VEHICLE EXTRICATION

Rio Hondo Regional Truck Operations Academy

COURSE OBJECTIVES

- Review of basic operations and terminology
- Review Airbags, SRS, Battery locations and 5-10-20 Rule
- Review Hybrid and AFV
- Review Stabilization
- Review Extrication techniques
- Station A Equipment Review
- Questions

BASIC OPERATIONS

- Scene Size Up
- Vehicle Assessment “Reading the Wreck”
- Patient Assessment
- Stabilization
- Scan for Airbags/SRS “Peel and Peek”
- Gain Access to Patient “5-10-20 Rule”
- Extrication Techniques
- Patient Removal

SIZE UP

- Scene Safety and assessment
- Victim assessment
- Vehicle assessment “Reading the Wreck”
- Extrication assessment
- 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

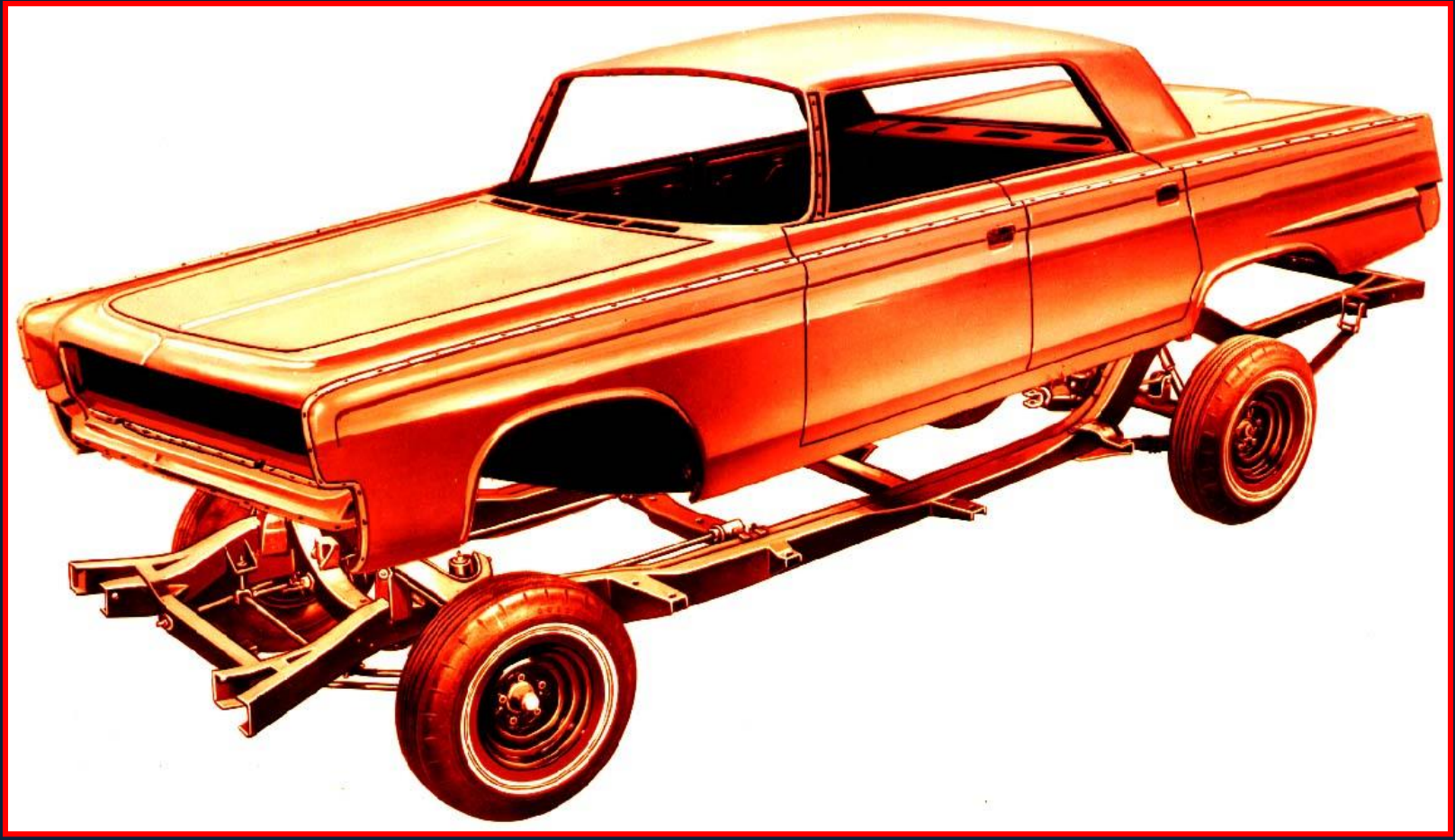
VEHICLE ASSESSMENT

- “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

READING THE WRECK

FULL FRAME CONSTRUCTION

Designed to Deflect Energy



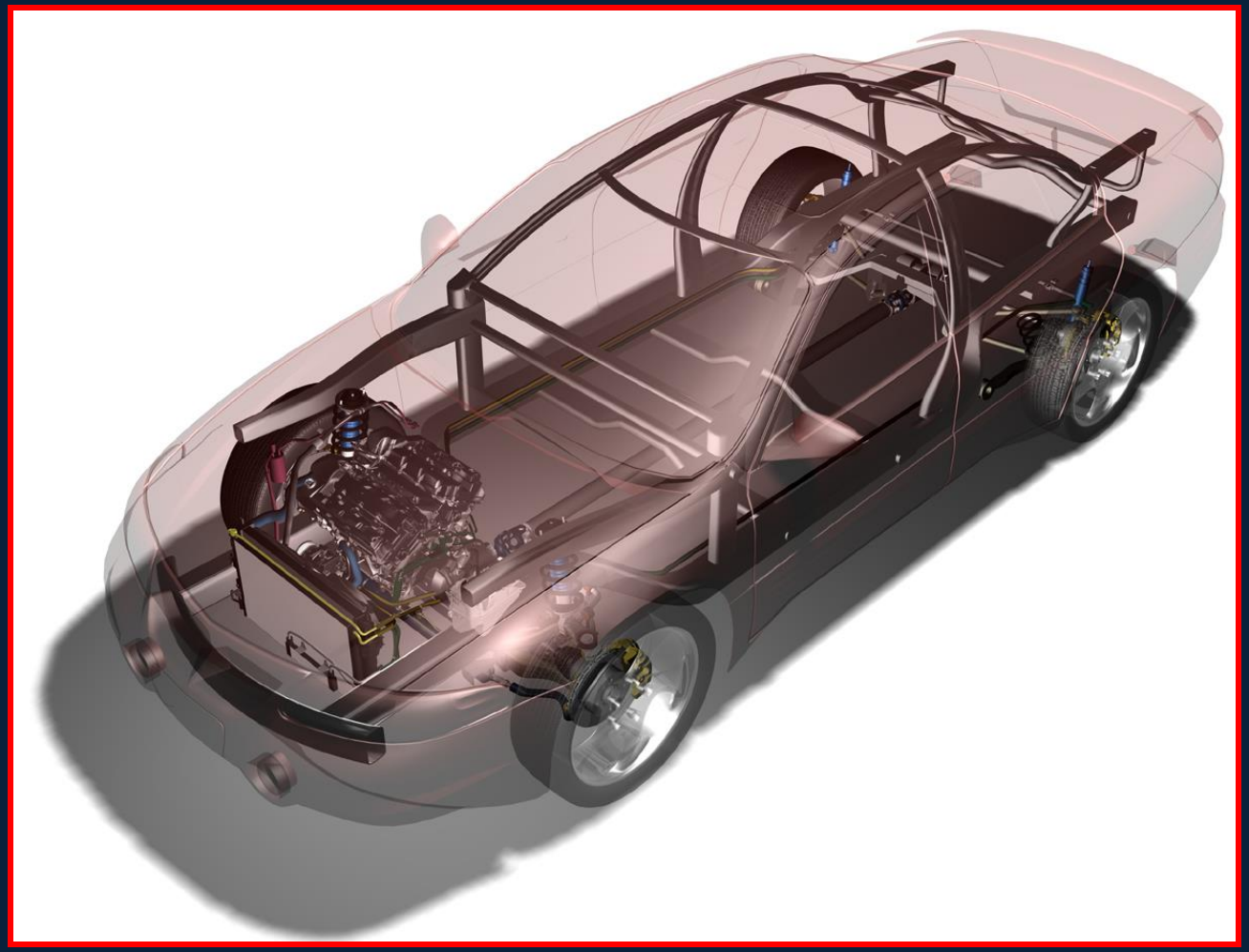
UNIBODY CONSTUCTION

Designed to Absorb/Transfer Energy

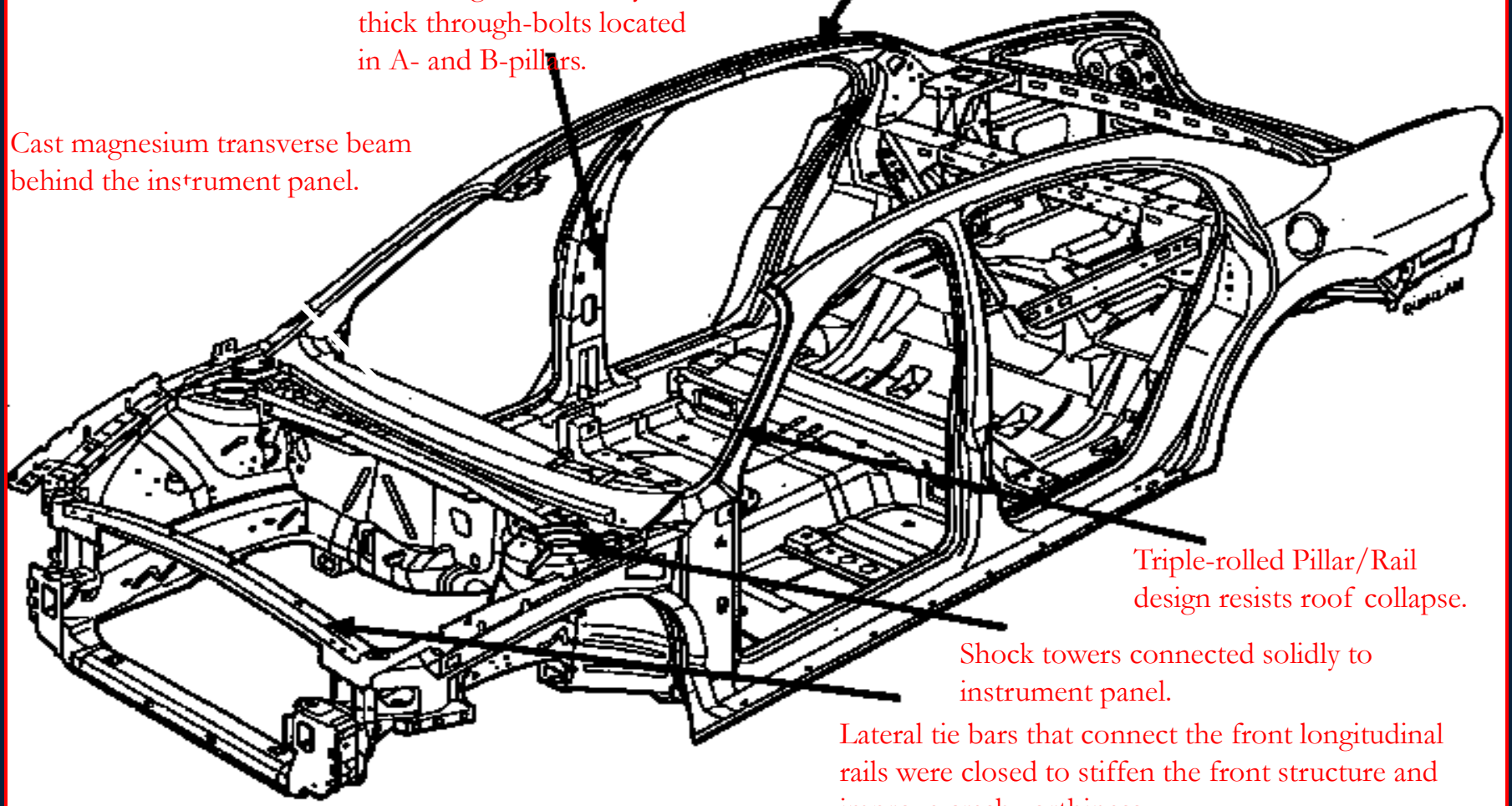
SPACE FRAME CONSTRUCTION

Designed to Absorb/Transfer Energy

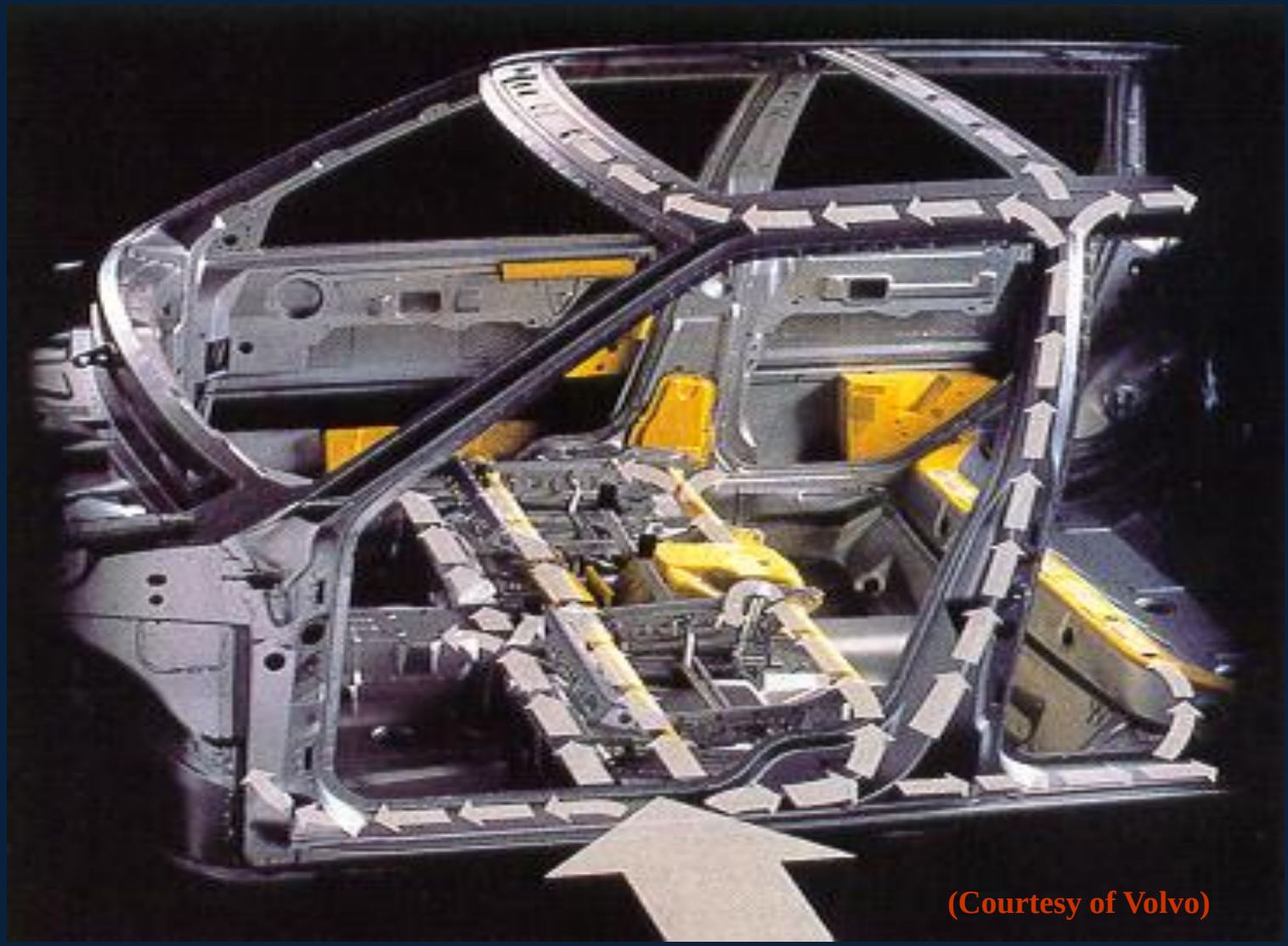
High Strength Steel



VEHICLE ANATOMY



STRUCTURAL COMPONENTS



BORON B-POST

In celebration of the
Insurance Institute for Highway Safety's
50th anniversary, a 1959 Chevrolet
Bel Air was crashed into a 2009
Chevrolet Malibu.

VEHICLE GLASS

- Laminated: Windshield
  - Two pieces of glass, one thin piece of plastic
  - Some Vehicles have laminated glass all around
- Tempered: Sides and back
  - Shatters with center punch
- EPG: Enhanced Protective Glass

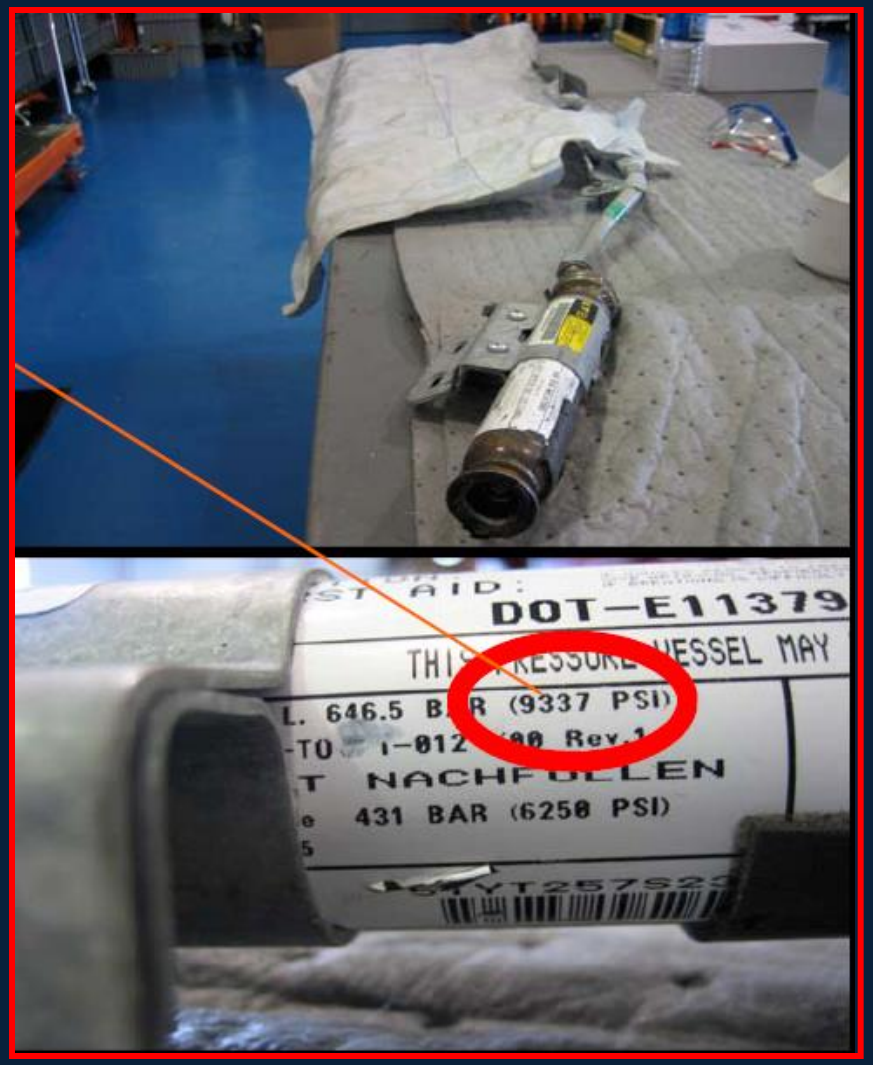
LAMINATED GLASS

PEEL AND PEEK

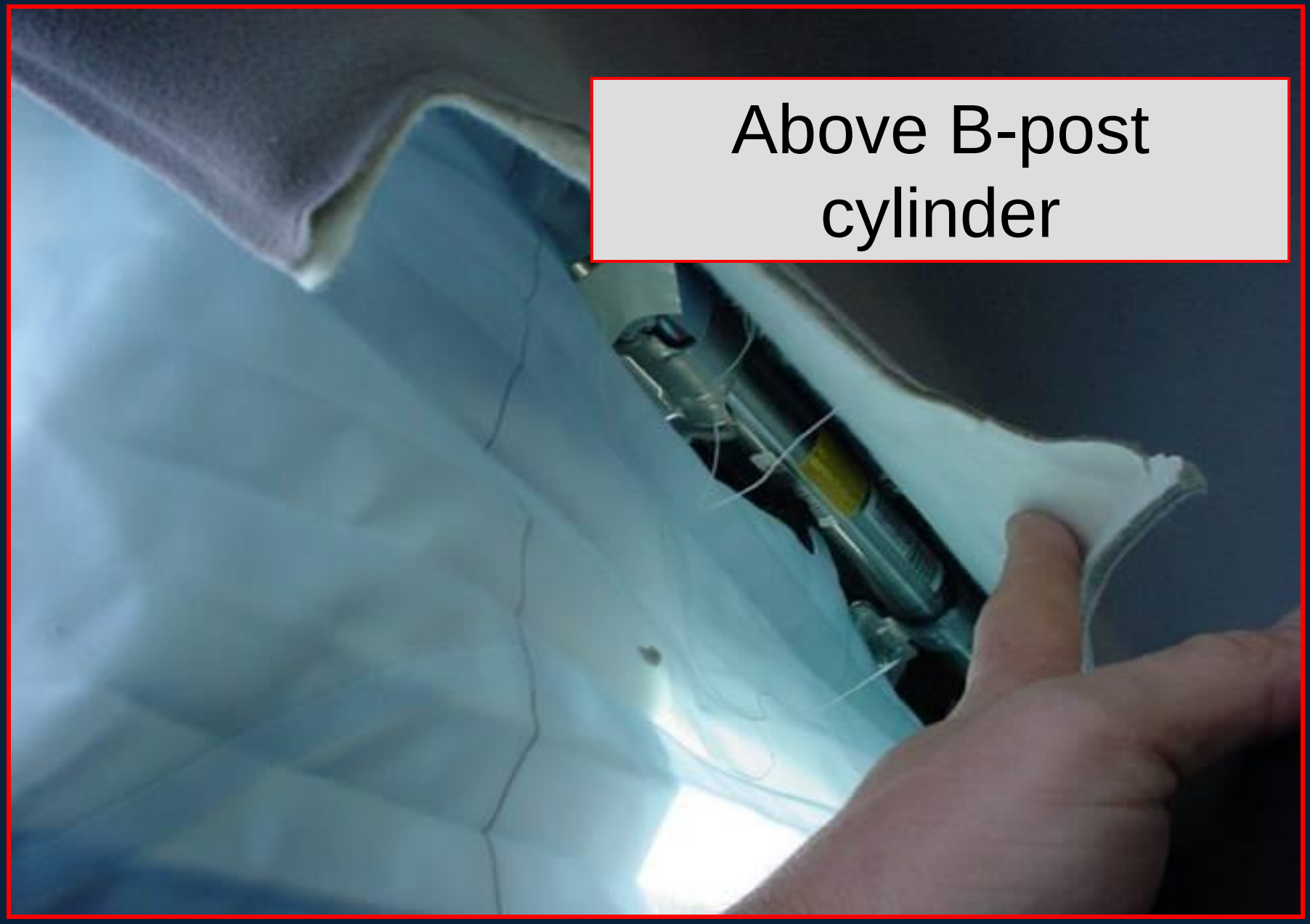
- Pulling the plastic or trim on:
  - A, B, C, Pillars etc….
  - Roof rail
  - Opposite side of Patients/Intrusion if possible
  - If it is true on one side it is true on the other….
- Expose Compressed gas cylinders/Pretensioners and cut around them
- Tools for Peel and Peek:
  - Brake Spring tool, flat bar, screwdriver, Tug tool hands, etc.

COMPRESSED GAS CYLINDERS

- High Pressure Cylinder
- Average 4000 psi
- Up to 9400 psi
- Argon / Helium
- Argon / Nitrous Oxide

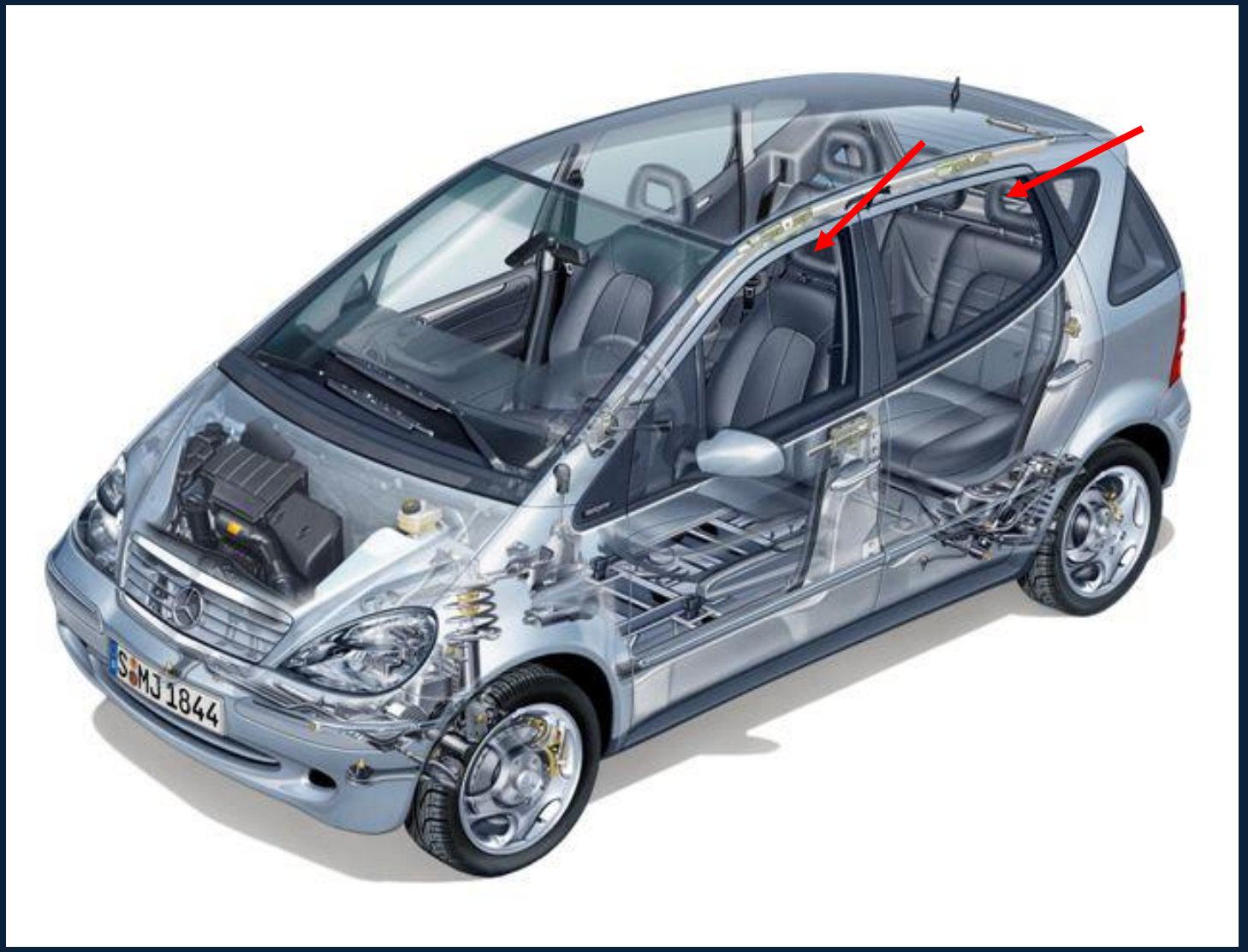



A-post cylinder


Above B-post
cylinder


C-post cylinder

MULTIPLE CYLINDERS

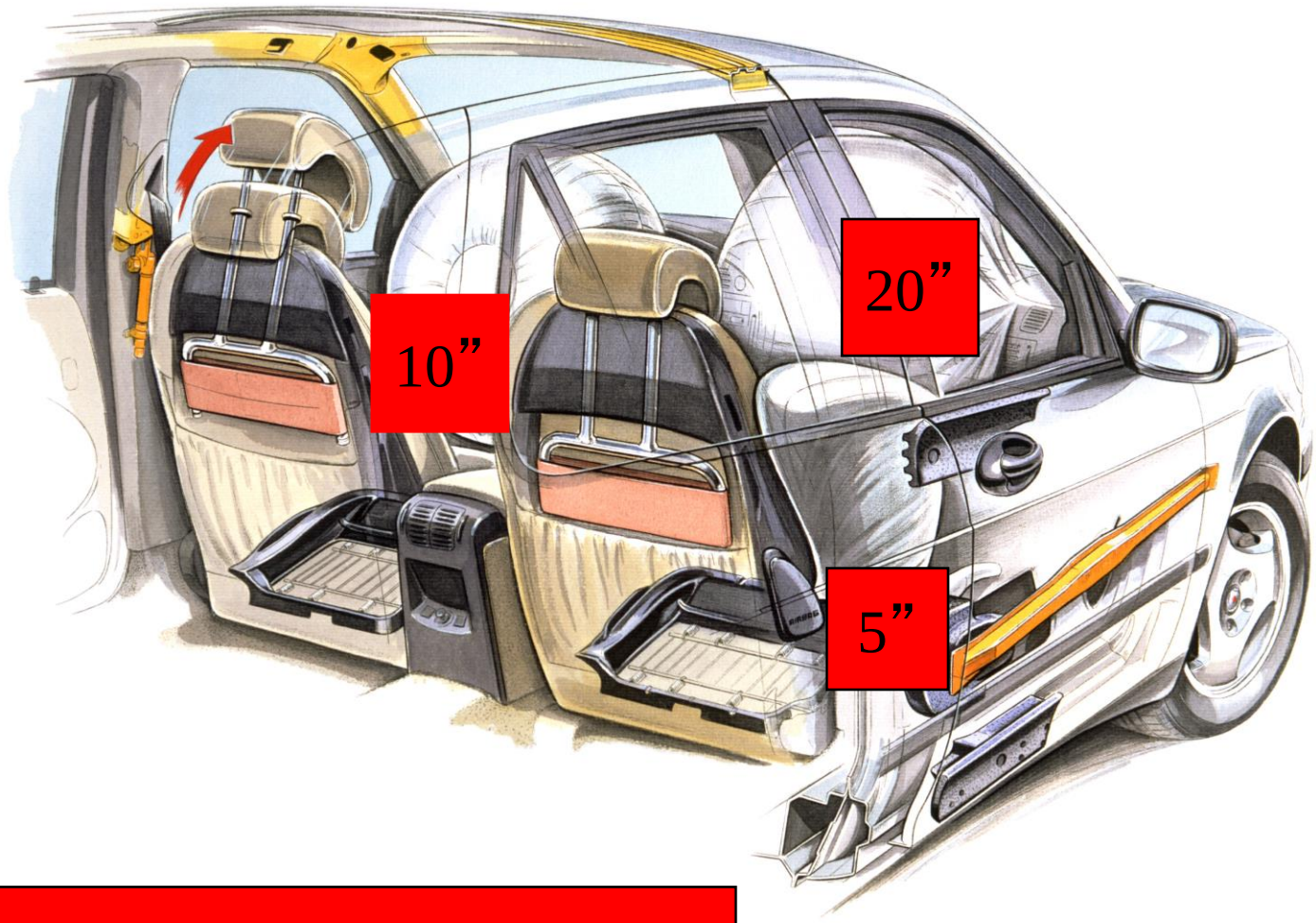


AIRBAGS

- Steering Wheel
- Dash
- Seats
- Doors
- Knee
- A, B, C Posts
- Roof
  - Side rails or rear windows

AIRBAGS

- Side Impact Curtains
- Head and Torso Airbag
- Hood /Windshield Bag
- Exterior Airbags
- Smart Airbags
- Gentle Airbags
  - Airbag using computer technology will deploy with less force



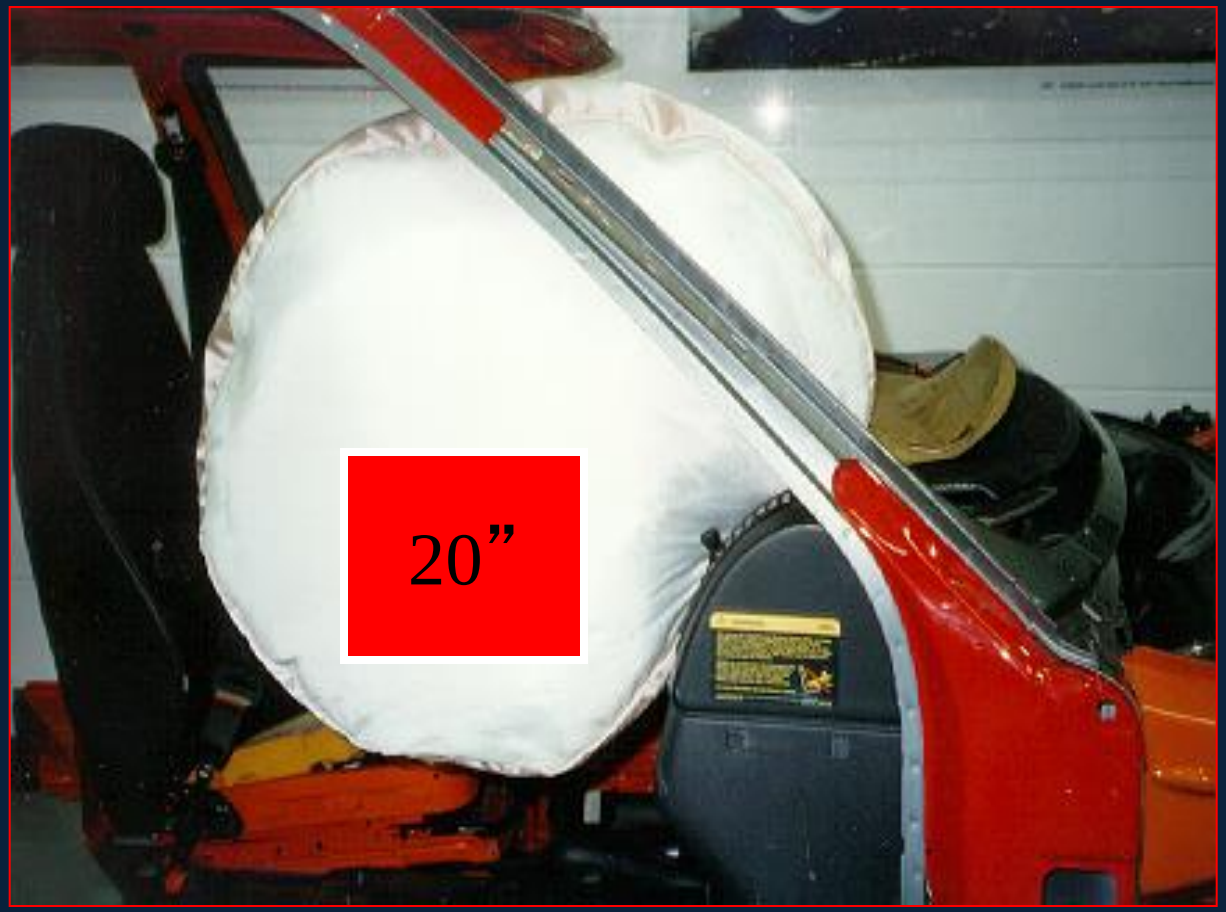
5-10-20 Rule

Airbag Deployment Zones

5” RULE

10” RULE

20” RULE



AIRBAGS

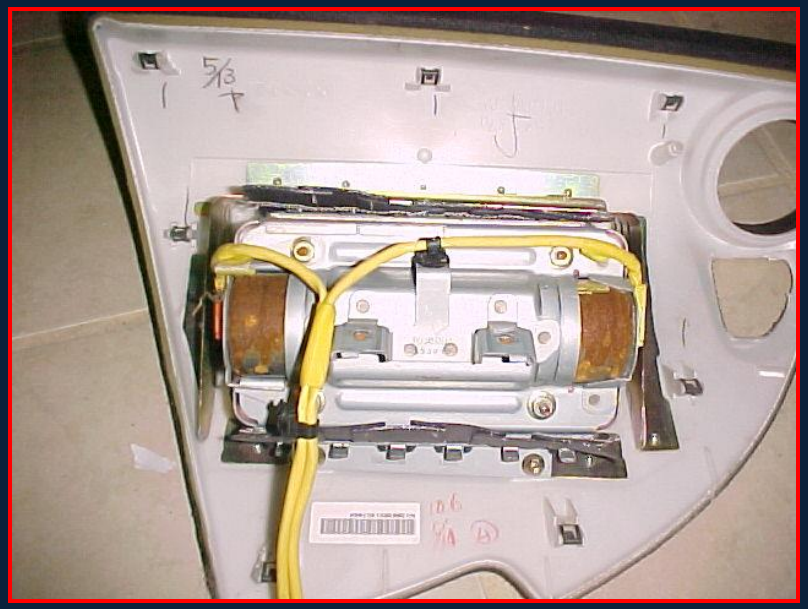
- Chemicals
  - Sodium azide and an Oxidizer (nitrogen gas)
  - Argon and Helium or Argon and Nitrous Oxide
- Powders
  - Talcum powder or corn starch for lubrication
- Heat
  - Inert gases can reach 2,100 degrees

AIRBAGS

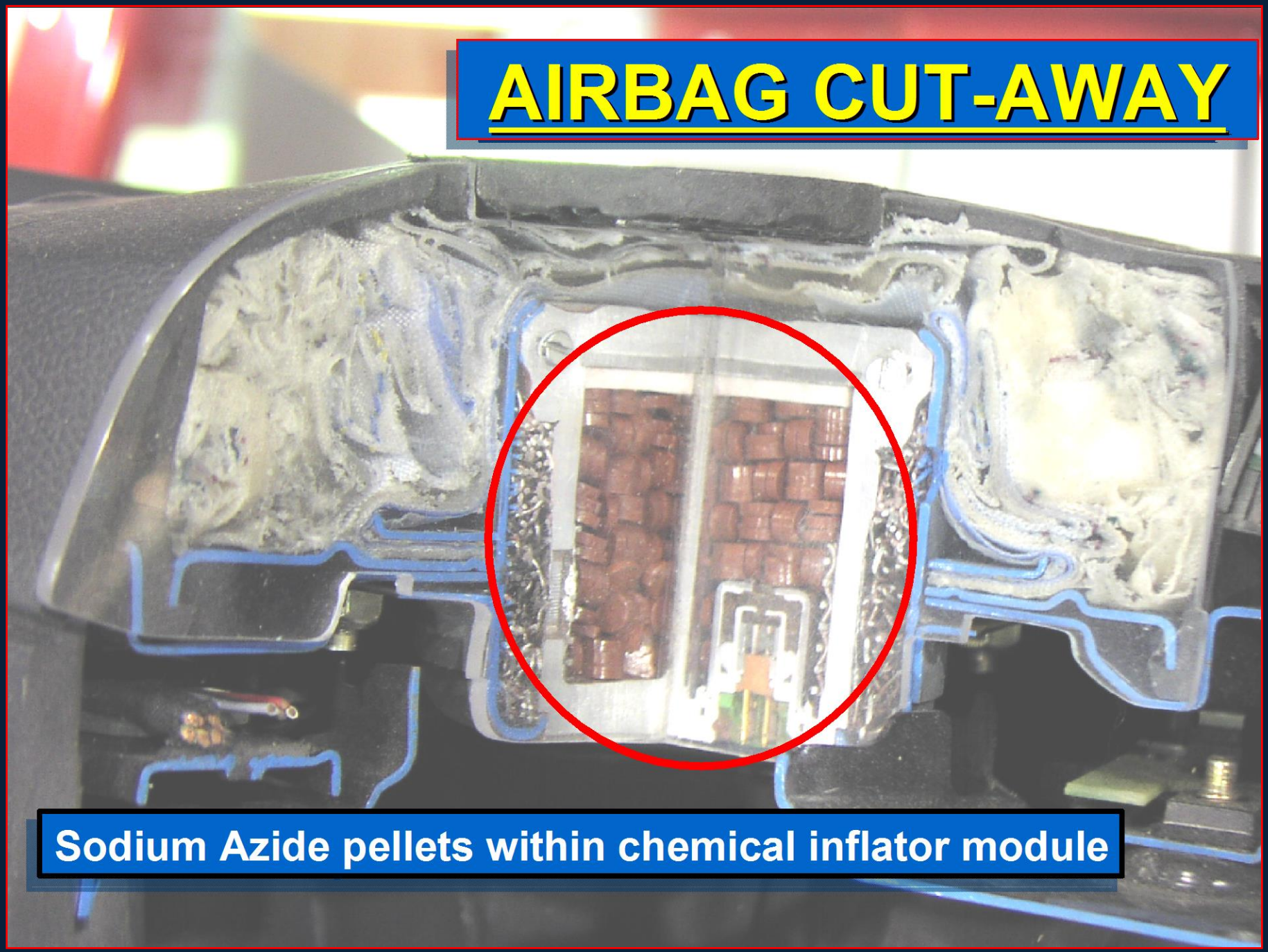
- Capacitors
  - Designed to assist with airbag discharge
  - They can hold a charge indefinitely
  - Accessories with batteries
- Observe The 5-10-20 Rule
  - Side impact: 5", Steering Wheel: 10", Dash: 20"

AIRBAGS

- Double-deployment or Dual-Action Airbags
- Smart Airbags & Advanced Airbag Systems
- Federal Motor Safety Standard 208
  - 100% of cars equipped with Smart Airbags by 2007



AIRBAG CUT-AWAY



Sodium Azide pellets within chemical inflator module

BRAIN SENSOR CPU COMPONENTS


CAUTION
ATTENTION
VORSICHT
MB921541
FORWARD
DEVANT
VORNE

SMART AIRBAGS

(Courtesy of Audi)

SMART AIRBAGS

SMART AIRBAGS

Adaptive Airbags

1. Ultra Sonic Sensor
2. Buckle Sensor
3. Weight Sensor

SEAT SENSOR ACTIVATION

- 65 pounds for General Motors & European vehicles
- 80 pounds for Toyota and most Asian vehicles
- Can be adjusted at Dealer

AIRBAGS SWITCHES

- Key Selector Switch
- On/Off
- Key Selector Switch
- Off/Auto
- Weight Sensor ID

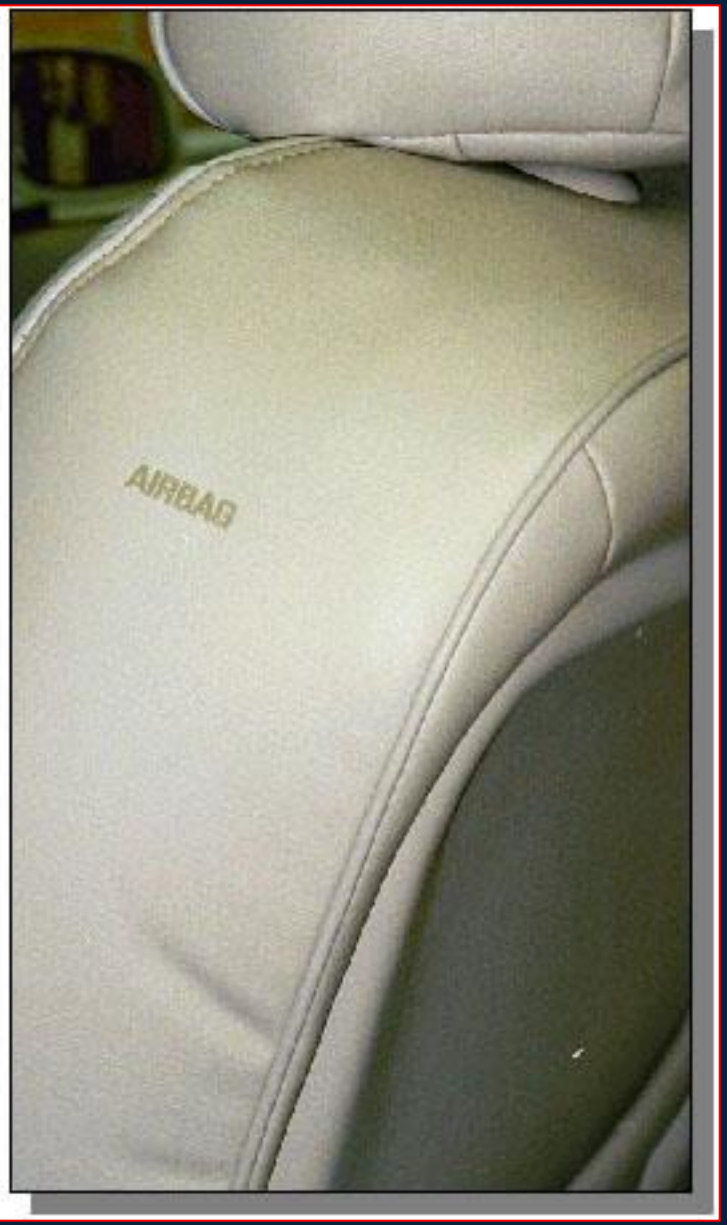
AIRBAG MARKINGS


AIRBAG

AIRBAG MARKINGS????

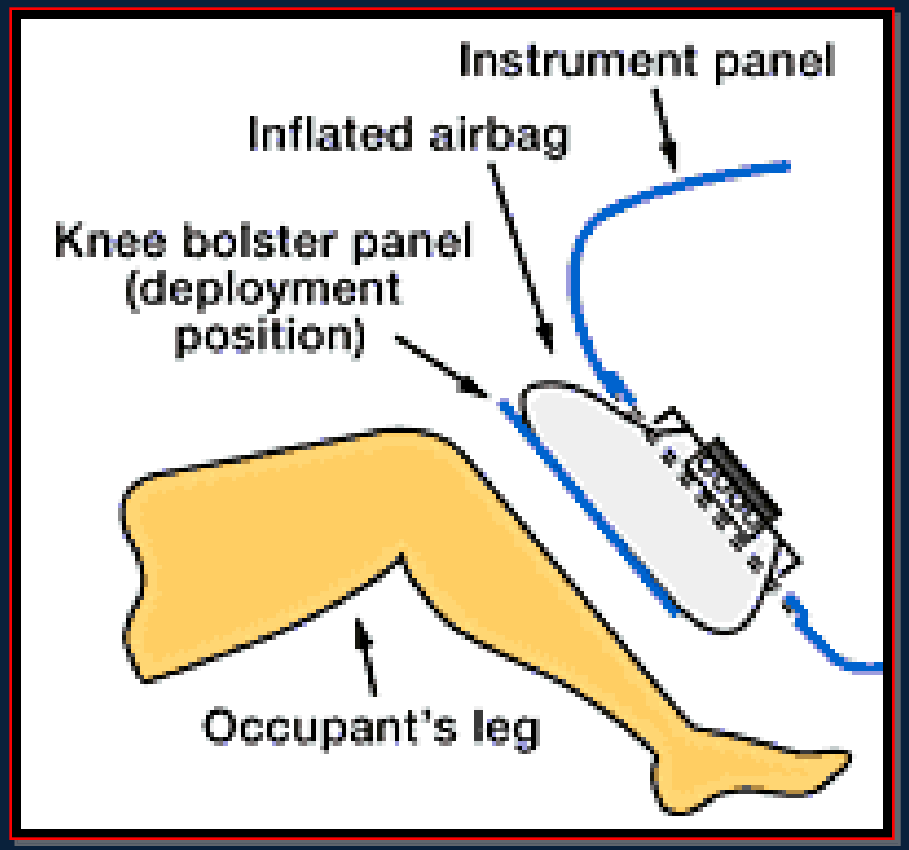

AIRBAG


SIPS BAG


AIRBAG

CONTRASTING COLORS

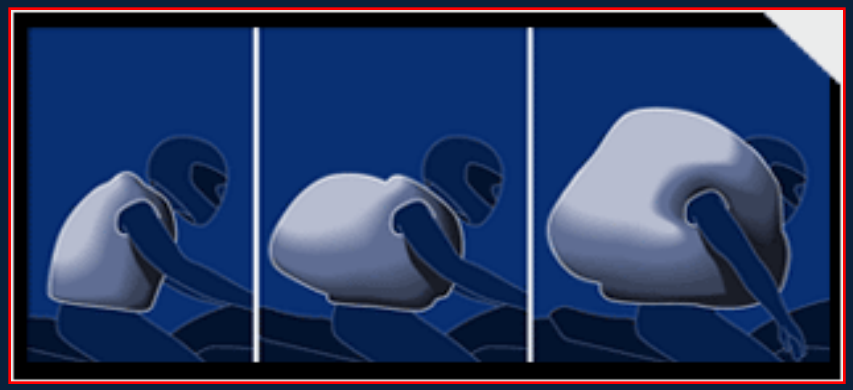
KNEE BOLSTER AIRBAG




HOLD

7 SERIES BMW KNEE BAG

MORE AIRBAGS



MORE AIRBAGS

Proposed, contd.

- ITTR (Inflatable Tubular Torso Restraint)

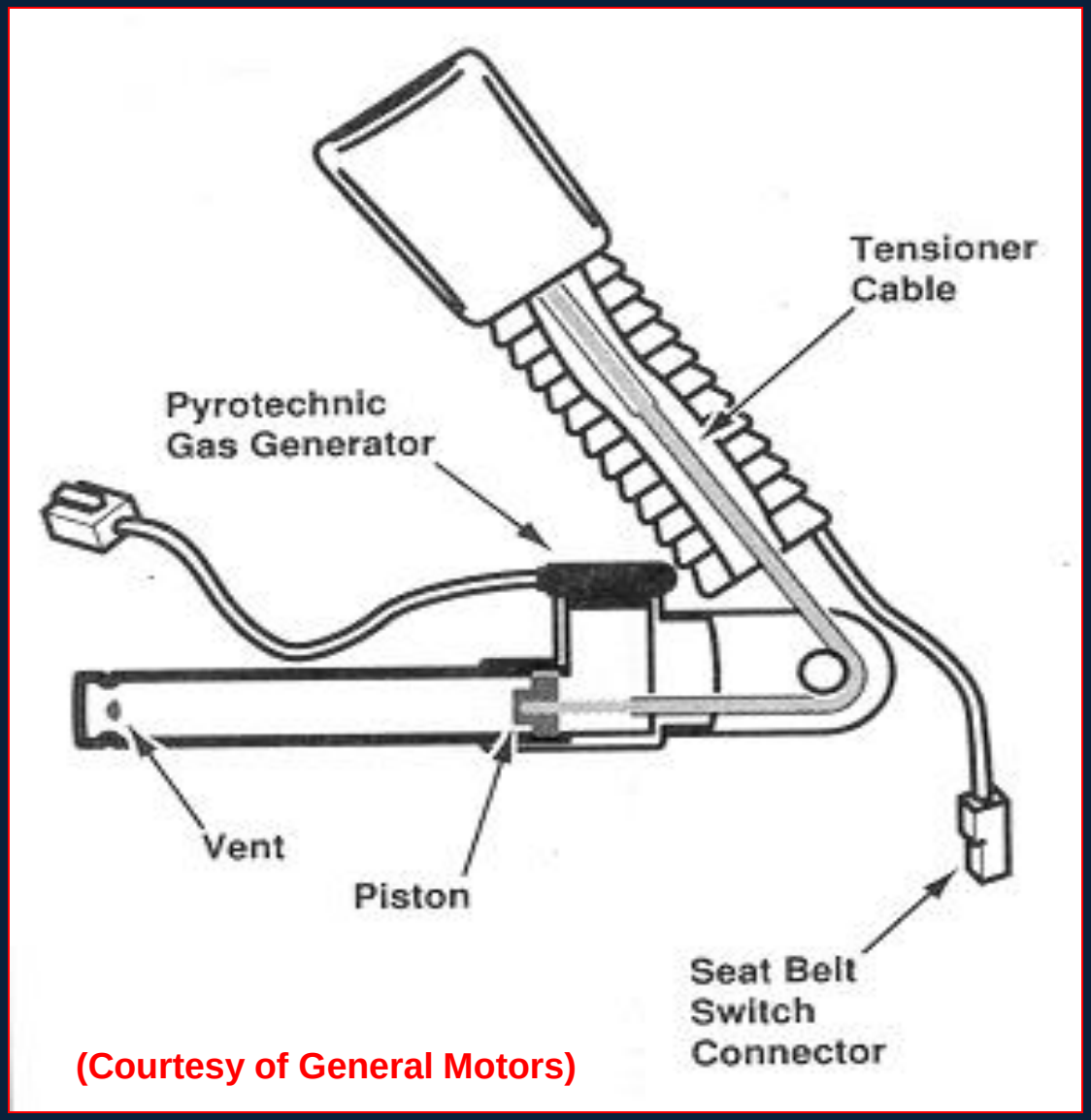
- Rear Seats Only

REAR SEAT AIRBAG

SEATBELT PRETENSIONER

- 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, C, D pillars

SEATBELT PRETENSIONER

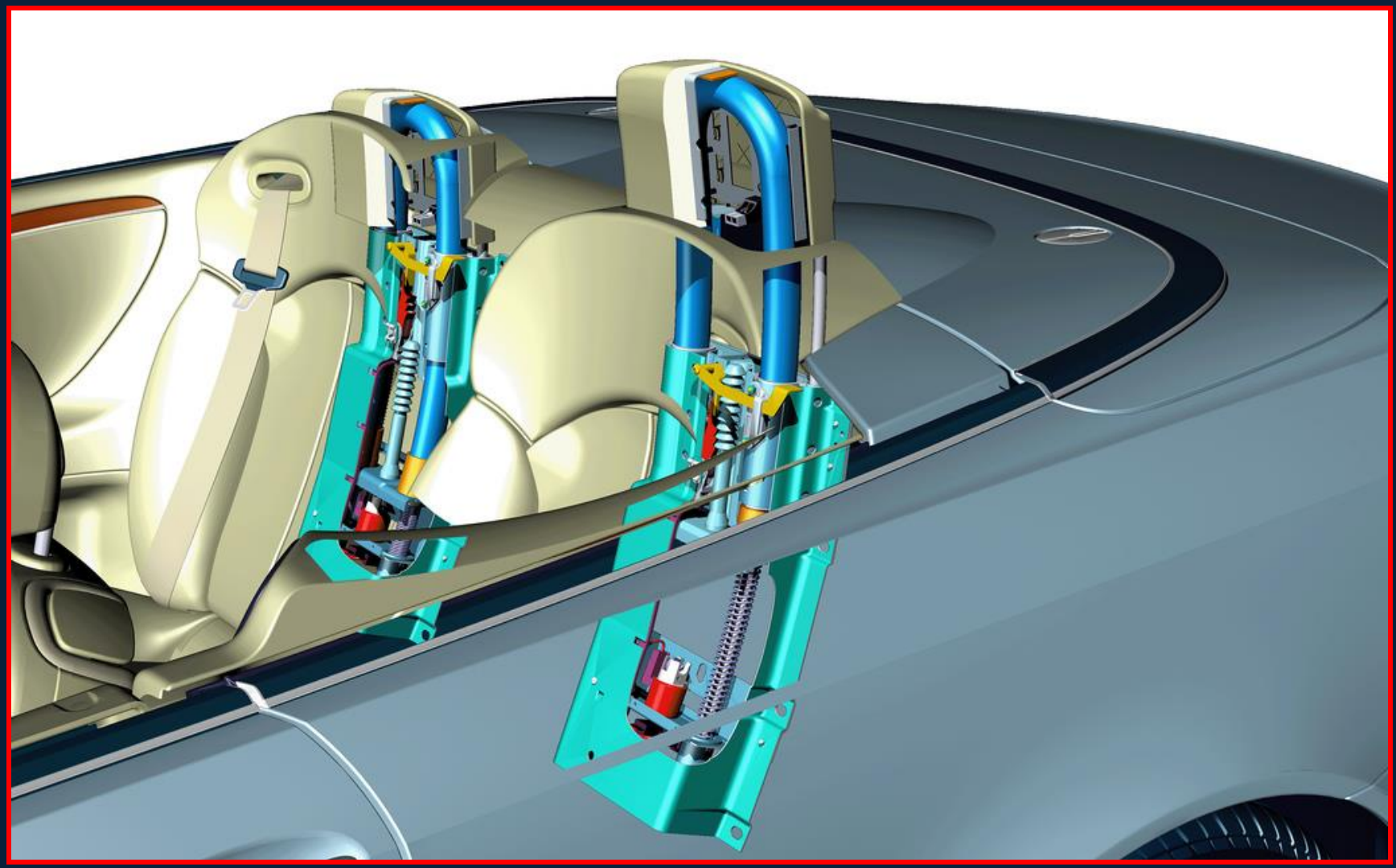


(Courtesy of General Motors)

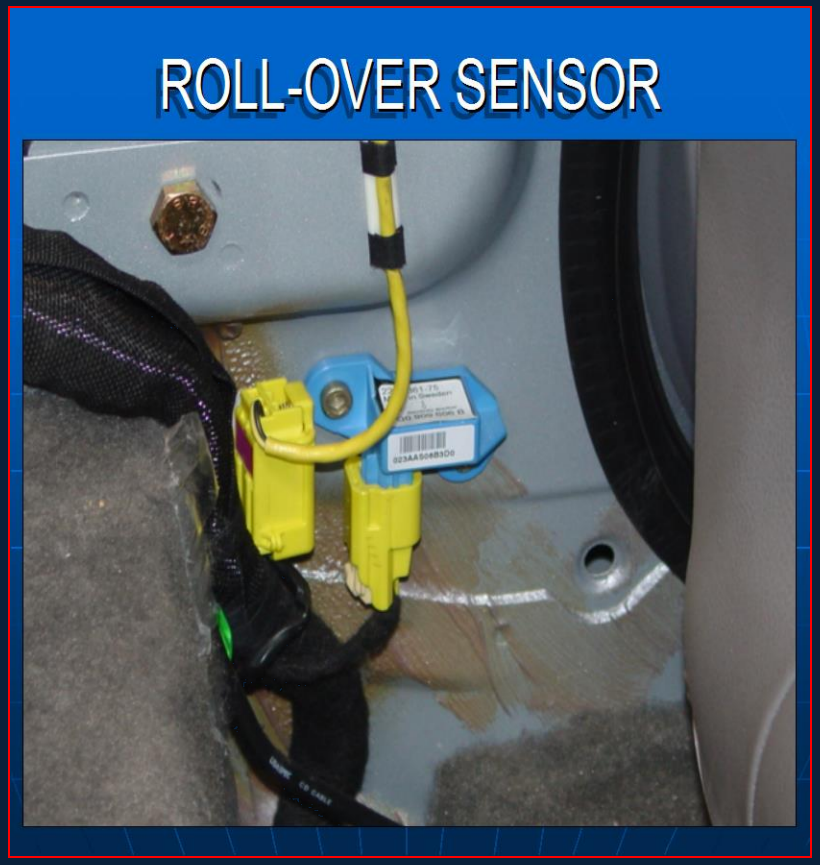
SEATBELT PRETENSIONER

ROLLOVER PROTECTION

(Courtesy of Mercedes-Benz)



ROLLOVER PROTECTION SENSOR



- Located on lower portion of B-post
- Activate at 51 degrees

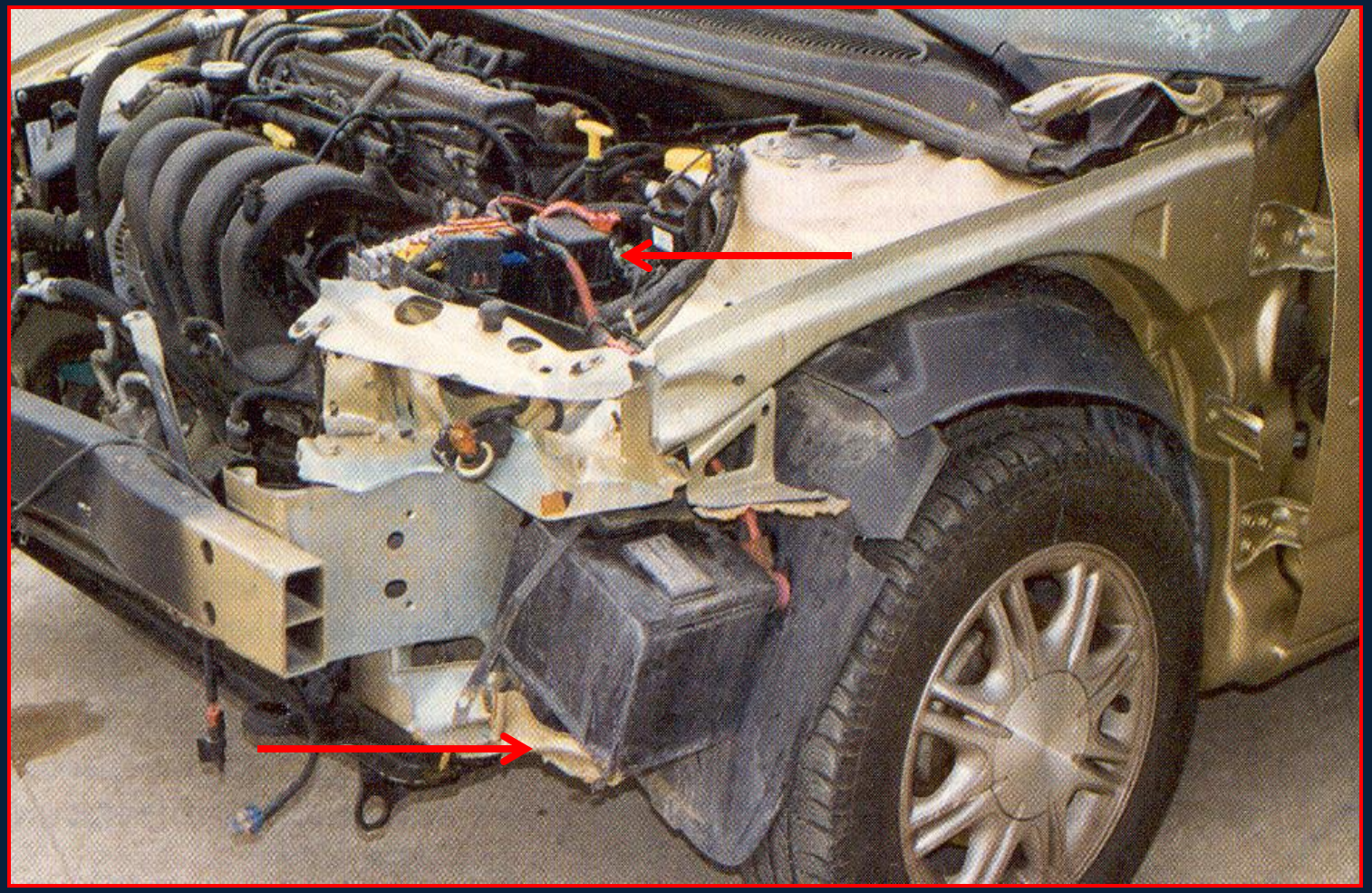
- Note if vehicle is on incline upon arrival
- Moving B-post while spreading doors

ROLL OVER PROTECTION

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

DANGER/POISON
VARTA

TRUNKS

GAS SHOCK BUMPERS AND LIFT CYLINDERS

- Approach vehicle from the side
- Struts and shocks now angled 45 degrees in front and rear bumpers
- Various configurations in hatch-backs, trunks and hoods

BUMPER SHOCK FAILURE

LIFT STRUT FAILURE


1
2
MERCO

OTHER HAZARDS

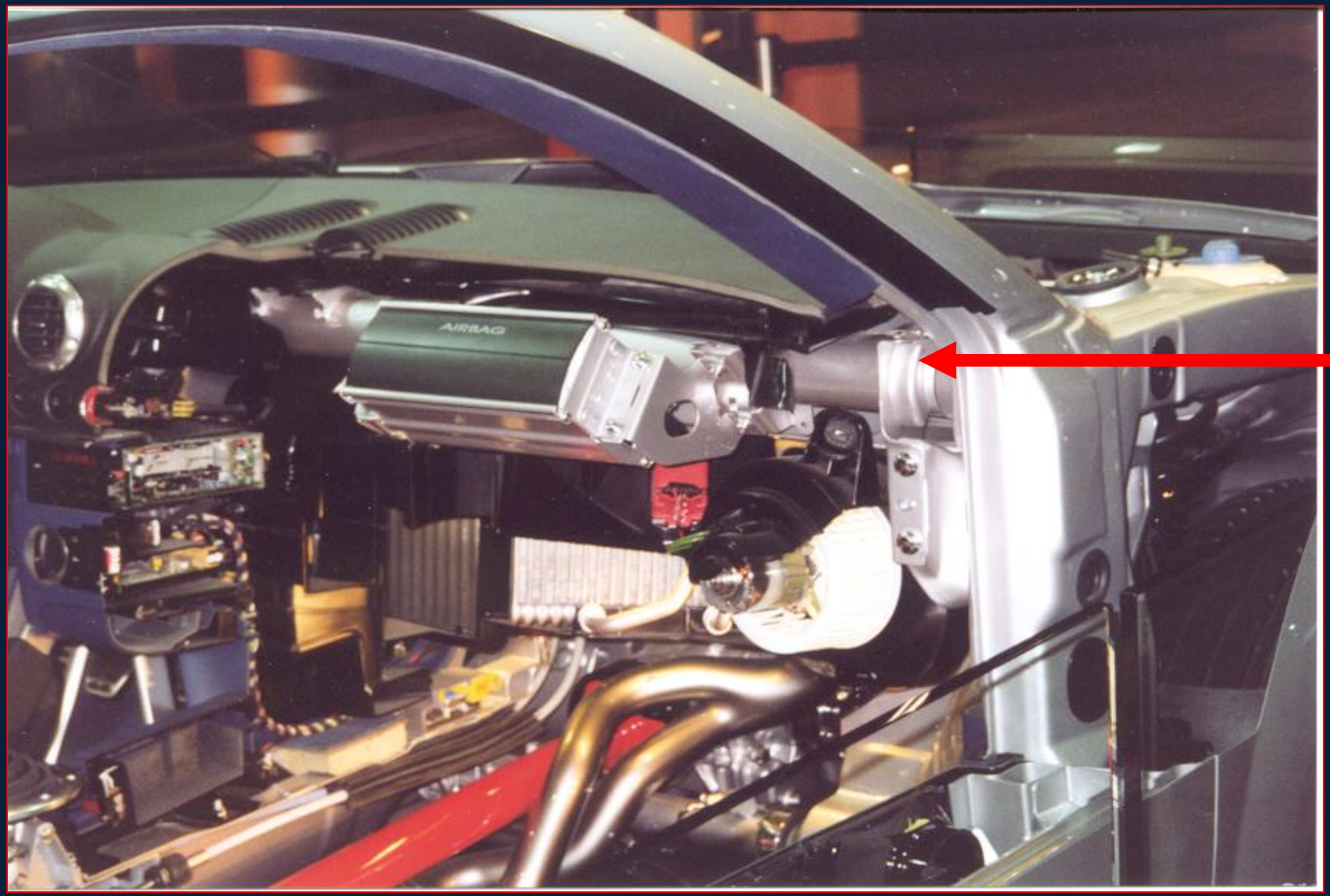
- Electrically adjustable accelerator and brake pedals
  - 2000 Ford, Lincoln, Mercury and 2001 Chevrolet

    SUV vehicles for short-stature or large-girthed

    drivers to properly adjust seat-positioning for

    airbag deployment
- Electrically controlled seats with memory settings

TRANSVERSE MAGNESIUM DASH BAR



ALTERNATIVE FUEL VEHICLES

- Gas/Electric Hybrids including Plug-in Hybrids
- Compressed Natural Gas (CNG)
- Liquefied Petroleum Gas (LPG)
- Ethanol Based Fuel (E85)
- Propane
- Hydrogen/Electric Fuel Cell
- Diesel/Electric Hybrids
- Combination of many types
- Electric Vehicles

HYBRID VEHICLES

- Define Hybrid Vehicle and Systems
- Power down procedures
- Fire & Submersion procedures
- Hybrid Myths
- Alternative Fuels
- Hands on training

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 1.7 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

HEV Operation

- Electric key or power button shuts down vehicle
- Standard parking brake
- Identify vehicle idiosyncrasies in owners manual

HYBRID VEHICLES

- High Voltage
  - DC (Direct Current)
    - High voltage battery pack/NiMH
      - Up to 300 volts
    - Inverter/Converter
      - Up to 650 volts
    - High voltage orange wires
      - Up to 300 volts
  - AC (Alternating Current)
    - 3 phase traction motor/2 motors found on AWD systems
      - Up to 650 volts
    - Inverter/Converter
      - Up to 650 volts
  - Air Conditioning Pump
    - Up to 300 volts

HYBRID VEHICLES

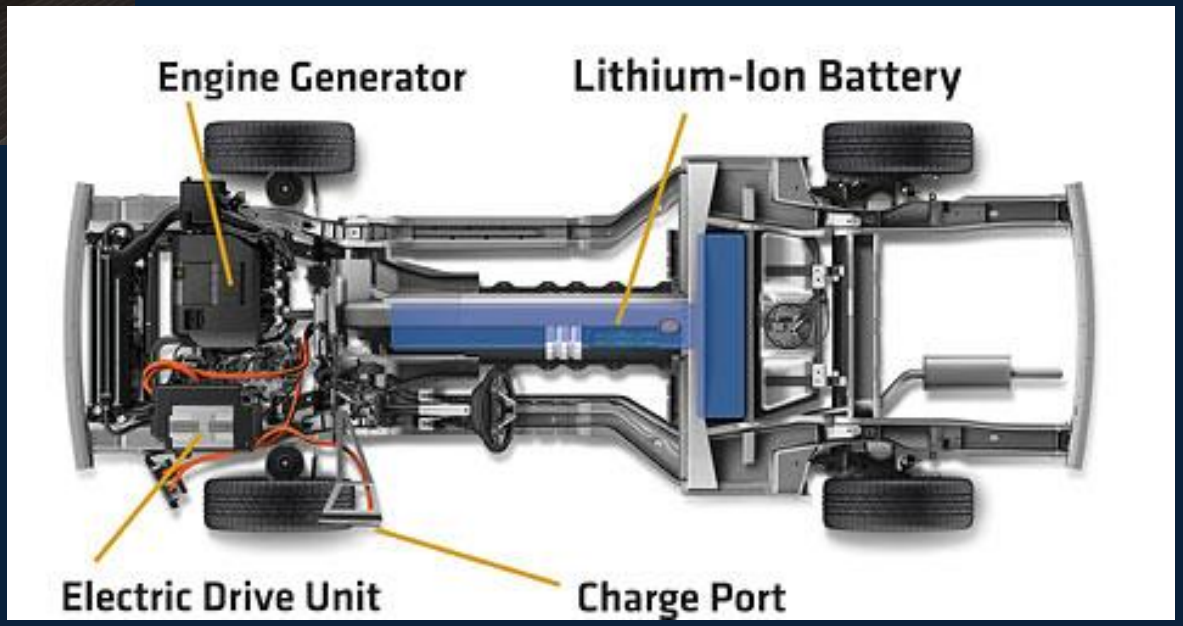
- Mid
  - -Power Steering
    - Up to 60 volts DC (dull yellow wiring on Toyota Highlander and Lexus LS600hL)
- Low
  - -All hybrid vehicles contain a 12 volt auxiliary battery that power all accessory systems
  - -Electric / Hydraulic Brake System
    - 12 volts (capacitor back-up)
- 0 to 60 volts (low injury hazard)
- Above 60 volts (high injury hazard)
  - -All wires containing above 60 volts are orange.

HYBRID VEHICLES

Lithium Ion Battery Configuration

Chevy Volt

- New Generation Hybrid Electric
- ICE generates electricity to recharge battery pack, vehicle operated in all electric mode



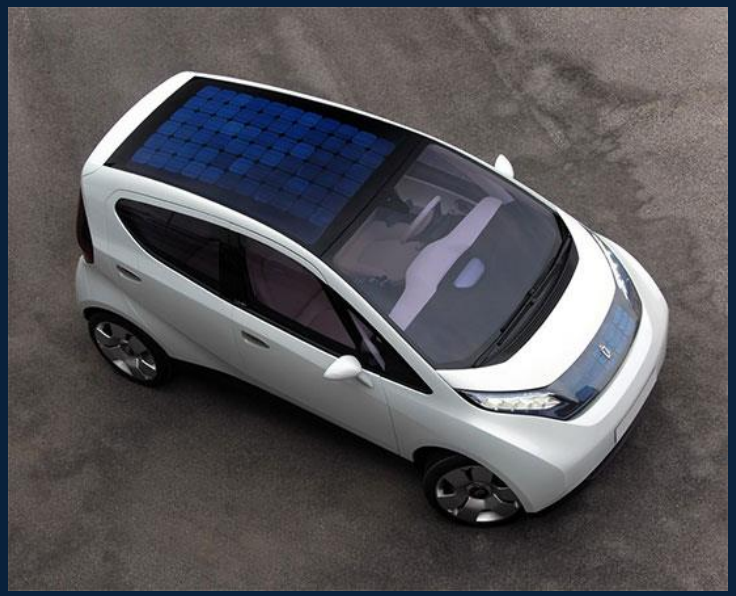
HYBRID VEHICLES

Plug-In HEV's

Currently HEV's recharge while the vehicle is operating eliminating the need for an external charge

- An additional battery pack and charging port turns an HEV into a PHEV
- PHEV's extend the mileage and range of the vehicle

HYBRID VEHICLES



SOLAR HEV

- Currently an after market application for Prius and soon other HEV's
- Will add 20 to 30 miles in range
- Toyota is adding photovoltaic panels (PV) to power A/C systems
- Pinifarina includes solar in their roll-out
- Only generates electricity when the sun is shinning!

HYBRID VEHICLES SHUT DOWN

- Identify Vehicle as Hybrid or AFV
- Stabilize Vehicle – Chock tires both sides
- Place gear shift into PARK before removing key
- Set Parking Brake
- Turn off and remove key if possible
- Check “Ready Light” or “Auto Stop” light is OFF
- Disconnect 12 volt DC battery

HYBRID VEHICLES SHUT DOWN

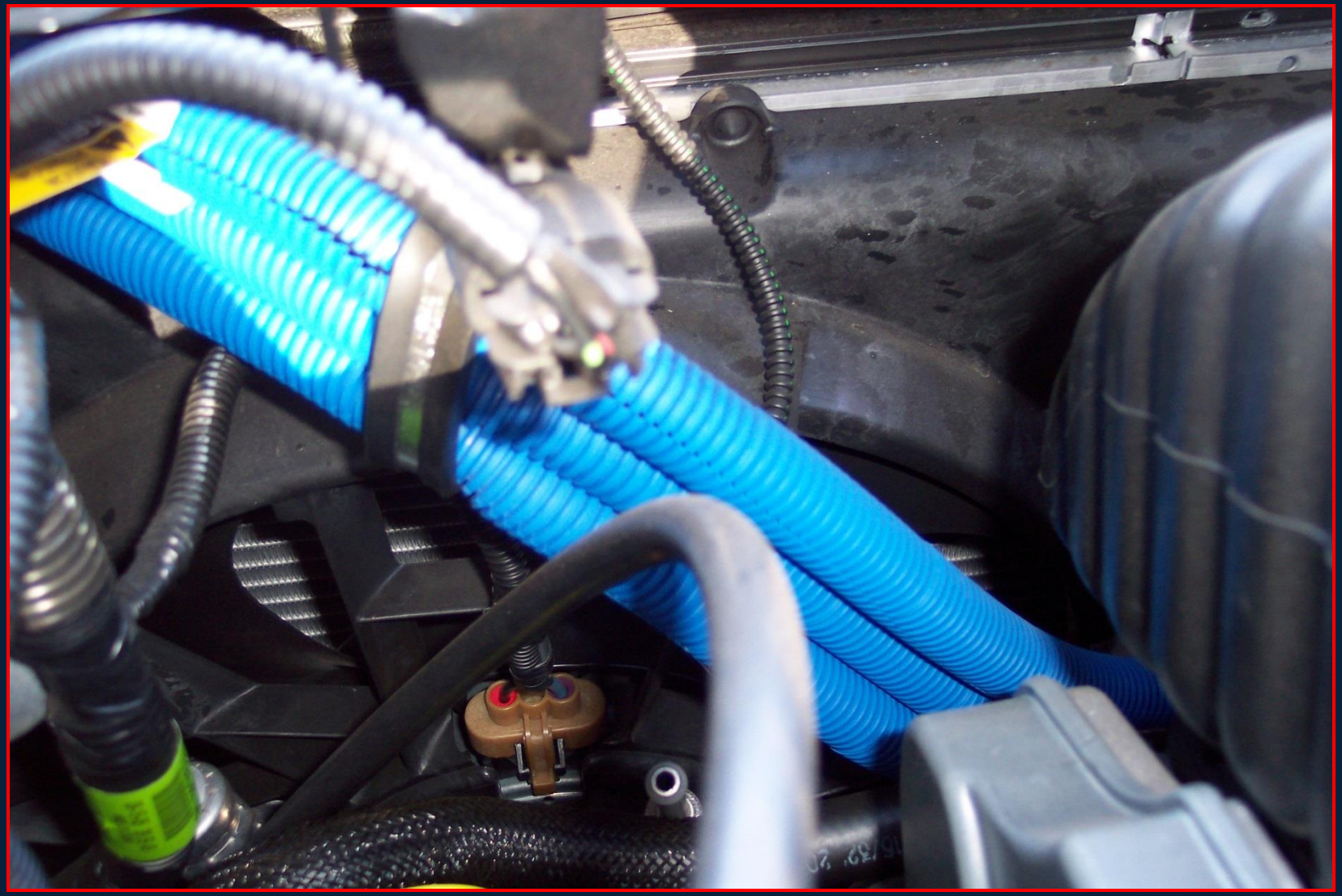
- If key or power button are not accessible:
- Disconnect the 12 Volt auxiliary battery located in rear cargo area
- Remove the 20 amp HEV fuse (yellow) in engine compartment
- When in doubt, pull all of the fuses in the fuse block.
- Confirm ***READY*** light is not illuminated in instrument cluster

HYBRID VEHICLES SHUT DOWN

- 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 can be 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
- 5-10-20 RULE/PEEL AND PEEK


DO NOT CUT High Voltage harness

2007 SATURN VUE HYBRID



HYBRID FIRE PROCEDURES

- Water has been proven to be an acceptable extinguishing agent
- Fire in the HV battery Pack
  - HV battery modules will burn rapidly and can quickly be reduced to ashes other than the metal alloy ell plates
  - Flooding the HV battery pack with copious amounts of water at a safe distance will cool NIMH battery modules below their ignition temperature and the remaining modules on fire, if not extinguished, will burn themselves out
- Fight vehicle fire from the side
- Life vs. Property
- Contain Run off (Haz Mat)

HYBRID SUBMERSION PROCEDURES

- 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 and drain water if possible
- Follow power down procedures as detailed for individual vehicles
- When the high voltage battery is under water, it should 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)

HYBRID MYTHS

- Electricity will follow the water stream when putting out a hybrid fire
- 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

ELECTRIC VEHICLES

- Electric vehicles improve air quality
- No tailpipe emissions
- New battery technologies increase vehicle range between charges
- Batteries are charging faster!
- EV decals and insignia on the rear of the vehicle
- Demonstration vehicles are clearly marked

ELECTRIC VEHICLES

Electric Motor

Battery Pack

Electric Control Module

High and Low Voltage

No emission

Combustion Engine

Fuel Tank

Electronic Ignition

Low Voltage System

Emission Issues

Hybrid Electric Vehicles

ELECTRIC VEHICLES

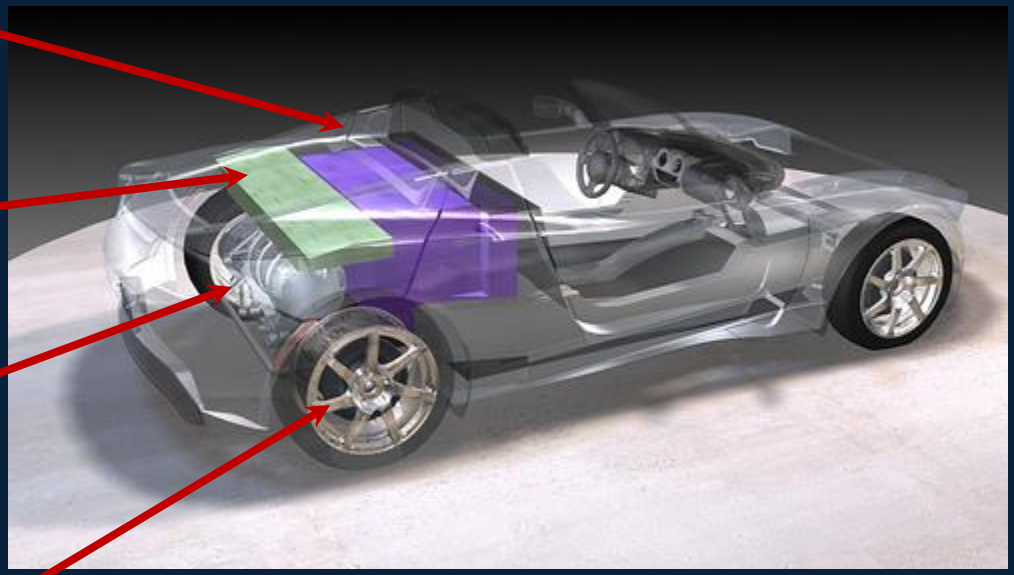
EV Operation

Electronic Control Module (Inverter/converter)

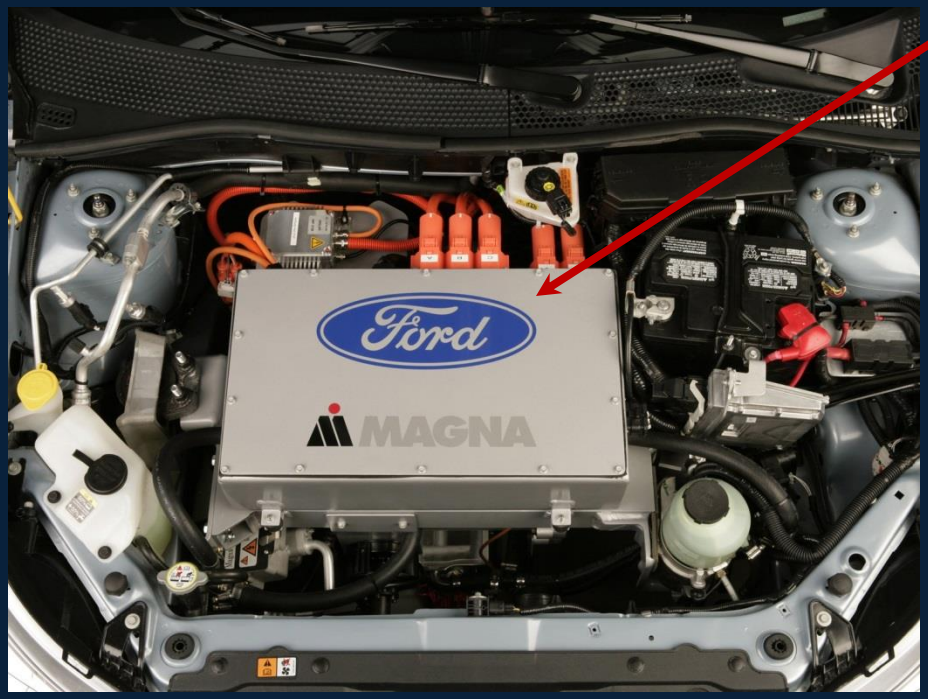
Battery Pack

Electric Traction Motor

Regenerative Brakes



ELECTRIC VEHICLES



Electronic Control Module

ECM is High Voltage!

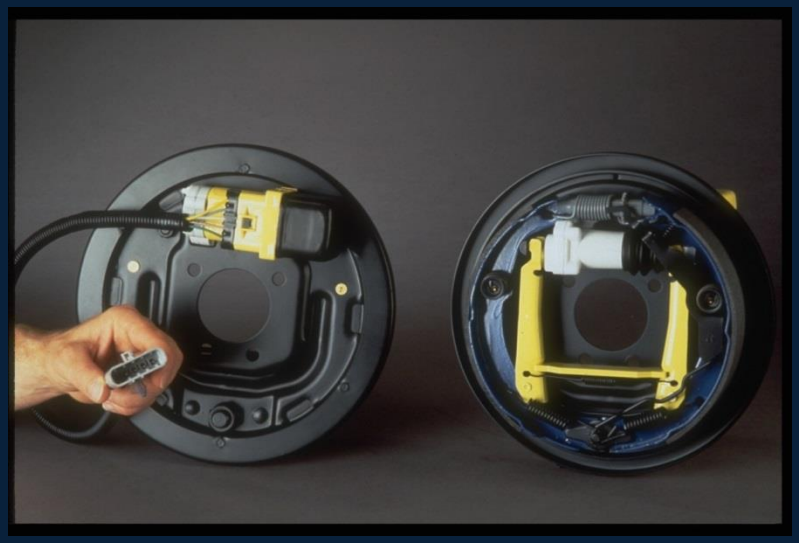
Accelerator pedal sends electric signal to ECM

ECM regulates the amount of current to the motor

ELECTRIC VEHICLES

- Battery Pack and Battery Management System
- Provides electrical power to engine and controls charging and overcharging
- High Voltage!

- Regenerative Brakes
- Converts kinetic energy into electricity replenishing the



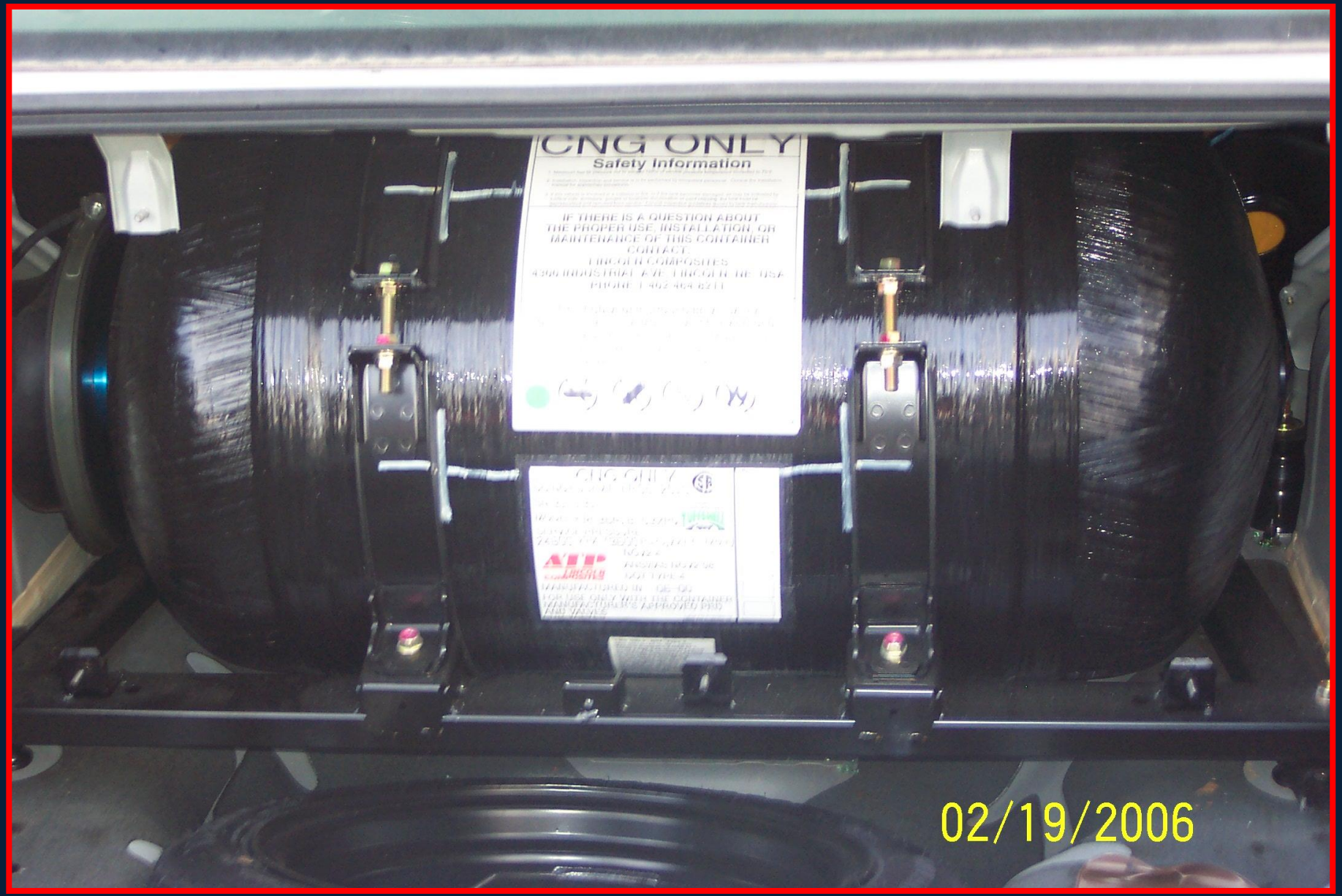
ELECTRIC VEHICLES

- Orange cables denote High Voltage– do not cut!
- Inertia switches and pilot circuits will shut down High Voltage
- It takes approximately 5 minutes for the energy to dissipate
- It is safe to work with submerged vehicles

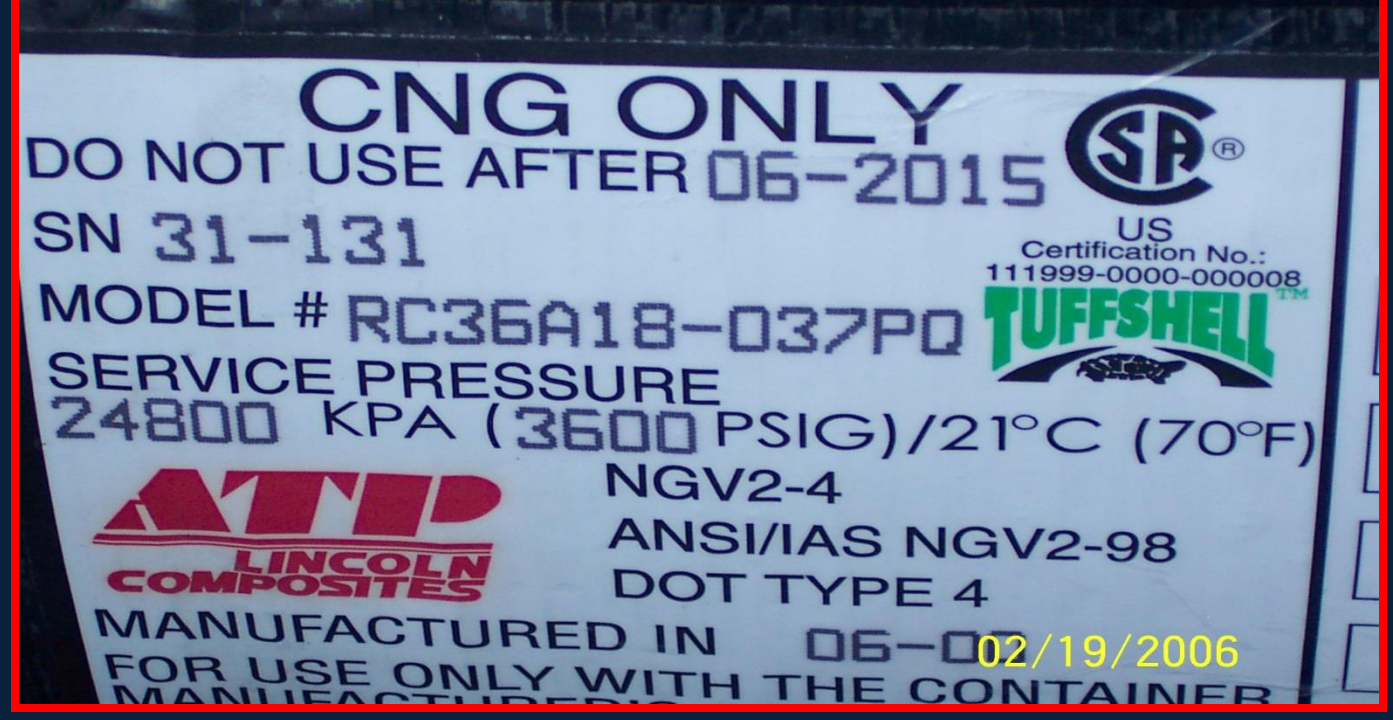
ELECTRIC VEHICLES SAFETY

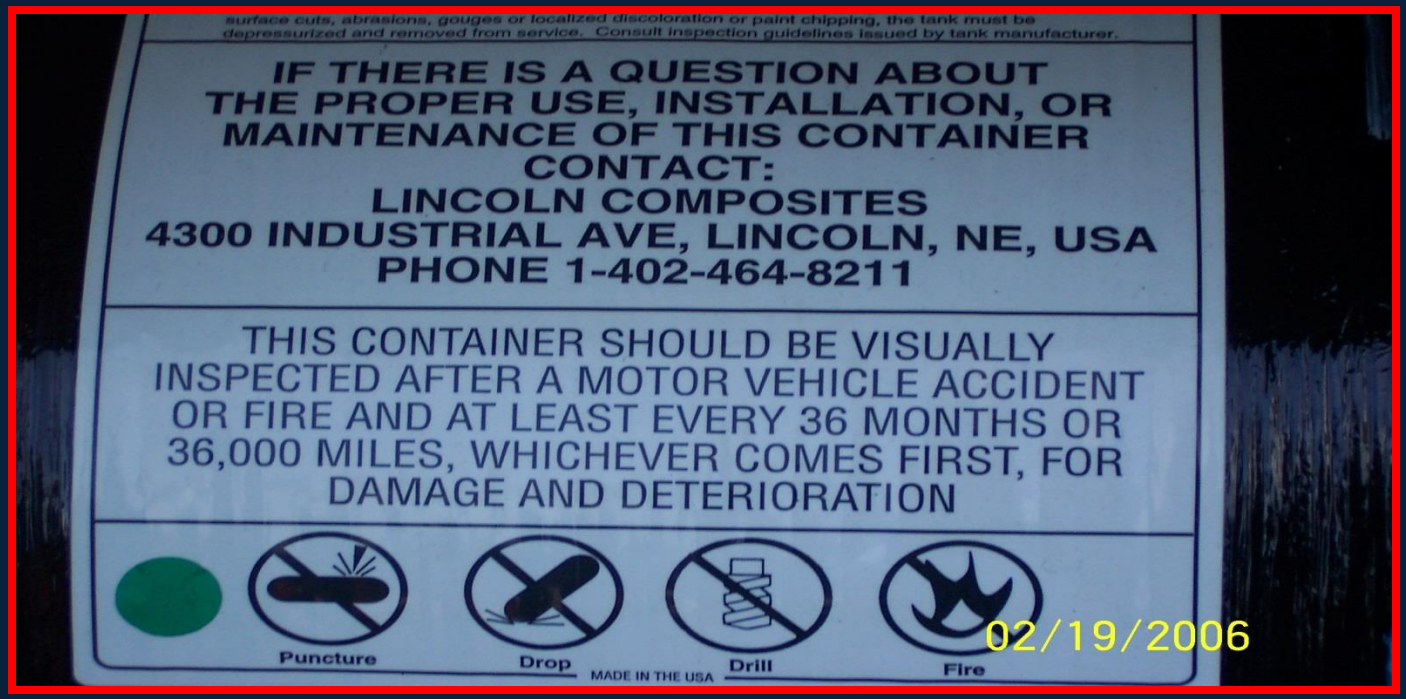
- Do not penetrate or cut any high voltage component!
- Avoid wearing jewelry
- Wear Full PPE
- Use insulated hand tools when possible
- Locate manual disconnects
- Use water or foam to extinguish vehicle fires
- Use recommended agent for battery pack fires

COMPRESSED NATURAL GAS

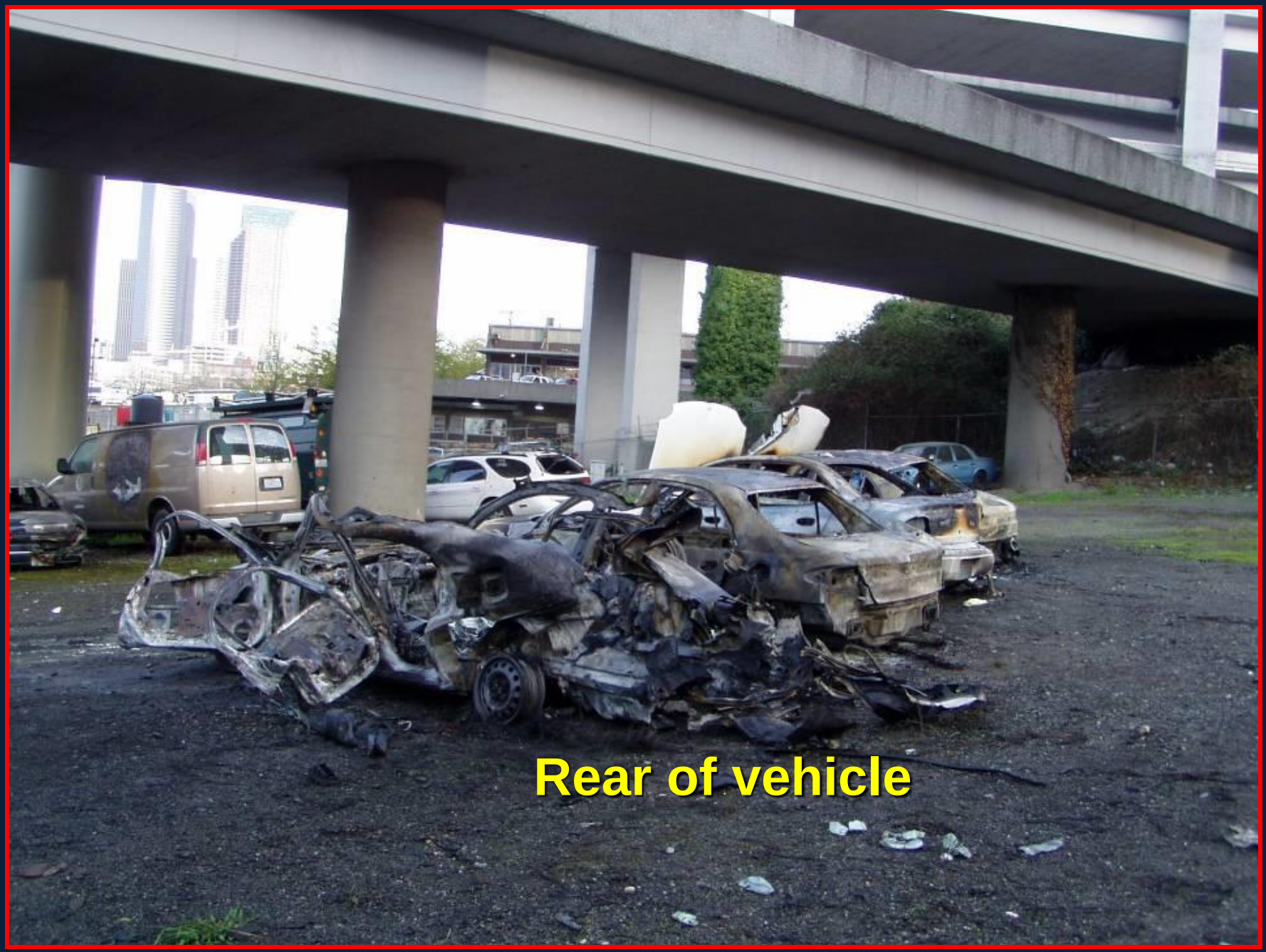

CNG ONLY
Safety Information
IF THERE IS A QUESTION ABOUT
THE PROPER USE, INSTALLATION, OR
MAINTENANCE OF THIS CONTAINER
CONTACT:
CNG ONLY
02/19/2006

CNG MARKINGS


CNG ONLY
DO NOT USE AFTER 06-2015
SN 31-131
US
Certification No.:
111999-0000-000008
MODEL # RC36A18-037PQ
TUFFSHELL
SERVICE PRESSURE
24800 KPA (3600 PSIG)/21°C (70°F)
ATP
LINCOLN COMPOSITES
NGV2-4
ANSI/IAS NGV2-98
DOT TYPE 4
MANUFACTURED IN 06-05
FOR USE ONLY WITH THE CONTAINER
02/19/2006


surface cuts, abrasions, gouges or localized discoloration or paint chipping, the tank must be depressurized and removed from service. Consult inspection guidelines issued by tank manufacturer.
IF THERE IS A QUESTION ABOUT THE PROPER USE, INSTALLATION, OR MAINTENANCE OF THIS CONTAINER CONTACT:
LINCOLN COMPOSITES
4300 INDUSTRIAL AVE, LINCOLN, NE, USA
PHONE 1-402-464-8211
THIS CONTAINER SHOULD BE VISUALLY INSPECTED AFTER A MOTOR VEHICLE ACCIDENT OR FIRE AND AT LEAST EVERY 36 MONTHS OR 36,000 MILES, WHICHEVER COMES FIRST, FOR DAMAGE AND DETERIORATION
Puncture
Drop
Drill
Fire
MADE IN THE USA
02/19/2006

CNG TANK FAILURE


Rear of vehicle

NATURAL GAS FILLING PORTS

ALTERNATIVE FUEL MARKINGS

- 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)

ALTERNATIVE FUEL VEHICLES

Considerations for these vehicles include:

- Compressed/ liquefied flammable gases
- Water miscible flammable liquids
- High voltage batteries/ DC and AC current
- Liquefied/ gaseous hydrogen
- Potential haz mat
- A ruptured Lithium Ion battery is highly toxic. Treat as haz-mat.
- Vehicles moving on their own

AFV FIRE RISKS

AFV FIRE RISKS AND TACTICS

- Do not park apparatus in front or aft of the vehicle
- Do not attack fire from front or aft of vehicle
- Fight vehicle fire from the side (90 degree approach)
- Do not get in smoke
- Spot apparatus to side of vehicle fire
- Provide distance from the vehicle fire
- Utilize full PPE with SCBA
- Contain run-off (haz mat)
- Life vs. Property

HYDROGEN FUEL CELL VEHICLE

FUEL CELL VEHICLE

Fuel Cell Benefits

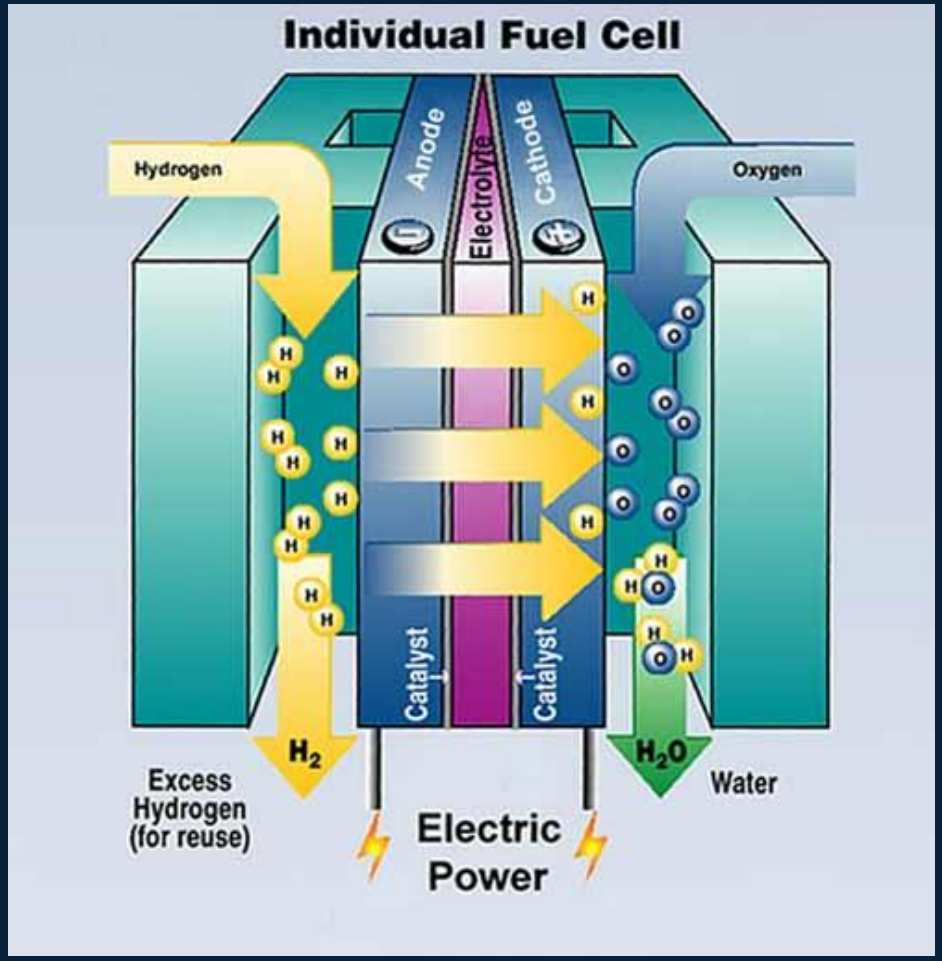
Zero Emissions

Quiet Operation

Energy Efficient

Energy Diversity

FUEL CELL VEHICLE



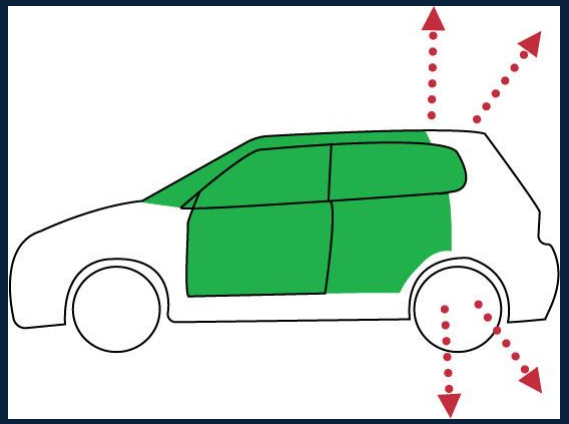
Fuel Cell Technology

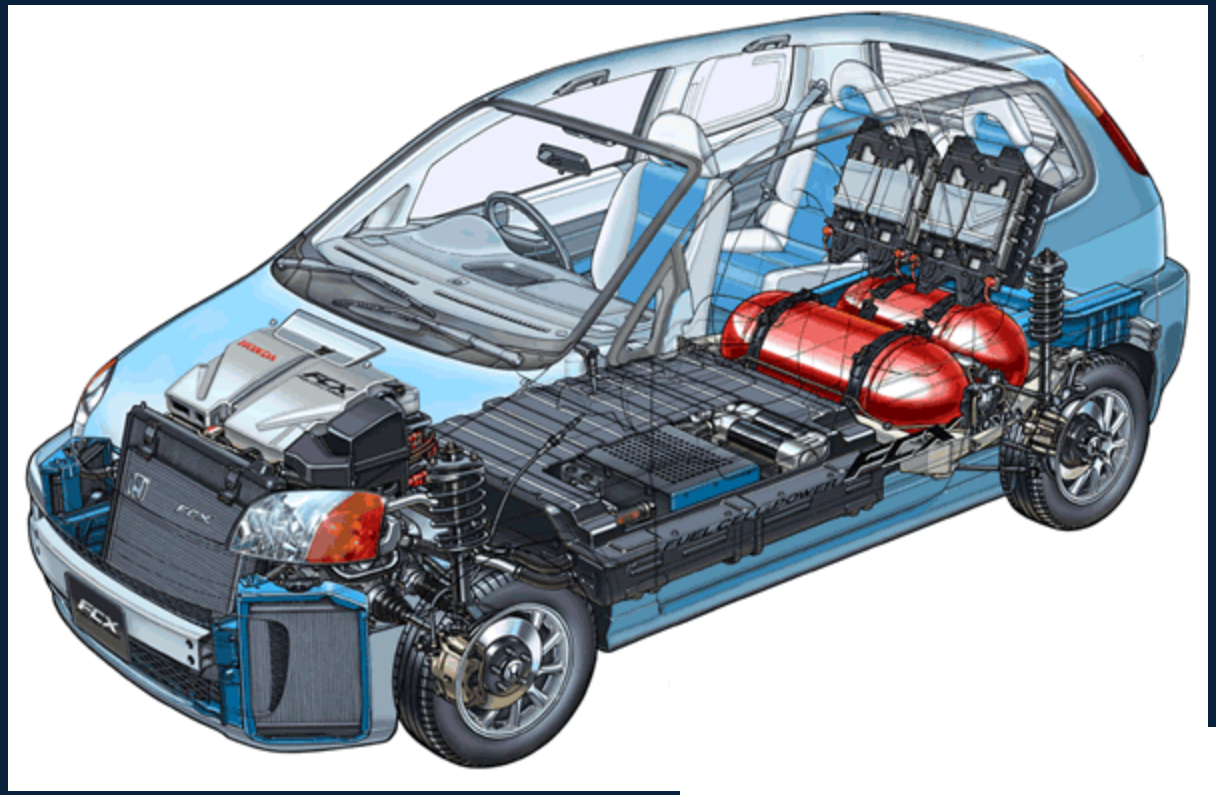
Automakers use Proton Exchange Membrane Fuel Cell

Hydrogen gas is essential to the process

FUEL CELL VEHICLE

- Drives like ICE counterpart
- Vehicles have both low and high voltage systems
- When heated, the H2 tank has a combination pressure relief device and a temperature relief device (PRD/TRD)
- PRD/TRD releases with a bang followed by a loud hiss

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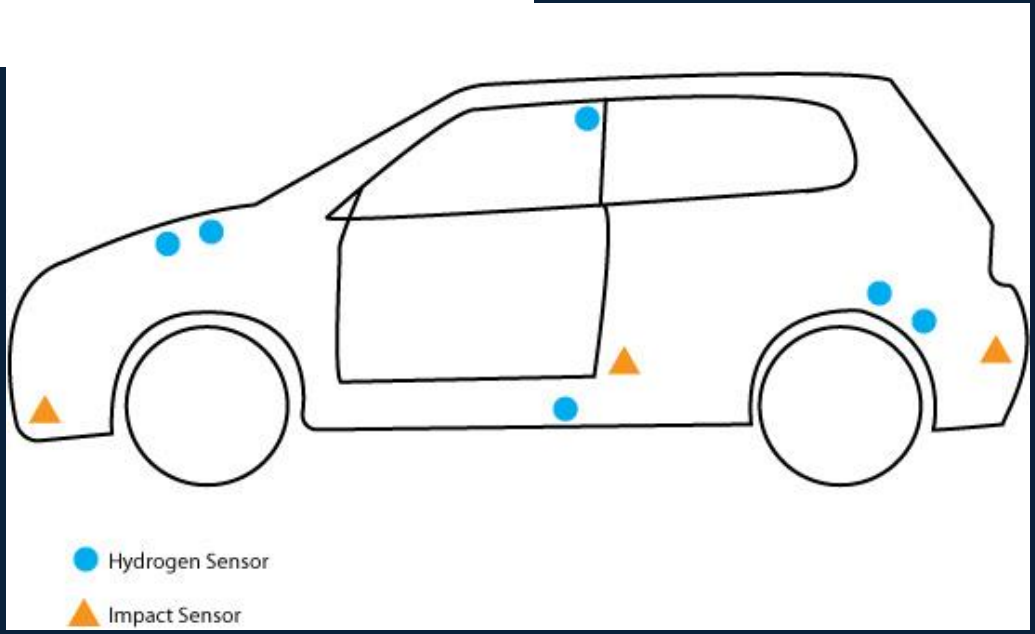
Hydrogen Sensor
Impact Sensor

RED HYDROGEN LINE!

FCHV MARKINGS

STABILIZATION

STABILIZATION

- Six-sided Approach
- Step Chocks
- Cribbing
- Remove Air from Tires
  - Bring Load to Stabilization
- Rope
- Ratchet Straps
- Tension Buttress
  - Rescue 42s, Paratech Struts

TENSION BUTTRESS SYSTEM

Stick and a strap

Build in Triangles

TENSION BUTTRESS SYSTEM

45 to 70 degrees when loaded

Insertion points above center of gravity

TENSION BUTTRESS SYSTEM

Align struts and bases

Solid strut points

TENSION BUTTRESS SYSTEM

Capture and control load

Anticipate lifts or movements

EXTRICATION TECHNIQUES

- Spreading and Cutting
  - Let the tool work…Build pressure
  - Good purchase point run the tool out
  - Open and close tool All the way
  - Focus arm parallel to the horizon
  - Concentrate on Hard points on the vehicle

EXTRICATION TECHNIQUES

- Anticipate tool movements
- Tool Angle and Placement
- Body and Hand Placement
- Tool “dance”
- Let the situation dictate cutters or spreaders

GAINING ACCESS

- Gaining purchase points
  - Fender crush
  - Vertical lift
  - Pinch and pry
  - Door squeeze
  - Hand Tools

GAINING ACCESS

Fender Crush

GAINING ACCESS

Vertical Lift

GAINING ACCESS

Pinch and Pry

GAINING ACCESS

Door Squeeze

GAINING ACCESS

Hand Tools

B POST BLOWOUT

B POST BLOWOUT

Gain access to rear door pin or nader

B POST BLOWOUT

Relief cut parallel to rocker panel

B POST BLOWOUT

Spread off rocker panel out to bottom

B POST BLOWOUT

Spread off rocker panel out to bottom

B POST BLOWOUT

Cut top of B post

B POST BLOWOUT

3RD DOOR

3RD DOOR

Relief cut parallel to rocker panel

3RD DOOR

Relief top of B post

3RD DOOR

Relief cut rear window down to wheel well

3RD DOOR

Relief cut rear window up into wheel well

3RD DOOR

Vertical lift

3RD DOOR

Vertical lift

3RD DOOR

Vertical lift with Ram

3RD DOOR

Rocker panel spread

DASH DISPLACEMENT

Relief cut the A-Post above the bottom

DASH DISPLACEMENT

Firewall may require multiple cuts and spreads

DASH DISPLACEMENT

Cut section out of A-Post roof rail

DASH DISPLACEMENT

Dash Jack

DASH DISPLACEMENT

Dash Roll

DASH DISPLACEMENT

Dash Push

REVIEW

- Scene Size Up
- Vehicle Assessment “Reading the Wreck”
- Patient Assessment
- Stabilization
- Scan for Airbags/SRS “Peel and Peek”
- Gain Access to Patient “5-10-20 Rule”
- Extrication Techniques
- Patient Removal

CONCLUSION

- Questions, Comments, Concerns
- Station A Equipment Review
- ***BE SAFE! EVERYONE GOES HOME!***