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Vehicle Extrication Classroom Notes

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NFPA 1670, Chapter 6 – The short version

Awareness Level Competencies

- Sizing up existing and potential conditions
- Identifying resources needed
- Implementing agency response
- Controlling and managing the scene
- Implementing initial traffic control

Operations Level

- Identifying victim locations/survivability
- Making the scene safe (isolation/stabilization)
- Identifying and controlling fuel leaks
- Patient protection/packaging
- Gaining access to trapped patients
- Use of hand tools to access/disentangle
- Mitigating scene hazards
- Gathering necessary resources
- Additional traffic control measures
- Establishing operational work zones; hot, warm, cold
- Recognizing and working around Supplemental Restraint Systems
- Understanding vehicle design and construction features
- Knowledge of crash types/ mechanisms of injury
- Basic vehicle stabilization techniques

Technical Level Competencies

- Extrication/disentanglement from large vehicles – bus, trains, truck
- Advanced stabilization – vehicles not on their wheels
- Use of air lifting bangs
- Use of chains, wire rope, winches
- Utilization of heavy wreckers for rescue
- Use of power tools – hydraulic, pneumatic, electric

Vehicle Anatomy/Terminology

Use driver and passenger side as opposed to left and right when referring to vehicle

- **Roof components**
  - Roof posts – A to Z from front to rear
  - Roof rail
  - Roof rib

- **Doors**
  - -Safety latch assembly
  - -Nader pin assembly
  - -Side impact bars

- **Rocker channel**

- **Dash/firewall assembly**
  - -Steering column
  - -Dash support bar/pipe
  - -Top rail/strut tower landmarks

- **Front/rear quarter panels**

- **Laminated safety glass** – used in windshields and throughout in some vehicles, must saw

- **Tempered safety glass** – used in side and rear windows, can break with tool

Vehicle Construction

Body On Frame (BOF) Construction

It's the mounting of a separate body to a rigid frame which supports the drive train. In 1997 regulations changed BOF vehicles and how impact forces travel through them.

Newer BOF designs are intended to react to a collision in much the same way as a UNI-body, however there are several differences that must be considered.

- BOF Vehicles have separate frames that are made of thicker, heavier metal.
- Weight and mass of larger BOF bodies will affect channeling of impact energy differently than UNI-body.
- BOF bolted body sections absorb energy differently than welded structures.
- Impact energy will telescope further along the BOF frame.

UNI-body Construction

Is in which the body is integrated into a single unit with the chassis rather than having a separate body-on-frame. The welded "Unit Body or Uni-Body" is the predominant automobile construction technology today.

UNI-body vehicles are designed to fold and collapse as they absorb the impact of the collision and protect the passenger compartment.

The front and rear body portions are designed to:

- Deform easily
- Collapse in a predetermined fashion (crush zones)
- Form a structure that absorbs initial impact energy and directs remaining damage through the vehicle.
- Preserve the passenger compartment.

For the most part all of today's passenger vehicles are made of a form of UNI-body construction.

Space Frame

Cage like steel structure from BOF or UNI-body designs in that is uses steel frame members to form a load-bearing cage that carries vehicles stresses and holds vehicles together.

Passive Safety Design

Modern vehicle design incorporates a number of built-in safety features, which are referred to as passive safety.

Passive Safety is meant to maximize passenger protection by channeling and absorbing impact forces throughout the entire vehicle and by creating a protective shell for passengers.

Example: A head-on collision with a barrier at 20 mph may cause the engine to move as much as 2-4 inches, while the passenger compartment may compact by as little as 1 to 2% of its length.

While passive safety design was originally a major feature of only UNI-body construction, many passive safety features have now been incorporated into the design and construction of newer BOF vehicles.

Newer BOF designs incorporate holes, convolutions, and other shapes which absorb energy.

Vehicle Materials and Processes

High-Strength Steel - Specially formulated steel used to reinforce selected areas of vehicles.

High-Strength, Low Alloy (HSLA) - Specially formulated steel designed to be lightweight yet strong enough to reinforce selected areas of a vehicle, 40,000-70,000 psi tensile strength.

Micro Alloy Steel - Specific steel designed to be lightweight yet structurally sound, 110,000-215,000 psi tensile strength.

Boron Steel - This metal is extremely strong, due in part, to its high phosphorous micro alloy content making it resistance to bending or crushing. Recip saws, air chisels, will not work. Hydraulic tools will squeeze the Boron and could twist/scissor or shatter the hydraulic cutter blades.

Aluminum - Lightweight metal used to form vehicle frames and outer body panels.

Aluminum Alloy - Special mix of chemical ingredients added to aluminum to increase the strength of aluminum.

Ultra Light Steel Auto Body Construction (ULSAB) - Unique new manufacturing process in which large sections of the vehicle body are manufactured as a single unit. This results in fewer presses and pieces during manufacturing. ULSAB bodies are lighter, stronger, and less expensive to manufacture. The full implication of this new design is still being learned.

Hydro forming - Allows steel to be preformed to "near design" in a die or mold, and allows the manufacturer to form more complicated designs using one piece of material.

Plastic Materials - Components of a vehicle that consists of various types of synthetic materials.

Collision Types

- Head on accident
  - Frontal vs. Offset frontal collision
- T-bone/ broadside
- Rear end
- Rollover onto side
  - Resting on tire edge
  - Resting on roof edge
- Rollover onto roof
  - Pancake from crushing roof posts
  - Engine down is most common position
- Vehicle under-ride/ over-ride
  - Normally smaller vehicle trapped under larger object
  - Example of car vs. semi trailer

Rescue Action Plan

- Arrival/Positioning/ICS
  - Create safe work zone with parking of rigs
  - Uphill, upwind, shield work area
  - Establish extrication, medical sectors, safety officer as needed

- Scene size-up and survey

- Scene stabilization
  - Fire protection, dry chem. And hose line
  - Hazards located and mitigated
  - Vehicles stabilized

- Patients accessed and triaged

- Disentanglement (tool work)
  -Relieve entrapments and create removal pathway

- Extrication (removal) of patient from vehicle and transport

Size-up Considerations

- **Can start en-route** to call with dispatch info
  - Number and type of vehicles?
  - Confirmed entrapment? People not getting out of vehicles?
  - Power poles involved/ lines down?

- **Standard crew assignments** to avoid confusion and save time
  - Size-up and walk around 360 done by officer
  - Initial vehicle stabilization and patient contact by firefighter
  - Hose line/lighting/tool staging by driver

- **Outer/ Inner circle** survey techniques
  - Outer – additional vehicles, walk away or ejected patients, hazards, back up for inner circle firefighter
  - Inner – hot zone survey to check for hazards, number of patients, severity of injuries, entrapment, fluid leakage

Common Scene Hazards

- **From the vehicle**
  - Silent running hazard (Hybrid & EV Vehicles)
  - Leaking fluids – fuel, battery acid
  - Blood – sharps from jagged metal and broken glass
  - Un-deployed airbags
  - Hood and hatch struts
  - Compressed strutted bumpers
  - Hazmat
  - Weapons/Pets

- **From the surroundings**
  - Traffic/ distracted drivers
  - Wires down – park 1 span length away, call power company
  - Electrical transformers
  - Broken power poles
  - Trip hazards
  - Water, slippery terrain

Vehicle Stabilization

- Any crash damaged vehicle considered unstable
- Stabilization must be maintained and rechecked
- Minimizes vehicle reaction to rescue efforts and painful movements for patient

- Upright vehicle
  - Chock wheels, set brake – horizontal stabilization
  - Block, step chock occupant compartment at minimum of 2 points – vertical stabilization
- Side resting vehicle
  - Crib voids with wedges, step chocks
  - Lock in place with jacks, struts, straps, chains
- Inverted vehicle
  - Wedges at front end
  - Fill voids with cribbing
  - Struts, jacks at rear of vehicle

Patient Contact/Access

- Make verbal contact with patient as soon as possible and give instructions, ie: "Don't move your head/neck" – calm and reassure pt.
- Initial C-spine from outside vehicle, with entry made as soon as it's stabilized
- Order of simple access (no tools required)
  - -Door
  - -Window – break furthest one from patient to gain entry
- Complex access requires heavy tools
  - -Example – undercarriage breach on pan-caked car in a ditch
- Jobs of interior rescuer
  - - Set brake, lower power windows, unlock doors, move power seats shutoff ignition, turn on 4-way flashers
  - -Cover patient
  - -Position away from un-deployed airbags
  - -C-spine, ABC's, comfort and reassure patient
  - -Keep outside rescuers informed of patient condition

Scanning for Airbags

- Quick scan of interior for airbag location identifiers
  - -Steering wheel hub, dashboard
  - -Opposite side A, B, C post trim panels
  - -Opposite side door panels
  - -Near side seatback uprights
- Announce location and status to crew

- Maintain 5, 10, 20 Rule for rescuers and patients
  - -5” from side impact systems
  - -10” from drivers front airbag
  - -20” from passengers front bag

Disconnect Electrical System

- Use power to your advantage first – windows, locks, seats
- Disconnect or cut negative cable (black) before positive cable (red)
- If multiple batteries, do both black cables, then both red
- Confirm power shutdown by checking lights, flashers
- Unplug any after market accessories
- May have to remove battery if housing breached by metal of engine compartment
- Battery may be located in trunk, under rear seat, in wheel wells
  - -If so, disconnect jump start connection points
- Trunk opening – good habit to ensure no hidden patients or hazards

Tool Staging Area

- Lay out small tool cache on tarp
- 5-10 yards away, position so it’s not a trip hazard
- Officer should anticipate rescue needs to avoid having to stop extrication while someone runs back to rig for a piece of equipment

Disentanglement

- Remove the vehicle from around the patient

- Two (2) considerations during plan formation
  - -Is there anything pinning the patient?
  - -What path is patient going to be removed from vehicle?

- Protect patient with soft and hard protection as needed
  - -Cover with tarp to keep glass shards and dust off patient
  - -Hard protection between tool/material being cut and patient
  - -No hard protection in front of un-deployed airbags

Opening Doors

- **Size up, Set up, Open up**

- Size-up for crash damage, purchase points, door mounted airbags

- Set-up of door
  - -Unlock, Nader bypasses techniques
  - -Remove side window glass
  - -Create purchase points

- Opening up
  - -Hinge attack
  - -Latch attach
  - -Through the window spread (vertical crush)

- Complete side removal – both doors and B post
  - -Maxidoor
  - -Side lay down
  - -Front pop, rear drop
  - -3rd door conversion (for 2 door vehicles)

Strip trim (Peel & Peek) to locate and avoid pre-tensioners, curtain airbag infators and reinforced areas.

Roof Options

- Very effective for accessing multiple patients
- Strip trim to expose before making any cuts
- Allows vertical, inline removal of patients
- Rear window spread
  -Break glass, single spread, recline seat, remove patient on long backboard
- Rear half roof flap/removal
- Flap to side, front, or rear
- Complete roof removal
- Trench cut of vehicle roof
- Be sure to cut seatbelts and cover patient if sawing out windshield

Dash Displacement

- Cut or tilt steering wheel/column

- Recline or slide back seats

- (Peel and Peek) Relief cuts in top rail, mid A pillar, disconnect roof and windshield

- **Options**
  -Dash jack with spreader
  -Modified dash roll with spreader
  -Dash roll with ram
  -Center console spread
  -Column pulling with pulling device and chains – hi-lift jack, spreader, Column-master tool
  -Inverted floorboard flip – for roof resting vehicles
  -Use of Halligan bar as push point

- Pedal manipulation to free foot entrapment

Patient Removal (Extrication)

- Removal method based on patient condition and not personnel preference

- Make sure all extremities free before attempting removal
  -Example, foot stuck behind gas pedal

- Normal extrication – stable patient with good vitals, main concern is potential spinal injury
  -Slow, controlled removal
  -Should cause no further harm and minimal pain
  -Time for thorough assessment and packaging

- Rapid extrication – critical patient needing surgical intervention at trauma center
  -Unconscious, decreased mental status
  -No radial pulse, symptoms of shock
  -Respiratory or cardiac arrest
  -Stable patient blocking access to critical patient
  -Hazardous condition to us or them, ie: engine compartment fire

- Rapid extrication with C-collar, manual stabilization, speed board (if available), onto long backboard

- Begin transport ASAP
  -IV's started en-route to hospital

- Use of hose strap techniques to assist with sliding patient onto backboard

World Rescue Organization Facts

- Today 3,205 people will die as a result of a motor vehicle accident.
- Every week 22,435 people will die on the world's roads – almost 100,000 every month.
- In addition to the 1.17 million people killed each year on the worlds roads a further 35 million are estimated to be injured.
- World Health Organization projections indicate that by 2020 road traffic injuries could rank 3rd among causes of death and disability, ahead of other health problems as malaria, tuberculosis and HIV/AIDS.

United States Vehicle Accident Facts

- Traffic accidents are the leading cause of death for children ages 6-14.
- Over 41,500 people die annually on U.S. highways.
- Over 9,000 fatalities annually are the result from rollovers.
- Over 8,500 fatalities are the result from offset crashes.
- Over 2000 deaths and 950,000 injuries result from rear end collisions each year.
- A person is injured every 10 seconds and killed every 13 minutes