TOYOTA RAV4 EV

Electric Vehicle

ELECTRIC VEHICLE DISMANTLING MANUAL



QEA38 Series

Foreword

This guide was developed to educate and assist dismantlers in the safe handling of Toyota RAV4 EV electric vehicles. RAV4 EV dismantling procedures are similar to other non-electric 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 RAV4 EV electric vehicle, as they may not be familiar to dismantlers.

High voltage electricity powers the electric motor, DC/DC converter, battery coolant heater, air conditioning (A/C) compressor, cabin coolant heater and inverter. All other automotive electrical devices such as the head lights, radio, and gauges are powered from a separate 12 Volt auxiliary battery. Numerous safeguards have been designed into the RAV4 EV to help ensure the high voltage, approximately 386 Volt, Lithium-ion (Li-ion) Electric Vehicle (EV) battery assembly is kept safe and secure in an accident.

The Li-ion EV battery assembly 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.

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 RAV4 EV identification.
- Major electric vehicle component locations and descriptions.

By following the information in this guide, dismantlers will be able to handle RAV4 EV electric vehicles as safely as the dismantling of a conventional non-electric automobile.

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About the RAV4 EV

The RAV4 EV continues into its 2nd generation as an electric vehicle. Electric Vehicle means that the vehicle contains only an electric motor and does not have a gasoline engine for power. Electricity stored in a high voltage Electric Vehicle (EV) battery assembly for the electric motor.

The following illustration demonstrates how the RAV4 EV operates in various driving modes.

- Utilizing the charge cable assembly connected to a 120/240 Volt outlet, the vehicle's EV battery assembly can be fully charged within 40 hours (when charging on 120 Volt / 15 Amp) or 6 hours (when charging on 240 Volt / 40 Amp) from a fully discharged state.
- A fully charged RAV4 EV will travel approximately 152 miles (245 km).
- During deceleration, such as when braking, the vehicle regenerates kinetic energy from the front wheels to produce electricity that recharges the EV battery assembly.
- While the vehicle is stopped, the electric motor is off, however the vehicle remains on and operational.



RAV4 EV Identification

In appearance, the 2012 model year RAV4 EV is nearly identical to the conventional, non-electric Toyota RAV4. The RAV4 EV is a 5-door SUV. Exterior, interior, and motor compartment illustrations are provided to assist in identification.

The alphanumeric 17 character Vehicle Identification Number (VIN) is provided in the front windshield cowl and on the left side B pillar.

Example VIN: 2T3YL4DV0C2020211

A RAV4 EV is identified by the first 8 alphanumeric characters 2T3YL4DV.



RAV4 EV Identification (Continued)

Exterior

- RAVAS and I logos on the back door.
- *CELECTRUC* logo on the driver and front passenger door.
- Charge inlet door located on the left side rear quarter panel.



RAV4 EV Identification (Continued)

Interior

• The instrument cluster (power meter, driving range & battery gauge, **READY** indicator, plug-in indicator and warning lights) located in the dash behind the steering wheel, is different than the one on the conventional, non-electric RAV4.

Hint:

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



RAV4 EV Identification (Continued)

Motor Compartment

G Logo on the plastic cover.Orange colored high voltage power cables.



Electric Vehicle Component Locations & Descriptions

	Component	Location	Description
	Volt Auxiliary	Motor Compartment	A lead-acid battery that supplies power to the low voltage devices.
Electric Vehicle (EV) Un Battery Assembly 2		Undercarriage	386 Volt Lithium-ion (Li-ion) battery assembly consisting of 3.6 Volt cells connected in a series-parallel circuit.
Po	wer Cables 9	Undercarriage, Motor Compartment and Left Side behind Rear Quarter Panel	Orange colored power cables carry high voltage Alternating Current (AC) between the charge port and on-board charger, and high voltage Direct Current (DC) between the EV battery assembly, DC/DC converter, inverter, A/C compressor, battery coolant heater and cabin coolant heater.
Drive Unit 3 5 Motor Compart		Motor Compartment	The drive unit integrates the inverter, electric motor, differential and p-lock actuator.
	Inverter 4	Drive Unit	Inverts the high voltage electricity from the EV battery to 3-phase AC electricity that drive the electric motor. Also converts the high voltage AC power generated by the electric motor during regeneration to high voltage DC power to charge the EV battery assembly.
	Electric Motor 9	Drive Unit	3-phase high voltage AC inductive electric motor contained in the drive unit. It is used to power the front wheels.
On-Board Charger G		Motor Compartment	Boosts the AC power supplied from an external power source and converts it to DC to charge the EV battery assembly.
· · · · · ·		Motor	3-phase high voltage AC electrically driven motor
(with Inverter) 🖸		Compartment	compressor.
DC/DC Converter for 12 Volt Auxiliary Battery ③		Motor Compartment	Converts 386 Volts from the EV battery assembly to 12 Volts for low voltage vehicle power.
Cabin Coolant Heater 9		Motor Compartment	Heats the coolant used for the cabin heater.

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

Electric Vehicle Component Locations & Descriptions (Continued)

Specifications

Electric Motor:	154 hp (115 kW), AC Inductive Motor
Transaxle:	Automatic Only
EV Battery Assembly:	386 Volt Sealed Li-ion Battery
Curb Weight:	4,032 lbs/1,829 kg
Frame Material:	Steel Unibody
Body Material:	Steel Panels
Seating Capacity:	5 passengers



Electric Vehicle Operation

Once the **READY** indicator is illuminated in the instrument cluster, the vehicle may be driven. However, as there is no gasoline engine, no sound will be produced from the vehicle. It is important to recognize and understand the **READY** indicator provided in the instrument cluster. When lit, it informs the driver that the vehicle is on and operational even though the motor compartment is silent.

Vehicle Operation

- With the RAV4 EV, the system is operational while the **READY** indicator is on.
- Never assume that the vehicle is shut off just because the motor compartment is silent. Always look for the **READY** indicator status. The vehicle is shut off when the **READY** indicator is off.



Electric Vehicle (EV) Battery Assembly and Auxiliary Battery

The RAV4 EV features a high voltage Electric Vehicle (EV) battery assembly that contains sealed Lithium-ion (Li-ion) battery cells.

EV Battery Assembly

- The EV battery assembly is enclosed in a metal case and is rigidly mounted to the undercarriage. The metal case is isolated from high voltage.
- The EV battery assembly consists of low voltage (3.6 Volt) Li-ion battery cells connected in a series-parallel circuit to produce approximately 386 Volts. Each cell is non-spillable and contained in a sealed metal case.
- The electrolyte used in the Li-ion battery cells is a flammable organic electrolyte. The electrolyte is absorbed into the battery cell separator and will not normally leak, even in a collision.

EV Battery Assembly				
Battery assembly voltage	386 V			
Li-ion battery cell voltage	3.6 V			
Li-ion battery cell dimensions	0.71 x 2.56 in.			
Diameter x Height	(18 x 65 mm)			
Li-ion cell weight	Approximately 0.1 lbs (46.5 g)			
Li-ion battery assembly dimensions	74 x 57 x 11 in.			
Length x Width x Height	(1876 x 1454 x 270 mm)			
Li-ion battery assembly weight	845 lbs (383.5 kg)			

Components Powered by the EV Battery Assembly

- Inverter
- Power Cables
- DC/DC Converter for 12 V Auxiliary Battery
- A/C Compressor
- Cabin Coolant Heater
- Battery Coolant Heater

Electric Vehicle (EV) Battery Assembly and Auxiliary Battery (Continued)

EV Battery Assembly Recovery

• Contact either your Toyota Distributor or the nearest Toyota dealer.

Auxiliary Battery

- The RAV4 EV contains a sealed 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 negative terminal of the auxiliary battery is grounded to the metal chassis of the vehicle.
- The auxiliary battery is located in the motor compartment.



High Voltage Safety

The EV battery assembly powers the high voltage electrical system with DC electricity. Positive and negative orange colored high voltage power cables are routed from the EV battery assembly, under the vehicle floor pan, to the drive unit (inverter and motor) and DC/DC converter. The inverter contains a circuit that boosts and inverts the 386 Volts DC from the EV battery assembly to 450 Volts AC to power the motor. Power cables are routed from the DC/DC converter (HV junction block) to each high voltage component (A/C compressor, battery coolant heater and cabin coolant heater). The following systems are intended to help keep occupants in the vehicle and emergency responders safe from high voltage electricity:

High Voltage Safety System

- High voltage fuses **0** provide short circuit protection in the EV battery assembly.
- Positive and negative high voltage power cables ② connected to the EV battery assembly are controlled by a 12 Volt contactor (relay) ③. When the vehicle is shut off and not charging, the contactor (relay) stops electricity flow from the EV battery assembly.

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 body. High voltage electricity flows through these cables and not through the metal vehicle body. The metal vehicle body is safe to touch because it is insulated from the high voltage components.
- The EV battery assembly contactors 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

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.

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 RAV4 EV contains some of the same common automotive fluids used in other non-electric Toyota vehicles, with the exception of the Li-ion electrolyte used in the EV battery assembly. The electrolyte used in the Li-ion battery cells is a flammable organic electrolyte. The electrolyte is absorbed into the battery cell separators, even if the battery cells are crushed or cracked, it is unlikely that liquid electrolyte will leak. Any liquid electrolyte that leaks from a Li-ion battery cell quickly evaporates.

MARNING:

- The Li-ion battery contains organic electrolyte. Only a small amount may leak from the batteries which may irritate the eyes, nose, throat, and skin.
- Contact with the vapor produced by the electrolyte may irritate the nose and throat.
- To avoid injury by coming in contact with the electrolyte or vapor, wear personal protective equipment for organic electrolyte including SCBA or full face respirator suitable for organic solvents.
- Handle Li-ion electrolyte spills using the following Personal Protective Equipment (PPE):
 - Splash shield or safety goggles. Fold down helmet shields are not acceptable for electrolyte spills.
 - Butyl rubber or suitable organic solvent gloves.
 - Apron or protective clothing suitable for organic solvents.
 - Rubber overboots or boots suitable for organic solvents.
 - Full face respirator suitable for organic solvents or SCBA.

Dismantling the vehicle

The following 5 pages contain general instructions for use when working on a RAV4 EV. Read these instructions before proceeding to the EV battery removal instructions on page 20.

M 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 any high voltage component.
- Shut off the ignition (READY indicator is off). Then disconnect the cable from the auxiliary battery negative (-) terminal.
 - (1) Open the hood.
 - (2) Disconnect the auxiliary battery negative (-) terminal.



- 2. Remove the front upper floor cover.
 - (1) Slide the passenger seat forward and tilt the seatback forward.
 - (2) Remove the carpeting underneath the seat.
 - (3) Remove the 4 nuts and front upper floor cover.
- 3. Remove the service plug grip.

Caution:

- Wear insulating gloves and protective goggles.
- Remove the service plug grip to interrupt the high voltage circuit at the time of inspection or repair.
- After removing the service plug grip, attach a note to it to prevent other technicians from mistakenly reconnecting it while you are servicing the vehicle.
- All the high voltage wiring connectors are orange.

Notice:

To prevent the electric vehicle battery assembly from being damaged by falling objects, temporarily install the front upper floor cover after removing the service plug grip.



 Using insulating gloves, press the part with the black claw and pull the handle up slightly to release the lock.



(2) Press the black-colored tab and lift the handle upright, then remove the service plug grip by taking the handle and pulling it directly upward.



- 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 19).

If the service plug grip cannot be removed due to damage to the vehicle, remove the IG2 fuse (15 A blue colored).

Caution:

This operation shuts off the EV system. Be sure to wear insulated gloves because high voltage is not shut off inside the EV 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.
- Check the EV battery assembly and nearby area for leakage. If you find any liquid, it may be Li-ion electrolyte. Handle Li-ion electrolyte



spills using the following Personal Protective Equipment (PPE):

- Splash shield or safety goggles. Fold down helmet shields are not acceptable for electrolyte spills.
- Butyl rubber or suitable organic solvent gloves.
- Apron or protective clothing suitable for organic solvents.
- Rubber overboots or boots suitable for organic solvents.
- Full face respirator suitable for organic solvents or SCBA.

Caution:

- The Li-ion battery contains organic electrolyte. Only a small amount may leak from the batteries which may irritate the eyes, nose, throat, and skin.
- Contact with the vapor produced by the electrolyte may irritate the nose and throat.
- To avoid injury by coming in contact with the electrolyte or vapor, wear personal protective equipment for organic electrolyte including SCBA or full face respirator suitable for organic solvents.

- 9. 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.
- 10. With the exception of the EV battery assembly, remove parts by following procedures which are similar to conventional Toyota vehicles. For the removal of the EV battery assembly, refer to the following pages.



Removal of EV Battery Assembly

MARNING:

- Be sure to wear insulated gloves when handling high-voltage parts.
- Even if the vehicle is shut off and the relays are off, be sure to remove the service plug grip before performing any further work.
- Power remains in the high voltage electrical system for 10 minutes even after the EV battery pack is shut off because the circuit has a condenser that stores power.
- Make sure that the tester reading is 0 V before touching any high-voltage terminals which are not insulated.
- The SRS may remain powered for up to 90 seconds after the vehicle is shut off or disabled. To prevent serious injury or death from unintentional SRS deployment, avoid cutting the SRS components.

1. SHUT OFF IGINITION (READY indicator is off)

2. REMOVE 12 V AUXILIARY BATTERY

- (1) Open the hood.
- (2) Disconnect the cable from the auxiliary battery negative (-) terminal.
- (3) Disconnect the cable from the auxiliary battery positive (+) terminal.
- (4) Remove the 12 Volt auxiliary battery.



3. REMOVE FRONT UPPER FLOOR COVER

- (1) Slide the passenger seat forward and tilt the seatback forward.
- (2) Remove the carpeting underneath the seat.
- (3) Remove the 4 nuts and front upper floor cover.



4. REMOVE SERVICE PLUG GRIP

Caution:

- Wear insulating gloves and protective goggles.
- Remove the service plug grip to interrupt the high voltage circuit at the time of inspection or repair.
- After removing the service plug grip, attach a note to it to prevent other technicians from mistakenly reconnecting it while you are servicing the vehicle.
- All the high voltage wiring connectors are orange.

Notice:

To prevent the electric vehicle battery assembly from being damaged by falling objects, temporarily install the front upper floor cover after removing the service plug grip.

 Using insulating gloves, press the part with the black claw and pull the handle up slightly to release the lock.



(2) Press the black-colored tab and lift the handle upright, then remove the service plug grip by taking the handle and pulling it directly upward.



- 5. REMOVE NO.1 MOTOR UNDER COVER ASSEMBLY
 - Remove the 8 screws, 11 clips and No.1 motor under cover assembly.
- 6. REMOVE UPPER NO. 1 FLOOR BOARD
 - Remove the 4 screws, 11 clips and upper No. 1 floor board.









- 7. DISCONNECT COOLING HOSE
 - Disconnect the No. 7 EV battery hose and detach the clamp.

(2) Disconnect the No. 8 EV battery hose and detach the clamp.

- 8. DRAIN COOLANT (for EV Battery)
 - (1) Remove the battery reservoir tank cap (for EV battery).

Caution:

To avoid the danger of being burned, do not remove the battery reservoir tank cap while the coolant for the radiator is still hot.

(2) Connect an air blow gun with a SST (air regulator) to either disconnected EV battery hose, apply air pressure of 172 kPa (1.75 kgf/cm², 25 psi) or less to the EV battery and drain coolant from the other side.



Caution:

Do not exceed 172 kPa (1.75 kgf/cm², 25 psi) because the seals inside the EV battery may be blown.

9. REMOVE ELECTRIC VEHICLE BATTERY ACCESS COVER Caution: Wear insulated gloves and protective goggles. (1) Using an insulated tool, remove the 4 holts an

 Using an insulated tool, remove the 4 bolts and electric vehicle battery access cover.



Hint:

Make sure to pull the electric vehicle battery access cover straight down, as a connector is connected to the bottom of the cover.

(2) Remove the gasket.



10. CHECK TERMINAL VOLTAGE

Caution:

Wear insulated gloves and protective goggles.

(1) for Motor cable side:

Using a voltmeter, measure the voltage between the terminals of the 2 phase connectors shown in the illustration.

Standard voltage: 0 V

Hint:

Use a measuring range of DC 750 V or more on the voltmeter.

(2) for Charge cable side:

Using a voltmeter, measure the voltage between the terminals of the 2 phase connectors shown in the illustration.

Standard voltage: 0 V

Hint:

Use a measuring range of DC 750 V or more on the voltmeter.

(3) for Motor cable side:

Using a voltmeter, measure the voltage between each terminal and body ground as shown in the illustration.

Standard voltage: 0 V

Hint:

Use a measuring range of DC 750 V or more on the voltmeter.

(4) for Charge cable side:

Using a voltmeter, measure the voltage between each terminal and body ground as shown in the illustration.

Standard voltage: 0 V

Hint:

Use a measuring range of DC 750 V or more on the voltmeter.









(5) for Fuse side:

Using a voltmeter, measure the voltage between each terminal and body ground as shown in the illustration..

Standard voltage: 0 V

Hint:

Use a measuring range of DC 750 V or more on the voltmeter.

11. DISCONNECT MOTOR CABLE

Caution:

Wear insulated gloves and protective goggles.

- (1) Remove the 2 nuts.
- (2) Using an insulated tool, remove the 2 bolts and pull out the motor cable.







12. DISCONNECT CHARGE CABLE Caution: Wear insulated gloves and protective goggles.

> Using an insulated tool, remove the 2 bolts and pull out the charge cable.



13. REMOVE HIGH VOLTAGE FUSE

Caution:

Wear insulated gloves and protective goggles.

Hint:

Perform this procedure only when replacement of the high voltage fuse is necessary.

(1) Remove the 2 bolts and high voltage fuse.



14. REMOVE ELECTRIC VEHICLE BATTERY ASSEMBLY

Caution:

Wear insulated gloves and protective goggles.

(1) Disconnect the connector. HINT:

Lift up the claw of the connector to release the lock.



(2) Remove the nut and disconnect the ground cable.



(3) Set an engine lifter. Check that the lifter is set securely.

Notice:

- Align the center of the battery shown in the illustration with the center of the engine lifter.
- Install a palette on the lifter cradle to make sure not to apply too much force to the underside of the battery.



- (4) Remove the 18 bolts.
- (5) w/Washer:

Remove the 2 washers.

(6) Raise the vehicle and remove the electric vehicle battery.



Caution:

After removing the HV battery, do not reinstall the service plug grip to the HV battery.

HV Battery Caution Label

- NEVER ATTEMPT TO REMOVE DISASSEMBLE OR MODIFY THIS UNIT OR USE IT FOR OTHER THAN ITS INTENDED PURPOSE. (PLEASE HAVE YOUR DEALER OR A QUALIFIED TECHNICIAN HANDLE THE BATTERY.)
- DO NOT DISPOSE OF THIS UNIT ILLEGALLY. IT MAY RESULT IN POLLUTION OR IN SERIOUS INJURY DUE TO A THIRD PARTY TOUCHING THE UNIT.
- DO NOT SUBJECT THIS UNIT TO PHYSICAL IMPACT THAT MAY CAUSE DAMAGE.
- KEEP THIS UNIT AWAY FROM FIRE.
- TRANSPORT THIS UNIT IN ACCORDANCE WITH ALL APPLICABLE LAWS.
- KEEP CHILDREN AWAY FROM THIS UNIT.

TO QUALIFIED (EV OR HV) TECHNICIANS:

BE SURE TO READ THE REPAIR MANUAL WHEN SERVICING OR REPLACING THIS UNIT. PLEASE PERFORM BATTERY DIAGNOSTICS TO CORRECT ECU DATA AFTER REPLACING THIS BATTERY.

TO HAULERS AND DISMANTLERS:

PLEASE CONSULT WITH YOUR DEALER OR YOUR NATIONAL DISTRIBUTOR WHEN HAULING OR DISMANTLING THIS UNIT.

HV BATTERY RECYCLING INFORMATION: PLEASE CONTACT YOUR NEAREST DEALER OR NATIONAL DISTRIBUTOR FOR INQUIRIES OR REQUEST DISPOSAL OF THIS UNIT.

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