Australasian Road Rescue Organisation Inc
http://www.arro.org.au
PO Box 831, Toowoomba, Queensland 4350
Telephone: (07) 4616 1562 Facsimile: (07) 4616 1593
Email: arro@arro.org.au
President: Lee Johnson Secretary: Glen Maule

TECHNICAL BULLETIN No. 2/2007

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SUBJECT

NEW VEHICLE TECHNOLOGY Version HVT 3.01

INTRODUCTION

This bulletin follows on from the previous ARRO Technical Bulletin 6/2005 'Hybrid Vehicle Technology' prepared by Tim Fox from the New South Wales Fire Brigade; and highlights further the operating systems of Hybrid vehicles available to the Australian market.

VEHICLES

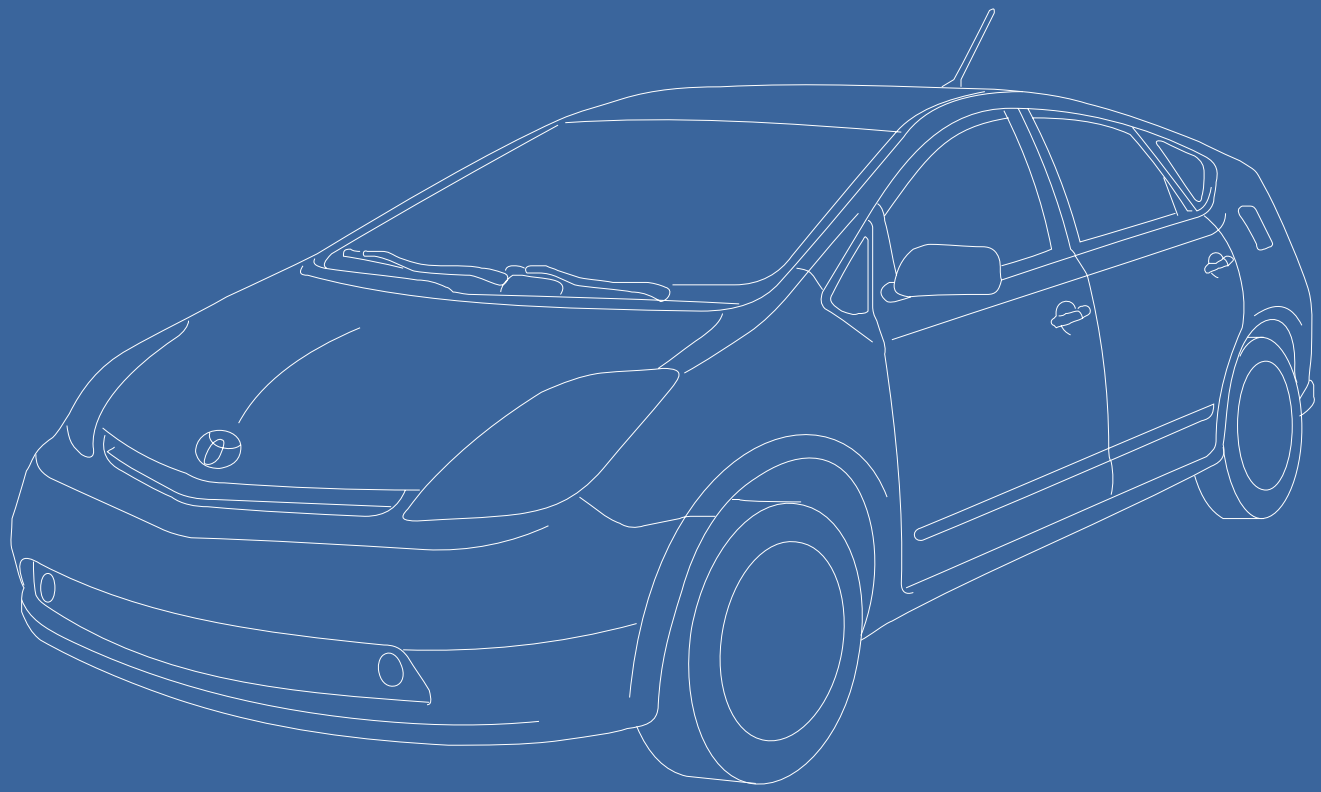
Various.

SOURCE **Mick Holton, Senior Rescue Instructor**
CONTACT **New South Wales Fire Brigade, Mick.Holton@fire.nsw.gov.au**

New Vehicle Technology

Version HVT 3.01

Produced by Mick Holton
Senior Rescue Instructor
NSW Fire Brigades



Part Two:

Hybrid Vehicle Technology

Hybrid Vehicle Technology

- Definition of a Hybrid Vehicle
- Hybrid Vehicles available in Australia
- Concept Hybrid Vehicles (some available off shore)
- Types of Hybrid Systems
- Identification of Hybrid Vehicles
- Hazards associated with Hybrid Vehicles
- Personal Protection Equipment (PPE)
- Emergency Response
- Fire Fighting
- HazMat

Definition - Hybrid Vehicle

A vehicle that has more than one source of on-board energy.
Example – a petrol / electric hybrid would have:

- an electric motor / generator
- an internal combustion engine

It would need two methods of storing the energy:

- a high voltage battery
- fuel (fuel tank)

Other examples are:
diesel / electric hybrids
fuel cell / electric
solar / hybrid electric

Hybrid Vehicles in Australia

At the time that this presentation was created the following new Hybrid vehicles were readily available in Australia

- Toyota Prius
- Honda Civic

Hybrid Vehicles in Australia

The following second hand (used) Hybrid vehicles are available in Australia

- Toyota Prius (2x models)

- Honda Civic

- Honda Insight

Concept Hybrid Vehicles

Concept Hybrid Vehicles

2004 Mitsubishi Eclipse Concept-E

3.8L V6 petrol engine driving front wheels
150 kW electric motor driving rear wheels

Types of Hybrid Systems

Series Hybrid System (Petrol / Electric)

Internal Combustion Engine

Generator Or Alternator

High Voltage Battery

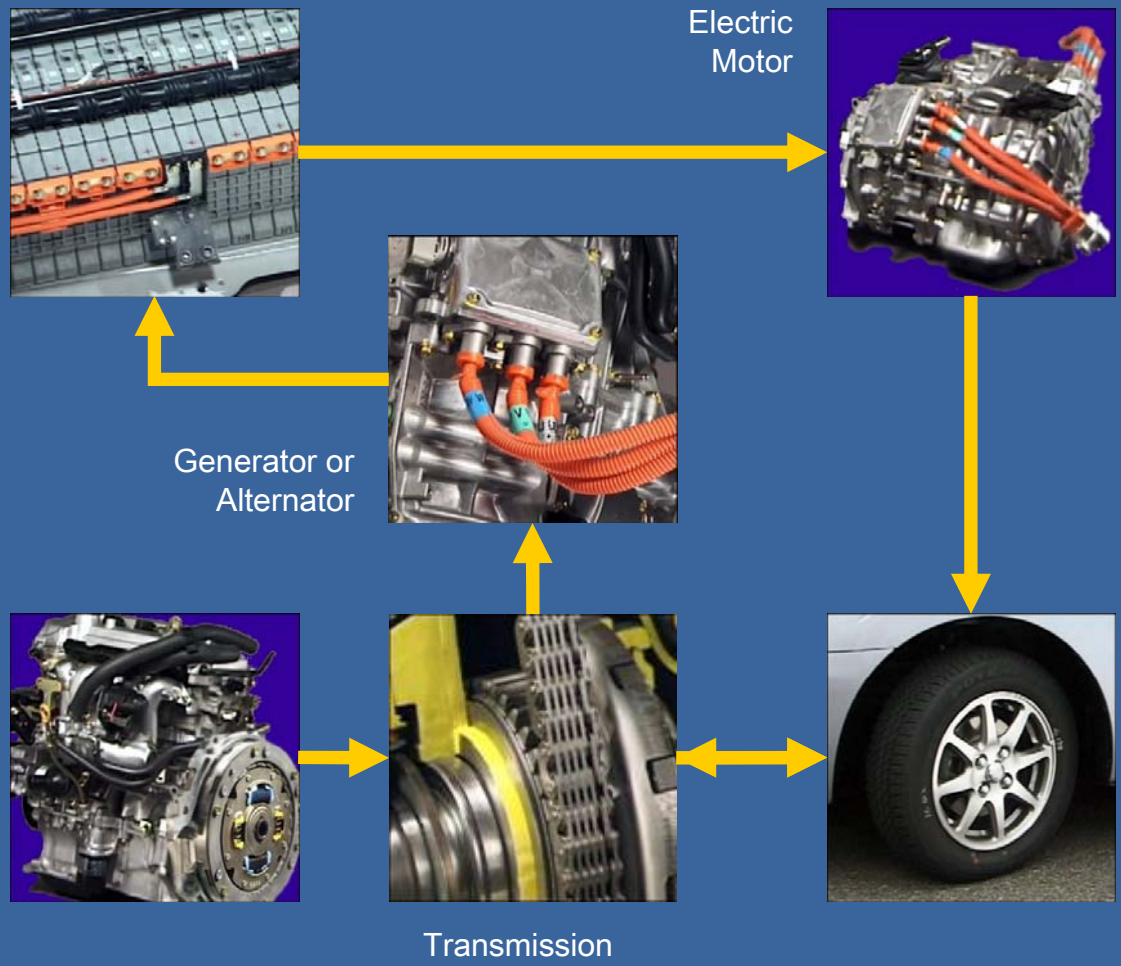
Electric Motor

Final Drive & Road Wheels

May have other power sources

Types of Hybrid Systems

Parallel Hybrid System (Petrol / Electric)



Identification - Hybrid Vehicles

- Look for a “Hybrid” logo or badge

- Manufacturers have adopted the word “Hybrid” to advertise and identify vehicles as being a combination of internal combustion engine and electric motor powered

- There is no legal requirement for manufacturers to display the “Hybrid” logo

Identification - Hybrid Vehicles

- Look for orange coloured electrical cables

  - High voltage cables have been coloured orange for easy identification
  - The presence of these cables will warn the rescuer of possible high voltage systems

Identification - Hybrid Vehicles

- Look for a battery pack (high voltage battery)

Honda Insight

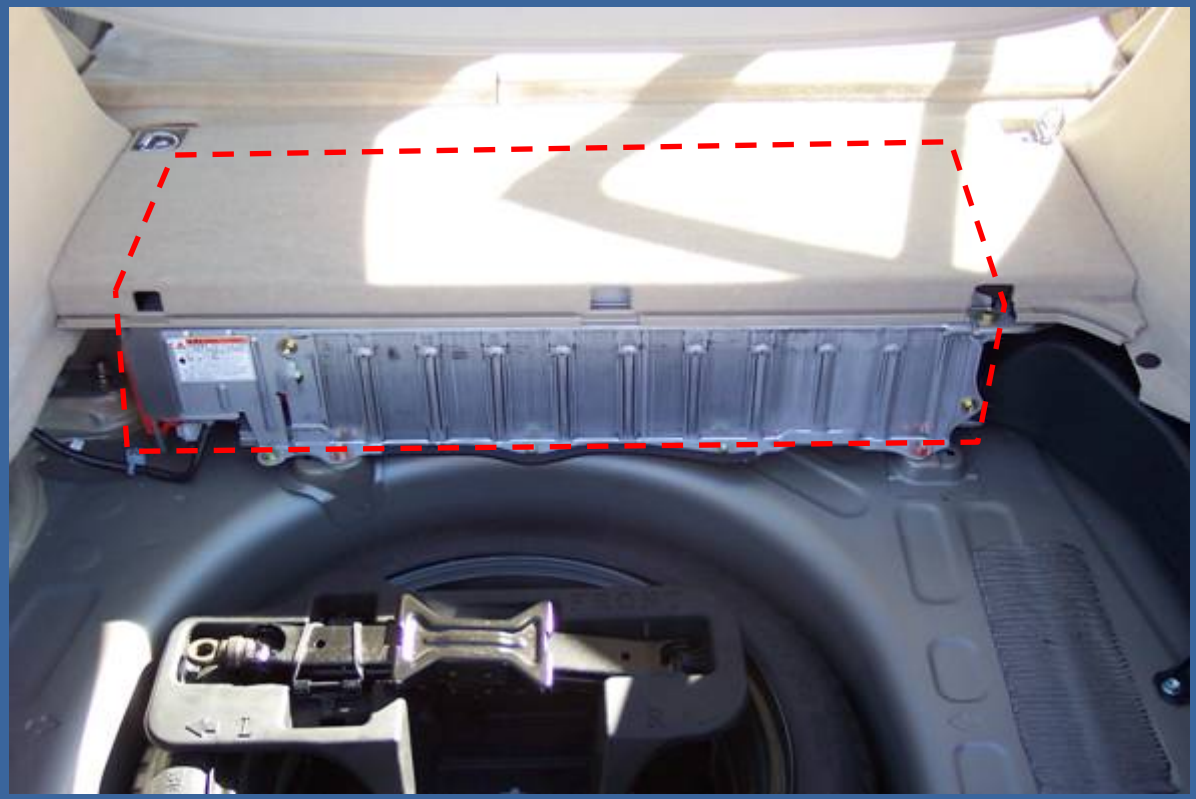
Identification - Hybrid Vehicles

- Look for a battery pack (high voltage battery)

Toyota Prius (1st Generation)

Identification - Hybrid Vehicles

- Look for a battery pack (high voltage battery)



Toyota Prius (Generation 2)

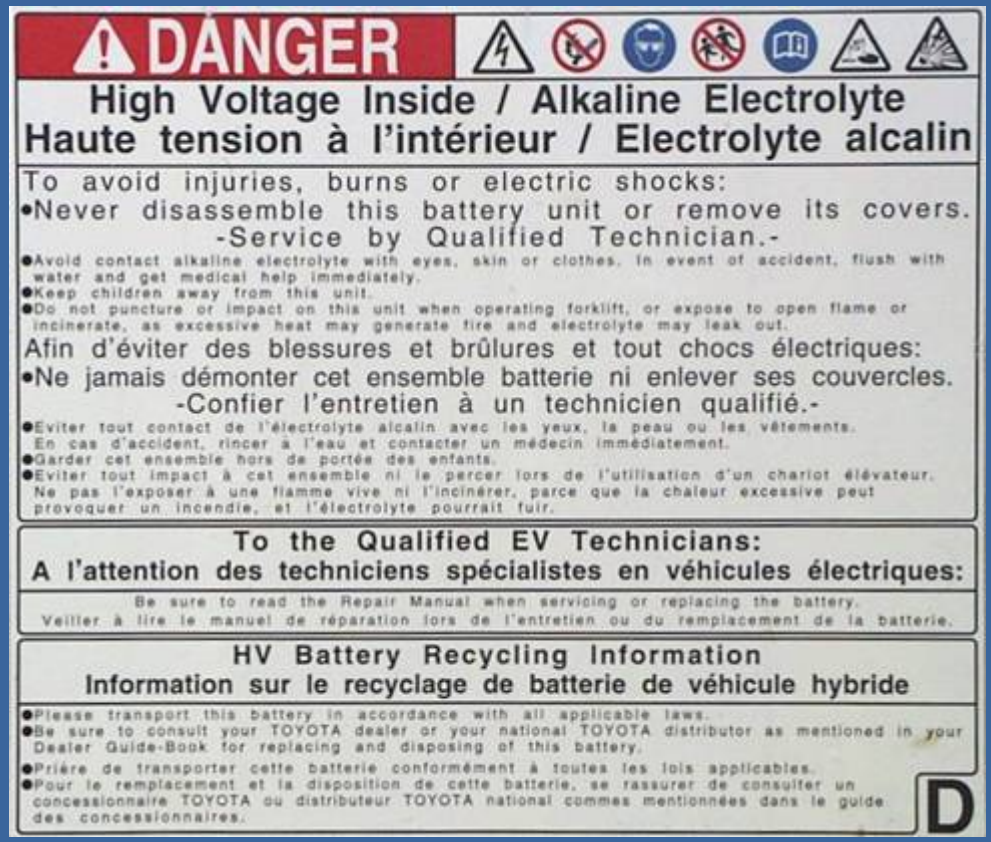
Identification - Hybrid Vehicles

- Look for a battery pack (high voltage battery)

Honda Civic

Identification - Hybrid Vehicles

- Look for warning labels



⚠ DANGER

High Voltage Inside / Alkaline Electrolyte
Haute tension à l'intérieur / Electrolyte alcalin

To avoid injuries, burns or electric shocks:
- Never disassemble this battery unit or remove its covers.
-Service by Qualified Technician.-
- Avoid contact alkaline electrolyte with eyes, skin or clothes. In event of accident, flush with water and get medical help immediately.
- Keep children away from this unit.
- Do not puncture or impact on this unit when operating forklift, or expose to open flame or incinerate, as excessive heat may generate fire and electrolyte may leak out.

Afin d'éviter des blessures et brûlures et tout chocs électriques:
- Ne jamais démonter cet ensemble batterie ni enlever ses couvercles.
-Confier l'entretien à un technicien qualifié.-
- Eviter tout contact de l'électrolyte alcalin avec les yeux, la peau ou les vêtements. En cas d'accident, rincer à l'eau et contacter un médecin immédiatement.
- Garder cet ensemble hors de portée des enfants.
- Eviter tout impact à cet ensemble ni le percer lors de l'utilisation d'un chariot élévateur. Ne pas l'exposer à une flamme vive ni l'incinérer, parce que la chaleur excessive peut provoquer un incendie, et l'électrolyte pourrait fuir.

To the Qualified EV Technicians:
A l'attention des techniciens spécialistes en véhicules électriques:

Be sure to read the Repair Manual when servicing or replacing the battery.
Veiller à lire le manuel de réparation lors de l'entretien ou du remplacement de la batterie.

HV Battery Recycling Information
Information sur le recyclage de batterie de véhicule hybride

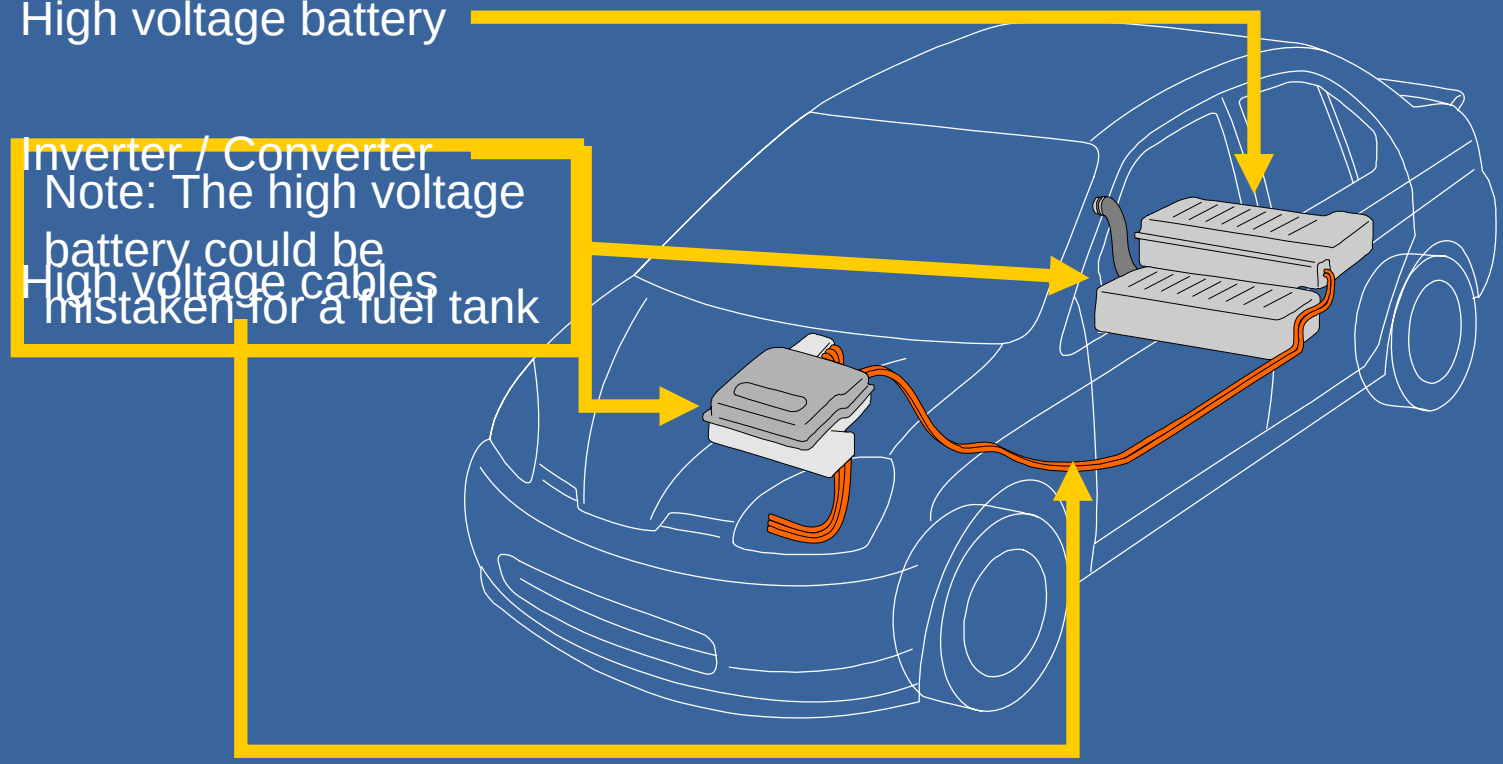
- Please transport this battery in accordance with all applicable laws.
- Be sure to consult your TOYOTA dealer or your national TOYOTA distributor as mentioned in your Dealer Guide-Book for replacing and disposing of this battery.
- Prière de transporter cette batterie conformément à toutes les lois applicables.
- Pour le remplacement et la disposition de cette batterie, se rassurer de consulter un concessionnaire TOYOTA ou distributeur TOYOTA national commes mentionnées dans le guide des concessionnaires.

D

Hazards - Hybrid Vehicles

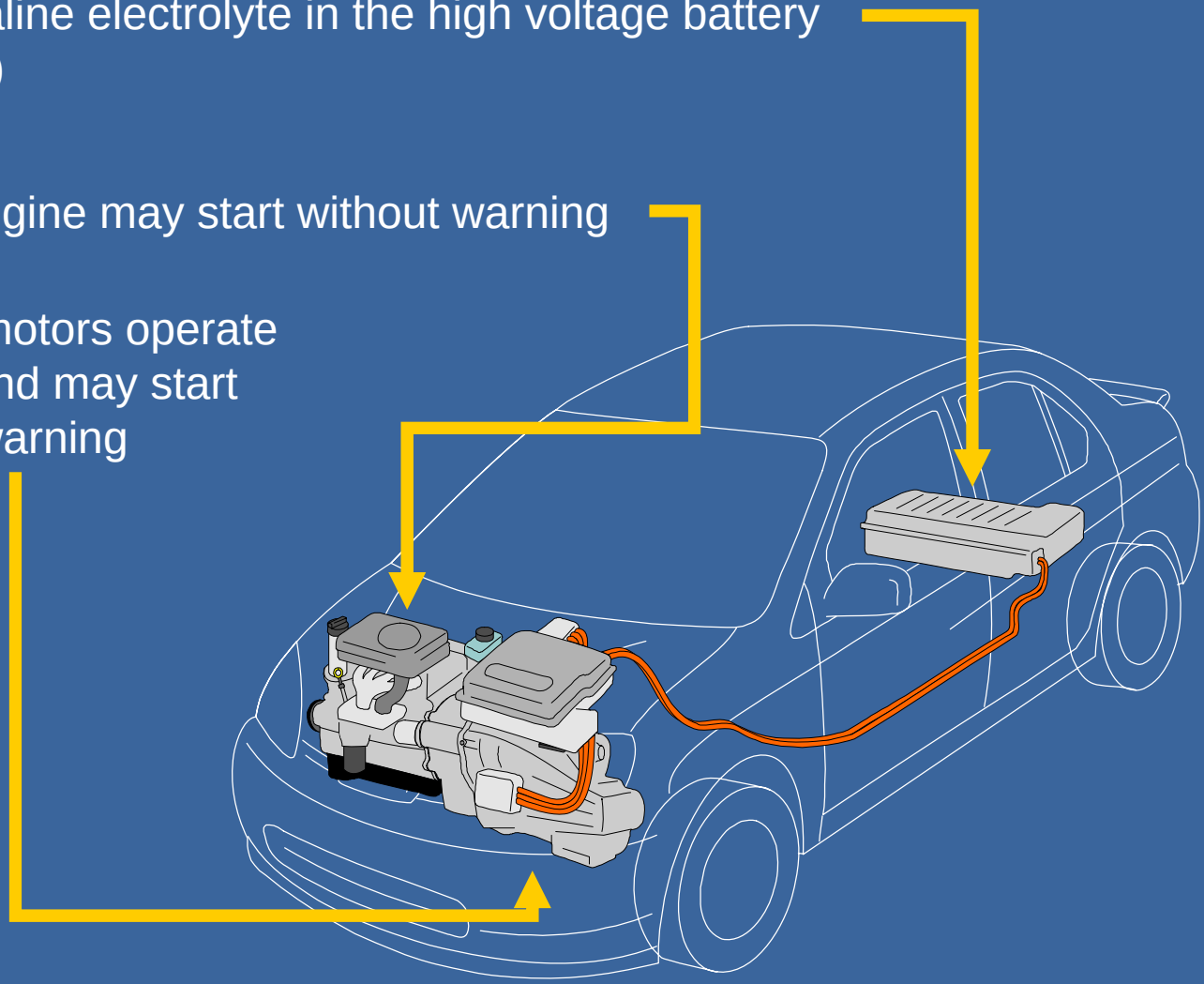
- A potential exists for electrocution or severe physical injury
- High voltage electrical components and circuits (can be as high as 500v and up to 350A)
- High voltage battery
- Inverter / Converter
- High voltage cables

Note: The high voltage battery could be mistaken for a fuel tank



Hazards - Hybrid Vehicles

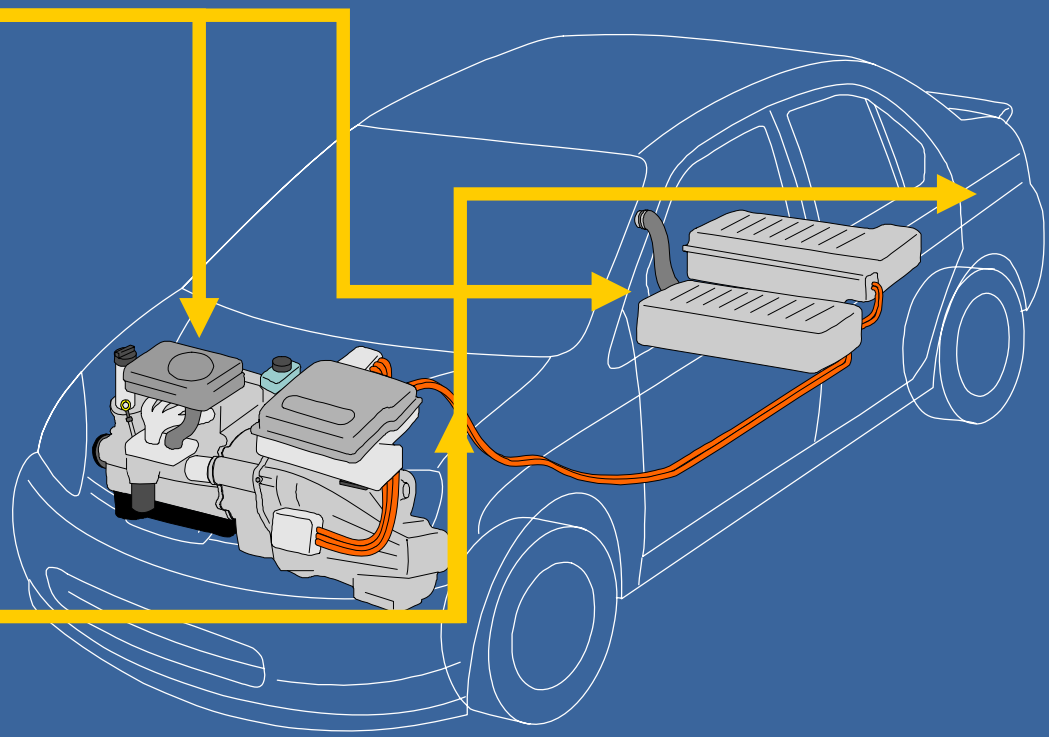
- High alkaline electrolyte in the high voltage battery (pH 13.5)
- Petrol engine may start without warning
- Electric motors operate silently and may start without warning



Hazards - Hybrid Vehicles

- Other hazards consistent with any modern motor vehicle design
- Battery acid from the 12v auxiliary battery
- Fuels and oils
- SRS

Note: Auxiliary batteries may be located in the boot (trunk), in the engine compartment or even hidden behind a firewall



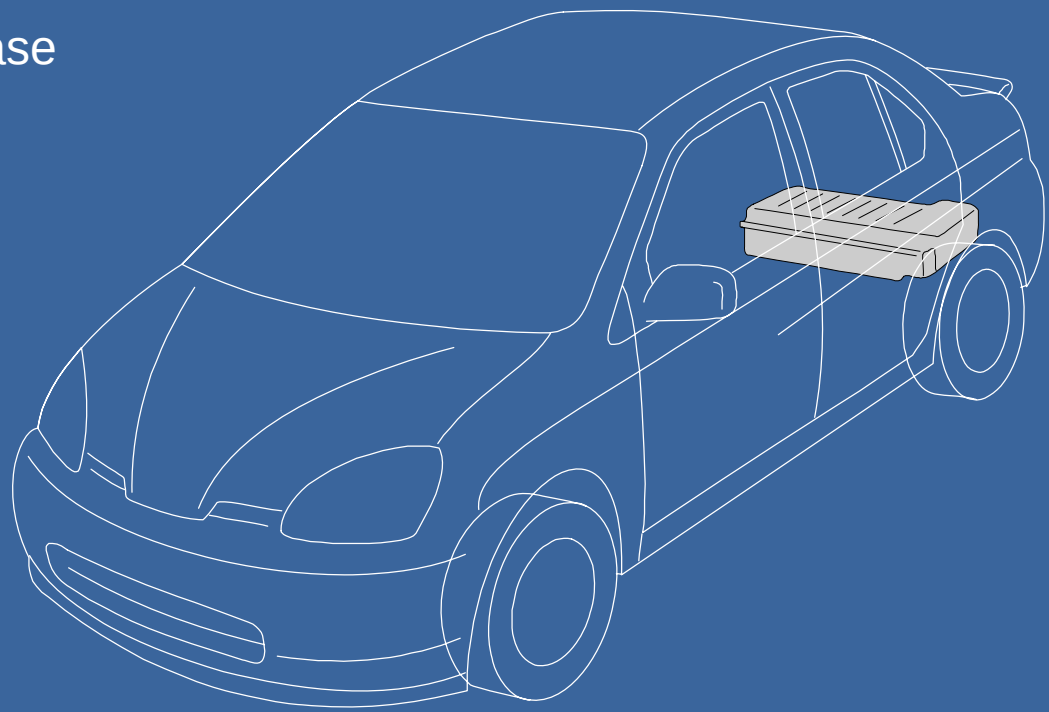
Hazards - Hybrid Vehicles

Hazards - Hybrid Vehicles

High Voltage Batteries

Toyota Prius 1st Generation

- 273.6 Volts
- Electrolyte is an alkaline of Potassium and Sodium Hydroxide (pH 13.5)
- The electrolyte is absorbed into the battery forming a gel that will not normally leak
- Sealed in a metal case

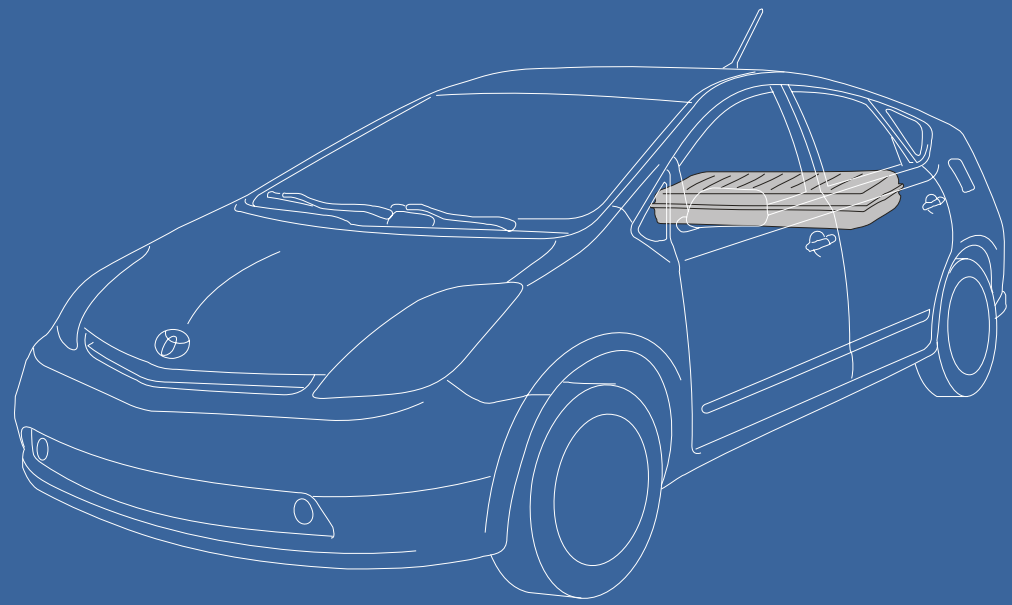


Hazards - Hybrid Vehicles

High Voltage Batteries

Toyota Prius 2nd Generation

- 201.5 Volts
- Electrolyte is an alkaline of Potassium and Sodium Hydroxide (pH 13.5)
- The electrolyte is absorbed into the battery forming a gel that will not normally leak
- Sealed in a metal case

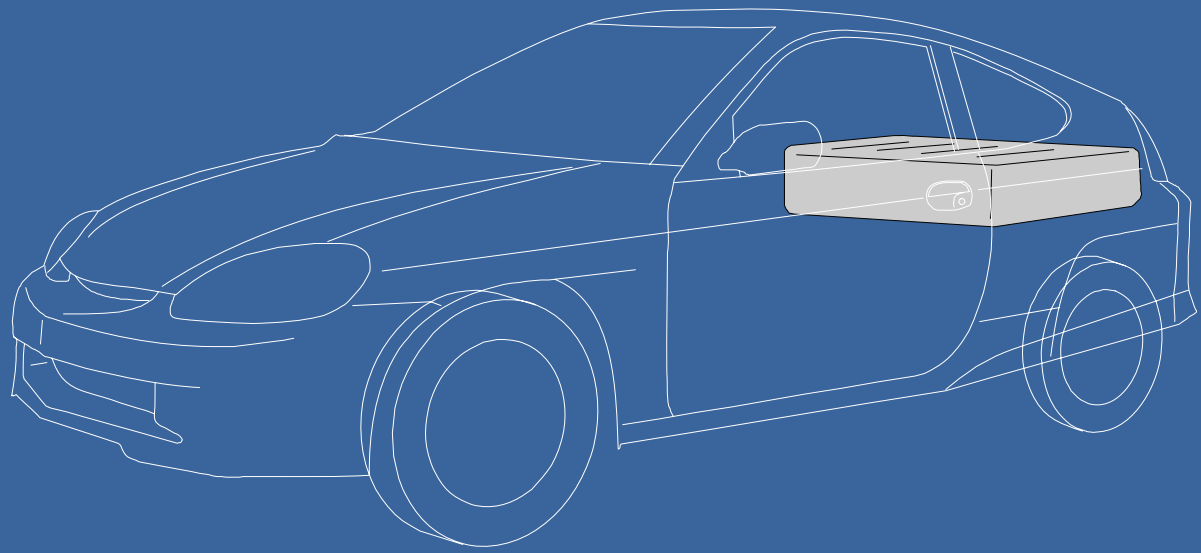


Hazards - Hybrid Vehicles

High Voltage Batteries

Honda Insight

- 144 Volts
- Electrolyte is Potassium Hydroxide, a strong alkaline solution
- The electrolyte is in a non-liquid form that will not normally leak
- Sealed in a metal case

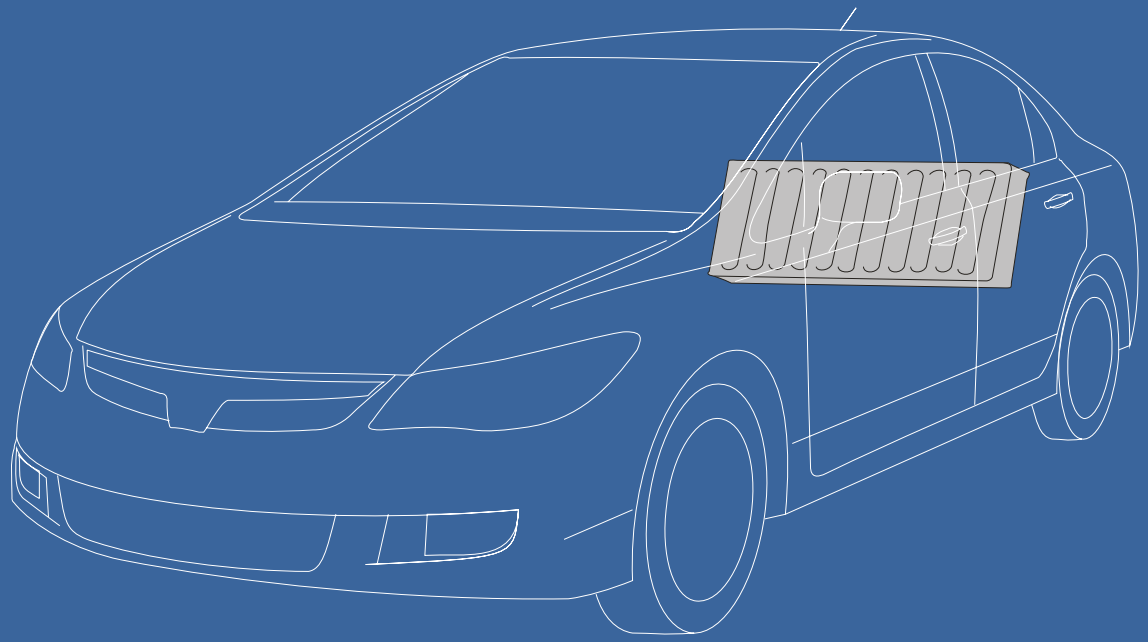


Hazards - Hybrid Vehicles

High Voltage Batteries

Honda Civic (2006 model)

- 158 Volts
- Electrolyte is Potassium Hydroxide, a strong alkaline solution
- The electrolyte is in a non-liquid form that will not normally leak
- Sealed in a metal case



Personal Protection Equipment

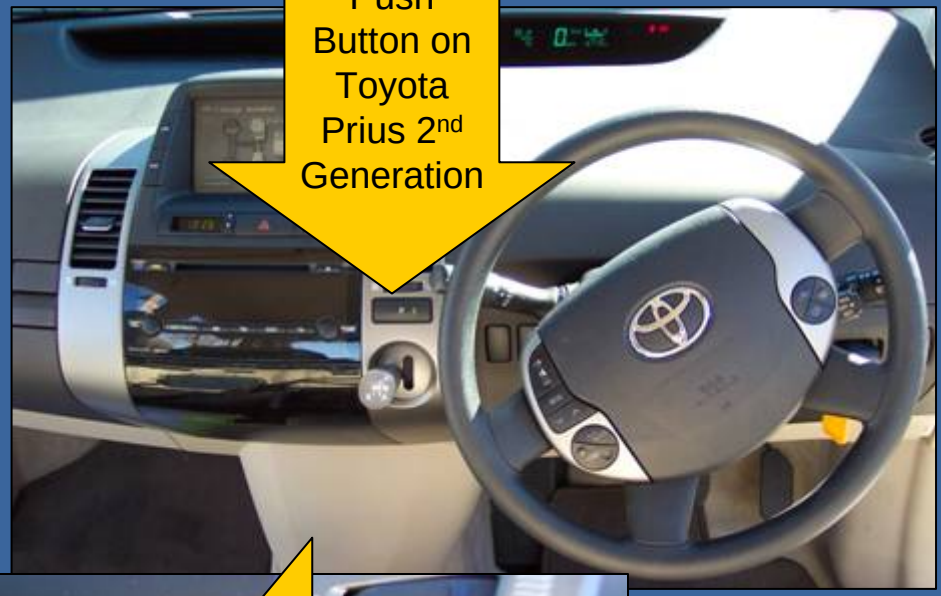
- Min PPE as required for all rescue work including head, eye and face protection
- Insulated electrical gloves & pliers for electrical work
- Chemical spillage suit, rubber boots, chemical gloves & goggles for alkaline electrolyte spills

Emergency Response

- Check for dangers before approaching or touching the vehicle
- Chock the wheels and stabilise the vehicle
- Don’t think that because the vehicle is silent that it is shut off
- Gain entry when safe to do so
- Apply the park brake if possible

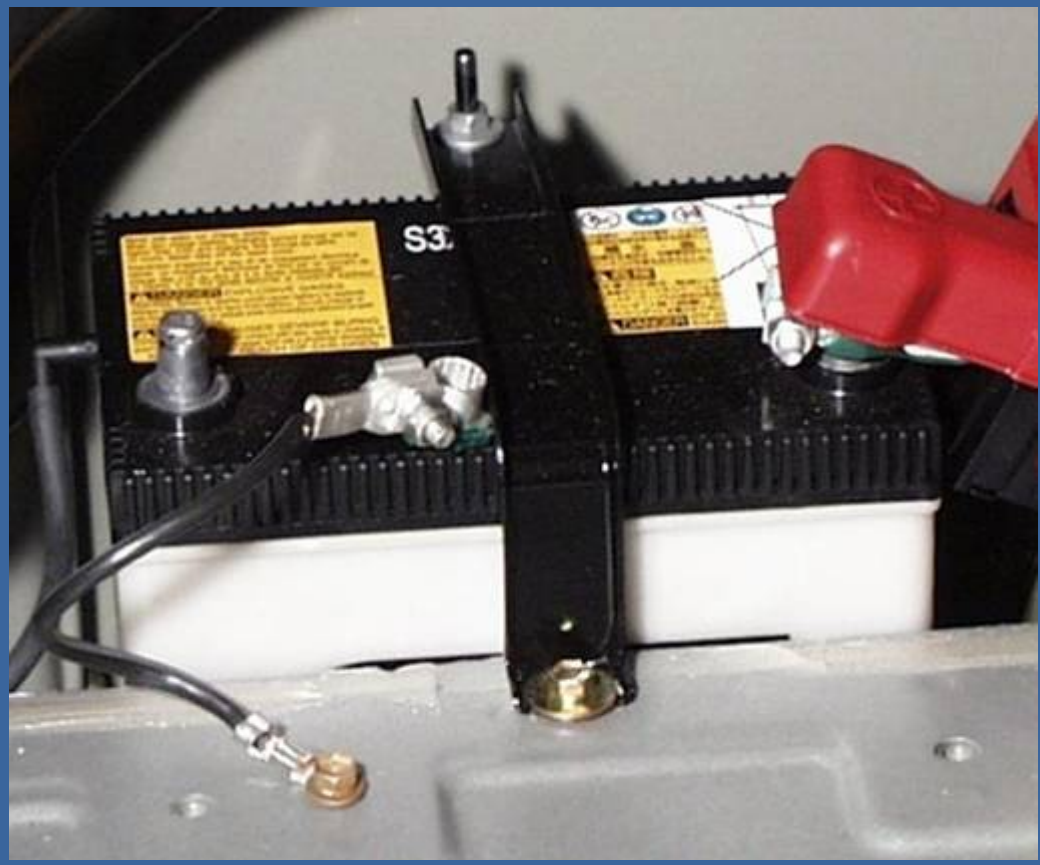
Emergency Response

- Select “Park” if possible
- Remove the ignition key or “Smart Key”



Emergency Response

- Locate and disconnect the negative terminal from the auxiliary battery



Toyota Prius 1st Generation

Emergency Response

- Locate and disconnect the negative terminal from the auxiliary battery

Toyota Prius 2nd Generation

Emergency Response

- Locate and disconnect the negative terminal from the auxiliary battery

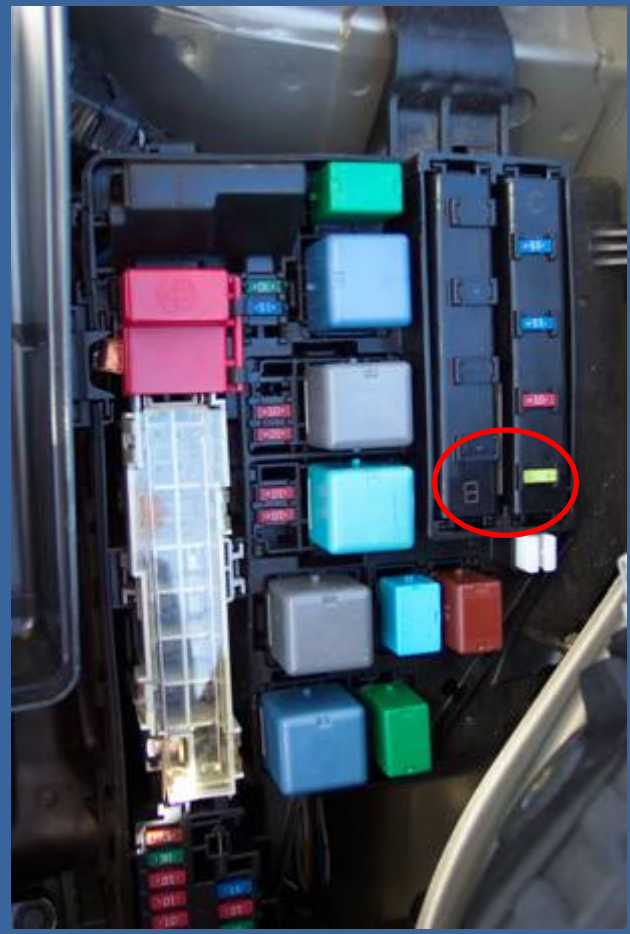
Honda Civic

Emergency Response

- Pull the fuses

  Which one is for the high voltage battery?

- If your unsure then pull them all



Emergency Response

- Locate and remove the high voltage battery service plug or operate the isolation switch if fitted

  (these switches are included to protect service technicians whilst carrying out repairs and maintenance)

Honda Insight

Toyota Prius 1st Generation

Emergency Response

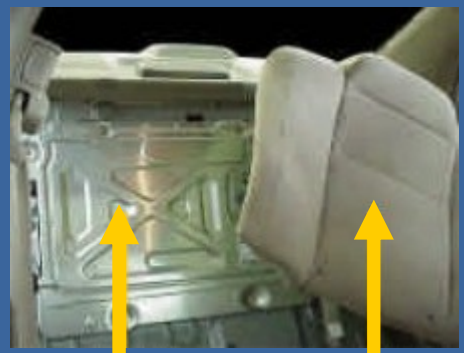
- Locate and remove the high voltage battery service plug or operate the isolation switch if fitted

Toyota Prius 2nd Generation

Emergency Response

- Locate and remove the high voltage battery service plug or operate the isolation switch if fitted

Honda Civic



Battery Cover

Rear Seat Cushion

Battery Module Switch Cover

Cover Bolts

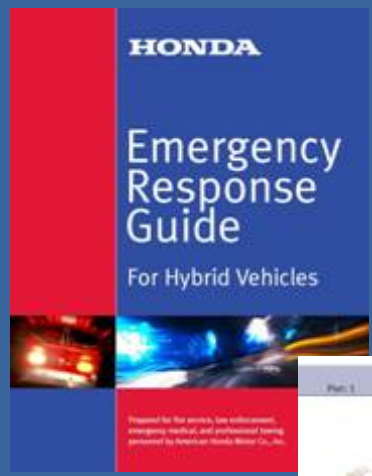
Locking Cover

Switch On Position

Emergency Response

Submerged or Partially Submerged Vehicles

- Manufacturers state: There is no risk of electric shock from touching the car's body or chassis – in or out of the water (Manufacturers HVT Response Guide publications)
- Do not make any cuts with rescue equipment in a submerged floor pan – use alternate rescue methods in this case
- Do not make direct contact with high voltage electrical components
- A potential exists for electrocution or severe physical injury if any part of your body comes into contact with and completes the high voltage electrical circuit



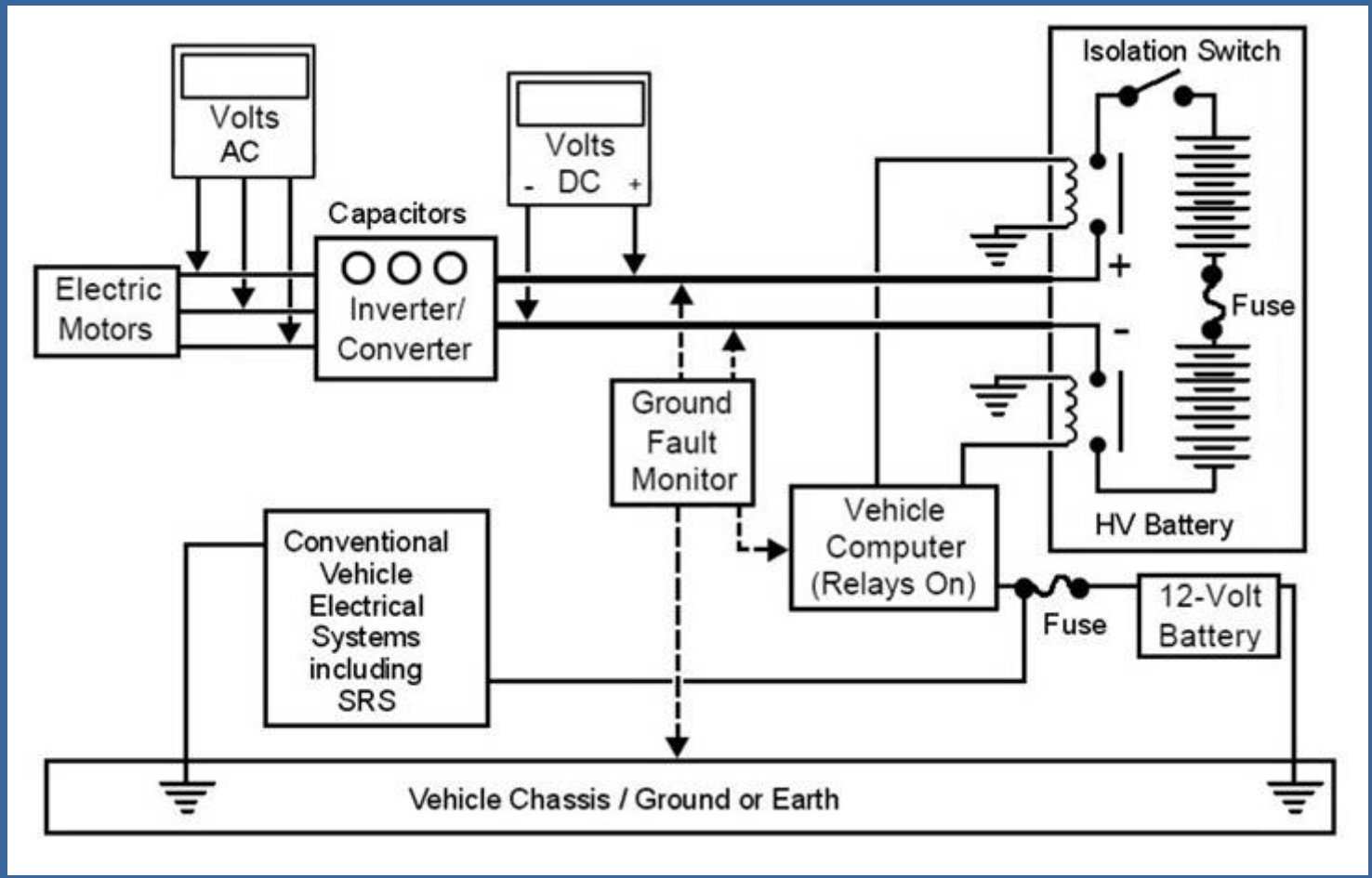
Emergency Response

Submerged or Partially Submerged Vehicles

- Extreme caution is required to identify and avoid high voltage components in a submerged or partially submerged vehicle
- Do not attempt to operate high voltage isolation switches that are wet – isolation may be possible with low voltage methods
- It may be safer to remove the vehicle from the water prior to patient extrication

Emergency Response

This circuit diagram represents common protection and safety features such as an isolation switch, fuses and relays



WARNING

Power remains in the SRS system and in the High Voltage Electrical system for up to 5 minutes

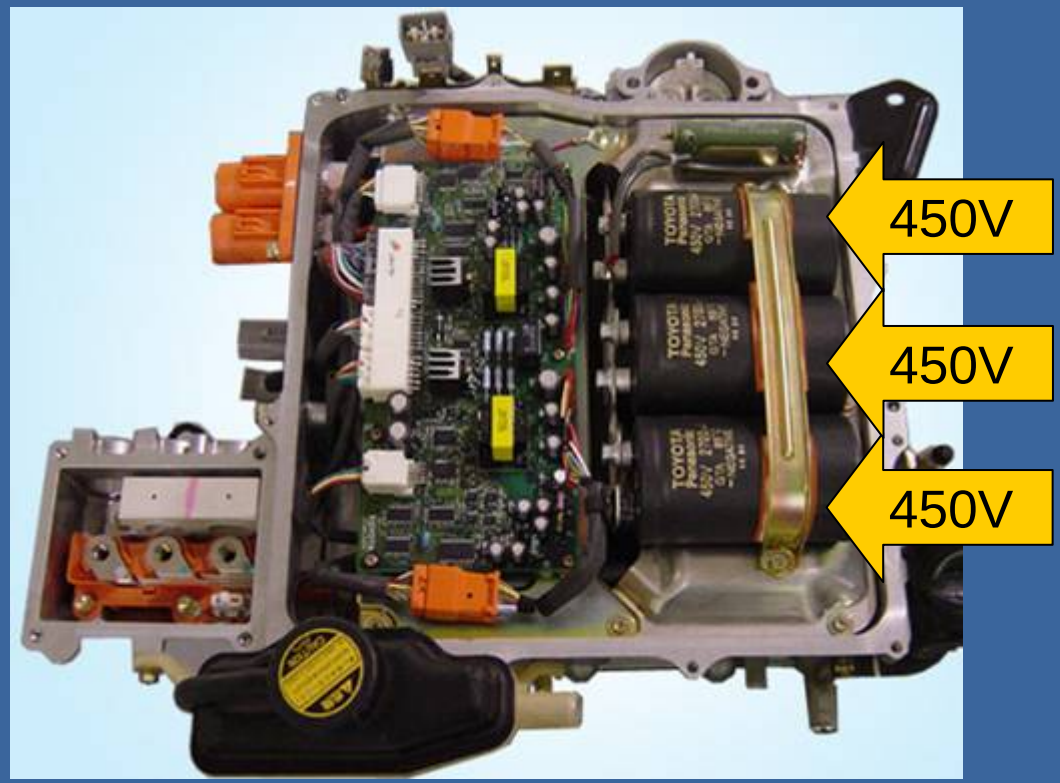
Proceed with caution

Emergency Response

These capacitors keep the SRS system active for a while after battery disconnection

Emergency Response

These capacitors keep the high voltage circuit between the inverter / converter and the electric motor active for a while after battery disconnection



Emergency Response

- The cutting of high voltage cables and the opening of high voltage components should be avoided
- Always carry out the high voltage battery isolation procedures prior to cutting any high voltage cables or opening any high voltage components
- Wear insulated electrical gloves that are in good condition and use insulated electrical pliers that are in good condition to carry out any cutting of high voltage cables
- Tape up any exposed electrical conductors with electrical tape

Fire Fighting

Vehicle fires that are not involving the High Voltage Battery

- Approach and extinguish a vehicle fire using standard vehicle fire fighting practices
- Min PPE as required for all fire fighting work including respiratory protection
- Water has been proven to be a suitable extinguishing agent
- Perform a fast aggressive initial fire attack
- If possible, divert runoff from directly entering waterways or storm water drains
- Attack teams may not be able to identify a “Hybrid” vehicle until the fire has been knocked down

Fire Fighting

High Voltage Battery fires

- Use a CO_2 extinguisher on a high voltage battery fire
- Never remove the battery case covers to access a high voltage battery fire, it is safer to protect exposures and allow the battery modules to burn themselves out
- Only use water on high voltage battery fires if you can flood the area around the high voltage battery with copious amounts of water from a safe distance. This will control the fire by cooling the modules to below their ignition temperature, the remaining modules that are not extinguished will burn themselves out

HazMat

- The HV battery pack consists of NiMH electrolyte cells which contain a strong alkaline gel (ph 13.5) that is destructive to human tissue
- PPE including chemical spillage suit, safety glasses, chemical gloves and rubber boots must be worn
- An acid solution or vinegar could be used to neutralize an alkaline spill
- A spillage of this size (HV battery) could easily be contained with dry earth or sand then placed into a HazMat bin for disposal
- Any residual alkaline gel can be diluted with a large quantity of water

New Vehicle Technology

a guide for emergency service workers