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Photo by Tony Greco.

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Overview of Large Vehicle Construction and Anatomy

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ALTHOUGH THERE ARE VAST DIFFERENCES between standard vehicle extrication and heavy vehicle scenarios, there are also some vital similarities. Safety of our personnel is always the main concern in any operation, but that concern must increase when the size and scope of the incident increase, such as with heavy extrication. Always remember that *everyone* is a safety officer. Strive to maintain good situational awareness regardless of your position or role. Never make assumptions when safety is in question. The results could be deadly.

“Stop” is always the key word used in technical rescue to halt all operations. Often in extrication, the word “Freeze” is alternatively used for the same purpose. The words “Whoa” and “Hold” often get confused with “Go”—avoid them.

Proper personal protective equipment is, of course, always important. No firefighter would enter a burning building today without turnout gear and self-contained breathing apparatus. The lessons learned from the past have conditioned us all to understand and respect the dangers and hazards, seen and unseen. When it comes to extrication, though, many departments are still practicing in the 1980s. Flash protection is required not only for flash fires in extrication but also abrasion and laceration protection. Turnout gear, even lightweight flash gear (such as wildland gear), is the right choice for this task—not a T-shirt, even if it is long sleeved.

Also often overlooked is respiratory protection. When cutting glass or fiberglass, we often take too many chances in the interest of speed or convenience. Although many professional rescue teams choose to wear full air-purifying respirators or dust masks during extrications, something as simple as pulling a Nomex hood over your mouth

and nose can make a world of difference on the exposed faced during a glass-cutting operation. Helmet, boots, gloves, and glasses are also sometimes overlooked or forgotten.

As we move into heavy vehicle extrication, we must always be aware of the special challenges we don't often face.

In a two-car accident, we think about spreading some oil absorbent for the antifreeze and oil; when dealing with big trucks, there are several *gallons* of these fluids to consider. There are air bag systems, air brakes, fuel crossover lines, hazardous cargo, and many other items that we just don't find in a stan-



(1) Photos by authors.

standard crash. As we explore the many features, always keep safety in mind.

Cargo is also a key concern with heavy vehicles; consider this and the impact on our safety. Size-up may begin with binoculars and identifying cargo content from a distance. The bill of lading would be the quickest way to identify cargo, but even that may be a challenge. Many shippers now keep the bill of lading digitally, meaning you'll need the driver and his password to access the information. Language barriers may also present problems with identifying cargo. Be sure to use all your resources to identify anything hazardous prior to committing personnel to the hot zone.

Transportation Statistics

Today, semi transport accounts for more than 70% of the goods moved in the United States. An estimated 13 billion tons of materials are moved annually by around 2 million semi trucks and 13 million by other large trucks.

According to the National Highway Traffic Safety Administration (NHTSA), of the 40,000-plus annual traffic deaths in the United States each year, about 5,000 of those involve semi trucks. Overall, commercial vehicles are involved in about 3% of all accidents. Large trucks account for an injury or a death almost every 15 minutes, and almost every time (98%) it is an occupant in the other vehicle. Annual NHTSA data indicate that roughly 13% of accidents involving a semi result in a fatality, or 1 in every 8 to 10, depending on the year.

It doesn't take much analysis to see that there are a lot of big trucks on the road and that these big trucks make accidents much more serious when they do happen. Being prepared for these serious and complex accidents is essential.

As we consider these potential accidents, it is important to remember the adage that rescue is the science of alternatives. We often talk about having a plan B, but in heavy truck extrication, we should be considering plans C, D, E, and so on. These extrications will be a multiprong approach, often spreading over multiple action areas. It's important to think outside the box as you approach

a heavy vehicle scene, as it is not standard in any way.

Most departments are ill-equipped to handle the tactics involved in a semi truck accident. Knowledge, skills, and abilities are only part of the equation. Proper stabilization tools, the right kind of cutting tools, and adequate external resources are also critical.

Heavy Vehicle Construction

We need to understand the components used in truck cab construction to fully understand how to attack the vehicle in extrication. Most people assume that a semi is built like a tank. In fact, the majority of the material used is fiberglass and aluminum to reduce weight. Those materials can become a tangled mess that you must cut through to remove an entrapped driver (photos 1-2).

There are as many different types of trucks on the road today as there are industries that need transport, but they have more similarities than differences. There are three broad categories that we can divide trucks into: straight trucks, capable of hauling 25,000 to 40,000 pounds; tractor-trailers, capable of hauling 40,000-plus pounds; and specialty

trucks, such as concrete mixers and dump trucks (photo 3).

Cab Designs

Cab over or tilt cab. This is an older style of semi tractor that was popular in the late 1970s and early 1980s; it is not seen as commonly today. The cab over puts the driver over the motor and the cab must be tilted forward to access the engine components. This is exactly like most custom cab fire apparatus (photo 4).

Conventional cab. The more commonly seen semi tractor is the conventional cab. This style has the motor in front of the cab in the "nose" section. The nose is normally constructed of mostly fiberglass and will crush easily but can be difficult to cut. The roof of the cab is commonly a metal frame also covered in fiberglass (photos 5-6).





Regardless of the construction style, both cabs have many similarities. Like many passenger vehicles, the side window glass is tempered and the front windshield is laminated glass. Newer designs have tempered side glass as well. In most semi cabs, the front windshield is held in by a gasket set that can be removed faster than cutting the glass (photo 7).

Cabs are commonly constructed of steel frames and then covered by sheet metal or fiberglass, depending on the make and age of the tractor. Neither provides much protection for the driver, as both will crush easily. Unlike passenger vehicles, semi cabs may have a variety of added features such as air dams, air cleaners, grab bars, and exhaust stacks.

Another big difference between the semi truck and a passenger vehicle is the door attachment. Hydraulic cutters today can make the hinge cut on a car door, but they will do little good on a semi. Instead, the semi door is attached with a piano hinge, a continuous two-section hinge that runs the length of the door connection. This hinge can be attacked with an air chisel or a reciprocating saw.

Trailer Construction—Van

Beyond the cab of the truck is the trailer, which is often where we'll find the vehicle that needs extrication. There are many different types of trailers, but they can be grouped into a few small categories for convenience. The most common

is the van. Commonly called a box trailer, the van is the typical use transport trailer seen every day on almost every road in our nation. When coupled with a refrigeration unit, the van becomes a reefer (short for refrigerated) trailer. The reefer trailer adds a few more hazards to the equation. In addition to the engine mounted to the front of the trailer, a 50-gallon diesel tank is located under the front of the trailer.

Whether the trailer is a reefer or not, all van trailers share some commonalities. There are no longitudinal frame members—the frame is integral, similar to bus construction without the undercarriage. The outer frame rails are thin aluminum rails that run the perimeter of the bottom of the box and are joined together by small metal floor joists. The components are easy to identify by looking at the rivet patterns on the bottom rail of the trailer.

The walls are a layer of thin metal or composite skin over wall joists and roof truss rails. On the inside, walls are often plywood panels with metal tie-down rails or pockets. When breaching a trailer, you must cut and remove both the skin and the inside paneling.

Always take the time to inspect the trailer before lifting or capturing with struts. All aspects of the van trailer are reliant on each other. If the roof or walls are compromised, the entire trailer can easily buckle and roll with only a small amount



of force. Watch for tears in the aluminum, flexing in the walls, or missing pieces.

When a trailer is in any position other than upright, leave the doors closed. The doors provide some of the best support for the trailer when it is racked.

If there is evidence of previous repairs to the trailer, it may eliminate the option to lift the trailer. Watch for degradation in the frame rail or obvious signs of repair, such as bolts and rivets mixed together (photo 8).

King pin. This is the primary, and only, attachment point of the trailer to the tractor. The king pin attaches to the fifth wheel plate of the tractor and allows that trailer to pivot when turning. All the weight is transferred from the floor joists to the side rails and then to the fifth wheel plate.

Jacks. Also called dollies or landing gear, the jack carries the weight of the trailer when it is disconnected from the tractor. The jack is rated to hold the loaded weight of the trailer, making it

a great starting point for stabilization. Most dollies are two-speed, meaning the jack will crank up or down at high speed to take up distance and then low speed to handle the weight. Pushing the handle in or out will determine the gear speed.

ICC bar. Commonly referred to as either the Interstate Commerce Commission bar or the Interstate Collision Control bar, this is the “bumper” at the back of the trailer (photo 9). It was introduced as a means of preventing rear underride collisions of passenger vehicles in a rear-end collision. This bar is a sound structural member, which can be used as a point of stabilization if not compromised. However, most ICC bars are already dented or flexed before the accident even happens.

Trailer Construction—Other

The van trailer is by far the most common, but there are other types of trailers on the road. Depending on the region and industry, you may see more varieties of a different style than the van.

Hopper trailers. Commonly used for both industrial bulk transport and agriculture, hopper trailers have a bottom dump or multiple dumps and haul grain, plastic pellets, dry bulk materials, and fertilizer.

Flat trailers. They haul any material that can be fork loaded, such as longer packages of lumber or steel members. They also haul rolled steel, frequently seen with just one or two rolls because of their weight. Side walls can also be added to flat trailers for hauling loose materials such as produce.

Dump trailers. They haul aggregate, such as cement mix, as well as grain, lime, sand, gravel, and other dry flowables. They have a large hydraulic cylinder that runs off a “wet kit” on the tractor; they can have a central frame or be frameless.

Drop deck trailers. They haul heavy equipment that can be self-loaded, often with ramps. There is also the double drop that provides even more overhead clearance for large loads. The lowboy trailer can also have ramps but often has a detachable front section that allows for loading on the trailer as well.

Tanker trailers. They haul liquids and gases.

Intermodal container trailers. They have the cargo container fastened to the trailer frame.

Special Hazards

Fuel crossovers. Almost all semi tractors have dual fuel tanks to allow for long-duration trips with less refueling. Each tank can hold 100 to 150 gallons of diesel fuel that will spill if the truck is on its side. Many trucks will have a crossover line that may or may not have a shutoff valve. If the valve is there, shut it off so that both tanks don't spill if the truck is on its side. When a truck is inverted, the fuel leak can be a key concern with an increased risk of fire.

Batteries. Generally, on most large trucks and semis, the batteries are located along the frame rail or under the cab steps (photo 10). Most often, they will be in a battery box, which is easily identified. If there are multiple potential boxes, look for the thick cables indicating the battery wiring, and start there. There may also be a red jumper post on the outside of the box. Like with a passenger vehicle, be sure to cut the negative cable first to avoid any arcing.

Air brakes. Semi braking systems are unique in many ways from a typical passenger vehicle. The brakes are actuated through a cam lever that is controlled by a spring-loaded air chamber. A single pancake service brake is commonly found on the front axle, but a double pancake, or maxi cylinder, will be found on drive axles. The maxi brake is a combination service brake and parking brake. The service brake works when the pedal is pressed and air flows into the chamber and presses the diaphragm to force the pushrod out, thus engaging the brake. The parking brake works when the control knob is pushed in and air flows into the back chamber of the maxi. That compresses the spring, allowing the brakes to release. Naturally, the service brakes are overridden when the parking brake is set. If the air pressure bleeds off in the system, the maxi brake spring will be allowed to release (no air), and the parking brake will set. This is true for any parking brake in the system, such as on the trailer, which allows us to set the parking brake by releasing air from the system (removing the glad hand connector).



Air and electrical lines. On the back of the cab of the tractor we find the lines that are connected to the trailer. At a minimum are a red line for the emergency parking brakes on the right and a blue line for the service brakes on the left. While the lines themselves may be black, they will be color coded on the connectors. The quick disconnect coupler is called a “glad hand” connection (shown at the right). If the glad hand is released on newer trailers, the air will bleed, causing the parking brake to engage. However, trailers manufactured in the mid-1970s or before require air to set the parking brake (opposite of modern systems). In addition to the airlines, we will find an electrical connection for the trailer lighting and power. If that line is green, it indicates the trailer is equipped with antilock brakes. Disconnecting the power cable will not shut down a refrigeration unit.

Air ride suspensions. All modern trucks and most trailers are equipped with air ride suspension systems. Although this improves the comfort of the driver, it is more a function of marketing in providing a smooth transport of the material or cargo in the trailer. The air ride works in a similar fashion to the shock absorbers and leaf springs on a passenger vehicle. Likewise, we must make sure our stabilization will be effective, just as we do in passenger vehicles.

When we stabilize a light vehicle, we also ensure positive contact with the frame members, watching for and avoiding the leaf springs or shock tower.

We know that capturing a moving piece with our cribbing will allow the vehicle to have movement, which is what we are attempting to eliminate. In the same way, we must be familiar with the air ride suspensions on trucks and trailers to ensure good, positive contact in stabilization.

To begin with, we need to know how many air bags the vehicle has and where they are located. From there, we can determine where the system pivots or carries the axle. For example, in an eight-bag system, the two axles are pivoting between the balance of the eight air bags. Capturing only two of these points may not have the effect we are looking for and may require bleeding the air out of the bags to gain positive contact. On the front axle, we will only find two bags. Again, we need to be able to capture the truck and frame to avoid the inherent "bounce" in those two bags.

There are a few ways to control the air bags and dump the air out. Keep in mind, this should be controlled, so cutting an air bag with a knife is not a

desired tactic. Instead, the first place to check is the cab for an air ride dump valve. This will bleed the air bags down in a controlled manner. The second option is to control the air bags individually through the leveling arm. If the control rod (connected to the axle) is disconnected, the leveling arm can be pressed, releasing air from the system.

Note: Never pull the valve stems on a heavy truck or trailer tire as a means of stabilization. These tires are inflated to 110 pounds per square inch, making that a dangerous and unacceptable tactic.

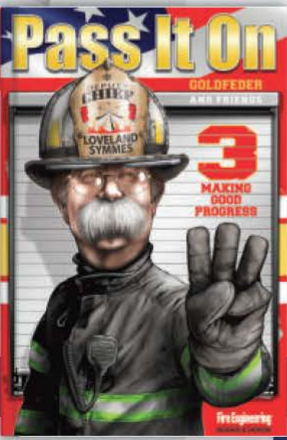
When we look at rescue and extrication in large vehicle incidents, we must consider all construction features. This article just looks at the most glaring issues we have in these types of incidents. To be good and knowledgeable rescuers, we must seek out classes. FDIC International is a good way to start. But, do not forget your recovery operators who work with these on a regular basis. Your local wrecker service may have just the information you are looking for. ■

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