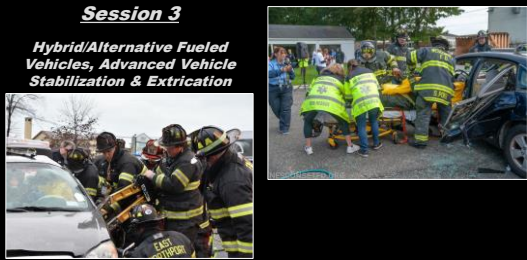



Heavy Rescue

Session 3

Hybrid/Alternative Fueled Vehicles, Advanced Vehicle Stabilization & Extrication

Suffolk County Fire Academy


1

Course Overview

4 Sessions

- **Session 1** – Vehicle Components/Construction, Size-up and Vehicle Stabilization, Basic Extrication Tools, and Extrication
- **Session 2** – Airbags/Vehicle Safety Systems, Other Extrication Tools and Techniques
- **Session 3** – Hybrid/Alternative Fuel Vehicles, Advanced Vehicle Stabilization and Extrication
- **Session 4** – Air Bags, Pneumatic Tools, Other Lifting Tools, Final Exam and Course Evaluation.

**** ALL SESSIONS REQUIRE PPE ****

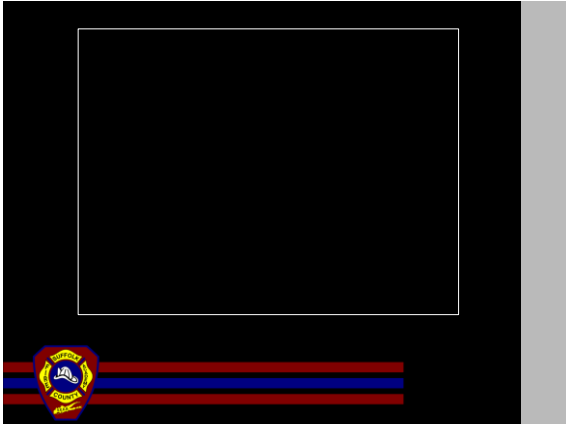


2

Session Objectives

- Explain the functionality of hybrid/alternative fuel vehicles
- Outline the safety features of hybrid/alternative fuel vehicles
- Explain operational considerations when hybrid/alternative fuel vehicles are encountered
- Describe size-up considerations for vehicles found on their side or roof
- Identify the equipment used for advanced vehicle stabilization and their application
- Explain the procedure for victim disentanglement and extrication when pinned in a vehicle on its side or roof.

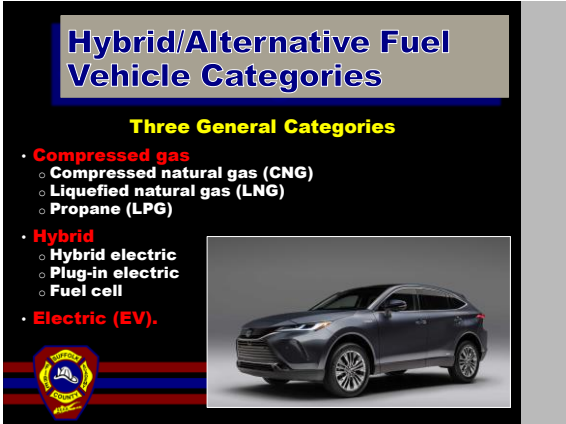
3



4



5



6



Compressed Gas Vehicles



7

Compressed Natural Gas (CNG)



- **Natural gas properties**
 - Lighter than air (will rise)
 - Flammable range 5% - 15%
 - Ignition temperature = 1,100°F
- Stored at 3,600 psi
- Odorized.

8

Compressed Natural Gas (CNG)

- **Tank location**
 - **Vehicle** – trunk or typical fuel tank location
 - **Truck** – vertical or horizontal behind cab or where saddle tanks might be
 - **Bus** – on the roof
- **Disable (flow of gas)**
 - Shut ignition
 - Manual shut-off.

9

Compressed Natural Gas (CNG)



CNG Garbage Truck - Town of Huntington






CNG Fueling Station - Suffolk County Water Authority



10

Liquefied Natural Gas (LNG)




- -260°F (Cryogenic)
- Stored at 120 psi
- Non-odorized.

11

Liquefied Propane Gas (LPG)



- Propane properties
 - Heavier than air (will sink)
 - Flammable range 2% - 10%
 - Ignition temperature = 1,000°F
- Stored at 240 psi
- Liquefied by pressurization.

12

Liquefied Propane Gas (LPG)

- Tank location
 - Vehicle – trunk or typical fuel tank location
 - Pick-ups / Van – underneath or in the bed
 - Truck – inside/outside frame rails
 - Will not be on roof due to heavier than air
- Disable (flow of gas)
 - Shut ignition
 - Manual shut-off.

13


Hybrid Vehicles



14

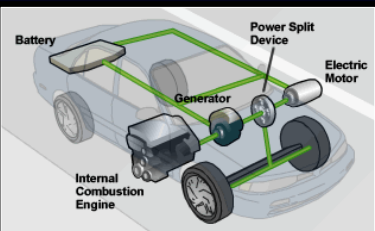
Hybrid Electric (HEV)

- Two power sources
 - Internal combustion engine (ICE)
 - Electric motor/battery combination
- Vehicle computer decides which source will be used based on driving conditions
- Batteries are continuously charged via ICE or other means (i.e. regen. braking).



15

Hybrid Electric (HEV)



16

Plug-in Hybrid Electric (PHEV)

- **Combination between hybrid electric and all electric vehicle**
 - Internal combustion engine (ICE)
 - Electric motor/battery combination
 - Ability to charge batteries via plug-in outlet.



17

Fuel Cell Vehicle (FC)



- **Another type of hybrid**
- **Fuel cell replaces internal combustion engine**
- **Chemical reaction between oxygen and hydrogen produces electricity**
- **Electricity powers drive motor and charges high voltage batteries**
- **No combustion – by products are heat and water vapor.**



18

Fuel Cell Vehicle Hydrogen



- **Hydrogen properties**
 - Lighter than air (will rise)
 - **Flammable range 4% - 74%**
 - Ignition temperature 1,085°F
- **Colorless, odorless, tasteless**
- **Cannot be odorized.**

19

Fuel Cell Vehicle Hydrogen

- **Tank location**
 - **Vehicle** – trunk or typical fuel tank location
 - **Truck** – vertical or horizontal behind cab or where saddle tanks might be
 - **Bus** – on the roof
- **Disable (flow of gas)**
 - Shut ignition
 - Manual shut-off.

20

Electric Vehicles



21

Electric Vehicles (EV)

- Electric motor for propulsion
- Must connect to a charging station to recharge batteries
- Most use lithium-ion batteries.



22

Electric and Hybrid Vehicle Batteries

- Nickel-Metal-Hydrate (NiMH)
- Lithium-ion
- Can have voltages greater than 300v
- Incasements virtually “bomb-proof,” not often breached.



Lithium



NiMH



23

Electric and Hybrid Vehicle Batteries



- If damaged / breached
 - May give off harmful/flammable fumes
 - Contents should be considered corrosive, toxic, and/or flammable
 - Avoid contact (shock hazard)
 - Can cause a delayed fire (lithium-ion)
 - Wear full PPE.



24

Electric and Hybrid Vehicle Batteries

- **Manual disconnects**
 - **Not** intended for emergency responders
 - **Requires use of insulated, electrical PPE**
 - **Disables the high voltage system, but not the 12v system (airbags still active)**
 - **Does not discharge the high voltage battery.**



25

Hybrid/Alternative Fuel Vehicles Response




26

Hybrid/Alternative Fuel Vehicles General Response

Regardless of Type, General Initial Response Procedures Apply:

IDENTIFY → IMMOBILIZE → DISABLE



27

Hybrid/Alternative Fuel Vehicles – Identify

- External badging
- Warning labels.




28

Hybrid/Alternative Fuel Vehicles – Identify

- NFPA Alternative Fuel Vehicles – Emergency Field Guide
 - General response section
 - Vehicle specific section
- NFPA EFG:

<https://catalog.nfpa.org/Emergency-Field-Guide-2015-Edition-P13872.aspx?icid=D762>
- Tesla First Responders Information website:

<https://www.tesla.com/firstresponders>



29

Hybrid/Alternative Fuel Vehicles – Identify

Hybrids/Alternative Fuel Vehicles No Longer Have One Particular Look

Gas



Gas



Hybrid





30

Hybrid/Alternative Fuel Vehicles – Immobilize

- Chock
- Parking brake **This Applies To All Vehicles**
- Park.

Approach the vehicle from a 45° angle to stay out of the potential path of travel, and:



31

Hybrid/Alternative Fuel Vehicles – Disable

- **Primary**
 - Turn off vehicle ignition (Proximity key > 16')
 - Disconnect the 12v battery
 - Standard – disconnect negative terminal
 - Emergency responder disconnect



32

Hybrid/Alternative Fuel Vehicles – Disable

- **Alternate (if ignition inaccessible)**
 - Refer to NFPA Alternative Fuel Vehicle Emergency Field Guide for vehicle specific information
 - Safety system may have detected a crash (airbag deployment) and already disabled the vehicle.



33

Hybrid/Alternative Fuel Vehicles – Extrication

- High voltage cabling
 - Blue/yellow – medium/intermediate voltage
 - Orange – high voltage (HV)
- Regardless of color, treat all cabling as HV
 - Avoid contact
 - Never cut
 - HV disabling disables HV system, but the HV battery will remain energized.



34

Hybrid/Alternative Fuel Vehicles – Extrication

Before Cutting or Prying Visually Check For:

- SRS and occupant protection systems
- HV components and cabling
- Gaseous fuel lines and cylinder/tanks.



35

Hybrid/Alternative Fuel Vehicles – Extrication

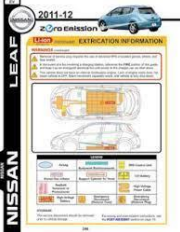
- HV components and cabling **not** found in typical extrication cut points
- Gaseous fuel lines **not** found in typical extrication cut points
- Avoid HV and gaseous fuel lines when placing cribbing
- Location of HV batteries and cylinders/ tanks may prevent advanced techniques:
 - Trunk tunneling
 - Through-the-floor extrication.



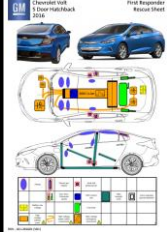
36

Hybrid/Alternative Fuel Vehicles – Extrication

Each hybrid/alternative fuel vehicle is unique. If available refer to specific manufacturer or NFPA guide



Disconnect of 12v system, however, is a universal technique for disabling.



37


Size-up and Advanced Stabilization



38

Vehicle Extrication Size-up

- Apparatus positioning
- Number of vehicles
- Number of victims (inside/outside)
- Vehicles secured (parking brake, keys - fobs, battery)
- Fire hazard (line stretched)
- Vehicles stabilized
- Extrication tools required.




39

Advanced Vehicle Stabilization (Considerations)

The goal of vehicle stabilization is to provide a safer platform for victims and responders

- Natural forces (where does the vehicle want to go)
- Vehicle balance
- Victim location
- Tool access.



40

Initial Stabilization

- Winch
- Chain
- Utility Rope
- Ratchet Straps
- Cribbing
- Step Chocks.



41

Initial Stabilization



42

Initial Stabilization



Utility Rope



43

Initial Stabilization



44

Advanced Stabilization

- Paratech VSK
- Res-Q-Jacks
- Junkyard Dogs
- Paratech Struts.



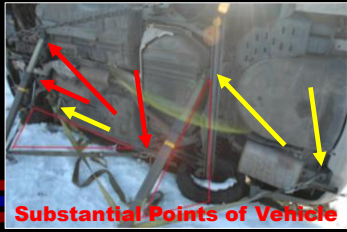
Res-Q-Jacks




45

Advanced Stabilization
(Vehicle On Its Side)

- Triangle = greatest strength
- Angle = 45°- 60°
- 1 sided method.



Substantial Points of Vehicle



46

Advanced Stabilization
(Vehicle On Its Side)

- 2-sided method
- Consider victim access
- Consider extrication access.



47

Advanced Stabilization
(Vehicle On Its Side)

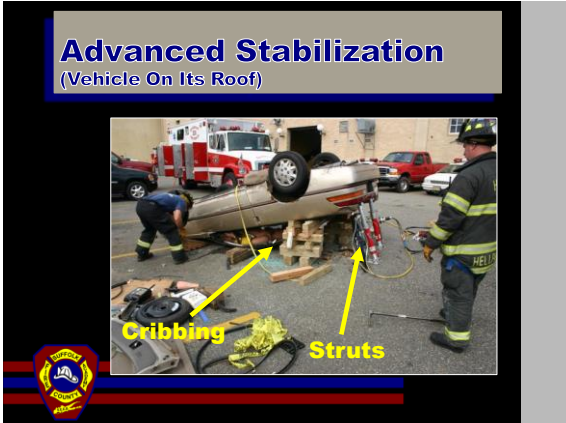
- Towman's cluster



48



49



50



51

Advanced Stabilization
(Vehicle On Its Roof)



52

Advanced Stabilization
(Vehicle On Its Roof)



Chain Cradle



53



Advanced
Extrication



54

Advanced Extrication
(Victim Access)

- After initial stabilization, victim access becomes the priority
- Front or rear windows (vehicle on side)
- Rear/side windows/doors (vehicle on roof).

55

Advanced Extrication
(Victim Access)

- Victim access from top (not ideal)



Secure Door



56

Advanced Extrication
(Vehicle On Its Side)

Roof Flap

- Remove glass (top/rear)
- Cut windshield
- Cut posts along roof line.




57

Advanced Extrication
(Vehicle On Its Side)

- Relief cuts made on lower A and C post



58

Advanced Extrication
(Vehicle On Its Side)

- Flap roof down



Be Aware of Sharp Edges

59



Advanced Extrication
(Vehicle On Its Side)



60

Advanced Extrication
(Vehicle On Its Roof)

- **Doors attacked similarly to vehicle on wheels**



61

Advanced Extrication
(Vehicle On Its Roof)

- **Fender crush to access hinges**



62

Advanced Extrication
(Vehicle On Its Roof)

- **Roof removal**



63

Summary

64

Summary

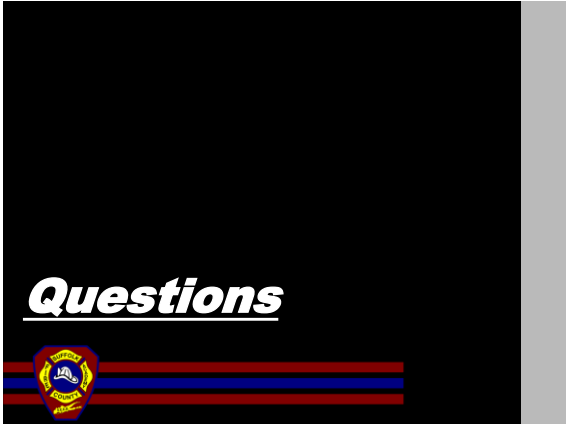
- **Three general categories of hybrid/alternative fuel vehicles:**
 - **Compressed gas (CNG, LNG, LPG)**
 - **Hybrid (Hybrid electric, Plug-In electric, Fuel cell)**
 - **Electric (EV)**
- **IDENTIFY → IMMOBILIZE → DISABLE**
- **Best methods to disable hybrid/alternative fuel vehicles:**
 - **Shut off the vehicle**
 - **Disconnect the 12v system**
 - **Utilize the emergency responder disconnect.**

65

Summary (Cont'd)

- **The goal of vehicle stabilization is to provide a safer platform for victims and responders**
- **Following initial stabilization, victim access becomes the priority**
- **Advanced stabilization tools should be placed at 45° - 65° angles and should form the strongest geometric shape - a triangle.**

66



67