7. REMOVE REAR SEAT CUSHION ASSEMBLY

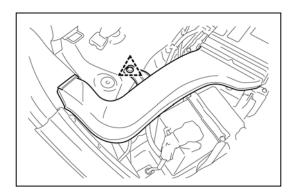
(1) Disengage the 2 clips.



- (2) Disengage the hook of the rear seat cushion assembly from the vehicle body as shown in the illustration.
- (3) Remove the rear seat cushion assembly.







8. REMOVE REAR SEAT CUSHION LEG SUB-ASSEMBLY

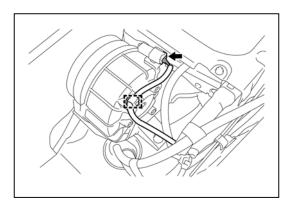
(1) Remove the 4 bolts and rear seat cushion leg sub-assembly.

9. REMOVE NO. 1 HYBRID BATTERY EXHAUST DUCT

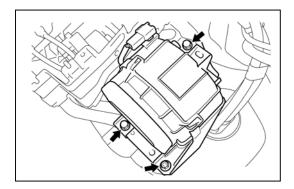
(1) Remove the clip and No. 1 hybrid exhaust duct.

10. REMOVE BATTERY COOLING BLOWER ASSEMBLY

 Disconnect the battery cooling blower assembly connector and clamp.



(2) Remove the 2 bolts, nut and battery cooling blower assembly.



11. REMOVE NO. 1 HYBRID VEHICLE BATTERY COVER PANEL LH Caution:

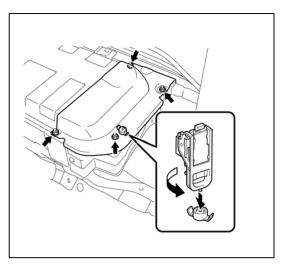
Wear insulated gloves.

(1) Using the service plug grip, remove the battery cover lock striker.

Hint:

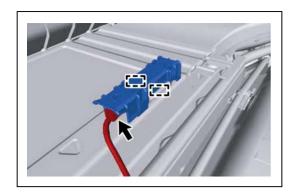
Insert the projecting part of the service plug grip and turn the button of the battery cover lock striker counterclockwise to release the lock.

(2) Remove the 4 nuts and No. 1 hybrid vehicle battery cover panel LH.



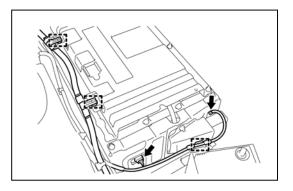
12. REMOVE NO. 3 INDOOR ELECTRICAL KEY ANTENNA ASSEMBLY

- (1) Disengage the 2 clamps.
- (2) Disconnect the connector and remove the No. 3 indoor electrical key antenna assembly.

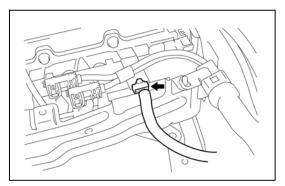


13. REMOVE WIRE HARNESS

 Disconnect the 2 connectors and 3 clamps as shown in the illustration.



(2) Disconnect the connector.



14. REMOVE FRAME WIRE

Caution:

Wear insulated gloves.

- (1) Disconnect the 2 connectors.
- (2) Disconnect the shielded wire ground and frame wire.

Shielded Wire Ground

15. REMOVE HV BATTERY

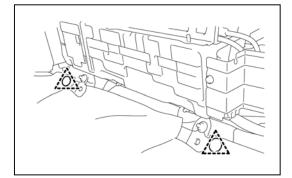
Caution:

Wear insulated gloves.

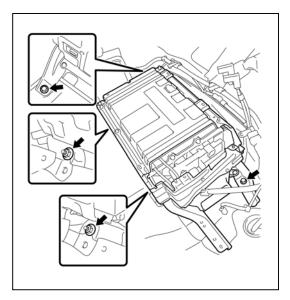
Notice:

When removing/installing/moving the HV battery, make sure not to tilt it more than 80°.

(1) Remove the 2 clips.



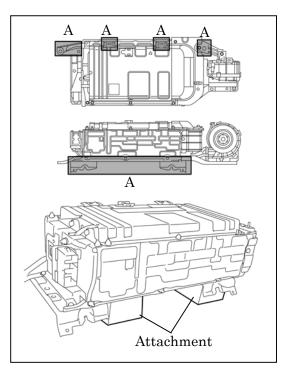
(2) Remove the 2 bolts and 2 nuts.



(3) Remove the HV battery.

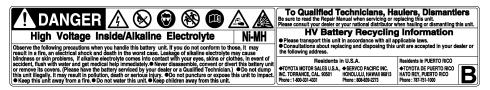
Notice:

- When moving the HV battery, be sure to hold area A shown in the illustration.
- Place the HV battery on the attachment.



HV Battery Caution Label

1. For U.S.A.



2. For CANADA



3. Others

