



Fresno Fire Department Auto Extrication Guide





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PURPOSE

Fresno Fire Department responds to numerous types of emergencies daily. Vehicle collisions are another type of emergency that we respond to. The mastery of auto extrication tools and techniques is directly related to the preservation of life and enhances the positive perception of the Fresno Fire Department. Effective auto extrication will enhance the golden hour of a victim trapped in a vehicle collision.



APPLICATION

Vehicle and extrication size up should begin in the warm zone as the initial incident commander (IC) arrives. The initial IC should locate and establish the number of trapped victims and begin to formulate a plan for engine and truck access. When the truck company arrives, pertinent information should be passed on to the truck captain to formulate a workable extrication plan and priority list of patients. While the plan is being formulated, truck members should be doing their own mental size up of the scene, looking for escape routes and safety zones. (definition of size up to include location of patients, type of vehicle, “reading the wreck” (“Reading the Wreck” Position, Damage and Stability, Vehicle construction and type, Vehicle and Patient Condition), extrication size up.



Figure 1. Vehicle Accident Scenes can be complex, Size Up should be the first priority

When the plan and priorities are established, truck crew members should have an idea of where and what they should need to accomplish the extrication. Before jumping into cutting and spreading, members need to do some additional size up to include safety restraint systems location and types, peel and peek under frame and door assemblies, stabilization size up, and patient access 5-10-20 rule. (Definitions of 5-10-20 rule in [hyperlink to definitions at bottom](#)). Vehicle safety systems include airbags, safety restraint systems, seat belt pre-tensioners, batteries, and glass management.

Consider the possibility of fuel leaks and provide for scene safety by deploying an appropriately sized hose line in case of fire.



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TYPES OF VEHICLE CONSTRUCTION:

Full Frame Construction- Designed to Deflect Energy



Figure 2. Full Frame Construction

Unibody Construction -Designed to Absorb/Transfer Energy



Figure 3. Unibody Construction

Space Frame Construction-Designed to Absorb/Transfer Energy High Strength Steel



Figure 4. Space Frame Construction

Vehicle Anatomy: New construction with Boron posts, cast magnesium transverse beams in firewall, door hinge types, one piece hydro formed body side rings, triple rolled pillar/rails that resist roof collapse, shock towers connected to fire wall, and lateral tie bars that connect the front longitudinal rails that are closed to stiffen the front structure and improve crash worthiness.

Basic Vehicle Anatomy

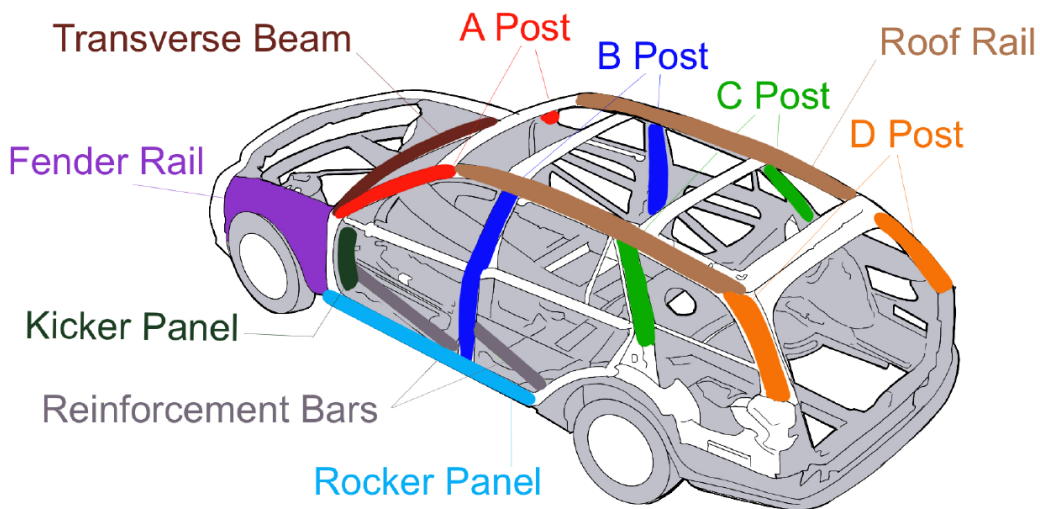


Figure 5. Basic Vehicle Anatomy



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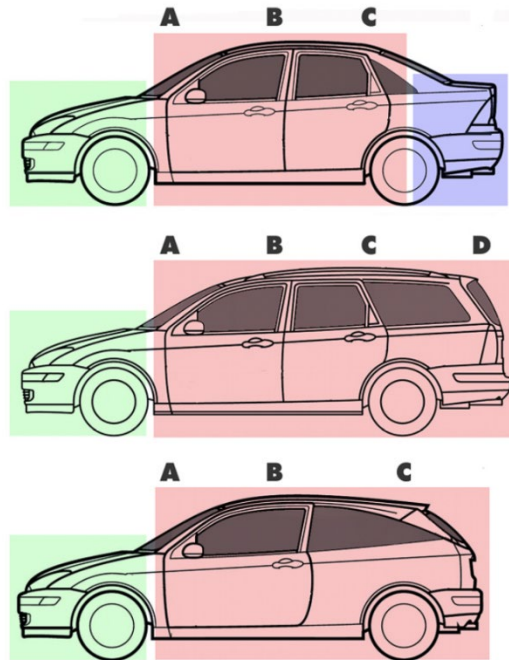


Figure 6. Various pillar configurations

Vehicle stabilization and size up go hand in hand. Using a six sided approach considering all 4 sides above and below the vehicle as a guide and using proper tools to achieve vehicle stabilization will guarantee success.



Figure 7. Dash displacement with stabilization of vehicle on top

Vehicle glass management includes laminated windshields that prevent complete removal but spray tiny glass shards in all directions. Truck crews can use several types of tools to remove windshield glass, including a sawzall, which makes removal



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quick. Ensure the patient is covered to prevent further injury prior to windshield removal. Tempered glass in windows surrounding the vehicle make removal quick and easy, but consideration to patient location and where the glass will end up after removal. Ensure that glass is cleared prior to extrication and note location to prevent rescuer injury and tool damage. Enhanced protective glazing (EPG) is a resistive glazing that provides added protection during a crash and from illegal entry and could represent an additional challenge at vehicle extrications.

Before cutting posts and roof, peel, and peek to ensure that struts and gas cylinders are clear of area that needs to be manipulated. Peel the plastic trim inside the roof frame rails and posts peek and make sure you do not accidentally deploy a safety system that has not already deployed.

A quick peel and peek of A, B, and C Pillar, roof rail on the opposite side of your patient will tell you what danger may be lurking near the patient. If you find gas cylinders or pre-tensioners, ensure you cut around them. Tools used for peel and peek consist of a brake spring tool, flat bar, flat head screwdriver, or tug tool.



Figure 8. Peel and peek for hidden hazards

Safety systems using compressed gas cylinders are high pressure cylinders with an average psi of 4000, and may be up to 9400 psi, contain argon/helium or argon/nitrous oxide.

Air bags are located in the dash, seat sides, door panels, dash panels at knee level, all posts, roof rails (known as side airbag curtains), side rails or rear windows. Side impact curtains are made to protect the head and torso in the event of a lateral collision. Hood and windshield bags protect the same from front impact collisions.

All air bags follow the 5-10-20 rule. (Front Passenger Air bags deploy approx. 20" into compartment. Steering Wheel Air bags deploy approx. 10" into compartment. Side impact air bags deploy approx. 5" into compartment.)



Figure 9. 5-10-20 rule

Chemicals associated with airbags consist of sodium azide and generally nitrogen gas. Argon/helium or argon/nitrous oxide are used as the accelerants. Powders are added to the bags for lubrication of the bag as it sets and deploys such as talcum powder or starch. The gases can produce heat that can reach up to 2,100 degrees F, but generally stay in the cylinder or behind the bag. It should be noted that since approximately 2010, recalls for gas cylinders that break apart upon deployment and send shrapnel into the passenger compartment have been initiated, so extreme caution should be maintained.

Capacitors that are designed to assist with airbag discharge can hold a charge indefinitely. Even after disconnecting batteries, safety systems can deploy. Additionally, some safety systems have separate accessory batteries in the event during a collision battery failure occurs. These accessory batteries will allow undeployed safety systems to remain live well after the initial collision. Ensure that rescue personnel observe the 5-10-20 rule when working around all safety systems.

Federal Motor Safety standard 208 mandates that 100% of vehicles are equipped with smart airbags by 2007. Smart airbags are adaptive airbags using ultra sonic sensors, buckle sensors, and weight limit sensors. Seat sensor activation ensures that occupants are at least 65 pounds for GM and European vehicles, and 80 pounds for Toyota and most Pan Pacific manufactured vehicles. It should be noted that these requirements can be adjusted by dealerships. They may also have a key selector on/off switch or weight sensor display.

Seat belt pre-tensioners are designed to tighten or back-wind a seat belt. Electrical pre-tensioners deploy simultaneously with front airbags. Pyrotechnic pre-tensioners deploy with a small gas generator. Models that back-wind a seat belt are generally located anywhere in B, C, and D posts.

Rollover Protection Sensors are located on the lower portion of the B post. They are designed to activate at 51 degrees. You should note if a vehicle is on an incline upon arrival, the rollover protection sensor may be activated. Care should be taken when



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spreading against the lower portion of the B post to not initiate rollover protection pre-tensioner.

Battery locations vary from vehicle to vehicle. Alternative vehicles utilizing large batteries may not be apparent. Care should be taken when doing vehicle size up to identify alternative vehicles and battery locations. Common battery locations include under the hood, in the truck, inside wheel wells, under front or back seats, and may be located in both the engine compartment and trunk.

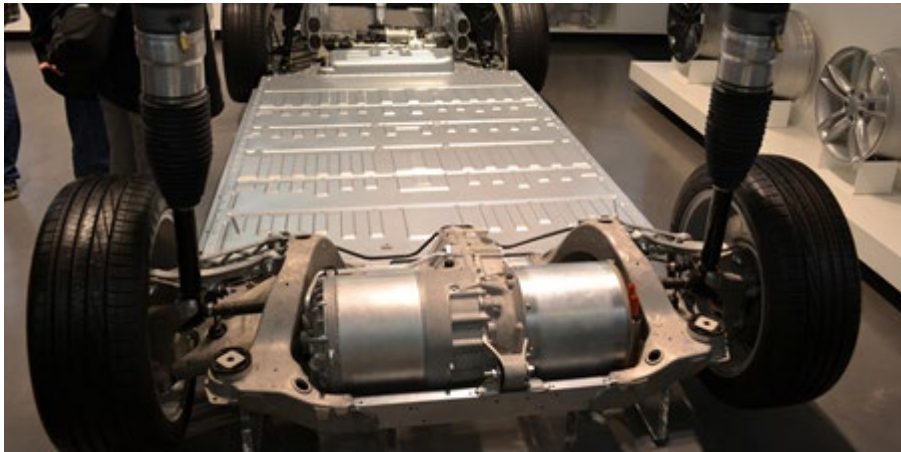


Figure 10. Battery Banks for Electrical Vehicles



Figure 11. Battery Banks for Electrical Vehicles

Gas shock bumpers and lift cylinders should be noted and care should be taken when approaching and working in areas where they are present. Approach the vehicle from a 90 degree angle. Struts and shocks are now angled 45 degrees in front and rear bumpers.

Other considerations prior to disconnecting batteries include electrically adjustable pedals, seats, head rests, and passenger compartment accessories. Using these



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accessories can make short work of repositioning victims and removing possible entanglement hazards.

Alternative fuel vehicles consist of compressed natural gas (CNG), liquefied petroleum gas (LPG), Propane, Hydrogen/Electrical fuel cell vehicles, Diesel/electric hybrids, and electric vehicles. All alternative vehicles have different power down procedures and are too numerous to detail in this manual. Hands on training with the various vehicle manufactures are the best option for familiarization with these types of vehicles. It should be noted that over 1.7 million hybrid vehicles are on US roads to date (8/20).

High voltage vehicles use Direct Current (DC). High voltage batteries use a battery pack that consists of NiMH and carries up to 300 volts, and inverter/converter can increase up to 650 volts. High voltage wiring will be bright orange and may not be visible during a collision. Alternating Current (AC) consists of a 3 phase traction motor or 2 motors found on all wheel drive systems. They can carry up to 650 volts and consist of an inverter/converter. All hybrid vehicles contain a 12 volt auxiliary battery that powers all accessory systems. It should also be noted that some manufacturers are adding photovoltaic systems to vehicles. As in cases with solar photovoltaic systems, you may not be able to shut down power supply unless the panels are covered.

Hybrid vehicle shut-down procedures consist of:

Identification of hybrid system stabilize the vehicle, place gear shift into park before removing the key, set parking brake, turn off key and remove if possible (note some vehicles do not have keys in the dash, only a button to turn on/off), check "ready light" or "auto stop" light is not laminated, identify, and disconnect the 12 V DC battery.

If key or power button is 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, and confirm the "ready" light is not illuminated in instrument cluster. Never assume the alternative vehicle is shut off simply because you cannot hear it, and always observe the "ready" light is not illuminated in the instrument cluster to confirm vehicle is off. Note that after shut down procedures, power can be maintained for 5 minutes in the high voltage electrical system and 90 seconds in the SRS systems.



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Figure 12. Access the 12 volt auxiliary battery and 20 amp HEV fuse

Electrical vehicle safety considerations: Do not penetrate or cut any high voltage component, wear full PPE, utilize insulated hand tools when possible, locate manual disconnects, use water to extinguish vehicle fires, and use dry chemical extinguishers for battery pack fires.



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GLOSSARY

5-10-20 rule - Front Passenger Air bags deploy approx. 20" into compartment. Steering Wheel Air bags deploy approx. 10" into compartment. Side impact air bags deploy approx. 5" into compartment.

Access — (1) Place or means of entering a structure or vehicle. (2) Roadways allowing fire apparatus to travel to an emergency. See Egress.

Egress — Place or means of exiting a structure or vehicle.

Air Bag Restraint Device - A supplementary restraint system fitted in the steering wheel, front passenger dash area, and can also be either seat or door mounted. In the event of a crash the bags will fill instantly with Nitrogen, either electrically or mechanically deployed on impact. Air bags offer additional protection to occupants in the event of a crash.

Cargo Compartment - The rear, (or front area on rear-engine car) that is used to store or carry items. Commonly known as the luggage compartment/trunk

Circle Survey - Procedure adopted by rescuers to conduct a thorough survey of the crash site where they walk in a circle around the entire scene.

Cold Zone - Support Zone, to include EMS, Command, and non-essential personnel not involved in direct involvement of the rescue and extrication of patients.

Dash Roll-Up - The relocation of the dash, steering wheel and column using heavy hydraulic powered rams.

Dash Displacement - A procedure used to lift the dash assembly up and off the trapped front seat occupant. This is normally achieved with heavy hydraulics - spreader, cutters and/ or rams.

Disentanglement - Aspect of vehicle extrication relating to the removal and/ or manipulation of vehicle components to allow a properly packaged patient to be removed from the vehicle.

Displacement - A term often used to describe the relocation of a door, by force, beyond its normal opening range or making space for gaining access to or removal of the casualty.

Engine Compartment - The area of the vehicle in which the engine is fitted. It is separated from the passenger compartment by a metal bulkhead known as the firewall.

Entrapment — When the victim or part of the victim is being mechanically restrained, or has restricted means of egress, by a damaged vehicle or machinery component.



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Extrication - To remove from danger. This term is used in rescue circles to describe the procedures used to cut away and displace vehicle wreckage, to release and remove casualties trapped by metal deformity or their injuries.

Fuel System - This includes the fuel tank, fuel pump and the feed and return lines to the fuel injection system. Fuel is pumped from the tank through the feed line to the injector pump where it is metered to the engine in the exact proportion as dictated by the accelerator pedal.

Full Frame - Vehicle construction design that is used in some large sedans, station wagons and light trucks.

Hazard Control - The term for controlling and reducing risk at the extrication scene. It can also be used within the extrication sector where specific risk needs to be managed.

Hot Zone - The area where tools and personnel are making access, cutting, and spreading, and rescue efforts are being conducted. The only personnel in the hot zone are personnel using tools and rescue personnel in the vehicle working on patient care. Only personnel with PPE suitable for auto extrication are allowed to work in the hot zone.

Inner Circle Survey - A procedure for recognizing and assessing risk after a vehicle has been in a collision. A full 360 degree survey is made around the vehicle looking for any hazards including under, on top or in the vehicle.

Laminated Glass - Manufactured for the windshield of vehicles it consists of a plate glass sheet, clear plastic membrane and another layer of glass all bonded together.

Loaded Bumper - A term used to describe bumpers fitted with shock absorbers whose pistons become compressed and jam in an impact. The danger then exists whereby they may release without warning and injure the rescuer.

Manual Hydraulics - Hydraulically operated rescue tools where the hydraulic power is generated by a manually operated pump.

Pancaked Vehicle - A term used to describe crash damage where the vehicle has come to rest on its roof where the roof structure has collapsed in on the occupants.

Peel and Peek - Pulling the plastic trim on the A, B, and C roof pillars and roof rail, looking for any compressed gas cylinders that will affect the cuts you make or purchase points for spreading.

Pillar/Posts - A vehicle anatomy term meaning the rolled sheet metal assemblies on vehicles that attach the roof to the main body of the vehicle, i.e., (A-Post, B-Post, etc.). Although post was a common term for years, it is now called a pillar by the car industry.

Reading the Wreck - Position, damage, and stability of the vehicle. Vehicle construction, vehicle, and patient condition.



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Roof Flap - Relocation evolution that involves the cutting of strategic roof pillars and conducting relief cuts so that a proportion of the roof structure can be lifted and folded away from the casualty. Depending on the cuts made the roof can be flapped back, to the side or forward over the front of the car.

Size Up - Location of patients, type of vehicle, "reading the wreck"

Space-Frame - A design of vehicle construction that uses a "cage" type frame to which body panels and component parts are attached.

Split Steering Column - A steering column made up of two or more pieces connected by universal joints when the column is assembled.

Stabilization - In vehicle rescue this refers to the immobilization and blocking of the wrecked vehicle in which a casualty is trapped. It can also refer to the casualty or the control of and handling a chaotic emergency scene or hazardous condition.

Steering Displacement - The forcing or relocation of a steering wheel and column in order to provide space for patient access and removal.

Tempered Glass - Specially manufactured glass used in automobile side and rear windows that is very resistant to breakage.

Third Door Conversion - A term that describes an evolution used to open the side panel of a two door automobile creating a "third door" or access opening to the trapped rear seat casualty.

Tilt Wheel Steering - A type of steering column assembly that adjusts both up and down to suit the driver's preference.

Unit-Body - A type of vehicle construction that uses the floor panels, undercarriage and all structural parts of the vehicle welded into a single unit eliminating the need of a full chassis for vehicle body support. Also known as 'monocoque'.

Warm Zone - Transitional zone where equipment is stored, the extrication group supervisor directs rescue efforts, and fire personnel are staged to support the rescue efforts. Additionally, EMS can stage in this area in anticipation of extrication.



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REFERENCES

Training and Equipment Manual:

[Section 306.001, Extrication Equipment Safety Precautions](#)

[Section 306.001a, Extrication Equipment Maintenance](#)

[Section 306.001b, Amkus Extrication Equipment](#)

[Section 306.001c, Hurst Extrication Equipment](#)

[Section 306.002, Rescue Air Chisel](#)

[Section 306.006, Hi-Lift Jack](#)

[Section 306.007, Come-A-Long](#)

[Section 310.007a, Truck Company Inventory – Standard](#)

Individual Performance Evolutions (IPE's):

[Section 316.032, Operate Vehicle Extrication Equipment](#)

[IPE Video 316.032 Operate Vehicle Extrication Equipment](#)