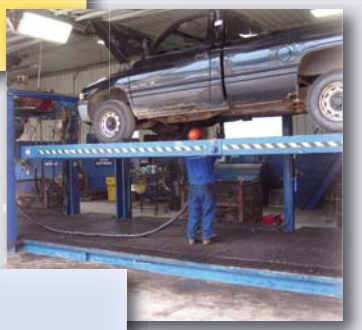
Safety Procedures Guide



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Clean Cities

U. S. Department of Energy

National Alternative Fuels Training Consortium

A Program of West Virginia University

Clean Cities Learning Program

Alternative Fuel and Advanced Technology Vehicles Curricula, Training, and Education and Outreach Activities

Automotive Recycling and Towing/Roadside Assistance

How to Use This Material

This Safety Procedures Guide has been developed as a quick resource for towing and roadside assistance and automotive recycling personnel to assist with safety procedures in dealing with alternative fuel and advanced technology vehicles.

The guide provides information on the main types of alternative fuel and advanced technology vehicles (biodiesel; ethanol; natural gas; propane; hydrogen; and electric drive), and includes information on the following:

- Identification
- Example Vehicles
- Safety and First Aid
- Warnings
- Special Notes
- Securing the Vehicle
- Towing
- Roadside Assistance
- Dismantling

This Safety Procedures Guide is to be used in conjunction with the First Responder Quick Reference Guide, available in hard copy or as a download for iPhone or Android devices. Information on the Quick Reference Guide can be found at www.afvsafetytraining.com.

For vehicle specifics and additional information regarding cut zones and where the alternative fuel and advanced technology vehicle components are located, download the free QRG app, or refer to Owner's Manual or OEM Emergency Response Guide from OEM website.

Ever since vehicles were first manufactured in the early 1900s, they have been towed and recycled. With as many vehicles on the roadways as there are today, it is inevitable that there will be a need for skilled and trained towing and roadside assistance and automotive recycling providers. While there are existing education and training programs in place for these industries, a new need is surfacing due to today's new vehicle technologies, in particular alternative fuel vehicles and advanced technology vehicles.

Approximately 10 million vehicles are recycled annually and at least 95% of all vehicles scrapped in the U.S. are collected for reuse and recycling. As of 2012, the towing industry was worth approximately $5 billion a year, with roughly 8,468 businesses in operation and a little over 60,000 people employed. Today's new vehicle technologies bring new challenges to these industries.

The U.S. Energy Information Administration (EIA) estimates that in 2011 there were nearly 11 million alternative fuel vehicles in the United States. Just like with conventional automobiles, these alternative fuel and advanced technology vehicles will end up being towed, needing roadside assistance, or in automotive recycling facilities. While these vehicles are different than most conventional vehicles, they are fundamentally safe. Even so, it's important that towing and roadside assistance and automotive recycling personnel understand how these vehicles are different and how to properly and safely handle them.

This Safety Procedures Guide will provide quick reference information for the safe handling of alternative fuel and advanced technology vehicles from the towing and roadside assistance and automotive recycling point of view.

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Moreover, it should not be assumed that every acceptable or necessary commodity grade, test, safety procedure, method, precaution, equipment, or device is contained within, nor that abnormal or unusual conditions or circumstances may not warrant or suggest further requirements or additional procedures.

This document is subject to periodic review and/or revision. Users are strongly cautioned to obtain the latest version.

Comments and suggestions are invited from all users for consideration by the NAFTC in connection with such review. Please send all comments to the NAFTC, to the attention of the Executive Director.

The guidance and information in this guide are not meant to take the place of vehicle or equipment manufacturer guidelines and are not intended to supersede other information, requirements, or regulations provided by manufacturers, the insurance industry, safety officials, or other applicable standards and recommended practices.

This document does not take the place of and should not be confused with federal, state, provincial, or municipal specifications or regulations, insurance requirements, or safety codes.

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IMPORTANT NOTE:

The guidance and information in this Safety Procedures Guide are not meant to take the place of vehicle or equipment manufacturer guidelines and/or emergency response guides, and are not intended to supersede other information, requirements, or regulations provided by manufacturers, the insurance industry, safety officials, or other applicable standards and recommended practices.

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National Alternative Fuels Training Consortium
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General information

Biodiesel Vehicles

BIO Biodiesel and Diesel

Identification

- Confirm vehicle is a biodiesel vehicle.
- Possible diesel label on fuel cap, trunk, and/or by fuel door.
- Special badging, such as: Ford Powerstroke B20 badge; Daimler BlueTec badge; Volkswagen TDI badge.
- Diesel vehicles have larger tailpipes.
- Dash lights.

Example Vehicles

- Chevrolet - Silverado 2500/3500 (2012)
- Chevrolet - Silverado HD 2500/3500 (2013)
- Ford - F-250/F-350 Super Duty (2012)
- Ford - F-450 Super Duty (2012)
- Ford - F-250/F-350 Super Duty (2013)
- GMC - Cab Chassis 3500 (2013)
- GMC - Savana 2500/3500 (2012)
- GMC - Savana 2500/3500 (2013)
- GMC - Sierra 2500/3500 (2012)
- GMC - Sierra HD 2500/3500 (2013)
- Ram - 2500/3500 (2013)
- Ram - 2500/3500 HD (2012)

Note: Biodiesel can be used in vehicles manufactured after 1994 that are equipped with diesel engines.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- In case of contact with biodiesel, immediately flush skin or eyes with running water for at least 20 minutes. Wash skin with soap and water. In case of burns, immediately cool affected skin for as long as possible with cold water.
- If biodiesel is ingested, drink one to two glasses of water. **DO NOT** give anything by mouth to an unconscious person. Seek immediate medical attention.

⚠ Warnings!

- **DO NOT** use water in case of fire. Biodiesel fires spread when water is applied.
- Keep fire from spreading to other areas.
- Pure biodiesel flames burn bright white and are nearly invisible in daylight.
- A pure biodiesel flame will not produce smoke.
- In case of fire, contact local fire department.

Special Notes

- Biodiesel may either be 100% pure or a petroleum-diesel blend.
- Biodiesel may contain some kerosene.
- Vehicle conversions may have both biodiesel and petroleum-diesel tanks or a straight vegetable oil tank.
- Use clean, non-sparking tools to collect absorbed materials.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off the vehicle and remove the ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices. Additional ramping may be required for loading.
- Towing a biodiesel vehicle is the same as towing a conventional/diesel vehicle.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- Jumpstarting a biodiesel vehicle is the same as jumpstarting a diesel vehicle.
- Refer to Owner's Manual for specifics on jumpstarting.
- Since biodiesel vehicles can also operate on diesel fuel, a fuel service call will require only normal procedures.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**, if possible.
- Make sure vehicle is immobilized. If necessary:
  - Set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Biodiesel vehicles are similar to conventional diesel and gasoline vehicles and the same general procedures should be followed.

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel system. First cut negative cable(s) and then cut positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.

Defueling

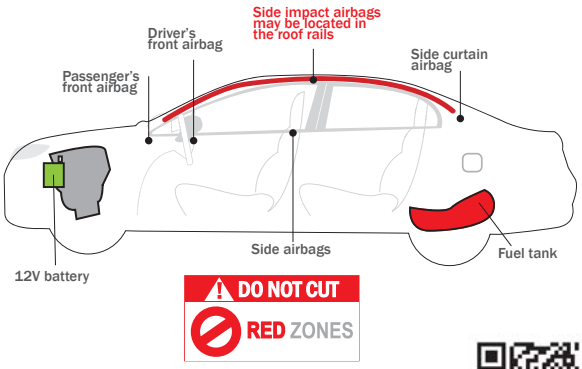
- Defueling requirements are the same as gasoline or diesel fuel.

Removing Components

- **DO NOT** cut through bottom of vehicle below floor line. Fuel lines and fuel storage are commonly located below floor line.

Example of Biodiesel Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

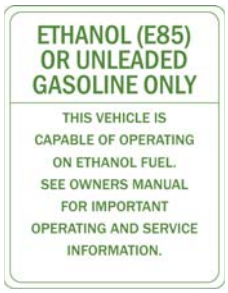
General information

Flexible Fuel Vehicles (FFVs)
E85 & Ethanol Blends

E85

Identification

- Confirm vehicle is a flexible fuel vehicle.
- Special badging, such as: Flex Fuel, E85 Ethanol, special leaf-sprouting logos that have the color green incorporated.
- Yellow gas cap and the wording E85 or ethanol inside fuel cap door.



Example Vehicles

- Audi A4/A5
- Bentley Continental
- Buick LaCrosse
- Buick Regal
- Cadillac Escalade
- Chevrolet HHR
- Chevrolet Malibu
- Chevrolet Silverado
- Chevrolet Suburban
- Chrysler 200/300
- Chrysler Town & Country
- Dodge Charger
- Dodge Durango
- Dodge Grand Caravan
- Dodge RAM
- Ford Crown Victoria
- Ford E-150/250
- Ford F-150
- Ford Focus
- Ford Fusion
- GMC Sierra
- GMC Yukon
- Jeep Grand Cherokee
- Lincoln Navigator
- Lincoln Town Car
- Mercedes-Benz C300
- Mercury Grand Marquis
- Nissan Titan
- Toyota Tundra
- Volkswagon Routan

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- In case of contact with ethanol, immediately flush skin or eyes with running water for at least 15 minutes. Wash skin with plenty of water. Remove contaminated clothing and wash before reuse. Seek immediate medical attention.
- If ethanol is inhaled, seek fresh air. If person is not breathing, provide artificial respiration. **DO NOT** use mouth-to-mouth resuscitation. If necessary, provide additional oxygen once breathing is restored. Seek immediate medical attention.
- If ethanol is ingested, **DO NOT** induce vomiting. Drink two to four glass of milk. **DO NOT** give anything by mouth to an unconscious person. Seek immediate medical attention.

⚠ Warnings!

- **DO NOT** use flares near E85 vehicles.
- **DO NOT** use water to extinguish fire. Ethanol can mix with water and still burn.
- It is common for an ethanol fire to start up again after you think the fire has been put out.
- Ethanol burns with a clear or blue flame that is nearly invisible in daylight.
- In case of fire, contact local fire department.

Special Notes

- **ALWAYS** ensure vehicle is stabilized before starting emergency procedures.
- Use clean, non-sparking tools to collect absorbed material.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off the vehicle and remove the ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices. Additional ramping may be required for loading.
- Towing an ethanol (flexible fuel) vehicle is the same as towing a conventional vehicle.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- Jumpstarting a flexible fuel vehicle is the same as jumpstarting a conventional vehicle.
- Refer to Owner's Manual for specifics on jumpstarting.
- Since flexible fuel vehicles can also operate on petroleum fuel, a fuel service call will require only normal procedures.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**, if possible.
- Make sure vehicle is immobilized. If necessary:
  - Set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Ethanol (flexible fuel) vehicles are similar to conventional diesel and gasoline vehicles and the same general procedures should be followed.

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel system. First cut negative cable(s) and then cut positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.

Defueling

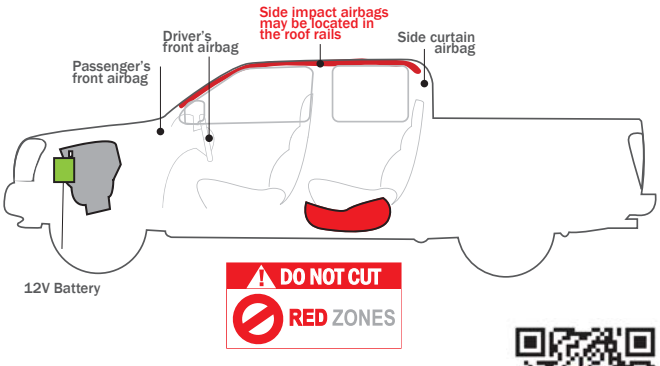
- Defueling requirements are the same as gasoline or diesel fuel.

Removing Components

- **DO NOT** cut through bottom of vehicle below floor line. Fuel lines and fuel storage are commonly located below floor line.

Example of Flexible Fuel Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

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General information for OEM and converted

Natural Gas Vehicles

CNG Compressed Natural Gas 3600 psi (250 bar)

LNG Liquefied Natural Gas Cryogenic-stored at typically 50-250 psi

Identification

- Confirm vehicle is a natural gas (CNG or LNG vehicle).
- Special badging, such as: green or blue NGV (natural gas vehicle), blue and white CNG (compressed natural gas), or LNG (liquid natural gas) badges, placards, and decals may be located on rear doors and/or trunk.
- Fuel tank may be located in trunk or in bed of truck.
- In Utah, CNG vehicles have a "Clean Fuel, Clean Air" sticker on license plate.
- Underhood cables or components.
- Special fueling port.
- Dash lights/gauges.

Example Vehicles

- Chevrolet Express 2500/3500
- Chevrolet Silverado HD 2500
- Ford E-150/ E-250/E-350
- Ford F-250/F-350 Super Duty
- Ford Transit Connect
- GMC Savana 2500/ 3500
- GMC Sierra HD 2500
- Honda Civic
- Honda Civic GX
- Honda Civic NGV
- Ram 2500
- Vehicle Production Group MV-1

Note: There have been thousands of vehicles converted to natural gas. These conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Since natural gas is a simple asphyxiant, in high concentrations it will displace oxygen from the breathing atmosphere, particularly in confined spaces.
- In event of natural gas (CNG and LNG) inhalation, seek fresh air. If the person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored. Seek immediate medical attention.
- Inhalation of high concentrations of natural gas may cause central nervous system depression such as dizziness, drowsiness, headaches, and similar narcotic symptoms, but no long-term effects. Numbness, a "chilly" feeling, and vomiting have been reported from accidental exposures to high concentrations.
- LNG is a cryogenic fuel and can cause additional health hazards. Contact with flowing CNG can cause additional health hazards. In case of blistering, frostbite or freeze burns, seek immediate medical attention. Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical attention.
- In case of eye burns due to combustion of natural gas, cover eyes to protect from light. Seek immediate medical attention.

⚠ Warnings!

- Failure to shut off vehicle before proceeding with towing or salvage yard break down may result in serious injury, explosion, and/or death.
- CNG is **FLAMMABLE** and explosive. Stay away from rear if vehicle is on fire. If no lives or other elements are threatened, it is advised to let fuel burn out.
- When on fire, LNG reacts violently when water is applied, causing it to intensify.
- An explosion may result if natural gas leaks into atmosphere. Ensure incident area is ventilated.
- In case of fire, contact local fire department.

Special Notes

- CNG tanks, on OEM vehicles, are usually equipped with a pressure relief device vented at the left side of the fueling port area. Vent may be in other areas on conversion vehicles.
- Turn electrical devices off before approaching incident area.
- Gas remaining in lines could leak even after vehicle is shut off and shutoff valve is closed.
- Identification labels may not be available for converted vehicles. Look out for fueling nozzles, gas tanks, and other indications that will confirm vehicle fuel type.
- Natural gas is lighter than air, highly flammable, colorless, odorless, and nontoxic when inhaled.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Listen for venting. Leaking fuel can cause a fire or an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible.
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove the ignition key (check for smart key); set the parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices. Additional ramping may be required for loading.
- Towing a natural gas vehicle is same as towing a conventional vehicle. The two main considerations are the fuel and either the compressed natural gas cylinder or liquefied natural gas tank. Be sure to check for spills or leaks and always be aware of the type of fuel tank or cylinder and its location.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- Jumpstarting a natural gas vehicle is the same as jumpstarting a conventional vehicle.
- Refer to Owner's Manual for specifics on jumpstarting.
- Since natural gas at the present time is not readily available in all areas, a fuel service call may require a tow to the nearest natural gas fueling station.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible.
  - Monitor air for **FLAMMABLE VAPORS**.
- Make sure vehicle is immobilized. If necessary:
  - Set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel system. First cut negative cable(s) and then cut positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.

Defueling

- Remove fuel prior to beginning dismantling of vehicle.

CNG

- CNG storage cylinders range from 3000 to 3600 psi.
- Look for automatic solenoid shutoff valve. Special tools are necessary for safe and sure venting.
- A vent stack is required to release the natural gas in a safe location.
- **DO NOT** make any piping disconnections before fuel pressure is fully released.

LNG

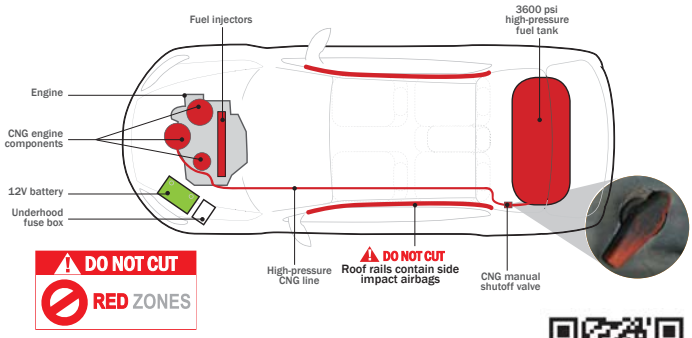
- Specialized equipment is required to empty tank. Contact local LNG supplier for assistance.
- When emptying fuel, do not allow direct contact or breathe in fumes; -260°F temperature can cause cryogenic burns or lung damage.

Removing Components

- **DO NOT** place yourself in line with valve as you remove it.
- **DO NOT** puncture or cut a CNG cylinder or LNG tank.
- If handling an LNG tank, use protective gloves, as frostbite can occur.
- Take special care when moving vehicles with a forklift to avoid damaging high-pressure lines or puncturing the CNG cylinder or LNG tank.

Example of CNG Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

General information for OEM and converted

Propane/Autogas/LPG Vehicles

Liquefied Petroleum Gas
125 psi (8.6 bar)

Identification

- Confirm vehicle is a propane vehicle.
- Special badging, such as: blue and white PROPANE or LPG badges, placards, and decals may be located on rear doors and/or trunk.
- Fuel tank may be located in trunk or in bed of truck.
- Underhood cables or components.
- Special fueling port instead of a regular gasoline port if it's a dedicated propane vehicle.
- Vehicle may have two ports for fueling both propane and gasoline if it is not a dedicated vehicle.
- Dash lights/gauges.

Example Vehicles

- Chevrolet Express 2500/3500
- Chevrolet Silverado HD 2500
- Ford E-150/ E-250/E-350
- Ford F-250/F-350 Super Duty
- Ford Transit Connect
- GMC Savana 2500/3500
- GMC Sierra HD 2500
- Honda Civic
- Honda Civic GX
- Honda Civic NGV
- Ram 2500
- Vehicle Production Group MV-1

Note: There have been thousands of vehicles converted to natural gas. These conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Contact with propane can cause frostbite. Cryogenic burns may result in blistering or deep tissue damage and should be promptly treated by a physician. Flush frozen tissue with plenty of tepid water (**DO NOT** use hot water). Seek immediate medical attention.
- Since propane is a simple asphyxiant, exposure can cause dizziness, shortness of breath, drowsiness, headaches, confusion, decreased coordination, and vomiting.
- In event of inhalation, seek fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored. Seek immediate medical attention.
- Eye contact can freeze the eye. Immediately flush with gently flowing, lukewarm water. Cover both eyes with sterile dressing and seek immediate medical attention.

⚠ Warnings!

- Failure to shut off vehicle before proceeding with towing or salvage yard break down may result in serious injury, explosion, and/or death.
- An explosion may result if propane gas leaks into the atmosphere. Ensure that incident area is well ventilated. Asphyxiation may also occur in confined areas.
- In case of fire, contact local fire department.

Special Notes

- Gas remaining in lines could leak even after vehicle is shut off and shutoff valve is closed.
- Fuel tanks are typically located under vehicle along or between frame rails.
- Nearly every propane vehicle is a converted vehicle, so identification features or labels may or may not be clearly visible. Look out for fueling nozzles, gas tanks, and other indications that will confirm vehicle fuel type.
- LPG is heavier than air. Leaking vapors are likely to collect in low areas.
- Propane is nontoxic, colorless, and odorless.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible. (Check for more than one fuel tank as most propane vehicles at present are bi-fuel.)
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove the ignition key (check for smart key); set the parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices. Additional ramping may be required for loading.
- Towing a propane vehicle is the same as towing a conventional vehicle. The two main considerations are the fuel and the tank. Be sure to check for spills or leaks and always be aware of the tank and its location.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- Jumpstarting a propane gas vehicle is the same as jumpstarting a conventional vehicle.
- Refer to Owner's Manual for specifics on jumpstarting.
- Since propane for vehicles at the present time is not readily available in all areas, a fuel service call may require a tow to the nearest propane fueling station.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible. (Check for more than one fuel tank as most propane vehicles at present are bi-fuel.)
  - Monitor air for **FLAMMABLE VAPORS**.
- Make sure vehicle is immobilized. If necessary:
  - Set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel system. First cut negative cable(s) and then cut positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.

Defueling

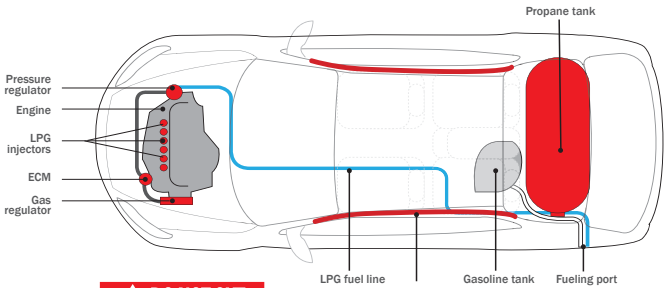
- Remove fuel prior to beginning dismantling of vehicle.
- Specialized equipment is required to empty propane tank. Contact your local propane supplier for assistance.
- **DO NOT** make any piping disconnections before fuel pressure is fully released.
- If depressurizing a propane tank, use protective gloves, as frostbite can occur.
- When emptying fuel, do not allow direct contact or breathe in fumes.

Removing Components

- After fuel is removed, remove tank and fuel lines prior to cutting with hydraulic tools near fuel system components.
- **DO NOT** puncture or cut a propane tank.

Example of Propane Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



DO NOT CUT BLUE & RED ZONES

For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

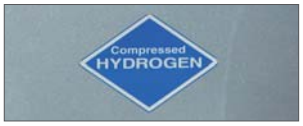
General information for OEM and converted

Hydrogen Internal Combustion Engine (ICE)

H_2 Hydrogen Compressed 5000-10,000 psi (350-700 bar)

Identification

- Confirm vehicle is a hydrogen ICE vehicle.
- Special badging, such as: Hydrogen, Compressed Hydrogen, LH_2, or H_2 located on doors, on rear of vehicle, near fueling ports, or under the hood.
- Hydrogen tank visible under vehicle at rear.
- Special fueling port.
- Underhood cables or components.
- Dash lights/gauges.



Example Vehicles

- All hydrogen ICE vehicles are aftermarket conversions (other than a small demo fleet of BMW vehicles). To identify vehicle, look for identifying fuel ports, tanks, lines, badges, and gauges.

Note: Aftermarket conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Hydrogen may be a simple asphyxiant. It should be noted that before suffocation could occur, the lower flammability limit of hydrogen in air would have to be exceeded, possibly causing both an oxygen-deficient and explosive atmosphere.
- Exposure to moderate concentrations may cause dizziness, headache, nausea, and unconsciousness.
- Exposure to atmospheres containing 8-10% or less oxygen will quickly bring about unconsciousness without warning, leaving individuals unable to protect themselves.
- Lack of sufficient oxygen may cause serious injury or death. Immediately seek fresh air and then medical attention.
- Contact with flowing hydrogen can cause additional health hazards. In case of blistering, frostbite, or freeze burns, seek immediate medical attention. Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical attention.

⚠ Warnings!

- **DO NOT** use flares. Hydrogen is highly flammable and explosive.
- Flames are nearly invisible in daylight.
- **DO NOT** cut hydrogen tank or its connecting lines.
- **DO NOT** approach vehicle if a hissing sound is present. Should the pressure relief valve open, hydrogen will flow out, making a hissing sound. It may take up to five minutes for tank to empty.
- Direct contact with liquid hydrogen, cold vapor, or cold equipment can cause serious tissue damage.
- In case of fire, contact local fire department.

Special Notes

- Hydrogen tank is equipped with a pressure relief device.
- Hydrogen is a colorless, odorless, **FLAMMABLE** gas that produces a colorless flame.
- Asphyxiation may occur if vehicle is in an enclosed area.
- High-voltage system and airbags lose power three minutes after shutoff.
- Some hydrogen powered vehicles use an electronic parking brake. Key is usually required to release brake.
- Hydrogen ICE converted vehicles could include electric drive vehicles. When this is the case, refer to electric drive information for additional considerations.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Listen for venting. Leaking fuel can cause a fire or an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible.
  - Since hydrogen is odorless, colorless, and tasteless, special flame detectors should be used at all times to monitor for flames.
  - Be aware of leaking battery acid.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices. Additional ramping may be required for loading.
- Towing a hydrogen ICE vehicle is the same as towing a conventional vehicle. The two main considerations are the fuel and the hydrogen tank. Be sure to check for spills or leaks and always be aware of the hydrogen tank and its location.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- Jumpstarting a hydrogen ICE vehicle is the same as jumpstarting a conventional vehicle.
- Refer to Owner's Manual for specifics on jumpstarting.
- Hydrogen is not available in all areas; a fuel service call may require a tow to nearest hydrogen station.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible.
  - Since hydrogen is odorless, colorless, and tasteless, special flame detectors should be used at all times to monitor for flames.
- Make sure vehicle is immobilized. If necessary:
  - Set the parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel system. Cut negative cable(s) and then positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.

Defueling

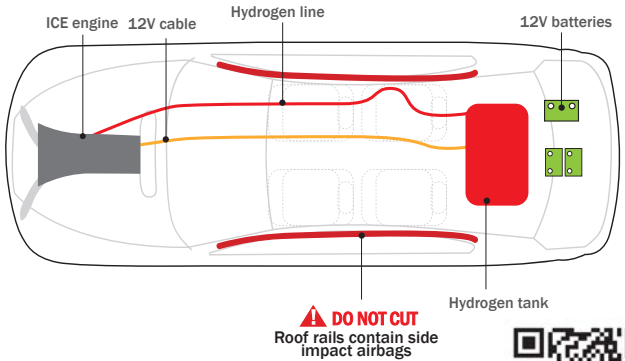
- Remove fuel prior to beginning the dismantling of the vehicle.
- Discharge hydrogen from fuel storage tanks through a closed transfer system or an approved method of atmospheric venting. Specialized equipment is required to empty the hydrogen tank. Contact your local hydrogen supplier or maintenance provider for assistance.
- **DO NOT** make any piping disconnections before fuel pressure is fully released. Disconnecting a fuel line under high pressure can result in severe injury or death.

Removing Components

- After fuel is removed, remove hydrogen tank and fuel lines prior to cutting near fuel system components.
- **DO NOT** cut through bottom of vehicle below floor line. Hydrogen fuel lines and batteries are commonly located below floor line.
- **DO NOT** puncture or cut a hydrogen tank.
- Take special care when moving with forklift to not damage or puncture batteries or high pressure lines or hydrogen tank.

Example of Hydrogen ICE Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

General information for OEM and converted

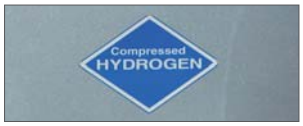
Hydrogen Fuel Cell (H_2)

288 Volts

Hydrogen Compressed
5000-10,000 psi (350-700 bar)

Identification

- Confirm vehicle is a hydrogen fuel cell vehicle.
- Special badging, such as: FCX, fuel cell, or H_2 located on doors, on rear of vehicle, and under the hood.
- Hydrogen tank visible under vehicle at rear.
- Special fueling port.
- Underhood cables or components.
- Dash lights/gauges.



Hydrogen fueling port — Honda

Example Vehicles

- Honda FCZ Clarity
- Hyundai Tucson FCV*
- Mercedes-Benz F-Cell

** Available Spring 2014*

Note: Aftermarket conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Hydrogen may be a simple asphyxiant. It should be noted that before suffocation could occur, the lower flammability limit of hydrogen in air would have to be exceeded, possibly causing both an oxygen-deficient and explosive atmosphere.
- Exposure to moderate concentrations may cause dizziness, headache, nausea, and unconsciousness.
- Exposure to atmospheres containing 8-10% or less oxygen will quickly bring about unconsciousness without warning, leaving individuals unable to protect themselves.
- Lack of sufficient oxygen may cause serious injury or death. Immediately seek fresh air and then medical attention.
- Contact with flowing hydrogen can cause additional health hazards. In case of blistering, frostbite, or freeze burns, seek immediate medical attention. Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical attention.

⚠ Warnings!

- **DO NOT** cut **ORANGE** cables.
- **DO NOT** use flares. Hydrogen is highly **FLAMMABLE** and explosive. Flames are nearly invisible in daylight.
- **DO NOT** cut hydrogen tank or its connecting lines.
- **DO NOT** approach vehicle if a hissing sound is present. Should pressure relief valve open, hydrogen will flow out, making a hissing sound. It may take up to five minutes for tank to empty.
- In case of fire, contact local fire department.

Special Notes

- Hydrogen tank is equipped with a pressure relief device.
- Hydrogen is a colorless, odorless, **FLAMMABLE** gas that produces a colorless flame.
- Asphyxiation may occur if vehicle is in an enclosed area.
- High-voltage system and airbags lose power three minutes after shutoff.
- Some hydrogen powered vehicles utilize an electronic parking brake. The key is usually required to release brake.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Listen for venting. Leaking fuel can cause a fire or an explosion. Be aware of leaking battery acid.
  - If fuel is leaking or escaping, shut off fuel source, if possible.
  - Since hydrogen is odorless, colorless, and tasteless, special flame detectors should be used at all times to monitor for flames.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices (use 4-wheel tie-downs to secure vehicle to avoid possible damage to high-voltage wiring). Additional ramping may be required for loading.
- There are three main considerations when towing a hydrogen fuel cell vehicle: the fuel; cylinder; and fuel cell/high-voltage system. Be sure to check for spills or leaks and in all cases, avoid contact with **ORANGE** cables, as they house high-voltage wiring.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- **DO NOT** confuse 12-volt battery (stored in various locations) with high-voltage battery system. Avoid contact with high-voltage cables and other high-voltage components.
- When jumpstarting, vehicle's electric motor may make little noise. Watch for "Ready" indicator on dash.
- Hydrogen is not available in all areas; a fuel service call may require a tow to nearest hydrogen station.
- If 12-volt battery has gone dead, it may be necessary to use a boosting pin, usually found in underhood fuse panel.
- Refer to Owner's Manual for specifics on jumpstarting.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - If fuel is leaking or escaping, shut off fuel source, if possible.
  - Since hydrogen is odorless, colorless, and tasteless, special flame detectors should be used at all times to monitor for flames.
- Make sure vehicle is immobilized. If necessary:
  - Set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel systems. Cut negative cable(s) and then positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.
- Be aware of high-voltage system. To prevent serious injury or death, avoid touching, cutting, or opening any **ORANGE** cable or high-voltage component.
- Some vehicles have a smart key system, which enables the low-voltage system when it is within 25 feet of the vehicle, even though ignition is off.

Defueling

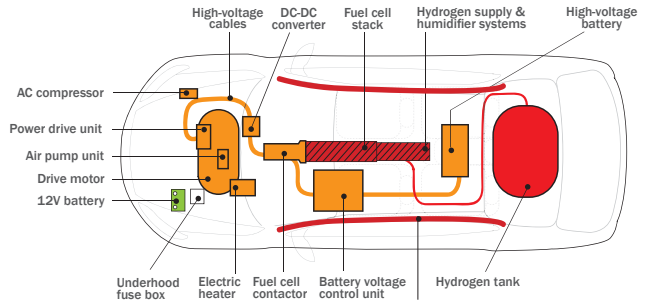
- Remove fuel prior to beginning the dismantling of the vehicle. Refer to Hydrogen ICE defueling information for further details.

Removing Components

- After fuel is removed, remove hydrogen tank and fuel lines prior to cutting near fuel system components.
- **DO NOT** cut the **ORANGE** cables, high-voltage battery pack, or fuel cell stack.
- **DO NOT** cut through bottom of vehicle below floor line where hydrogen fuel lines, high-voltage lines, batteries, and fuel cell units are commonly located.
- **DO NOT** puncture or cut a hydrogen tank.
- Take special care when moving with forklift to not damage or puncture fuel cell; high pressure lines; or hydrogen tank.

Example of Hydrogen Fuel Cell Vehicle Diagram

Key Components and Cut Zones — **These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.**



DO NOT CUT ORANGE & RED ZONES

DO NOT CUT Roof rails contain side impact airbags

For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

General information for OEM and converted

Hybrid Electric Vehicles (HEVs)

360 Volts

HEV Hybrid Electric and Gasoline Vehicle

Identification

- Confirm vehicle is a hybrid electric vehicle.
- Special badging, such as: hybrid badges, decals, or placards on fenders, rear, and under the hood.
- Underhood **ORANGE** cable components.
- Dash lights/gauges.

Example Vehicles

- Acura ILX
- Audi Q5 Hybrid
- BMW Active Hybrid
- Cadillac Escalade
- Chevrolet Silverado
- Chevrolet Tahoe
- Ford C-MAX
- Ford Escape
- Ford Fusion
- GMC Sierra
- GMC Yukon
- Honda Civic
- Honda CR-Z
- Honda Insight
- Hyundai Sonata
- Infiniti M35h
- Kia Optima
- Lexus CT/ES/GS/HS/LS/RX
- Lincoln MKZ
- Mercedes-Benz S400
- Mercury Mariner
- Mercury Milan
- Nissan Altima
- Porsche Cayenne S
- Porsche Panamera S
- Toyota Camry
- Toyota Highlander
- Toyota Prius/C/V
- Volkswagon Jetta Hybrid
- Volkswagen Touareg

Note: Aftermarket conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Breathing battery electrolyte vapors may cause severe respiratory problems, including severe irritation of mouth, throat, esophagus, and stomach.
- If skin contact occurs, remove contaminated clothing and flush affected areas with plenty of water for at least 20 minutes.
- If inhalation occurs, seek fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored. Seek immediate medical attention.
- If battery electrolytes are ingested, **DO NOT** induce vomiting. Dilute by giving large volumes of water or milk. Get immediate medical attention. **DO NOT** give anything by mouth to an unconscious person.
- If electrolytes come in contact with eyes, flush with plenty of water for at least 20 minutes. Seek immediate medical attention.

⚠ Warnings!

- **ALWAYS** assume vehicle has power and that high-voltage exists. There is no guarantee high-voltage system, airbags, or fuel pump are disabled.
- Use proper protective clothing and equipment if possibility exists of contact with high-voltage electricity.
- Failure to shut off vehicle before proceeding with towing or salvage yard break down may result in serious injury, electric burns, explosion, and/or death.
- **DO NOT** cut any **ORANGE** (or **BLUE**) cables, high-voltage battery pack, airbag charge cylinders in the supplemental restraint system or inverter/converter.
- Battery electrolytes contain sulfuric acid.
- Use only a Class ABC powder type fire extinguisher on a high-voltage battery pack fire.
- In case of fire, contact local fire department.

Special Notes

- Wait at least two minutes after shutoff so supplemental restraint system is disabled.
- These vehicles commonly have a smart key. Smart keys should be at least 25 feet away from vehicle.
- Some hybrid vehicles utilize an electronic parking brake. Key is usually required to release parking brake.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices (use 4-wheel tie-downs to secure vehicle to avoid possible damage to high-voltage wiring). Additional ramping may be required for loading.
- The main consideration when towing an HEV is the high-voltage system and its components. In all cases, avoid contact with **ORANGE** (or **BLUE**) cables, as they house high-voltage wiring.
- Also be aware that the vehicle has a regular gasoline tank.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- **DO NOT** confuse 12-volt battery (stored in various locations) with the high-voltage battery system. Avoid contact with high-voltage cables and other high-voltage components.
- When jumpstarting, vehicle's electric motor may make little noise. Watch for "Ready" indicator on dash.
- Since HEVs also operate on gasoline, a fuel service call will require only normal procedures.
- If 12-volt battery has gone dead, it may be necessary to use a boosting pin, usually found in underhood fuse panel.
- Refer to Owner's Manual for specifics on jumpstarting.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion
  - Monitor air for **FLAMMABLE VAPORS**.
- Make sure vehicle is immobilized. If necessary:
  - Set the parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel and high-voltage battery systems. Cut negative cable(s) and then positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.
- Be aware of high-voltage system. To prevent serious injury or death, avoid touching, cutting, or opening any **ORANGE** (or **BLUE**) cable or high-voltage component.
- Some vehicles have a smart key system, which will enable the low-voltage system when within 25 feet of the vehicle, even though ignition is off.
- All HEVs should have a manual high-voltage service disconnect switch/plug for safety. It is used to shut down the high-voltage system. Wearing insulating gloves, remove service disconnect switch/plug. Remove service plug from area to prevent other staff members from reinstalling it.

Defueling

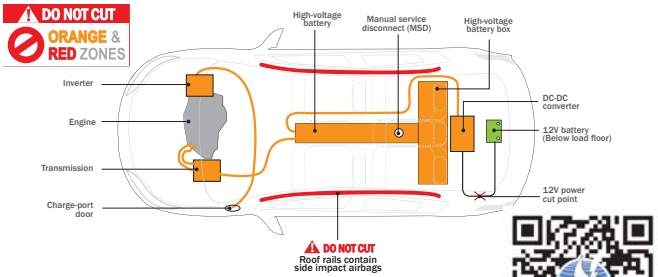
- Remove fuel prior to beginning dismantling. (Use same procedure as a conventional gasoline vehicle.)

Removing Components

- **DO NOT** cut the **ORANGE** (or **BLUE**) cables, high-voltage battery pack, or other high-voltage components.
- **DO NOT** cut through bottom of vehicle below floor line where high-voltage lines and batteries are commonly located.
- Take special care when moving with forklift to not damage/puncture high-voltage lines or other components.

Example of Hybrid Electric Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

General information for OEM and converted

Plug-in Hybrid Electric Vehicles (PHEVs) ≠ 360 Volts

HEV Hybrid Electric and Gasoline Vehicle

Identification

- Confirm vehicle is a plug-in hybrid electric vehicle.
- Special badging, such as: hybrid or plug-in hybrid badges, decals, or placards on fenders, rear, and engine cover.
- Underhood **ORANGE** cable components.
- Electric charging port and gasoline port.
- Dash lights/gauges.

Example Vehicles

- Chevrolet Volt
- Fisker Karma
- Ford C-MAX ENERGI
- Ford Fusion ENERGI
- Toyota Prius Plug-in

Note: Aftermarket conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Breathing battery electrolyte vapors may cause severe respiratory problems, including severe irritation of mouth, throat, esophagus, and stomach.
- If skin contact occurs, remove contaminated clothing and flush affected areas with plenty of water for at least 20 minutes.
- If inhalation occurs, seek fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored. Seek immediate medical attention.
- If battery electrolytes are ingested, **DO NOT** induce vomiting. Dilute by giving large volumes of water or milk. Get immediate medical attention. **DO NOT** give anything by mouth to an unconscious person.
- If electrolytes come in contact with eyes, flush with plenty of water for at least 20 minutes. Seek immediate medical attention.

⚠ Warnings!

- **ALWAYS** assume vehicle has power and that high-voltage exists. There is no guarantee that high-voltage system, airbags, or fuel pump are disabled.
- Use proper protective clothing and equipment if the possibility exists of contact with high-voltage electricity.
- Failure to shut off vehicle before proceeding with towing or salvage yard break down may result in serious injury, burns, explosion, and/or death.
- **DO NOT** cut any **ORANGE** cables.
- Battery electrolytes contain sulfuric acid.
- Use only a Class ABC powder type fire extinguisher on a high-voltage battery pack fire.
- In case of fire, contact local fire department.

Special Notes

- Wait at least two minutes after shutoff so supplemental restraint system is disabled.
- These vehicles commonly have a smart key. Smart keys should be at least 25 feet away from vehicle.
- Some plug-in hybrid elecric vehicles utilize an electronic parking brake. Key is usually required to release parking brake.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices (use 4-wheel tie-downs to secure vehicle to avoid possible damage to high-voltage wiring). Additional ramping may be required for loading.
- The main consideration when towing a PHEV is the high-voltage system and its components. In all cases, avoid contact with **ORANGE** (or **BLUE**) cables, as they house high-voltage wiring.
- Also be aware that the vehicle has a regular gasoline tank.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- **DO NOT** confuse 12-volt battery (stored in various locations) with the high-voltage battery system. Avoid contact with high-voltage cables and other high-voltage components.
- When jumpstarting, vehicle's electric motor may make little noise. Watch for "Ready" indicator on dash.
- Since PHEVs also operate on gasoline, a fuel service call will require only normal procedures.
- If 12-volt battery has gone dead, it may be necessary to use a boosting pin, usually found in underhood fuse panel.
- Refer to Owner's Manual for specifics on jumpstarting.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking fuel or battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- Make sure vehicle is immobilized. If necessary:
  - Set the parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate fuel and high-voltage battery systems. Cut negative cable(s) and then positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.
- Be aware of high-voltage system. To prevent serious injury or death, avoid touching, cutting, or opening any **ORANGE** (or **BLUE**) cable or high-voltage component.
- Some vehicles have a smart key system, which will enable the low-voltage system when within 25 feet of the vehicle, even though ignition is off.
- All PHEVs should have a manual high-voltage service disconnect switch/plug for safety. It is used to shut down high-voltage system. Wearing insulating gloves, remove service disconnect switch/plug. Remove service plug from area to prevent other staff members from reinstalling it.

Defueling

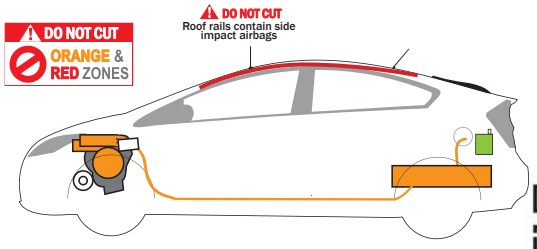
- Remove fuel prior to beginning dismantling. (Use same procedure as a conventional gasoline vehicle.)

Removing Components

- **DO NOT** cut the **ORANGE** (or **BLUE**) cables, high-voltage battery pack, or other high-voltage components.
- **DO NOT** cut through bottom of vehicle below floor line where high-voltage lines and batteries are commonly located.
- Take special care when moving with forklift to not damage/puncture high-voltage lines or other components.

Example of Plug-in HEV Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

General information for OEM and converted

Battery Electric Vehicles (BEVs)

360+ Volts

100% Electric Vehicle

Identification

- Confirm vehicle is a battery electric vehicle.
- Special badging, such as: battery/electric badges, decals, or placards on fenders, rear, and engine cover.
- Underhood **ORANGE** cable components.
- No tailpipe.
- Electric charging port.
- No fuel port.
- Dash lights/gauges.

Example Vehicles

- Chevrolet Spark
- Coda Automotive - CODA
- Fiat 500e
- Ford Azure Transit Connect
- Ford Focus EV
- Honda FIT EV
- Mitsubishi i-MiEV
- Nissan LEAF
- Scion iQ EV
- Smart forTwo
- Tesla Motors Model S
- Tesla Motors Roadster
- Tesla Motors Roadster 2.5
- Toyota RAV4 EV
- Wheego Electric Cars, Inc. LiFe

Note: Aftermarket conversion vehicles may not have the badge marks of a factory manufactured alternative fuel vehicle, but they will have identifying fuel ports, tanks, lines, and gauges.

For a complete list of vehicles, visit
afdc.energy.gov/fuels/

SAFETY CONSIDERATIONS

Safety and First Aid

- Breathing battery electrolyte vapors may cause severe respiratory problems, including severe irritation of mouth, throat, esophagus, and stomach.
- If skin contact occurs, remove contaminated clothing and flush affected areas with plenty of water for at least 20 minutes.
- If inhalation occurs, seek fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored. Seek immediate medical attention.
- If battery electrolytes are ingested, **DO NOT** induce vomiting. Dilute by giving large volumes of water or milk. Get immediate medical attention. **DO NOT** give anything by mouth to an unconscious person.
- If electrolytes come in contact with eyes, flush with plenty of water for at least 20 minutes. Seek immediate medical attention.

⚠ Warnings!

- **ALWAYS** assume vehicle has power and that high-voltage exists. There is no guarantee that high-voltage system, airbags, or fuel pump are disabled.
- Use proper protective clothing and equipment if possibility exists of contact with high-voltage electricity.
- Failure to shut off vehicle before emergency response may result in serious injury, burns, explosion, and/or death.
- **DO NOT** cut any **ORANGE** cables.
- Battery electrolytes contain sulfuric acid.
- Use only a Class ABC powder type fire extinguisher on a high-voltage battery pack fire.
- In case of fire, contact local fire department.

Special Notes

- Wait at least two minutes after shutoff so supplemental restraint system is disabled.
- These vehicles commonly have a smart key. Smart keys should be at least 25 feet away from vehicle.
- Some battery electric vehicles utilize an electronic parking brake. Key is usually required to release parking brake.

TOWING AND ROADSIDE ASSISTANCE

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of leaking battery acid, which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- If providing roadside assistance, immobilize vehicle:
  - Power off vehicle and remove ignition key (check for smart key); set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Towing

- Use wheel-lift or car carrier equipment with proper tie-down devices (use 4-wheel tie-downs to secure vehicle to avoid possible damage to high-voltage wiring). Additional ramping may be required for loading.
- The main consideration when towing a BEV is the high-voltage system and its components. In all cases, avoid contact with **ORANGE** cables, as they house high-voltage wiring.
- Refer to Owner's Manual on vehicle specific towing instructions.

Roadside Assistance

- **DO NOT** confuse 12-volt battery (stored in various locations) with the high-voltage battery system. Avoid contact with high-voltage cables and other high-voltage components.
- When jumpstarting, vehicle's electric motor may make little noise. Watch for "Ready" indicator on dash.
- Since BEVs operate on electricity only, a fuel service call will require a mobile charging unit or a tow to the nearest charging facility.
- If 12-volt battery has gone dead, it will be necessary to use a boosting pin, usually found in underhood fuse panel.
- Refer to Owner's Manual for specifics on jumpstarting.

AUTOMOTIVE RECYCLING

Securing the Vehicle

- Size up the scene to determine hazards:
  - Be aware of battery acid which can ignite and/or cause an explosion.
  - Monitor air for **FLAMMABLE VAPORS**.
- Make sure vehicle is immobilized. If necessary:
  - Set parking brake; chock vehicle wheel(s).
- Follow normal operating procedures.

Dismantling

Shutdown/Isolate Fuel System

- Before dismantling, isolate high-voltage battery systems. Cut negative cable(s) and then positive cable(s) of 12-volt auxiliary battery. Remove 3-4 inches from both battery cables.
- Be aware of high-voltage system. To prevent serious injury or death avoid touching, cutting, or opening any **ORANGE** cable or high-voltage component.
- Some vehicles have a smart key system, which will enable the low-voltage system when within 25 feet of the vehicle, even though ignition is off.
- All BEVs should have a manual high-voltage service disconnect switch/plug for safety. It is used to shut down the high-voltage system. Wearing insulating gloves, remove service disconnect switch/plug. Remove service plug from area to prevent other staff members from reinstalling it.

Defueling

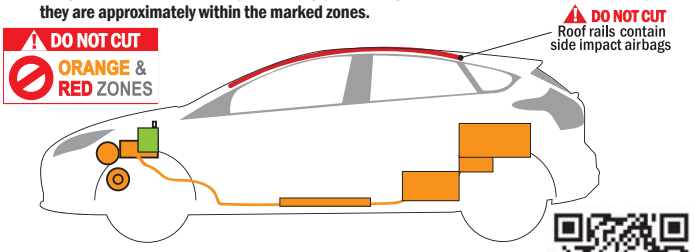
- A BEV does not have fuel.

Removing Components

- **DO NOT** cut the **ORANGE** cables, high-voltage battery pack, or other high-voltage components.
- **DO NOT** cut through bottom of vehicle below floor line where high-voltage lines and batteries are commonly located.
- Take special care when moving with forklift to not damage or puncture high-voltage lines; batteries; or other high-voltage components.

Example of Battery Electric Vehicle Diagram

Key Components and Cut Zones — These drawings suggest where components are located. They do not imply that components are at these exact locations, but they are approximately within the marked zones.



For vehicle specifics and a complete list of AFVs, download the free QRG app.

All images courtesy of NAFTC, unless otherwise indicated.

The National Alternative Fuels Training Consortium (NAFTC) is working in partnership with the U.S. Department of Energy (DOE) Clean Cities Program to develop and disseminate the turn-key Clean Cities Learning Program to raise awareness and foster a greater understanding of alternative fuels, alternative fuel vehicles, and advanced vehicle technologies through a targeted outreach and education effort. This program enables Clean Cities Coalitions and other stakeholders to better implement petroleum reduction technologies by advancing the use of alternative fuels, alternative fuel vehicles, advanced vehicle technologies, and idle reduction technologies through state-of-the-art curricula, training, and education and outreach materials, all of which are disseminated by the NAFTC and U.S. DOE Clean Cities.

Training courses include...

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Designed specifically to raise awareness and foster a greater understanding of alternative fuels, alternative fuel vehicles, advanced vehicle technologies, petroleum reduction technologies, fuel economy and idle reduction, and related technologies. Workshops available on the following topics:

- Biodiesel
- Ethanol
- Natural Gas
- Propane
- Electric Drive
- Hydrogen
- Fuel Economy
- Idle Reduction
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Designed specifically to reduce the risks taken by first responders when responding to an incident involving alternative fuels, alternative fuel vehicles, and advanced technology vehicles.

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- First Responder Safety Training: Gaseous Fuels (natural gas and propane) and Gaseous-Fuel Vehicles
- First Responder Safety Training: Hydrogen and Hydrogen-Powered Vehicles
- First Responder Safety Training: Electric Drive Vehicles

Safety Training

Designed specifically to reduce the risks taken by automotive recycling, and towing and roadside assistance personnel when dealing with alternative fuels, alternative fuel vehicles and advanced technology vehicles.

- Automotive Recycling
- Towing and Roadside Assistance

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www.naftc.wvu.edu/cleancitieslearningprogram
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The National Alternative Fuels Training Consortium is the only nationwide alternative fuel and advanced technology vehicles training organization in the U.S.

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