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TECHNICAL BULLETIN No. 6/2005

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SUBJECT

HYBRID VEHICLE TECHNOLOGY

INTRODUCTION

This bulletin highlights the operating systems of some Hybrid vehicles available to the Australian market.

VEHICLE

Toyota Prius and Honda Insight.

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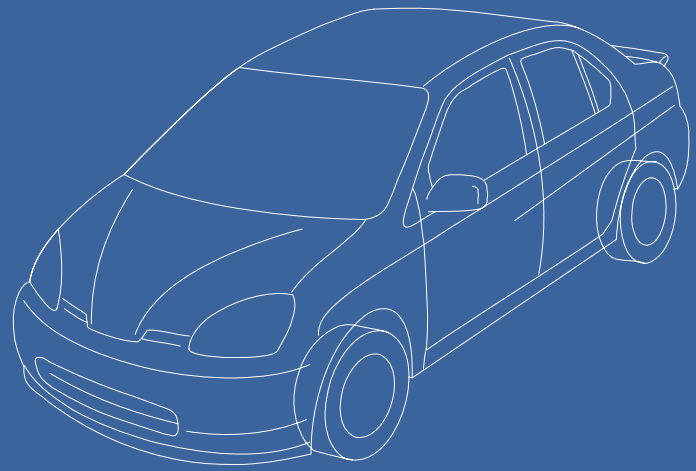
ARRO acknowledges the New South Wales Fire Brigades as the author of this document

Hybrid Vehicle Technology



By Mick Holton & Tim Fox

Hybrid Vehicle Technology

- Definition of a Hybrid Vehicle
- Types of Hybrid Systems
- Identification of Hybrid Vehicles
- Hazards associated with Hybrid Vehicles
- Personal Protection Equipment (PPE)
- Emergency Response
- Fire Fighting
- HazMat

Definition of a Hybrid Vehicle

A Hybrid Vehicle is a vehicle that has both

- an internal combustion engine
- an electric motor / generator

Two energy sources are stored on the vehicle

- fuel
- a high voltage battery

Definition of a Hybrid Vehicle

At the time that this presentation was created there were two Hybrid vehicles available in Australia

- Toyota Prius
- Honda Insight

A Hybrid version of the Honda Civic is said to be available in Australia by the middle of 2003 and many other manufacturers have prototypes that are using this technology

Types of a Hybrid Systems

Series Hybrid System

Internal Combustion Engine

Generator Or Alternator

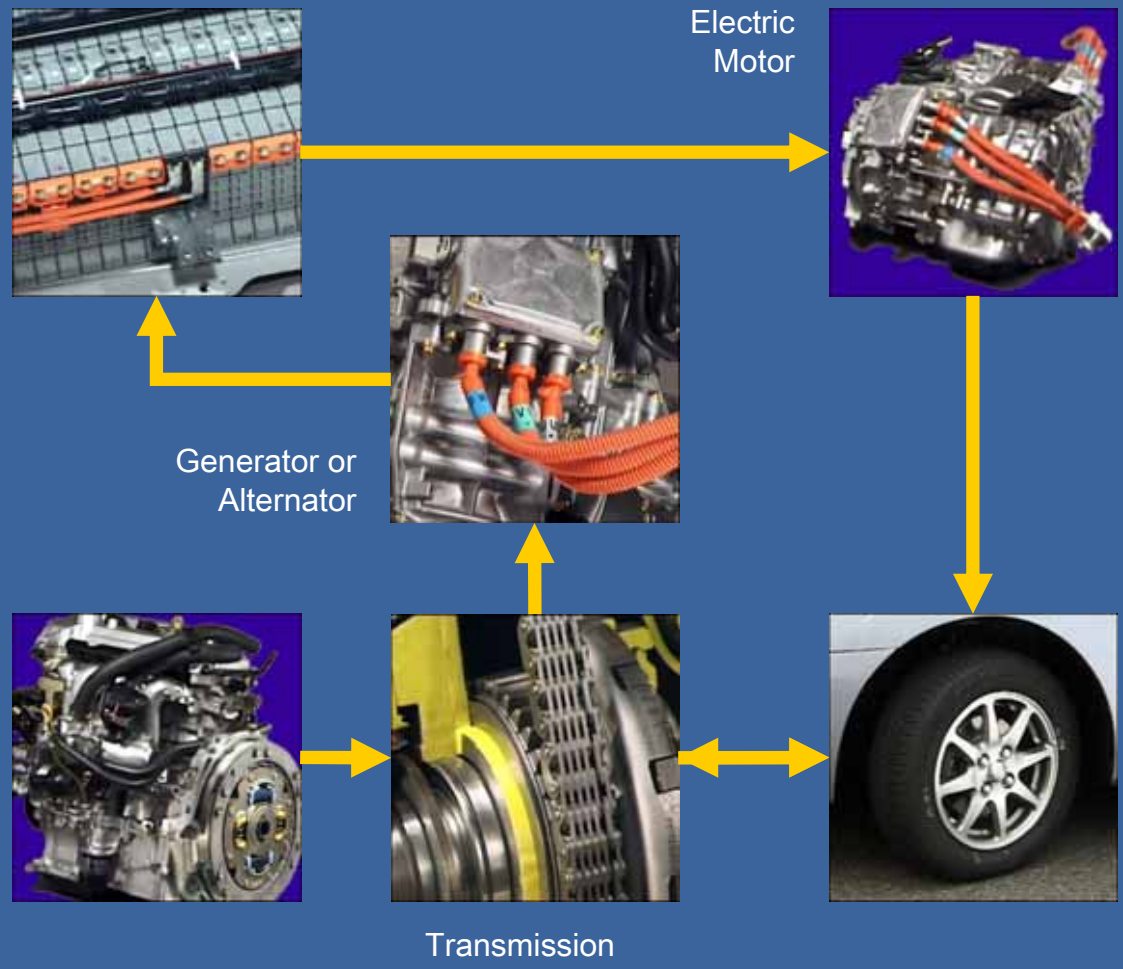
High Voltage Battery

Electric Motor

Final Drive & Road Wheels

Types of a Hybrid Systems

Parallel Hybrid System



Identification of 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 of Hybrid Vehicles

- Look for orange coloured electrical cables

  - High voltage cables have been coloured orange for easy identification

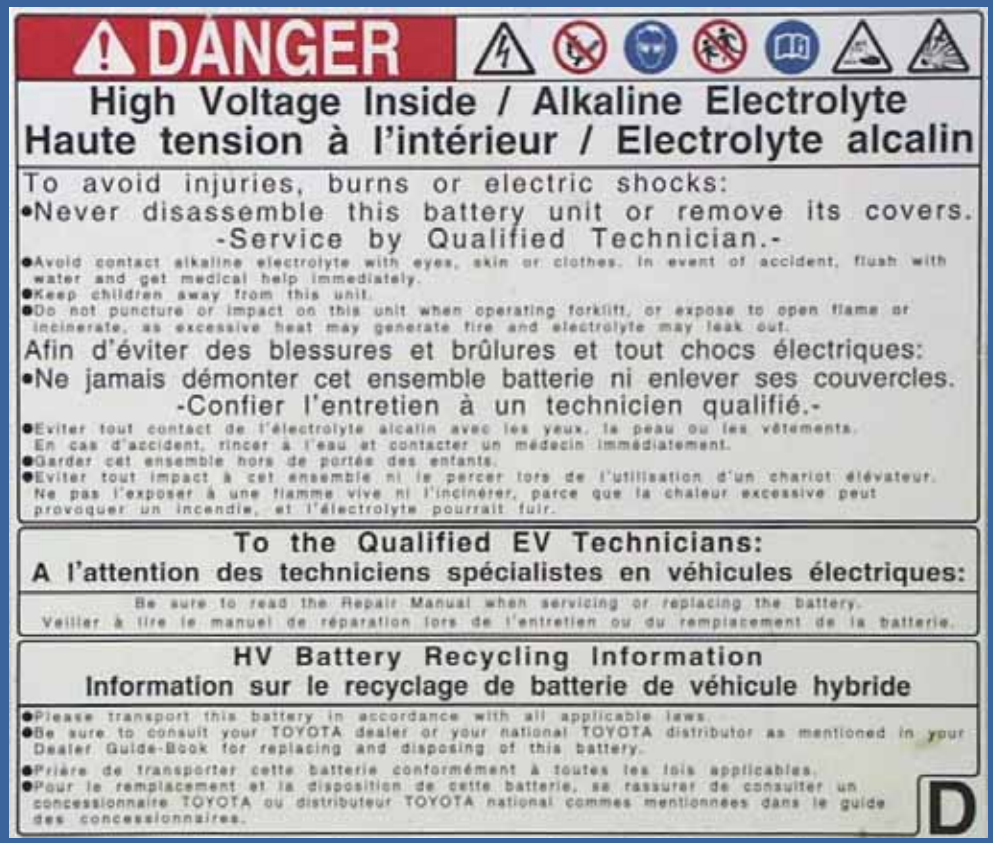
  - The presence of these cables will warn the rescuer of possible high voltage systems

Identification of Hybrid Vehicles

- Look for a large battery pack (high voltage battery)

Identification of 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

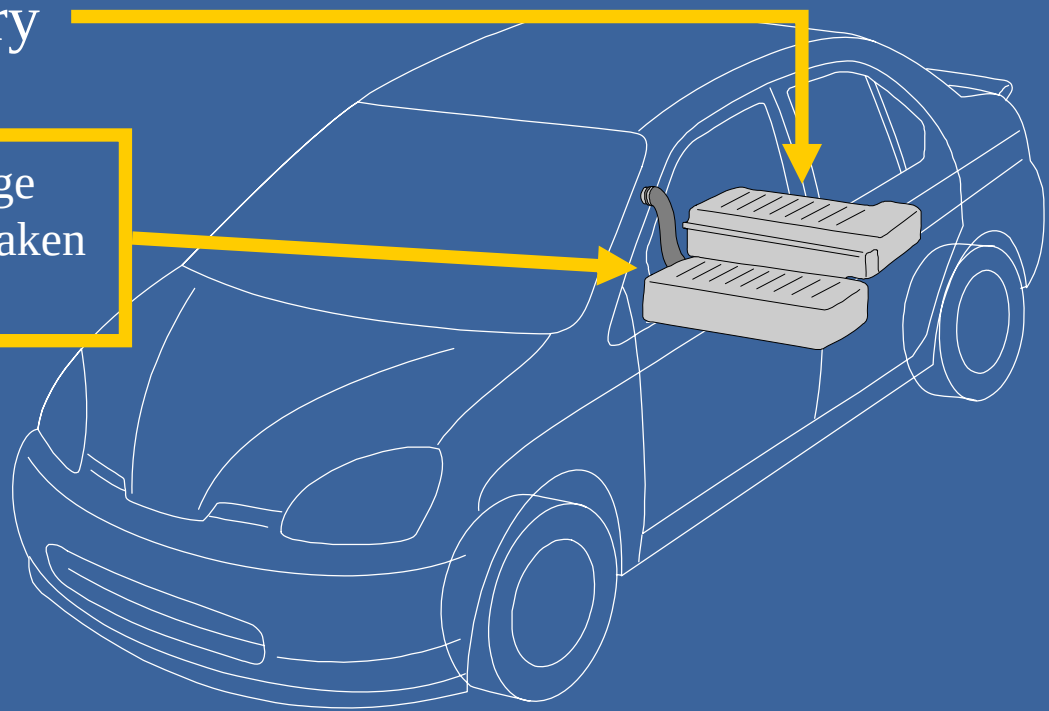
- Please transport this battery in accordance with all applicable laws.
- Be sure to consult your TOYOTA dealer or your national TOYOTA distributor as mentioned in your Dealer Guide-Book for replacing and disposing of this battery.
- Prière de transporter cette batterie conformément à toutes les lois 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 associated with Hybrid Vehicles

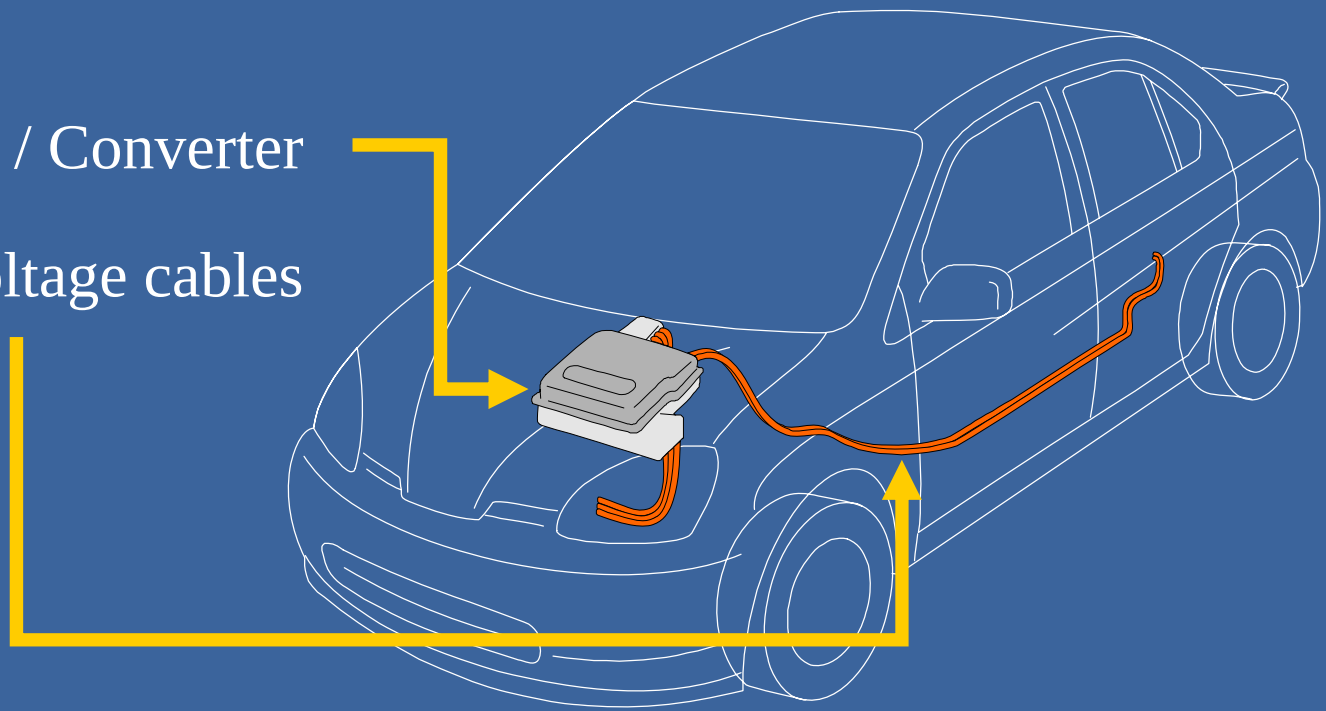
- A potential exists for electrocution or severe physical injury
- High voltage electrical components and circuits (300v at up to 350A)
- High voltage battery

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



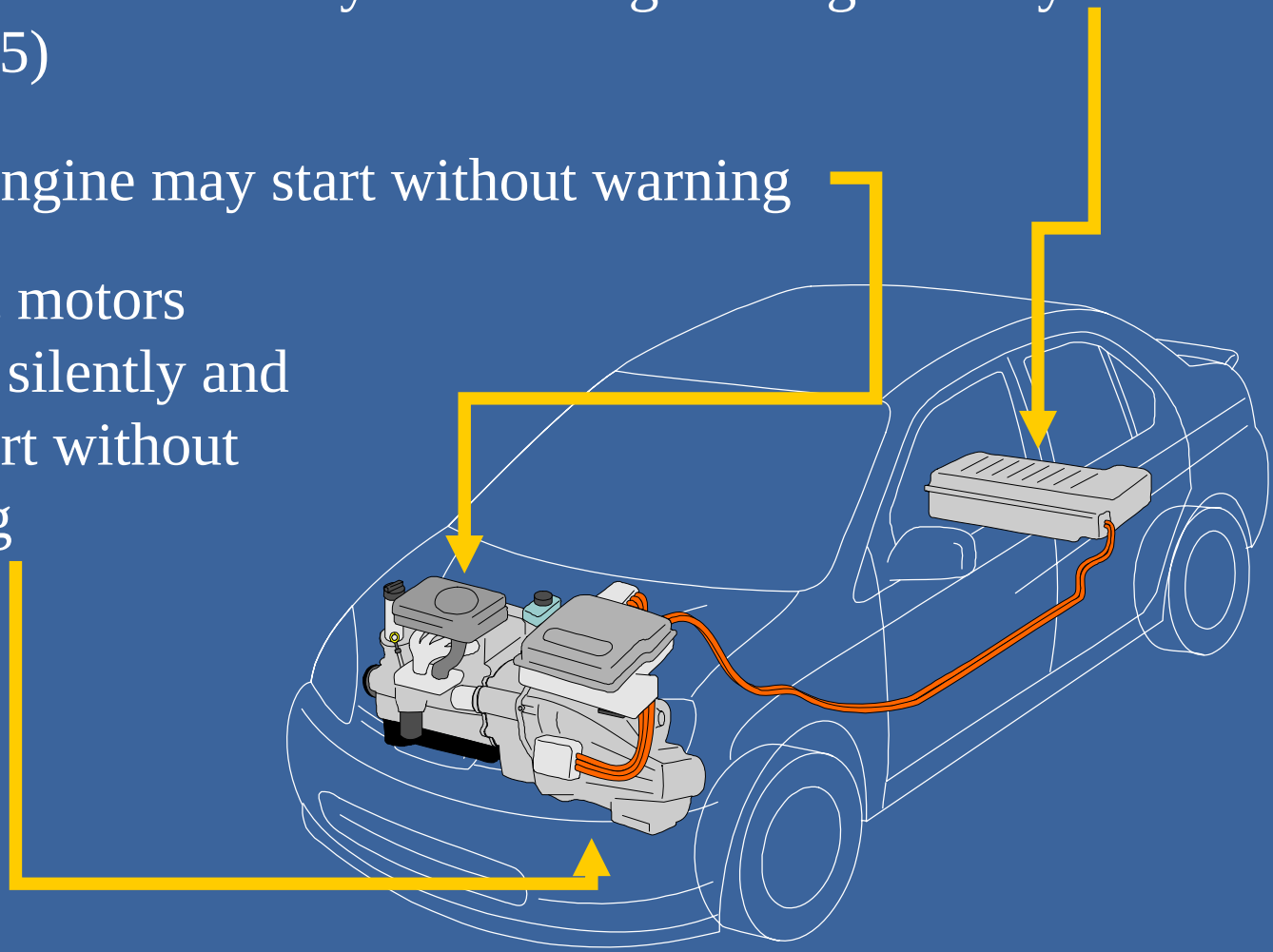
Hazards associated with Hybrid Vehicles

- Inverter / Converter
- High voltage cables



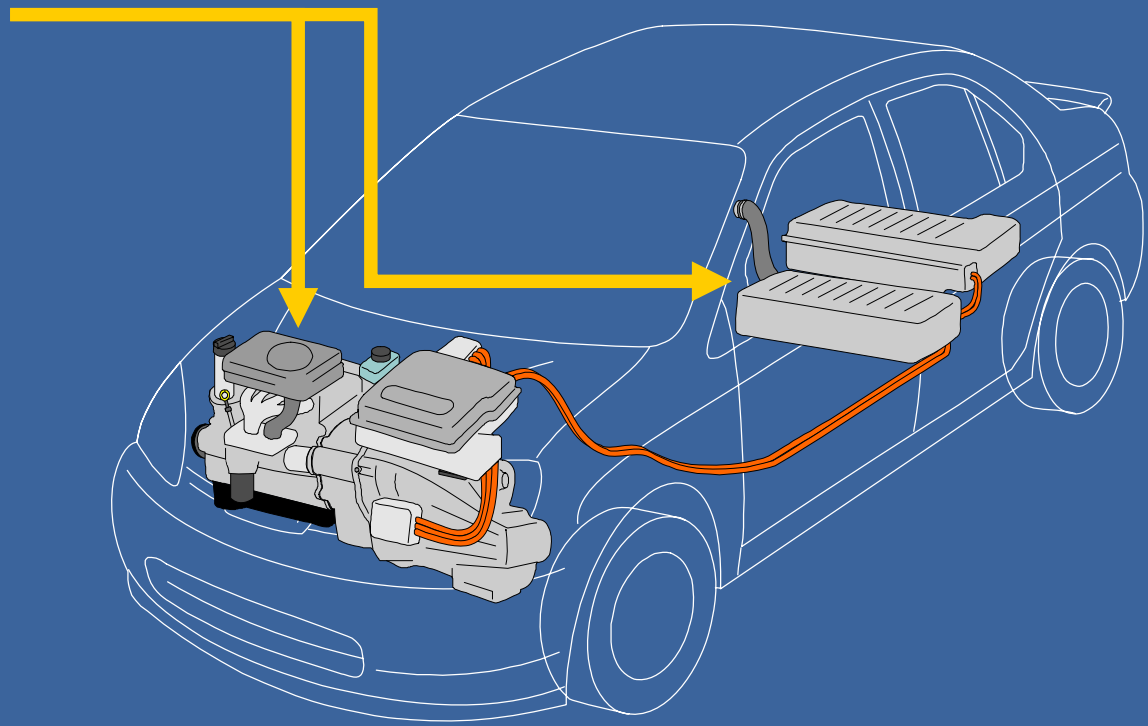
Hazards associated with Hybrid Vehicles

- 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 associated with Hybrid Vehicles

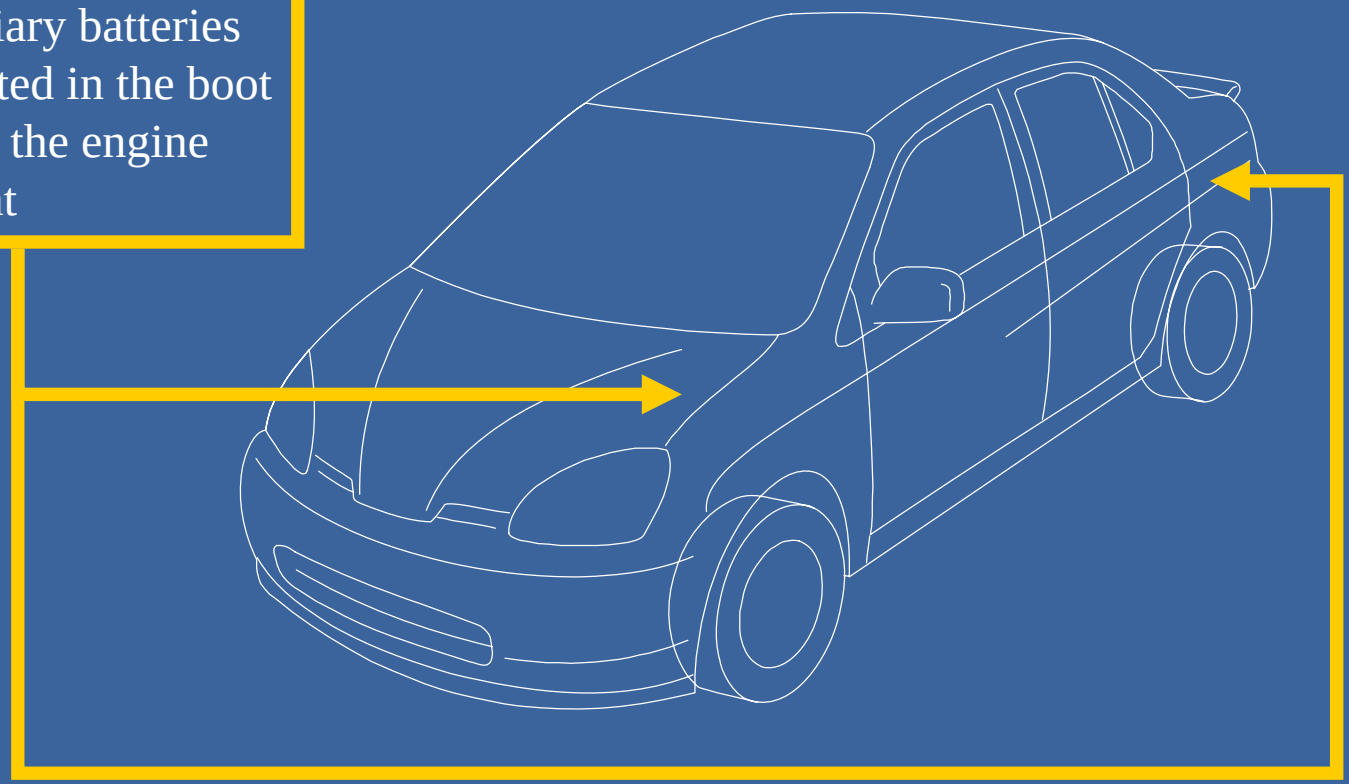
- Other hazards consistent with any modern motor vehicle design
- Battery acid from the 12v auxiliary battery
- Fuels and oils



Hazards associated with Hybrid Vehicles

- SRS (airbags & seatbelt pre-tensioners)

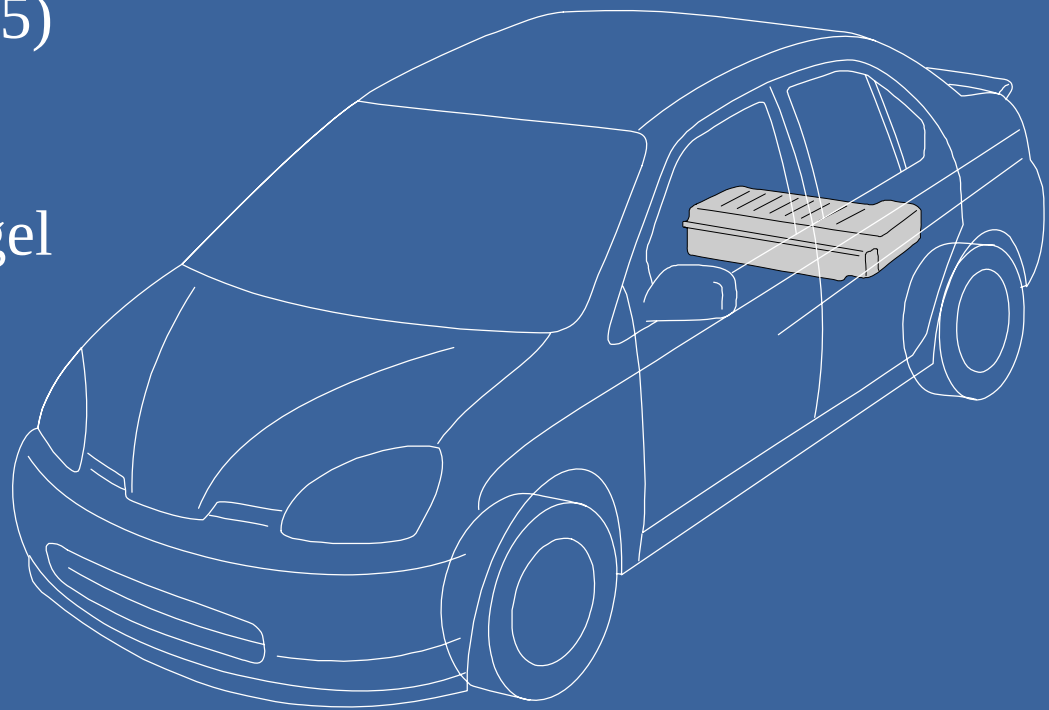
Note: Auxiliary batteries may be located in the boot (trunk) or in the engine compartment



Hazards associated with Hybrid Vehicles

High Voltage Batteries — Toyota Prius

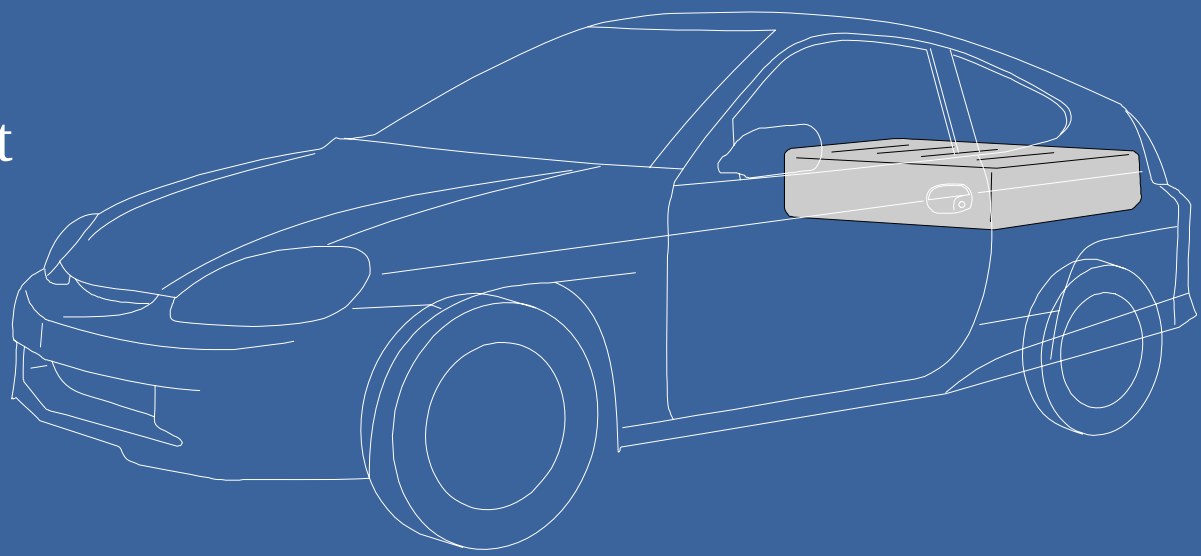
- 6x 1.2V cells form a module, 38x 7.2V NiMH modules are then connected in series to produce 273.6V
- Electrolyte is an alkaline of Potassium and Sodium Hydroxide (pH 13.5)
- The electrolyte is absorbed into the battery forming a gel that will not normally leak
- Sealed in a metal case



Hazards associated with Hybrid Vehicles

High Voltage Batteries — Honda Insight

- 6x 1.2V cells form a cell group, 20x 7.2V NiMH cell groups are then connected in series to produce 144V
- 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

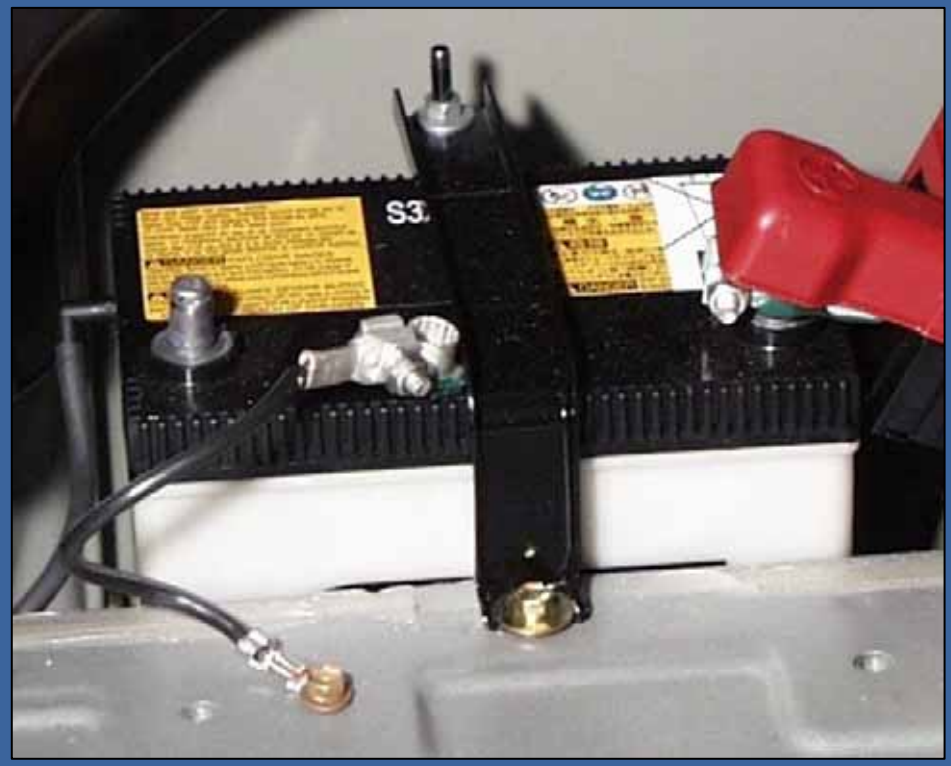
- Min PPE as required for all rescue work including head, eye and face protection
- Insulated electrical gloves & pliers for electrical work
- Chemical spillage suit, rubber boots, chemical gloves & goggles for alkaline electrolyte spills

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
- Select “Park” if possible
- Remove the ignition key

Emergency Response

- Disconnect the negative terminal from the auxiliary battery



Emergency Response

- Remove the high voltage battery service plug or operate the isolation switch if fitted

Emergency Response

WARNING

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

Proceed with caution

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 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 is 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

THE • END