COURSE OBJECTIVES

• Discuss vehicle construction and terminology
• Discuss Scene Size-up, Vehicle Assessment and Patient Assessment
• Discuss Vehicle Stabilization Techniques
• Discuss Airbags, SRS, Battery locations and 10-10-20 Rule
• Discuss Vehicle Extrication Techniques
• Discuss the Training Rotations
• Answer Questions
FULL FRAME CONSTRUCTION
Commonly found on older model vehicles, pick-up trucks, sport utility vehicles and full size vans
FULL FRAME CONSTRUCTION
UNIBODY CONSTRUCTION

A manufacturing process where sheet metal body parts are combined with stress-bearing elements to form the body and chassis as a single piece, as opposed to attaching body parts to a frame.
UNIBODY CONSTRUCTION
SPACE FRAME CONSTRUCTION

The spaceframe of a vehicle is a load bearing structural frame which supports a vehicle's powertrain components and body panels.
SPACE FRAME CONSTRUCTION
VEHICLE BODY CONSTRUCTION

Door hinges secured by thick through-bolts located in A- and B-pillars.

Cast magnesium transverse beam behind the instrument panel.

One-piece hydroformed body side rings.

Triple-rolled Pillar/Rail design resists roof collapse.

Shock towers connected solidly to instrument panel.

Lateral tie bars that connect the front longitudinal rails were closed to stiffen the front structure and improve crashworthiness.

Hydroformed engine cradle (not shown)
BORON B-POST & OTHER HIGH TENSILE STEELS
Now found in most new technology vehicles
VEHICLE EXTRICATION OPERATIONS

What needs to get done?

• Scene Size Up and Assessment
• Vehicle Assessment “Reading the Wreck”
• Patient Assessment
• Stabilization
• Scan for Airbags/SRS “Peel and Peek”
• Gain Access to Patient “10-10-20 Rule”
• Extrication Techniques
• Patient Removal
SCENE SIZE UP

- Scene Safety – Watch for Traffic
- Number and Condition of Vehicles
- Number and Condition of Patients
- What Resources are Responding and do you need more?
- Need for Specialized Resources/Equipment?
- Size-up continues until the incident is terminated
SCENE ASSESSMENT

• Scene Safety
• Vehicle traffic
• Safe working area
• Fuel spills
• Down power lines
• Environmental considerations
• Fires
• Alternative Fuel Vehicle leak
VEHICLE ASSESSMENT

• “Reading the Wreck”
  Position, Damage and Stability
  Vehicle construction and type
  Vehicle and Patient Condition

• Vehicle safety systems
  Air bags/SRS
  Seat belt Pretensioners
  Batteries
  Glass Management
PATIENT ASSESSMENT

- Communication with on-scene paramedics is very important
- Determine mode of removal and urgency
- Confirm number of patients and locations
- What are the entrapment issues
- What are the patient priorities for extrication
- Understand that patient conditions constantly change and your priorities may change
USE CAUTION WHEN APPROACHING COMPROMISED VEHICLES

Gas Shock Bumpers and Gas Lift Shocks

• Approach vehicle from the side
• Struts now angled 45 degrees in front and rear bumpers
• Various configurations in hatch-backs, trunks and hoods
BUMPER GAS SHOCK FAILURE
GAS LIFT STRUTS
SECURING THE VEHICLE

Whenever Possible:

• Place the vehicle in **PARK** and engage parking brake – **stay clear of airbags when doing so**

• Turn **OFF** the motor and remove the keys – remove “smart keys” 20 feet away from vehicle

• Prior to turning off the vehicle consider unlocking all doors and lowering all windows if electric

• Disconnect the vehicle battery / cut both cables

• **STILL CONSIDER ALL AIRBAGS AND SRS TO BE LIVE EVEN WITH BATTERY DISCONNECTED!!!!!**
SECURE THE VEHICLE

STAY CLEAR OF AIRBAG IMPACT ZONES (MAINTAIN THE 10-10-20 RULE) WHEN PLACING THE VEHICLE IN PARK, TURNING IT OFF AND REMOVING THE KEY. REMEMBER TO
SECURE THE VEHICLE

STAY CLEAR OF AIRBAG IMPACT ZONES (MAINTAIN 10-10-20 RULE) WHEN ACTIVATING THE VEHICLE’S PARKING BRAKE, USE A HALLIGAN OR AXE TO DEPRESS THE BRAKE
BATTERY LOCATIONS

• Multiple Battery Locations
• Under hood
• Trunk
• Wheel wells
• Under front and/or back seats
• Both under hood and in the trunk
• Batteries in odd places may have remote jumper cable terminals in the engine compartment which may be used to disconnect the battery system
WHEEL WELLS
UNDER SEATS
TRUNKS
VEHICLE STABILIZATION

Points to Remember:
• Maintain current vehicle position and do not allow it to move
• Take the vehicle’s suspension out of the equation
• Position your stabilization with your extrication work in mind
• Use what equipment you have – step chocks, lumber cribbing, apparatus chock, deflating the tires is also an option
VEHICLE STABILIZATION
USE WHAT YOU HAVE

STEP CHOCS    LUMBER CRIBBING
VEHICLE STABILIZATION

“TAKING AIR” TIRES MAY BE DEFLATED TO ALLOW THE VEHICLE TO BE STABILIZED AND THE SUSPENSION NOT BE A PROBLEM

KNIFE “KEY” METHOD  STEM REMOVAL
GLASS REMOVAL

Remove the glass in a controlled manner and **ONLY** when necessary, protecting the patients while doing so:

- Breaking glass at a top corner is preferred
- Strike the glass so that tool handle hits car frame
- Windshield and possibly Side Windows (on new vehicles) are Laminated Glass
- Remaining windows are Tempered Glass
GLASS REMOVAL

WINDSHIELD IS LAMINATED GLASS AND MUST BE CUT
GLASS REMOVAL
THE SIDE WINDOWS AND USUALLY REAR WINDOW ARE TEMPERED GLASS AND SHOULD BE SHATTERED, WHEN POSSIBLE BREAK INSIDE OF DOOR.
“PEEL AND PEEK”

Remove the interior covering the A, B, and C posts as well as the Headliner to locate:

• Airbags
• Airbag Gas Canisters
• Seatbelt Pretensioners
• Seatbelt Backing Plates
“PEEL AND PEEK”
AIRBAGS

- Steering Wheel: SRS, SIR, Airbag
- Dash: SRS, SIR, Airbag
- Seats: SIPS, SRS/Airbag, Airbag
- Doors: SIPS, SRS/Airbag, Airbag
- Knee: SRS (Kia Sportage, 2002 BMW)
- A-Post/Roof: HPS(BMW, Lexus, Infinity & others)
AIRBAGS

- Side Impact Curtains: IC/Inflatable Curtain
- Head and Torso Airbag
- Head/Thorax Airbag
- Bag-in-the-Belt (Renault – located in rear lap belt)
- Smart Airbags Systems
- Dual Stage Airbags
LOCATE THE AIRBAGS
KNOW WHERE THEY ALL ARE AND STAY CLEAR

LOOK AT THE STEERING WHEEL FIRST:
IF YES – CONTINUE YOUR SEARCH
IF NO – THE CAR HAS NO AIRBAGS
LOCATE THE AIRBAGS

IF THE STEERING WHEEL HAS AN AIRBAG THEN LOOK AT THE PASSENGER DASHBOARD NEXT:
IF YES – THEN YOU MUST CHECK THE ENTIRE CAR
IF NO – THEN THE ONLY AIRBAG IS IN THE STEERING WHEEL
LOCATE THE AIRBAGS

IF THERE IS A DASHBOARD AIRBAG THEN YOU MUST CHECK THE ENTIRE CAR FOR YOUR SAFETY

“A” POST SIDE CURTAIN  “C” POST SIDE CURTAIN
LOCATE THE AIRBAGS
LOOK CLOSELY THEY MAY BE DIFFICULT TO LOCATE

DRIVERS SEAT SIDE AIRBAG   PASSENGER SEAT SIDE AIRBAG
10-10-20 Rule
10” RULE
STEERING WHEEL AIRBAG
10” RULE
SIDE CURTAIN AIRBAGS
20” RULE
PASSENGER DASH AIRBAG
SEATBELT PRETENSIONERS

- Designed to tighten or back wind seat belt
- Can be electrical or mechanical
  - Electrical pretensioners deploy with front airbags
  - A pyrotechnic device with a small gas generator
- Models that back wind the seat belt are located anywhere in the B pillar
SEATBELT PRETENSIONERS

• Models that use a cable to tighten the seat belt can be located on the buckle side or b pillar side

• **Solution:** Cut seat belt early in the extrication and avoid cutting into loaded pre-tensioning devices
SEATBELT PRETENSIONERS
SEATBELT CUTTING

CUT THE SEATBELT EARLY IN THE EXTRICATION, PULL THE BELT ALL THE WAY OUT WHENEVER POSSIBLE AND THEN CUT AT A 45 DEGREE ANGLE WITH WHATEVER TOOL YOU HAVE.
Prior to the Truck Company arrival, an Engine Company could and should:

- Perform a Scene Size-Up and Assessment
- Perform a Vehicle Assessment “Read the Wreck”
- Perform a Patient Assessment
- Secure and Stabilize the involved vehicles – use what you have

- Break “Take” necessary glass, Scan for Airbags / SRS systems
- “Peel and Peak” the vehicle interior to locate Airbags, Airbag gas canisters, pre-tensioning devices and seatbelt backing plates
- Gain access to the patient(s) if possible – maintain the 10-10-20 Rule

Basic toolshed and basic extrication skills
The Truck Company upon their arrival should:

- Locate the apparatus so that it allows the working personnel the best possible protection from traffic but also quick tool deployment.
- Face to face with Engine Company personnel for extrication needs and priorities.
- Perform a Scene Size-Up and Assessment.
- Perform a Vehicle Assessment “Read the Wreck.”
- Perform a Patient Assessment.
- Secure and Stabilize the vehicles – remove the suspension from the equation on all vehicles requiring extrication work.
- Break “Take” necessary glass, Locate Airbags/SRS, Peel and Peak the interior to locate airbag gas canisters, pre-tensioning devices, and seatbelt backing plates.
- Perform necessary extrication tasks while maintaining the 10-10-20 Rule and assist with patient removal.
GAINING A “PURCHASE POINT”

Five Ways to Gain a Purchase Point:

• Hand Tool – Halligan Bar
• Fender Crush – Front or Rear
• Door Pinch
• Pinch and Peel
• Vertical Lift
PURCHASE POINTS

HAND TOOLS  FENDER CRUSH
PURCHASE POINTS

DOOR PINCH

PINCH AND PEEL
PURCHASE POINTS
VERTICAL LIFT / WINDOW SPREAD
EXTRICATION TECHNIQUES

• Door Removal
  – Hinge Side
  – Pin Side

• “B” Post Blowout – Pin to Hinge

• Dash Displacement
  – Dash Jack
  – Dash Roll

• Third Door – For two door vehicles

• Roof Removal – Partial and Complete
Hinge Side

- Create a purchase point
- Hinges can be popped or cut
- Work from the top hinge down when possible
- Smaller doors may allow both hinges to be popped with Spreaders between them
- Control the doors explosive movement as the hinges are popped
DOOR REMOVAL

Pin Side

- Create a purchase point
- Nader Pin can be popped or cut
- Work the door from either top or bottom depending on what you are given
- Allow gravity to aid your operation whenever possible
- Control the doors explosive movement as the pin is popped
DOOR REMOVAL
HINGES AND PINS CAN ALSO BE CUT
“B” POST BLOWOUT

- Operation should be done from Pin to Hinge, (Back to Front) Crib under B Post
- Create a Purchase Point
- Open rear door
- Create Relief Cut at bottom of B Post (as deep as able)
- Spread B post up and away (Spreaders from rocker panel to underside of bottom hinge or placed in relief cut)
- Cut top of B Post
- Hinge both doors outward
- Pop or cut front door hinges
- Remove both doors and B Post as one piece
“B” POST BLOWOUT

ONCE REAR DOOR IS POPPED OPEN ON THE PIN SIDE:

MAKE RELIEF CUT IN B POST JUST ABOVE ROCKER PANEL

SPREAD B POST UP AND AWAY FROM ROCKER PANEL TO UNDERSIDE OF BOTTOM HINGE
“B” POST BLOWOUT

CUT TOP OF B POST

HINGE BOTH DOORS AND B POST FORWARD
“B” POST BLOWOUT
CUT OR POP FRONT DOOR HINGES REMOVING ENTIRE SIDE OF CAR AS ONE PIECE ALLOWING FOR FULL ACCESS TO TRAPPED PATIENTS
DASH DISPLACEMENT
The Dashboards of New Technology Vehicles are Structured to NOT BE “DISPLACED”

DASH STRAPS
Straps the Dash to the Trans Hump & Floor Board at the Center Console

DASH TRANSVERSE BEAM
Horizontally Supports the Dash and Fire Wall to Prevent PSI
Dash Jack

- Stabilize/Crib under “A” Post if not already done
- Make relief cut in “A” Post between the hinges – CUT DEEP AND INTO FIRE WALL
- Cut out 4 inch piece of “A” Post above the dash
- Crush/Cut the front fender to weaken car structure (optional)
- If vehicle has strut towers be aware of their location and do not cut or crush them
- Place Spreaders in relief cut and Jack the dash upward
DASH JACK

ONCE CRIBBING IS UNDER THE “A” POST AND THE FRONT DOOR IS REMOVED:

MAKE A RELIEF CUT IN THE “A” POST BETWEEN THE HINGES – CUT DEEP AND INTO THE FIRE WALL

CUT OUT A FOUR INCH SECTION OF THE “A” POST – REMOVE THE WINDSHIELD ONLY IF NECESSARY
DASH JACK

CRUSH OR CUT THE FRONT FENDER TO WEAKEN STRUCTURE ONLY IF FRONT END DAMAGE HAS NOT DONE SO (OPTIONAL)

PLACE SPREADERS IN RELIEF CUT AND JACK THE DASH UP – WATCH THAT THE FIRE WALL TEARS AND/OR RIVETS POP
Dash Roll

- Stabilize/Crib under “A” and “B” Post if not already done
- Make relief cut in “A” Post between the hinges – **CUT DEEP AND INTO FIRE WALL**
- Cut out 4 inch piece of “A” Post above the dash
- Crush/Cut the front fender to weaken car structure *(optional)*
- If vehicle has strut towers be aware of their location do not cut or crush
- Anchor Ram against base of “B” post and Roll dash up and forward
  - place working end at angle of “A” Post
  - may need to use 10” extension
  - may need to anchor off “Adjustable Halligan Anchor Point” in Rocker Panel
DASH ROLL DISPLACEMENT

HALLIGAN ANCHOR POINT

Driving the Pick(Hook) of the Halligan deep into the body of the Rocker Panel where needed allows for a solid and adjustable anchor point to push off of with the Amkus Ram when the B Post has either been removed, is too far back, or has been significantly damaged and is not a usable anchor point for the Ram.
DASH ROLL DISPLACEMENT

HALLIGAN ANCHOR POINT

Make sure to crib under the Rocker Panel at the Halligan Anchor Point so that the Rocker Panel does not fatigue and blow out to the ground.
THIRD DOOR TECHNIQUE

USED ON TWO DOOR VEHICLES TO GAIN ACCESS TO TRAPPED BACKSEAT PATIENTS

- Create a Purchase Point and remove the Front Door
- Crush the “B” Post and side structure just above the Rocker Panel with the Spreaders
- Make a deep relief cut through the “B” Post just above the Rocker Panel
- Cut the “B” Post just below the Roof Rail
- Crush the vehicle’s side structure vertically just ahead of the “C” Post
- Cut a deep relief cut vertically just ahead of the “C” Post
- Start with a Vertical Lift to displace the “Third Door” downward then pinch the Spreaders vertically onto the Third Door just behind the “B” Post and flap down the cut section
ROOF REMOVAL

PARTIAL REMOVAL - FLAP
Consider partial removal only when complete removal is not possible. Make relief cuts in roof on both sides where flap is to be, secure flapped roof section.

COMPLETE REMOVAL
Removing the roof weakens the vehicle structure – may need to do it last, consider using a reciprocating saw to cut all posts.
HYBRID AND ALTERNATIVE FUEL VEHICLES
HYBRID VEHICLES

• A Hybrid vehicle blends a gasoline engine and high voltage electric motor technology together to reduce greenhouse gas emissions and increase fuel economy

• Over 2 million Hybrid vehicles on the US roads today

• The gasoline engine does not need to be running for the vehicle to be in motion
HYBRID VEHICLES

- Most manufacturers currently offer hybrid vehicles

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- Some manufacturers utilize lithium ion battery technology that extends fuel economy by allowing longer battery-only operation incorporating plug-in technology (70-90 MPG)
- Most major cities required public transportation conversion to hybrid vehicles since 2012
1. 12-Volt Auxiliary Battery
2. Underhood Fuse Box
3. High-Voltage Battery Box
4. Fuel Tank
5. High-Voltage Cables
6. Engine, Motor & Transmission
7. Fuel Lines
1. 12-Volt Auxiliary Battery
2. Hybrid Vehicle Battery Pack
3. Power Cables
4. Inverter/Converter
5. Gasoline Engine
6. Front Electric Motor
7. Electric Generator
8. A/C Compressor
9. EPS DC-DC Converter
10. Rear Electric Motor (4W-Motor Optional)
11. IGCT Fuse (red in color)
1. 12-Volt Auxiliary Battery
2. Hybrid Vehicle Battery Pack
3. Power Cables
4. Inverter
5. Gasoline Engine
6. Electric Motor
7. Electric Generator
8. IGCT Relay
• High Voltages
  – Motor, three phase
    • Max input voltage 346 volts AC, 500HZ
  – Generator, three phase
    • 610 volts AC, 400HZ
  – Propulsion Control System (PCS)
    • Ties all high voltage components together
  – Batteries, 46 each
    • 500 to 700 volts DC
POWERDOWN PROCEDURE

- Immobilize vehicle (chock wheels)
  - Silent running hazard
- Observe dash for vehicle running status
  - Ready light/illumination
- Locate and remove key
  - Smart key
    - Remove key and keep at distance greater than 16ft
    - Press power button once
- Locate and disconnect 12 volt battery
- Confirm ready light/instrument lighting is not illuminated
- Follow proper power down times in HRG manual
  - Up to 10 minutes to power down capacitors
POWERDOWN PROCEDURE

If key cannot be located or is inaccessible

- Immobilize vehicle (chock wheels)
  - Silent running hazard
- Observe dash for vehicle running status
  - Ready light/illumination
- Locate and disconnect 12 volt battery
- Pull fuses according to HRG manual
- Confirm ready light/instrument cluster lighting is not illuminated
- Follow power down times in HRG manual
  - Up to 10 minutes to power down capacitors
Power Down Procedures Overview

Power Down—to disable vehicle (HV battery pack, SRS airbags, & gasoline fuel pump):

Procedure #1
- Confirm status of READY indicator in instrument cluster.
- If READY indicator is illuminated, the vehicle is on and operational. Shut off the vehicle by pushing the power button once.
- Locate and remove the electronic key and keep it 16 feet away from vehicle.
- Disconnect the 12 Volt auxiliary battery located in rear cargo area (1)

Procedure #2 (If the electronic key cannot be located or the power button is not accessible)
- Disconnect the 12 Volt auxiliary battery located in rear cargo area (1)
- Remove the 20 amp HEV fuse (yellow) in engine compartment (9)
- When in doubt, pull all of the fuses in the fuse block.
- Confirm READY light is not illuminated in instrument cluster.

WARNING:
- Never assume the Prius is shut off simply because it is silent.
- Always observe the instrument cluster for the READY indicator status to verify the vehicle is on or shut off.
- After disabling the vehicle, power is maintained for 5 minutes in the high voltage electrical system and 90 seconds in the SRS system.
- If either of the disabling steps above cannot be performed, proceed with caution as there is no assurance that the high voltage electrical system, SRS, or fuel pump are disabled.
- Never touch, cut, or open any orange high voltage power cable or high voltage component.

Example from HRG Prius ‘04-’08
Do not cut any portion of any high-voltage orange wiring harness
Approach and extinguish a fire using proper vehicle fire fighting practices as per NFPA, IFSTA, or the National Fire Academy.

- **Extinguishing Agent**
  Water has been proven to be an acceptable extinguishing agent.

- **Initial Fire Attack**
  Perform a fast aggressive fire attack.
  Divert the runoff from entering the watershed areas.

- **Fire in the HV battery Pack**
  Should a fire occur in the NiMH HV battery pack, the incident commander will have to decide whether to pursue an offensive or defensive attack. When allowed to burn themselves out, the HV battery modules will burn rapidly and can quickly be reduced to ashes other than the metal alloy ell plates.

- **Offensive Fire Attack**
  Flooding the HV battery pack, located in the cargo area, with copious amounts of water at a safe distance will effectively control the HV battery pack fire by cooling the adjacent NIMH battery modules to a point below their ignition temperature. The remaining modules on fire, if not extinguished by the water, will burn themselves out.

- **Defensive Fire Attack**
  If the decision has been made to fight the fire using a defensive attack, the fire attack crew should pull back a safe distance and allow the NiMH battery modules to burn themselves out. During this defensive operation, fire crews may utilize a water stream or fog pattern to protect exposures or to control the path of smoke.
HYBRID SUBMERSION PROCEDURE

Handle vehicle that is submerged either partially or fully by disabling the HV battery pack, SRS airbags, and fuel pump.

- Remove vehicle from the water.
- Drain water from the vehicle if possible.
- Follow power down procedures as detailed for individual vehicles.
- When the high voltage battery is under water, it will fizzle and short internally.
- The high voltage battery will be discharged when the fizzing or bubbling has completely stopped.
- Hydrogen/oxygen will be produced in sealed passenger compartment (vent appropriately).

Low risk of high voltage electrocution
HYBRID MYTHS

• Electricity will follow the water stream when putting out a hybrid fire
• The high voltage battery will explode if on fire
• The high voltage battery pack can leak acid if the battery cells are ruptured
• You can be shocked if you touch the body of a hybrid if it’s been in an accident
• If submerged, a hybrid can shock you if you’re in the water with the vehicle
• You cannot cut, move, or touch orange high voltage wires
ALTERNATIVE FUEL VEHICLES

• Hydrogen fuel cell
  – Multiple manufacturers currently in prototype and early production
  – Infrastructure being developed at this time for national production
  – Commercialization approx. 2015

• Liquid Natural Gas (LNG)
  – Cargo trucks

• Compressed Natural Gas (CNG)
  – Light fleet vehicles

• Liquid Propane Gas (LPG)

• Full Electric

• Biodiesel

• Flex-fuel (E85)
Considerations for these vehicles include:

- Compressed/liquefied flammable gases
- Water miscible flammable liquids
- High voltage batteries/DC and AC current
- Liquified/gaseous hydrogen
- Potential haz mat
- A ruptured Lithium Ion battery is highly toxic. Treat as haz-mat.
- Vehicles moving on their own
CNG FUELED VEHICLE
When these vehicles are on fire. You and your crew are really at risk!
How do we safely fight vehicle fires involving AFVs and EVs?

- Do not park apparatus in front or aft of the vehicle
- Do not attack fire from front or aft of vehicle
- Fight vehicle fire defensively from the side only
- Do not get in smoke
- Spot apparatus to side of vehicle fire
- Provide distance from the vehicle fire. The further the better!
- Utilize full PPE with SCBA
- Contain run-off (haz mat)