Emergency Vehicle Inspection, Preparation, and Driving Techniques

INTRODUCTION

The intent of this portion of the manual is to provide the candidate with the information needed to safely and efficiently operate emergency apparatus. This section includes but is not limited to vehicle knowledge and inspection, general operation and safety features of the vehicle, and proper driving techniques in normal as well as emergency operations.

The candidate must be completely knowledgeable in all aspects of the vehicle they intend to operate. It is important the candidate is able to demonstrate safe driving habits and is fully knowledgeable of the safety features inherent to the vehicle. The candidate shall be able to identify the various components of the vehicle and explain their use. The candidate will be able to identify any defects, make minor repairs, and understand when the vehicle is to be placed out of service due to safety reasons or major defects. In turn the candidate will be able to complete the necessary documentation required by the Department.

OBJECTIVES

Upon completing this module of the Driver Training Manual, the candidate will be able to correctly identify, maintain, evaluate, adjust, and operate an emergency vehicle. This will involve: being able to identify major components of an emergency vehicle and being able to prepare the vehicle for an emergency response. These operations will include - preventive maintenance, pre-response preparation, safety checks and adjustment. The candidate will know, understand, and successfully demonstrate safe and correct handling of the vehicle in routine, emergency, and dangerous driving situations.

VEHICLE INSPECTION AND DRIVING PREPARATION

Major Motor Vehicle Components

There are many motor vehicle components to be discussed when describing any motor vehicle and some are specifically associated with emergency vehicles. The following is a list of components covered in this section:

- Vehicle characteristics – height, weight, length, and width
- Motor / engine components
- Braking systems: drum, disc, air, ABS, and engine retarders
- Exhaust systems
- Driveline
- Steering system
- Electrical system
- Suspension
- Wheels and tires

VEHICLE CHARACTERISTICS

The characteristic of an emergency vehicle affects the impact on the physical forces of the vehicle. The **height, weight, length**, and **width** of the vehicle are those items that are going to affect to the action and reaction of the vehicle while it is in motion. These items limit the direction of travel of the vehicle due to weight limitations (bridges), height constraints (overpasses), and width restrictions (tunnels).

Height: It is important to know the *overall* height of the vehicle including all lights and other equipment mounted on the top of the vehicle. The operator should be able to recognize not only structural overhangs but also other potential problems, for example tree limbs, power and phone lines, and any other low hanging objects. It is also important to understand the vehicle height plays a roll in how the vehicle is going to handle in terms of braking and turning. The taller the vehicle is the higher the center of gravity. This is important when making turns. Because the center of gravity is higher, the potential for rollover is higher if the vehicle is exceeding a safe turning speed. This higher center of gravity changes the braking on the vehicle as well.

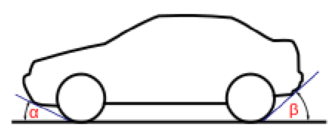
Weight: The gross vehicle weight rating (GVWR) is the maximum operating weight specified by the vehicle manufacturer including the vehicle itself, fluids, accessories, passengers, and cargo. The GVWR is vital to know because of posted weight limits on bridges, overpasses, roadways, and parking areas. All publicly maintained roads have a safety factor designed into the road bed or supporting structures, however privately maintained facilities are unpredictable.

Where a weight limit is posted on a public roadway it can be assumed that the actual designed weight limit is higher. Before entering an area with weight limit restrictions, consider the GVWR of your apparatus compared to the weight limit, the apparent condition of the roadway or bridge, and whether you will be simply passing across the surface or parking on it. When apparatus weight exceeds posted limits, consider another route. Knowledge of territory is key to avoiding these situations.

As with height, the weight of the vehicle influences vehicle handling. The weight of the vehicle has a direct impact on the braking system. The weight distribution between the front and rear axle must be appropriately distributed. The vehicle should have approximately 1/3 the weight over the front axle and 2/3 of the weight over the rear axle. Additionally the weight should be distributed evenly from side to side. Personnel, equipment, and accessories must be placed on the apparatus in a way that avoids overloading components of the vehicle. When weight is distributed correctly the braking, suspension, and steering systems will work as designed.

Another term to be familiar with is “curb weight”. The curb weight of a vehicle is the weight of the vehicle with all of the standard equipment and amenities, but without any passengers, cargo or any other separately loaded items in it. For fire apparatus, this is essentially the weight of the vehicle when it is brand new and leaving the manufacturing plant.

Length: The length of the vehicle is a primary factor in turning radius (wheel base contingent) and angle of approach and angle of departure. It is safe to assume that the longer the vehicle the larger the turning radius must be. The angle of approach and departure are important when moving across changes in grade. Angle of approach and departure are the angles made between the road surface and a line drawn from the point of ground contact and either the front or rear of the tire to any projection of the apparatus. This is important so that the front or rear bumpers or any object of the undercarriage of the vehicle does not come into contact with the road surface.



Angle of Approach and Departure

Width: The width of the vehicle comes into play when driving into diminished clearance environments. It is important that the width of the vehicle is the *overall* width that includes mirrors and any piece of equipment mounted to the exterior of the vehicle. Public roadways have lanes varying from 9 to 12 feet wide.

MOTOR/ENGINE COMPONENTS

There are two types of engines, gasoline and diesel. Their components are very similar in nature. The primary concern to the operator is the type of fuel used by the engine. Care should be taken to ensure the proper fuel is used. The following is a list of the basic components in the motor compartment of the vehicle.

Engine Block: The engine block is where the pistons perform the work to create the motion of the vehicle. The block becomes extremely hot during the operation of the vehicle. Oil and antifreeze pass through the block during its operation.

Radiator: The radiator contains the fluid used to keep the engine block from overheating. The cooling system is a closed system working under a vacuum. ** *NOTE* ** The fluid in this system becomes extremely hot and should not be handled until cooled.

Battery(s): The batteries are the storage area of the electrical system. They are used when starting the vehicle and maintain steady current to electrical components during the operation. Most ambulances have four 12-volt batteries wired in parallel; larger apparatus may have six or more. Older apparatus have a selector switch to opt for either or both batteries. The switch indicates which battery is being charged. Generally, the switch needs to be in the "both" position when starting and running the vehicle. Never turn off the battery switch while the engine is running. This will cause damage to the alternator and electrical system. If the batteries need to be charged, only charge one at a time, and not both, on the selector switch. Charging both could cause one battery to receive an excessive charge, causing the contents to boil, resulting in battery damage or destruction. ** *NOTE* ** The battery (s) contain acid which will harm you if you come in contact with it.

Power Steering Pump: The power steering pump pressurizes the fluid used to assist in steering the vehicle. The fluid in this system is stored in a reservoir and can be checked either while the engine is cold or hot. There are differentiating indicator marks on the dipstick for this purpose.

Brake Master Cylinder: The fluid for a hydraulic brake system is contained in the brake master cylinder. Most are translucent so the fluid level can be checked without removing the caps. It is important that no contaminants enter the brake system, therefore it is best not to remove the caps. If brake fluid is found low, consult with CMF prior to adding any fluid.

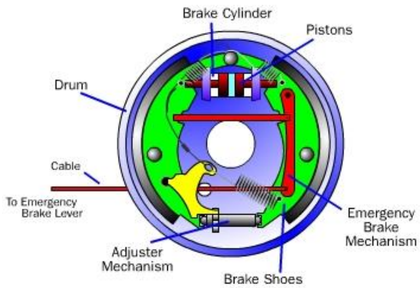
Fan/Accessory Belts: These belts are used to power various motor accessories, such as the cooling fan for the radiator, alternator, and air conditioning compressor.

BRAKING SYSTEMS

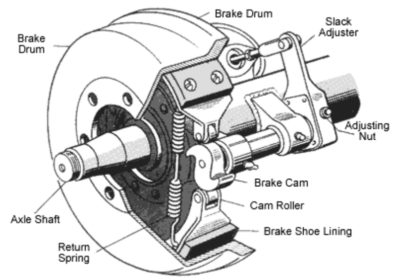
A vehicle's braking system converts inputs from the brake pedal or parking brake controls in the cab to the friction devices (brakes) located at each vehicle wheel.

Systems on MCFRS apparatus either use liquid or air to create the forces to engage the friction devices. Liquid systems are known as hydraulic.

There are generally two types of friction devices used to slow or stop vehicles, *drum* or *disc* brakes. *Drum* brakes contain two brake shoes that create friction when pushed outward against a surrounding drum. The drum is attached, and rotates with, the wheel. Pressure on the brake pedal causes fluid or air to actuate a cylinder at the wheel. The cylinder then moves the brake shoes outward against the brake drum to create friction. The friction of the shoe against the drum causes the wheel to slow or stop.

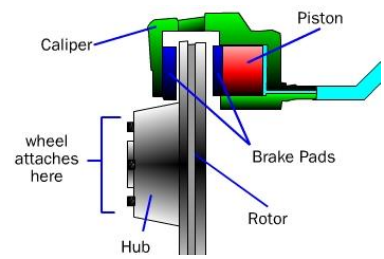


Hydraulic Drum Brake



Pneumatic Drum Brake

Disc brakes are comprised of brake pads and a caliper that squeeze the rotor to stop the vehicle. The rotor is a disc that is attached to the wheel axle. When the brake pedal is depressed, a piston in the caliper causes the caliper to squeeze together, bringing a pair of brake shoes into contact with the rotor. The friction of the opposing brake pads as they squeeze the rotor slows the rotor rotation and causes the wheel to slow and stop.



Disc Brake

Air brakes use compressed air to control the application of the brakes. An air brake system is comprised of three primary parts: service brake, parking brake, and emergency brake systems.

- The *service brake* system applies and releases the brakes when you depress the brake pedal during normal driving operations.
- The *parking brake* system applies and releases the parking brakes when you use the parking brake control.
- The *emergency brake* system uses parts of the service and the parking brake systems to stop the vehicle in the event of a brake system failure.

There are many individual components of the air brake systems. The following are some major parts of the system:

Air compressor – The air compressor pumps air into the air storage tanks. The compressor is connected to the engine through gears or a V-line belt. The compressor may be air or oil cooled.

Air Compressor Governor – The governor controls when the air compressor will pump air into the air storage tanks. When the air tank pressure rises to a preset level (around 125 psi) the governor stops the compressor. When the tank pressure falls below a preset level (around 100 psi) the governor allows the compressor to start pumping again.

Air Storage Tank – Air storage tanks are used to hold the compressed air. The number and the size of the tank(s) depend on the size of the vehicle. The tanks will hold enough air for the brakes to be used several times if the compressor fails to work. Compressed air usually has some moisture in it, which is bad for the air brake system. The water can freeze up in cold temperatures and make the brake system fail. The moisture tends to collect at the bottom of the air storage tanks. To ensure the moisture is removed form the tanks; each is equipped with a method of *bleeding* the tank. There is a manual method, which is done by either turning a stopcock valve located at the bottom of the tank allowing the air and moisture to be removed, or by pulling on a cable attached to a bleed off valve located at the bottom of the tank allowing the air and moisture to be removed. ***NOTE*** It is important to remember that once the tanks have been bled the system must be recharges prior to moving the vehicle. In some vehicles there is an *automatic bleed and dryer*. The automatic system responds by bleeding small amounts of air during normal operations. This has little impact on the operation of the brakes but does remove the moisture from the system. In addition there is a dryer attached to the system, which heats the air to keep the moisture level down in the system.

Safety Valve – A safety valve is installed in the first air tank the air compressor pumps air to. This valve protects the tank and the rest of the system from being over pressurized. This valve is usually set to release at 150 psi. ***NOTE*** If this safety valve releases air there is a problem that a mechanic should be notified immediately.

Brake Pedal – To apply the brakes you press down on the brake pedal. Pushing the pedal down harder applies more air pressure. Letting up on the brake pedal reduces the air pressure and releases the brakes. Releasing the brakes lets some of the compressed air to go out of the system, so the air pressure in the tanks is reduced. Pressing and releasing the pedal unnecessarily can let air out faster than the compressor can replace it. I f the pressure gets to low the brakes will not work.

Foundation Brakes – Foundation brakes are used at each wheel. The most common type is the S-cam drum brake. The following is the break down of the brake parts:

- **Brake drums, shoes, and linings** – Brake drums are located on each end of the vehicles axles. The wheels are bolted to the drums and the braking mechanism is inside the drum. To stop, the brake shoes and linings are pushed against the inside of the drum. This causes friction, which slows the vehicle (and creates heat). The heat a drum can take without damage depends on how hard and how long the brakes are used. Too much heat can make the brakes stop working.

- **S-cam Brakes** – When you push the brake pedal, air is let into each brake chamber. Air pressure pushes the rod out, moving the slack adjuster, thus twisting the brake camshaft. This turns the S-cam (named because of its S design). The S-cam forces the brake shoes away from one another and presses them against the inside of the brake drum. When you release the brake pedal, the S-cam rotates back and a spring pulls the brake shoes away from the drum, letting the wheels roll freely again.
- **Wedge Brakes** – In this type of brake, the brake chamber push rod pushes a wedge directly between the ends of the two break shoes. This shoves them apart and against the inside of the brake drum. Wedge brakes may have a single brake chamber, or two brake chambers, pushing wedges in at both ends of the brake shoes. Wedge type brakes may be self-adjusting or may require manual adjustment.
- **Disc Brakes –** In air-operated disc brakes, air pressure acts on a brake chamber and slack adjuster, like S-cam brakes. But instead of the S-cam, a "power screw" is used. The pressure of the brake chamber on the slack adjuster turns the power screw. The power screw clamps the disc or rotor between the brake lining pads of a caliper, similar to a large C-clamp.

Supply Pressure Gauge(s) – All air-brake vehicles have a pressure gauge connected to the air tank. If the vehicle has a dual air brake system, there will be a gauge for each half of the system. (Or a single gauge with two needles). These gauges let you know how much pressure is in the tanks.

Low Air Pressure Warning – A low pressure warning signal is required on all vehicles with air brakes. A warning signal you can see must come on before the air pressure in the air tanks falls below 60 psi. The warning is usually a red light and on some vehicles a warning buzzer sounds as well.

Stop Light Switch – Drivers behind you must be warned when you put your brakes on. The air brake system does this with an electric switch that works by air pressure. The switch turns on the brake lights when you are applying the brakes.

Spring Brakes – All vehicles must be equipped with emergency brakes and parking brakes. They must be held on by mechanical force (because air pressure may leak out). Spring brakes are used to meet these needs. When driving powerful springs are held back by air pressure. If the air pressure is removed, the springs put on the brakes. A parking brake control in the cab allows the driver to let the air out of the spring brakes. This lets the spring brakes on. A leak in the air brake system, which causes all the air to be lost, will also cause the springs to put on the brakes.

Parking Brake Controls – In most vehicles, you apply the parking brakes using a *diamond-shaped, yellow, pull-push control knob.* You pull the knob out to put the parking brakes on (spring brakes), and you push it in to release them.

NOTE Never push the brake pedal down when the spring brakes are on. The combined forces of the springs and the air pressure could damage the brakes.

Apparatus equipped with air brakes use two methods for parking brakes. First is a driveline brake, which is an actual disc or drum that attaches to the drive shaft and is operated by cables or levers. The second type is a spring-activated brake atop a service brake chamber that automatically applies the brake when the air pressure drops below a preset pressure.

It is important to define what a *Dual Air Brake System* is. Most new vehicles use a dual air brake system for safety reasons. A dual air brake system has two separate air brake systems that use a single set of brake controls. Each system has its own tanks, hoses, and lines, etc. One system typically operates the regular brakes on the rear axle(s). The other system operates the regular brakes on the front axle. The first system is called the primary and the other called the secondary system.

Many vehicles are equipped with *Antilock Braking Systems (ABS)*. The purpose of the *ABS* is to permit the driver of the vehicle to stop the vehicle in the shortest possible distance while maintaining full control. By preventing the wheels from locking, *ABS* helps to improve control and stability. *ABS* allows steering during braking applications, and in most instances, reduces stopping distances, especially on wet, icy, or loose gravel surfaces. *ABS* use sensors at each of the wheels to send wheel speed information to a central computer. When the computer senses that a wheel is about to lock up, it automatically “pumps” the brakes on that wheel.

Due to the size and weight of today’s apparatus, secondary or auxiliary braking systems have been added to increase the braking capabilities of the vehicles. Essentially there at three (3) types of auxiliary braking systems:

- Engine Brake
- Automatic Transmission Retarder
- Driveline Retarder

The *engine brake* is known as a compression brake. The brake mechanism uses the “compression” that the engine creates to slow the vehicle down. Essentially the system is allowing more new air into the cylinders of the engine causing it to work or bear down harder creating less horsepower and a force. The *engine brake* customarily comes with a selection switch allowing the driver to decide on the amount of work the braking system should do (2 cyl, 4 cyl, 6 cyl) or high or low. It should be noted that *engine brakes* on vehicles with automatic transmission are typically not effective below 20 miles per hour (mph) due to the low rpm’s of the engine while operating at low speeds. ***NOTE*** Most manufacturers recommend the retarder be turned off during inclement weather or slippery road conditions.

The *automatic transmission retarder* is attached to the transmission either on either end of the transmission. The input retarder operates on the input end and the output retarder, which is the most prevalent on fire service apparatus, is attached to the output end of the transmission. The retarder system is selfcontained and consists of a vaned rotor, which rotates in a vaned cavity. The rotor is splined to and driven by the output shaft. An external accumulator holds transmission fluid until the retarder is activated. When activated, the fluid in the accumulator is pressurized and directed into the retarder cavity. The interaction of fluid with the rotating and stationary vanes causes the retarder rotor speed, and hence the output shaft, to decrease and slow the vehicle. ***NOTE*** Most manufacturers recommend the retarder be turned off during inclement weather or slippery road conditions.

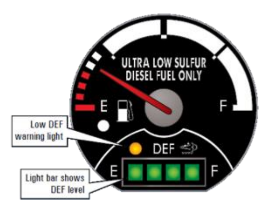
The *driveline retarder* can be divided into 2 types, hydraulic and electromagnetic. Both types are attached to the driveshaft between the transmission and the rear axle. The hydraulic type absorbs energy by pumping oil around the driveshaft slowing the vehicle down. The electromagnetic retarder sets up a magnetic field that grabs the driveline. The absorbed energy is transferred to the surrounding atmosphere as heat. ***NOTE*** Most manufacturers recommend the retarder be turned off during inclement weather or slippery road conditions.

EXHAUST SYSTEMS

Vehicle exhaust systems have grown increasingly complicated as emission control standards have increased. Since 2007 most diesel engines are equipped with "aftertreatment" systems integral to the exhaust system. For the apparatus operator, there are two primary areas of concern that impact vehicles equipped with these systems; the Diesel Exhaust Fluid (DEF) and the Diesel Particulate Filter (DPF). Both the DEF and DPF are included in the instrument panel light cluster to alert the driver to the system status.

DEF is a non-hazardous solution of 32.5% urea and 67.5% de-ionized water used in post-2009 diesel vehicles. DEF is sprayed into the exhaust stream of diesel vehicles to break down nitrogen oxide emissions into nitrogen and water. DEF is **not a fuel additive** and never comes into contact with diesel. It is stored in a separate tank, typically with a blue filler cap.

The DEF tank is separate from the diesel fuel tank and should be refilled only when it reaches half. There is no need to continuously top off the DEF tank. The DEF level indicator is generally located immediately adjacent to the diesel fuel level indicator on the dashboard. DO NOT allow the DEF tank to reach empty or the vehicle will automatically reduce power.



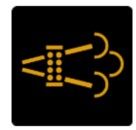
CMF stocks DEF in 2.5 gallon containers with filler tubes. DEF may be requested as needed through normal supply procedures.

DEF crystallizes when stored for prolonged periods as the water evaporates. Do not use DEF that shows signs of crystallization and always completely use a container to avoid storing opened containers.

Use the filler tube supplied with the case to avoid spills or splashes. Spills can be safely washed down with water. DEF is not corrosive to human skin, however is corrosive to aluminum. Do not allow it to remain on the diamond tread.

The freezing point of DEF is 12°F, however vehicles are equipped to thaw the DEF and this should not restrict use of the vehicle.

Personal protective equipment is not necessary when handling DEF, however it will stain clothes.



The DPF indicator illuminates when sufficient particulate has accumulated in the system to require regeneration. Regeneration occurs in one of two modes; automatically when the vehicle is at highway speeds for in excess of 20 minutes or while parked. Parked regeneration is most likely the mode required simply due to the type of driving done by fire apparatus. Personnel must refer to the manufacturer's instructions for the breed of apparatus for specific instructions on conducting regeneration.

Beyond the emissions control features, the exhaust system is basic and is comprised of a muffler or mufflers, exhaust pipes, tail pipes, and or vertical stacks. It is important to note that a faulty exhaust system affects the performance of the motor and can emit poisonous fumes into the crew area causing serious illness.

DRIVELINE

The driveline consists of the transmission, front universal joint, driveshaft, rear universal joint, differential, and the rear axle. The transmission is a system of gears that allows change in the ratio of the number of engine revolutions to the number of wheel revolutions. The drive shaft connects to the rear of the transmission and is powered to turn the differential. The differential is a component of the rear axle that the rear wheels are attached to. The entire system works in unison to rotate the rear wheels.

There are two types of transmissions: standard and automatic. The standard or manual transmission uses a clutch assembly to shift the transmission gears depending on the RPMs of the motor and the desired speed requested. Computer modules control the automatic transmissions. The modules signal and influence the engines RPMs during transitional shifting.

STEERING SYSTEM

The steering wheel and column connect to steer the vehicle. They connect to a gear and linkage mechanism that changes the direction of the front wheels. In most vehicles this either "power assist" or "power steering" to ease the turning of the steering wheel. These are both hydraulic (fluid) driven systems.

ELECTRICAL SYSTEMS

The electrical system supplies power for primary and auxiliary functions. The primary functions of the electrical system include: power the generator and storage battery, generator/alternator, and voltage regulators; power distribution (via engine wiring); timing (distributor); and spark generation if equipped. Auxiliary functions include: inside/outside lighting (headlights; amber, red signaling or warning lights; turn signals; instrument panel lights; etc.); and horn, siren, and public address system.

SUSPENSION

This system is comprised of leaf springs, shock absorbers/coils, air rides, and wheels, and tires that enable the driver to handle the vehicle properly on rough terrain and sharp curves.

WHEELS AND TIRES

As mentioned before the wheels and tires are a part of the suspension system; however, it's important to define them a bit more. Both wheels and tires must have a weight rating which will accommodate the weight distributed through the axle and springs. The condition of the tires is based on inflation, tread design, and tread wear. All of these have a major impact on vehicle handling. Each tire has only about 40 square inches of contact with the road. It is imperative that both the inflation pressure and tread be in good condition to provide maximum safety. The minimum recommended tread depth for emergency vehicles is 4/32 inches for front tires and 2/32 inches for rear tires.

EMERGENCY VEHICLE PRE-RESPONSE PREVENTIVE INSPECTIONS

Emergency vehicles of all types should be inspected prior to and again within 24 hours after being used for an emergency response. Emergency vehicle accidents caused by the lack of maintenance or vehicle malfunction are preventable. Physical and visual inspections must be done on a routine basis. In the final analysis, no matter who performs the actual maintenance on the vehicle, it's the driver's responsibility to confirm the vehicle has been inspected prior to use. The driver *must* verify that the vehicle is in proper operating condition. The responsibility for the mechanical safety of the vehicle is that of the driver. *IF IT ISNT RIGHT, DON'T DRIVE IT*. The purpose of the pre-response preventive maintenance inspection is two fold – identify and correct unsafe conditions.

Inspection guidelines are broken down into nine (9) core areas to expedite the inspection process.

- Check prior maintenance records
- Conduct a vehicle overview
- Conduct an engine compartment check
- Conduct an interior cab check
- Conduct a vehicle walk around check
- Conduct a compartment and equipment check
- Conduct an undercarriage check
- Conduct a moving and driving test
- Complete inspection process

All inspections, maintenance, and repairs must be recorded by the Department. The records must include the date and description of all maintenance, repairs, and inspections performed. The following is a break down of the nine categories listed above:

Check PM Records - Each day the records of the previous days should be reviewed for defects and repairs.
Vehicle Overview – Conduct a vehicle overview including inspecting for body damage and cleanliness; and leveling of the vehicle (indicates suspension problems).
Engine Compartment – Conduct an engine compartment check with the engine off. You should check the following:

- Oil levels
- Coolant levels
- Power steering fluid level
- Transmission fluid level
- Air compression belts
- Hydraulic reservoir
- Brake fluid level
- Battery fluids both left and right
- Windshield washer fluid levels
- Belts and wiring harnesses
- Steering box not leaking
- Safety devices including hood latches and safety bars for tilt cabs

Interior Cab – Conduct an interior cab check by first properly preparing for the vehicle inspection:

- Engage the parking brake, chock the wheels, turn the batteries on, turn on the ignition master, place gears in neutral, and start the engine.
- Check the instrument/dash gauges for operating voltages, temperatures, pressures, and levels.
- Check the accelerator pedal padding, in place and not loose.
- Engage and disengage emergency air brake system.
- Conduct air/hydraulic brake test and listen for oblivious leaks, and/or blown diaphragms.

- Check steering wheel and column for centering, excessive play (greater than 10 degrees), and abnormal movement.
- Check electric/air horns for equal tone quality from each horn and blown diaphragm for moisture or oil on the windshield of the horn.
- Check electronic and mechanical sirens for excessive draw on ammeter and voltage fluctuations and electrical system problems.
- Check windshield wipers and washers as well as heating and defrosting systems.
- Transmission controls, such as the clutch catch or friction point, should be checked to ensure there is no hang up or binding and that it does not jump out of gear.
- Check radio equipment including fixed, portable, public address system, and cellular phone.
- Interior lighting systems in the cab and crew compartments should be checked to ensure they are working properly.
- Mechanisms for the seat adjustment, both mechanical and pneumatic, should be checked to ensure they are working properly.
- Check seatbelt (occupant restraints) systems.
- Check the interaxle differential locking systems, both dual and tandem axle.
- Check warning lights and buzzers systems, including oil, water, and transmission fluid level and temperature and open door compartment warning lights.
- Ensure outside mirrors, both manual and mechanical, can be adjusted and the wiring for the heating system is intact and operational.
- There should be the appropriate maps and accountability rings/systems on board.
- Internal communication devices and equipment (David Clark Systems) should be checked.
- Check the fast idle RPMs to ensure that it can maintain the electrical system.
- Check emergency lighting.

Vehicle Walk Around – Conduct a vehicle walk around and operate and/or check the following:

- Windshield and windows for any cracks that may necessitate taking the vehicle out of service.
- Check headlights, both low and high beams and four way flashers.
- Check the strobe lights and all the emergency vehicle-warning lights.
- Light bars, rotating lights, and/or oscillating lights should be checked.
- Check side markers and reflectors.
- Check turn signals.
- With assistance, check to make sure all the brake lights are operational.
- Check flood light systems.

- On the tires and wheels, check for oblivious gouges, slashes, cuts, bubbles, or any other damage. Make sure they are the proper size and are not mismatched. Look for indications of rust or peeling paint on non-aluminum rims. Check the condition of the lug nuts and wheel hubs. Check for any grease leaks. Inspect the rims for damage and missing weights. Make sure the tire pressure is correct and the valve stems are intact with caps. The depth of the tread should be 4/32" in the front and 2/32" in the rear.
- Check the auto chain systems for the rear wheel to make sure they function properly.
- The undercarriage should be checked for any oblivious fluid leaks in the engine area (note the color of the fluid leaking).

Compartment Check – Conduct the compartment and equipment check:

- Make sure the compartment latching mechanisms work properly.
- Compartment equipment must match the inventory and are in its proper place.
- Make sure the circuit breakers are working properly.
- Ensure there are sufficient warning devices such as cones, flares, and reflective triangles on board.
- Fire extinguisher is on board and fully charged.
- Check for appropriate documentation (accident reports, vehicle registration etc.)
- Crew equipment should include SCBA, hand lights, AED, EMS, as the basic, should be checked to ensure they are in working order.
- Ensure all other equipment is working properly.

Undercarriage – Conduct an undercarriage check:

- On the undercarriage bleed the moisture from the air tanks as required to check the color of the fluid being emitted – light gray sludge indicates a bad compressor: leaks from system ***NOTE*** Moisture should be bled from tanks frequently during inclement weather and temperature fluctuations. The brake lines should be checked for cracks, fraying, dry rot, pulling or distortion, or wear marks. ***NOTE*** Check slack adjusters for excessive movement, not more than 1 inch, and whether they are frozen in place. Do not attempt to make slack adjustments; trained personnel should conduct the adjustments.
- The driveline (engine to differential/rear axle) should be properly greased, make sure there is no excessive movement in the joints, and the dust covers are intact.
- Check the exhaust system for soot, black smoke, clamps and hangers, and any pitting on the underside.
- On the suspension system, mechanical or pneumatic, check the leaf springs for cracks and breaks, shackles and hangers, shock towers, and leaks and air leaks (shocks or bags).

- Make sure the automatic chain systems are securely attached and lined up properly.
- Look for oblivious damage, such as rust, loose parts, shiny spots, asymmetrical parts (out of alignment), any cracks in the frame rails, and shifting body mounts.
- The inner sides of wheels and tires/ sidewalls on the tires should be checked for excessive dusting, fluid leaks, bad seals, and cracked brake drums and shoes.
- The wiring harness should be checked fro frayed or cut wire.
- Check the fuel tank for oblivious leaks that straps and grounding pad are intact, fuel lines are ok, and the overflow is not kinked.
- Check for leaks of any fluids and if there is, their point of origin, either the transmission, rear end, or plugs, vents or right side or rear axle. Do not paint over any of these areas.

Brake Test/Air Brakes – For vehicles equipped with service air brake systems, conduct a DOT Brake Test. Reference the Practical Application Guide Sheet for Pre-Trip Air Brake Check. Note: this test is ONLY to be used on apparatus with air brakes. Some EMS Units are equipped with hydraulic brake systems.

Complete Inspection Process – Document the pre-response inspection and compare it to the previous report. Follow-up on discrepancies noted. If discrepancies are noted that influence on function, operational/directional ability, and/or safety, place the unit out-of-service and consult with the appropriate maintenance personnel before placing the unit back in service for responses.

ROUTINE MAINTENANCE ON EMERGENCY VEHICLES

Operator safety is dependant on the vehicle condition. Well-maintained vehicles have fewer malfunctions and are easier to control. The Department must identify the role of the emergency driver in the inspection and maintenance program. Routine maintenance of the vehicle is the responsibility of the driver. The Department should maintain checklists for these types of inspections and routine maintenance functions. Deficiencies should be repaired or reported in writing to the individual responsible for the maintenance. The role of the emergency driver as it pertains to preventive and routine maintenance is defined in NFPA Standard 1002, Fire Department Vehicle Driver/Operator Professional Standards. Applicable, with minor adjustments, to all emergency vehicles the standards states:

"… Prior to operating fire department vehicles the fire apparatus operator **shall** meet the job performance requirements as defined in …"

As this relates to the preventative maintenance function, it specifically states that the driver shall be able to "perform routine tests, inspections, and servicing functions on the specified systems and components and ... so that the operational status of the vehicle is verified."

The systems and components identified in NFPA 1002 are listed here. Items for consideration under each are identified as reference:

Batteries:
- Connections of the cables are clean and tight
- Battery box/compartment is clean and secure

Braking System:
- Air Brakes
  - Pressure prior to starting the engine (air) should be approximately 125 psi;
  - Build-up time, if appropriate (air), when the engine is operating at normal RPMs, the pressure should build from 85 psi to 100 psi within 45 seconds in dual air systems. In single air systems, pressure should build up from 50 to 90 psi within 3 minutes when operating at normal RPMs.
  - Moisture in system/drain air tanks, in tanks with manual bleed valves, turn the valve ¼ turn to drain air, moisture, and dirt from system. Return valve to closed position to build up air in system again
- Hydraulic Brakes
  - Proper fluid level in the master cylinder
  - No signs of leaks or damaged lines
- ABS verification (dash light)
- Braking Operation (during runs as well as at inspection time)
- Brake pedal (proper range of motion)

Coolant System:
- Correct level (generally approximately 2 inches below the top of the radiator, check with local requirements)
- Hose and/or connections wear/leaks

Electrical System:
- Ensure all lights and audio equipment is operational, if bulbs need to be replaced make sure the correct bulb size and style is used and replace faulty fuse in audio system if needed.
- Voltmeter should be reading between 12 and 14 volts

Fuel:
- If not above ¾ full, fill tank with proper type of fuel

Lubrication:
- Check for leaks on the floor of grease droppings
- Ensure there is not grease thrown in the engine compartment or body

Oil (Motor):
- Leaks on the floor under the vehicle

- Proper levels checked using the dipstick in the engine compartment ***Note*** The engine oil should be checked when the engine is cool or cold, when the motor is warm or hot the oil is dispersed throughout the engine. To properly check the level the oil should be allowed to settle back into the oil pan located at the bottom of the engine. This typically takes 20 to 30 minutes after the engine is shut down
- The color and texture of the oil on the dipstick should be noted. If the oil is frothy (bubbly) or a color other than dark brown or black, it should be investigated

Tires:

- Condition (sidewalls, rims, tread)
- Correct inflation pressure, fill as needed to the rated pressure for that tire

Steering System:

- Ease of operation (power OK and no extra play)
- Correct fluid level, this may be checked while the engine is hot or cold and the fluid level should correspond to that on the dipstick

SAFETY CHECKS AND ADJUSTMENTS MADE BEFORE DRIVING

There are certain items that should be checked by the driver prior to moving the vehicle:

Occupant Restraint Systems – Restraints reduce the likelihood of serious injury or death in the event of an accident. The law requires that there be a restraint for all riders and that they be used any and all times the vehicle is in motion. The restraints keep the driver in position behind the wheel and in front of the controls during sharp turns, over excessive maneuvers, roll overs, and yaw skidding or spins.

Adjustable Head Restraints – Head restraints help prevent cervical spine and other in juries from hyperextension and hyperflexion; ie. forces resulting from rear end collisions. The proper adjustment for the head restraints is to have the center of the restraint at the center of the scull not at the base of the neck. If the restraint is to low, the neck could be broken if force of impact is great.

Seat Position – When the seat is properly adjusted, the brake and accelerator can be applied fully without fully extending the leg. The steering can be held with only a slight bend at the elbows. The seat should be fully locked into position. If the seat was to move during operation, it could cause the driver to loose control.

Mirrors – Check for proper adjustment of the inside mirror if applicable. This mirror is used to watch personnel if need be. The outside, side-view mirror should have the edge of the vehicle’s rear fender and side lanes visible. Convex mirrors assist drivers by providing wide-angle views of traffic on either side of the vehicle. In all vehicles the most dangerous blind spots are by the rear quarter panels. In larger vehicles there are generally blind spots below the mirrors.

PRECAUTIONS BEFORE MOVING

The safety of the entire crew pertaining to the vehicle movement is that if the driver. Prior to moving the vehicle an audible signal from all crewmembers that they are belted and ready should be heard by the driver. Only one person (besides the driver) should be in the front seat or control cab. Prior to moving, ensure the station doors are opened, all compartments and cab doors are closed, and there are no obstacles in the path of the vehicle. If responding, ensure that all emergency lights and audible warning devices are on and sounding. Taking these precautions will provide a safe operation of the vehicle.

OPERATING AN EMERGENCY VEHICLE

Purpose of Emergency Vehicle Signaling Equipment

Lights and sirens (Emergency Vehicle Signaling Devices) are used to inform traffic, both vehicular and pedestrian, of an emergency vehicle presence and aids in clearing a path for the emergency vehicle. Warning and signaling equipment assist the operator with arriving at an incident safely. Due regard ***MUST*** always be exercised, regardless of the seriousness of the emergency.

Local Law (Maryland)

Maryland law requires an emergency vehicle operator to activate and use emergency warning and signaling devices while responding to a “bonafide” emergency call. In return for this, emergency vehicle operators are granted “qualified privilege” with regard to basic rules of the road. To respond to an emergency call, and be covered as an emergency vehicle under statue or law, the emergency vehicle operator must display all appropriate audible and visual warning and signaling devices. Responses to incidents are either emergency or non-emergency. If the operator decides to take advantage of “qualified privilege”, full use of audible and visual devices must be used. You can’t be selective. It is important to remember use of signaling equipment by the operator ***DOES NOT*** guarantee operator safety, nor does it free the driver from the possibility of civil or criminal liability if a mishap does occur.

To better understand the liability and responsibility of the driver, a few definitions will be discussed. They are as follows:

- **True Emergency** – is defined as a situation in which there is a high probability of death or serious injury to an individual or significant property loss.
- **Due Regard** – for the safety of others means that a reasonably careful person performing similar duties under similar circumstances would act in the same manner.

- **Negligence** – A legal deficiency or wrong that results whenever a person fails to exercise that degree of care that a prudent person would exercise under similar circumstances.
- **Gross Negligence** – Is the reckless disregard of the consequences of an act to another person. It occurs when a person's actions (or lack of) result in the failure to exercise even a slight degree of care.
- **Willful and Wanton** – Intentional or with careless indifference (considered the most serious for of negligence).
- **Vicarious Liability** – The legal liability placed on one person for the acts committed by another person.

Usually a court will judge the actions of an emergency vehicle driver based on two primary considerations: First, was the emergency vehicle responding to a **true emergency**? Second, did the emergency vehicle driver exercise **due regard for the safety of others**? If the answer to both questions is yes, the emergency driver has demonstrated a responsible and professional attitude through his/her subsequent action(s).

Using Emergency Vehicle Signaling Equipment

An emergency vehicle driver should use all signaling devices when responding. Remember that most emergency vehicles are taller than the average automobile on the road. You, as a driver should use all means to gain the attention of the vehicles in front of you. When approaching a vehicle from the rear at night, flick the vehicle's high beams on and off to get the attention of the vehicle in front of you.

It's a good practice while responding to an emergency to leave the drivers' and officers' windows down at least partially. This will aid in hearing other responding apparatus, trains, and approaching traffic. Pay attention to the reaction of the other drivers. They, for the most part, are trying their best to move out of your way, however; they are reacting to your actions and not paying attention to the other vehicles on the road. **PAY ATTENTION!**

BASIC EMERGENCY VEHICLE CONTROL TASKS

Steering, accelerating, and braking accomplish directional and velocity control. A competent emergency vehicle driver understands and properly completes all of the basic driving maneuvers necessary to operate the emergency vehicle they are certified to operate.

Steering – Steering an emergency vehicle, whether driving non-emergency, responding to an emergency, or making an evasive maneuver, requires certain habits. These include:

- Use both hands on the steering wheel. Exception includes operating another device on the vehicle such as shifting or turning on the windshield wipers.

- Keep arms inside the vehicle. Do not engage in other activities such as drinking, eating, smoking, or talking on the phone while operating the vehicle.
- Maintain hands in the "3 and 9" position on the steering wheel.

Braking and Stopping – Effective braking is essential to the safe operation of an emergency vehicle. The intent is to stop the vehicle in as short a distance as possible while maintaining control. In a vehicle with hydraulic brakes, this involves firmly pumping on the brake pedal and releasing it prior to the locking of the wheels. Air brakes require firm and steady pressure without pumping. To have effective braking on a vehicle with anti-lock braking system (ABS), whether installed in conjunction with a hydraulic or an air system, you must follow the procedures below:

- On vehicles equipped with air brakes, the brake pedal should be initially firmly pressed. The driver must ease up as the braking continues, and ease the pressure on the brake pedal just before stopping to avoid a jerking action.
- If the vehicle's wheels lock, immediately release the brake pedal and steer with the skid. Reapply the brakes when control has been established.
- It is important to recognize the continuous braking over a period of time builds up a tremendous amount of heat. This could cause glazing of the brakes that greatly reduces the braking capacity of the system and could cause brake failure.
- On vehicles equipped with a secondary breaking system, apply the system in accordance with the manufacturer's recommendations. Recognize that some applications of secondary braking systems can cause a reduction in tire traction.
- In areas where there is a high probability of braking, passing through an intersection or traveling against traffic; the driver should place their foot over (cover) the brake pedal. This action will reduce the reaction time.

Backing – Backing mishaps account for a large portion of emergency vehicle accidents. Most backing accidents are relatively minor, however, they can have a wide range of consequences. Accidents keep emergency vehicles out of service for repairs; they cause the operator a lot of paperwork and time, and cost the taxpayers money. These accidents also create a bad public image.

Techniques to minimize backing accidents require common sense. Take a few extra seconds to ensure safety in backing. Plan ahead. Some guidelines for backing an emergency vehicle include:

- Park so as to minimize the need for backing - If thought is given to the position necessary for a vehicle leaving its location, a simple adjustment in the final placement can minimize or even eliminate the need for backing.
- Give audible notice – If the vehicle is equipped with a back-up alarm, shift the vehicle into reverse while applying the brakes. This will initiate most back-up alarms. If the vehicle is not equipped with an alarm, touch the horn lightly 3 times before beginning the backing maneuver.

- Use a spotter – The spotter is to be located at the rear and left of the vehicle. Remember, the driver must be able to see the spotter and vice versa. The driver and the spotter must make mutual eye contact. If the spotter disappears from the mirror, the driver must stop immediately. *IF* a spotter is absolutely unavailable, conduct a walk around the vehicle before backing.
- Understand hand and audible signals – Ensure that the driver and spotter have the same understanding of what the signals mean.
- Use side mirrors – The driver should not attempt to lean out the window or turn around trying to see. Periodically check the right side mirror for objects in the path of the vehicle.
- Check the front corners – Either the right or left front of the vehicle may swing around and strike a fixed object that did not initially appear to be a potential problem.
- Maintain speed control – Backing should be done at an extremely slow speed. It is imperative to maintain tight control on the speed of the emergency vehicle.

The bottom line is this – when you strike something while in reverse and you do not have a spotter in place, you don't have any excuse! If it's predictable it's preventable. There are no excuses for backing accidents when spotters are available.

Parking – Good parking skills are essential. Parking is a basic control task, but requires many driving skills. When it is performed under stress, it can be difficult and time consuming. Parking in the emergency mode must be done quickly. It requires skill to do it fast and without mishap. Parking generally consists of three types – angular, perpendicular, and parallel. On an incident any one or all of these skills may be used to properly place the vehicle. Some factors to take into account when positioning an emergency vehicle are as follows:

- Position emergency vehicles at incidents so as to minimize the blinding effect of warning lights on approaching and passing vehicles.
- Identify potential hazards at the incident and the possibility of escalation.
- Identify appropriate safe distances for certain type of emergencies.
- Consider the ease of leaving the scene because of changing conditions at the emergency incident or a directive to either leave the scene and respond to another incident or be available for another potential incident.

URBAN DRIVING SKILLS

Even in normal, non-emergency conditions, operating an emergency vehicle in urban areas requires a high degree of skill. Emergency vehicle operator must present good examples to other motorists and pedestrians. The key to successful urban driving includes keeping alert for pedestrians, alleys and cross walks. Anticipate other motorist's actions – expect the unexpected! Always make an eye contact with other motorists to anticipate and communicate movement and/or intentions. If they don't see you, they can't transmit or communicate their intentions.

When driving in urban areas in an emergency mode, your speeds in excess of a posted limit are rarely justified. Excess speed should only be used in extreme cases and **ONLY** if the road conditions permit it. Reasonable speeds allow more time to react and more opportunity to control the emergency vehicle if an evasive action is required.

Urban driving in an emergency mode requires effective use of lights and sirens in order to warn motorists and pedestrians of the approaching emergency vehicle and to clear traffic and/or help the operator negotiate through heavy or blocked traffic. The typical motorist's reactions to lights and sirens will generally be to try to pull to the right and slow down or stop when they detect and approaching emergency vehicle. Some motorists, however, will do senseless, unexpected things. Some of the possibilities are: stopping in the middle of a lane, blocking the emergency vehicles forward progress, trying to compete (race) with the responding vehicle, or beat the emergency vehicle to and/or through an intersection. In some cases they do nothing at all and just keep traveling. Contributing factors to this could be that the radio or air conditioner is on and/or failure of the driver to check the rear-view mirror.

Backing off the siren and giving the other driver a chance to think and react is the best way to handle confused motorists. Tap the horn or flash the vehicles lights to try to establish eye contact. When following an automobile, beware of startling an unsuspecting motorist. They could respond hazardously. Vary the siren pitch and duration; use headlights, horn, siren, or spot light to get their attention. Be patient, keep signaling. Try and avoid passing on the right, unless it's the only way. Do not cross double solid lines to pass or avoid stopped traffic. The law does not allow for this and if the emergency vehicle collides with oncoming traffic, the emergency vehicle driver will be held accountable.

Traffic blockages are unavoidable, particularly during rush hour. In these situations route planning, including alternate rush hour routes is essential. If traffic is blocked, slow down before reaching the blockage. This will give the emergency vehicle operator a better view and make it easier to detect what effect the signaling equipment is having on the other motorists. Use the siren intermittently and be patient. If traffic is unable to move, it does no good to keep the siren wailing constantly. Everyone involved is likely to become irritable and impatient.

NEGOTIATING INTERSECTIONS

Intersections are the most accident likely areas. There are two types of intersections: an *uncontrolled intersection* is any intersection that does not offer a control device (stop sign, yield sign, or traffic signal) in the direction of travel of the emergency vehicle; or when a traffic signal is in the green mode for the emergency vehicle. A *controlled intersection* is defined as any intersection that the vehicle must stop at, including stop signs and traffic signals. Some things to keep in mind for each are:

Uncontrolled

- Scan the intersection for possible hazards (right turn on red, pedestrians, vehicles traveling very fast, etc.). Observe traffic in all four directions.
- Slow down and cover the brake pedal with your foot.
- Change the siren cadence not less than 200 feet from the intersection.
- Avoid using the opposing lane of traffic, if at all possible.

Controlled

- Do not rely on warning devices to clear traffic.
- Scan the intersection for possible hazards as well as alternatives.
- Begin to slow down well before reaching the intersection and cover the brake with your foot.
- Change the siren cadence not less than 200 feet from the intersection.
- Scan the intersection for possible passing options (pass on the right, left, wait, etc.). Avoid using the opposing lane of traffic, if at all possible.
- Be prepared to come to a **complete and controlled stop**.
- Establish eye contact with other vehicle drivers; have partner communicate all is clear; reconfirm all other vehicles are stopped.
- Proceed one lane of traffic at a time. Treat each lane of traffic as a separate intersection.

Some techniques best used for intersections are basic but can prevent many accidents. Before crossing an intersection, the vehicle operator must make sure there is an adequate gap in traffic. From a full stop a small vehicle needs about four to seven seconds to cross an intersection 30 feet wide (two lanes). For larger vehicles, the time increases according to size, accelerative capability, etc. Cars approaching from either direction should be at least six seconds from the intersection. The vehicle operator should look left, then right, then left and straight ahead before crossing an intersection. When making a right turn at an intersection from a stop it takes about six seconds to turn right and accelerate to a speed of 30 mph. This time increases with the size of the vehicle. When the driver begins the turn, any vehicle approaching the intersection from the left should be at least eight seconds away from the intersection. This will allow the approaching vehicle two seconds of space between the two vehicles. Left turns at intersection require a larger gap than right turns because of the need to cross traffic lanes. Ten seconds is the minimum safe time needed.

When moving through an intersection while responding on an emergency, the vehicle operator should provide as much information as possible to other motorists. Use all means of signaling – lights, sirens, turn signals, lane position, and eye contact or hand signals. Signal the emergency vehicles intent at least one block in advance of an urban intersection and five seconds in the country. **Maryland law refers to 100' and 200'.** Check for traffic control indicators in advance of intersections, such as lane markings, signals, stop or yield signs, and crosswalks.

It's important to check for hazards well in advance of intersections. Make sure the vehicle operator's and officer's windows are partly open. This will enable detection of other emergency vehicles and traffic. Stay especially alert and search for actual hazards such as bad road surfaces and other motorists in the traffic lane, potential hazards like bicyclists or pedestrians, and finally for crossing traffic.

TURNING VEHICLES AROUND

Any type of turnabout can create a hazardous situation when performed on a street. Generally, the fastest way to turn around is to use reverse but remember to always use a spotter. In congested areas, going around the block may not only be safer, but also faster! Choosing a safe location to turnabout is important; choose an area with good visibility. You should have a clear view of the entire path of travel and all traffic lanes. Avoid hills, curves, and blind intersections.

The types of turnabouts, in order of increased hazard potential, include the U-turn, the two-point turn, and the three-point turn.

- The *U-turn* is the least hazardous type of turnabout. It is the easiest to perform but requires a wide roadway and good visibility.
- The *two-point turnabout* is made when the road is to narrow or restricted visibility wont permit a U-turn. The type or turnabout made depends on whether there is a side road or alley. The left side-road turnabout is more hazardous than the right. It should be a common practice not to use driveways to turnabout in because they may not support the weight of the larger emergency vehicles.
- The *three-point turnabout* is the most hazardous. It should only be used when the road is to narrow for a U-turn, there are not any alleys or side roads on either side, or if traffic is light.

In turnabouts in the emergency mode, if any exemptions are being exercised (e.g. U-turn where illegal) emergency-signaling equipment must be activated. The emergency mode may dictate performing more hazardous types of turnabouts. Always use regular signaling equipment, as well as emergency signaling devices.

SAFE FOLLOWING DISTANCES

A safe following distance enables a driver to stop or maneuver safely to avoid a collision or unexpected hazard ahead. Rear-end collisions often result from driver inattention to time and distance requirements. It is the responsibility of the following vehicle to maintain alertness and proper vehicle spacing. When proper distance is maintained, evasive and other abrupt maneuvering is minimized. Emergency vehicles are considerably larger in size and weight than passenger vehicles requiring longer stopping distances and generating greater reaction forces during evasive maneuvers.

Safe following distance is based upon the anticipated stopping distance of your vehicle. Stopping distance is comprised of three primary components. First, *perception distance* is the distance traveled before the driver recognizes that braking is needed. This can range from 3/8 to ¾ seconds. Perception distance varies with driver alertness and visual scanning skills. Second, *reaction distance* is the distance traveled from the time the driver perceives the need to stop until pressure is applied to the brake pedal. On average, reaction time is about ¾ to 1 second. The driver's ability to perform under stress and the drivers experience are also factors that influence reaction distance. As reaction time increases, the reaction distance increases. Reaction distance is a direct function of vehicle speed. Reaction distance for a vehicle traveling 45 miles per hour approaches 70 feet; while reaction distance for a vehicle traveling 60 miles per hour approaches 90 feet. Third, *braking distance* is the distance traveled from the first pressure applied to the brake pedal until the vehicle comes to a full stop. There are too many variables to reliably identify an average braking distance. Vehicle speed and weight, brake system condition, brake system type, tire condition and inflation, road surface, and weather conditions all affect the braking distance.

An appropriate following distance allows enough space cushion to come to a full stop if the vehicle ahead comes to a sudden stop. An accepted practice to determine safe following distance for an emergency vehicle is the *four second rule*. At speeds up to 40 miles per hour the four second rule maintains a separation of at least four seconds between the emergency vehicle and the vehicle ahead. When speeds exceed 40 miles per hour, an additional 1 second is added to the separation for each additional 10 miles per hour. In adverse weather conditions, another 1 second is added in anticipation of reduced traction. The four second rule is applied by selecting a stationary object ahead as a point of reference and beginning a timer as the vehicle ahead passes the object. Maintain the timer until the trailing vehicle reaches the point of reference and note the time. This time should exceed the safe following distance dictated by the four second rule. In the absence of a timer, estimate the time by counting "1001, 1002, …..." or "1 Mississippi, 2 Mississippi, ……"

Rules and procedures cannot replace good judgement by the driver and officer when determining following distances. Driver experience, skill, and alertness must be considered. Vehicle characteristics such as weight, braking effectiveness, and brake usage intensity (overheating brakes) must be considered. The driving environment such as traffic density, traffic speed, road surface conditions, weather, sight distance, route familiarity, and speed limits must be considered. The four second rule is a minimum guideline; increase your spacing when conditions are not optimal.

PASSING ANOTHER VEHCILE

Often it is necessary for the emergency vehicle to pass other vehicles that may or may not be stopped. Some considerations before attempting a passing maneuver are:

- Is it necessary to pass?
- Is there a legitimate need to "get around" the vehicles ahead?
- Will vehicle traffic ahead yield in response to your audible/visual warning devices? Do the other drivers see you?
- Does your vehicle have enough residual power to accelerate effectively beyond a moving vehicle?

Roadway information is critical to successful passing. When gathering information to decide about passing, be certain to include the following in your assessment:

- Road signs: No Passing, Intersection Ahead, Pedestrian Crossing
- Pavement markings: Solid centerline, broken centerline
- Road configurations: hills, curves, intersecting roads, driveways

If "No Passing" is advised by road signs or markings, there is a good reason, such as a hidden driveway, schools, poor sight distance, or poor road design. Never pass a stopped car or line of cars without being able to see why they are stopped. Most motorists will attempt to pull over when confronted with a responding emergency vehicle. Others will continue to move, but slow their speed in an effort to let you pass. Regardless of the reason a motorist has yielded make efforts to verify they see you before you begin to pass them. The following are some good tips to avoid mishaps when passing:

- Pass assertively. Do not hesitate as conditions change rapidly.
- Stay in the passing lane the shortest time possible.
- Constantly scan the roadway for unmarked, intersecting roadways.
- Mentally note the location of each vehicle you pass so you can identify in the mirror when you've cleared the final vehicle. Visualize their location in relation to the side of the apparatus.
- In non-emergency situations it is often better to decelerate and merge in behind other vehicles than to attempt to accelerate past.

EXPRESSWAY OPERATIONS

The term expressway includes interstates, freeways, turnpikes, or any other type of limited access multi-lane high speed roadway. Entering and exiting expressways require the operator to make quick and accurate decisions in rapid succession. Expressway traffic is often driving in excess of posted speeds and exposes emergency vehicles to traffic that is much more agile.

Entering and exiting expressways is generally accomplished via ramps with varying lengths of acceleration or deceleration lanes. These ramps can be some of the most difficult areas to navigate in larger vehicles as one group of vehicles is slowing down to exit while another set is accelerating to enter. When entering or exiting the expressway, you must monitor the road ahead while simultaneously checking your mirrors. Key points to remember while merging on an expressway:

- Use your mirrors to keep track of adjacent lanes.
- Always be prepared to stop suddenly.
- Look well in advance of your current position. Note vehicles that are approaching the merge area and identify gaps for your merge.
- Adhere to ramp speed limits. Beware of signage indicating roll-over hazards or sharp curves.

Beware that warning devices may startle other motorists as your apparatus approaches from a ramp. Other vehicles may stop suddenly or change lanes in panic. The curve of a ramp and presence of overpasses or sound walls makes visual and audible warning devices less effective. Expect to merge into the flow of traffic as normal, assess traffic flow, and then decide your best lane or approach. Remain predictable to other drivers and avoid weaving from one lane to another.

DRIVING AT HIGH SPEEDS

Driving at highway speeds or in excess of the posted speed limits presents significant hazards to emergency vehicles. Exceeding a posted speed limit is a privilege granted only during emergency response and should only be done with due regard for the safety of other motorists and the emergency apparatus. In all cases, consider the following:

- Posted speeds are based upon the roadway characteristics in good weather conditions.
- Gain and lose speed in straight lines, not in curves.
- Recognize when stopping distance exceeds sight distance. Sight distance is not under the driver's control, but stopping distance is controlled by speed.
- Driving at higher speeds increases the potential for heavy or excessive braking action that may lead to brake fade.
- Higher speeds result in higher momentum and shifts in the center of gravity for a large vehicle.

A moving vehicle naturally wants to stay in a straight line. As a vehicle enters a turn inertia results in centrifugal force that pushes the vehicle in a straight line rather than turning. This centrifugal force increase exponentially with speed. When the centrifugal force becomes too high, the vehicle will either slide or roll over. For every curve or turn, there is a maximum speed for traveling through the curve safely. The tighter the curve, the higher the potential is for centrifugal force, therefore the slower the vehicle must travel. Roadways are sometimes built with a slight side grade to the inside of the curve that aids in countering the centrifugal forces working against the vehicle. If the road is graded toward the outside of the curve this will work against the vehicle and require even slower speeds. In addition to the grade of the surface, the type and condition of the road surface plays an important role in maintaining sufficient traction in turns.

Due to land availability or restrictions, designers often lay out curves in a decreasing radius pattern. This is a design by which the turns start out with a relatively large radius (curve) that tightens as the vehicle passes through the curve. On decrease radius curves, the maximum entry speed is too fast for the later (tighter) portion of the curve. If the speed is too high for the tighter portion of the curve, physics will cause the vehicle to slide or roll over. Drivers must recognize when a ramp or curve is decreasing in radius.

To better define the safe mechanics of transitioning a curve, the following is a breakdown of a curve and proper techniques to pass through it.

Entry – Brake or decelerate to the proper entry speed *before* entering the curve. Enter the curve as far to the outside as possible. Entering on the outside of the curve effectively increases the radius of the track for the vehicle. The greater the radius, the faster the turn can be safely negotiated. Begin the turn as early as possible.

Transition – If the maximum safe speed to maintain control passing through a curve has been attained, the emergency vehicle operator experiences full control of the vehicle. The maximum “safe” speed is not the maximum “possible” speed that conditions will allow. When approaching maximum possible speeds, it will feel as though the suspension is straining. Do not apply aggressive breaking. Allow natural friction of the engine and compression to slow the vehicle down. If you are traveling at near maximum speed in a curve, a relatively small event (e.g. some sand or gravel on the road) can cause complete loss of control. Once in the curve, it is best to coast at speed to maintain maximum traction. Attempting to accelerate while in a turn can result in loss of steering control and traction at the rear wheels.

Exiting – Exiting curves requires the vehicle operator to keep the vehicle’s speed steady. Maintain position on the inner surface of the curve. Gently accelerate out of the curve after the apex has been reached and the vehicle is on a straight path.

Stopping at higher speeds requires more stopping distance and is harder on the braking systems. Things to consider when braking at high speeds include:

- Braking creates friction that results in heat.
- Overheating in the brake system reduces braking effectiveness.
- Reduce the stress on brake systems by engaging auxiliary braking systems and downshifting the transmission.
- Drum brakes typically fade more quickly than disc brakes due to differences in heat dissipation capability.

UNUSUAL OR DANGEROUS DRIVING SITUATIONS

Driving In Adverse Conditions

Emergency vehicle operators cannot choose to avoid driving in weather conditions that would normally stop civilian drivers. Adverse conditions can be categorized as follows:

- Traction Implications
- Environmental Hazards
- Vision Implications

Emergency vehicle drivers must adjust their driving techniques for all adverse conditions as well as adjust the auxiliary braking systems that may be on their unit. The driver's primary responsibility is the safety of the passengers and arriving safely at the incident. Slow down and drive at a speed reasonable and appropriate for the conditions. Increase following distances and drive smoothly with any vehicle to avoid sudden and dramatic maneuvering.

Traction Implications – Traction can be adversely affected by a variety of conditions. Any materials or changes in the road surface will alter the friction between the road and the tires.

- Rain – In addition to oil buildup, water forms a layer that builds between the tires and the road surface. As little as $1/16^{th}$ of water can cause hydroplaning of a vehicle. Standing water may also impact steering, braking, and general vehicle operation.
- Chemicals – Road surfaces may have any number of chemicals, but the most common are oil, grease, and fuel. Chemicals can be particularly problematic early in the onset of wet weather before the rain washes away the residue.
- Snow and Ice – Snow, slush, and ice create variable road conditions resulting in reduced traction for vehicle tires. Certain roadway features such as bridges or shady areas may accumulate snow or ice prior to other parts of the travelway.
- Leaves – Leaves or other vegetation debris can create slippery conditions when allowed to accumulate on the road surface.

Whenever conditions have caused reduction in traction, the driver must reduce speed: and, steer, accelerate, or brake smoothly and evenly. The required stopping distances multiply depending on the condition of the road surface.

Environmental Hazards – Adverse handling could be caused by natural conditions such as high winds, vegetation, and the contour of the terrain. Road construction and design are examples of manmade conditions.

Vision Implications – Conditions that affect visibility include low-light driving, precipitation, vehicle construction, and the condition of the driver.

- Low-light Driving – Low-light conditions create various challenges: hidden hazards; increased difficulty in judging the speed of other vehicles, and distance; limited highway lighting; and glare from roadside lights. Even with these limitations and possibly impaired vision, a few simple rules can help the driver compensate.
- Dim dash and cab lights at night.
- Reduce speed.
- Keep headlights and windshield clean.
- Recognize the blind spots created by the vehicle characteristics.
- Look beyond the headlights.
- Keep eyes moving and scan continuously.
- Precipitation – Rain, fog, and snow reduce visibility. In addition, rain and fog increase glare both during the day and at night. During the day when the sun is out, the snow on the ground creates a considerable glare as well. Poor visibility conditions require the operator to:
  1. Drive slowly but keep moving.
  2. Turn headlights (low beams only) and wipers on.
  3. Use four way flashers if traveling 15 mph or more below the posted speed limit.
  4. Watch for cars ahead that are moving very slowly.
  5. Avoid decelerating suddenly.
  6. If you must pull off the road, use four way flashers and warning lights.
  7. Use the defroster or air conditioning to minimize fogging on the inside of the windows.

CONTINGENCY SITUATIONS – CAUSES AND PREVENTION

Contingency situations can arise at any time. A contingency situation is described as a possible future event, condition, or an unforeseen occurrence that may necessitate special measures. When they arise, normal traffic flow may be suddenly interrupted and the safety of all persons in the general area is diminished. Emergency vehicle operators must be familiar with contingency situations that occur most often, and to understand the actions that can be taken to minimize to reduce their impact. Five common contingency situations are:

1. *Vehicle malfunction or component failure* – Thorough pre-trip inspections are the key to reducing roadside emergencies. Inspect the vehicle at the beginning of every shift and note any deficiencies. Correct any deficiencies that are easily fixed in the station.
2. *Change or deterioration in the road* – The key to managing changing road conditions is to expand your look ahead distance to recognize approaching

hazards. Remain alert, scan well ahead, and look for clues like construction signs or skid marks on the road. Operators must also remain aware of projects or existing conditions in their response district so they can anticipate poor conditions.

3. *Obstacle in the roadway* – Be prepared for an appearance of obstacles in the road (e.g. pedestrians, other vehicles, animals, etc.). In congested urban areas anticipate hazards appearing from side streets, alleys, parking garage exits, or between parked vehicles. Rural roads present more opportunities for animals or debris to enter the roadway.
4. *Weather change* – The DC Metro area presents widely varying and sometimes unpredictable weather conditions. Cold weather brings ice or snow. Summer storms bring the threat of hydroplaning and debris from high winds.
5. *Driver error, inattention, and inexperience* – Fatigue is a significant factor for drivers operating on shift work. Operators must determine for themselves when they are too tired, too sick, too stressed, or otherwise physically or psychologically unprepared to operate an emergency vehicle.

HANDLING CONTINGENCY SITUATIONS

Emergency vehicle operators must be prepared to encounter unusual situations or conditions. The nature of the vehicles combined with the environment offer endless variables that impact safe operations.

Evasive steering and skidding often occur when avoiding pedestrians, animals, vehicles, or other obstacles. These reactions usually occur because the driver either failed to recognize an impending hazard or the hazard appeared so suddenly that it was unavoidable. A driver in this situation needs to weigh the risk versus reward of their action. Is it worth risking loss of control of the vehicle to avoid a collision with a small animal?

The vehicle driver must constantly scan ahead and to the sides of their vehicle to identify escape routes in the event that braking is not going to avoid a collision. Beware that the crest of a hill, curves, and intersections limit your ability to identify escape routes and therefore reduce your options.

When braking will not avoid a collision, evasive steering may be employed to avoid or minimize the impact of a collision. Operators need to become accustomed to maintaining their hands at the 9 and 3 o'clock position on the steering wheel. This will allow the largest possible turn without moving the hands. The 10 and 2 o'clock positions are more comfortable, but the 9 and 3 o'clock position allows maximal directional control. Evasive steering occurs in two phases; to avoid a collision, turn the steering wheel sharply in the direction of the escape route and then counter steer as soon as the vehicle is clear of the obstacle. If a collision is unavoidable, choose an object with which to collide. When facing such a choice, the operator must rapidly decide which course and object(s) will result in the least severe collision. Head-on collisions are the most damaging collisions because the entire force of the striking vehicle is applied to the fixed object. A sideswiping or indirect collision allows the energy of the collision to dissipate over a long distance since the vehicle remains in motion. Impact absorbing objects are better to choose than large immobile items that will not “give”. Some examples of impact absorbing objects are parked cars, bushes and shrubs, guardrails, and small signs. Examples of nonimpact-absorbing objects include bridge abutments, retaining walls, buildings, large trees, and utility poles.

In addition to evasive steering, there are two other forms of maneuvering to avoid collisions – *emergency braking and evasive acceleration.*

- *Emergency braking* – The goal for emergency braking is to produce the shortest possible stopping distance without locking the wheels or losing control. The threshold braking method for accomplishing this is hard pressure to the brake pedal without locking the wheels. Modulate the pressure on the pedal. Apply steady pressure to the point of locking, and then release pressure slightly to get rolling traction. If the wheels lock, **release the brake pedal.** A vehicle with ABS does not require threshold braking because the computer will not allow the brakes to lock up; a steady pressure should be maintained on the pedal. Remember that a rapid stop could cause a rear-end collision; however, this is more preferable than hitting a pedestrian. Remember the action vs. outcome formula.
- *Evasive acceleration* – Evasive acceleration means a quick burst of speed. It can be used to avoid collision with side approaching or merging vehicles. When a vehicle is approaching from the side or merging, increasing speed can often avoid a side impact collision.

HANDLING SKIDS

While weather or road conditions may increase the possibility of skidding, skids are generally caused by one or a combination of these factors:

- Sudden change of speed or direction
- Change of speed or direction under conditions of poor traction
- Weight shift in the vehicle
- Poor tire condition
- Improper tire inflation
- Failure to identify a hazard through inattention
- Improper application of the brakes

To help regain control no matter what type of skid is occurring, ***STAY OFF THE BRAKE; STAY OFF THE ACCELERATOR; AND COUNTERSTEER****!* Steer in the direction that the vehicle rear end is skidding.

There are two key elements to effective countersteering:

1) the steering wheel does not have to be turned violently to correct a skid. This a common "panic" reaction, and further trouble arises because the rear tends to skid back and forth (fishtailing);

2) After the initial effort to countersteer, it may be necessary to immediately steer in the other direction to help recover.

Skids can be generalized into four categories:

- **Braking skids –** This skid occurs when sudden, hard brake pressure is applied causing one or more of the vehicles to lock. Regardless of how many wheels lock, some control of the vehicle will be lost. If all wheels lock evenly or if just the front wheels lock, the vehicle will continue in a straight line on its prior trajectory unless influenced by some other force (e.g. a dip in the road). If just the rear wheels lock, the vehicle will tend to spin around and end up facing the opposite direction. If a braking skid occurs:
    - Release the brakes immediately in an attempt to regain traction; this will return the ability to steer and attempt further braking.
    - If braking is still necessary, use less pressure to avoid the wheels locking again.
- **Power skid –** The power skid occurs due to sudden, hard acceleration. Since fire apparatus is typically rear-wheel driven, sudden acceleration can cause the rear wheels to lose traction. The back of the vehicle may skid to one side, trying to overtake the front end. The tendency for the rear end to slide will be greatest if the front wheels are turned. The vehicle may even spin all the way around. If a power skid occurs:
    - Release the accelerator.
    - Steer in the same direction as the rear end is skidding.
    - Counter steer to straighten the vehicle.
- **Cornering Skids** – Cornering skids (also called yaw skids) occur when speed is too great or traction is insufficient to keep the vehicle on the intended track around a curve. While the name "cornering" implies travel through an intersection, these skids can also occur on highway ramps or any area where the roadway changes direction. A vehicle naturally wants to follow a straight line and must be forced to follow the intended path around the curve through traction with the road surface. Much like a braking skid, a cornering skid may involve one or more wheels with the vehicle reacting accordingly. If a cornering skid occurs:
    - Release the accelerator.
    - Avoid the temptation to abruptly apply the brakes as this may further reduce traction; it is best to allow natural forces to slow the vehicle.
    - Light application of the brakes may be necessary, but needs to be done cautiously to avoid full loss of control
    - Countersteer as necessary to regain the desired trajectory.

- **Hydroplane Skids** – Hydroplane skids occur when the tire is moving too fast for the water on the road to escape into the tire tread and permit direct contact between the rubber and the road. A small wedge of water builds up in front of the tire and lifts it off the road surface. The water then effectively forms a barrier between the tire and the road surface. Hydroplaning can occur on minimally wet surfaces at speeds of 25 mph. Vehicle reaction during a hydroplane skid is hard to predict. As in all skids, there are varying degrees of brake and/or steering control. A hydroplane skid may not even be perceived by the driver unless the driver attempts to brake or steer. If a hydroplane skid occurs:
  - Release brake and/or accelerator.
  - Allow the vehicle to slow naturally. The vehicle will drop through the water barrier and regain contact with the road surface.

OTHER VEHICLE EMERGENCIES

There are a number of other emergencies that can occur while in transit. The following are some possible emergencies and ways to control them:

- **Rapid Tire Deflation** – Rapid tire deflation is most hazardous when it occurs on the steering axle. The vehicle can violently pull to the side of the blowout or deflated tire. The vehicle will pull to the side of the deflated tire because the flat tire grips the road with more rubber (and more friction) an acts as a pivot. As soon as deflation is detected, the driver should begin to slow the vehicle gradually while seeking a safe area to stop. Anticipate difficult steering and be prepared to make firm movements with the steering wheel. Avoid aggressive braking as they may further disrupt vehicle control.
- **Brake Failure (non-ABS hydraulic brakes)** – Brake failure in hydraulic brake systems generally results from neglect or deterioration of the system. For systems that are not ABS, pumping the brake pedal rapidly during a failure may build up enough pressure (fluid) in the system to provide minimal braking action. Leave any auxiliary braking systems engaged and down shift to allow the transmission to slow the vehicle. As a last resort once the vehicle has slowed, rub the tires against a curb for additional friction. For vehicles equipped with hydraulic service brakes, but an air parking brake another last resort is to apply the parking brake. Beware that applying the parking brake can lock up the wheels abruptly and cause the vehicle to skid.
- **Brake Failure (ABS hydraulic brakes)** – Anti-lock braking systems (ABS) have similar characteristics to non-ABS except they are controlled by a computer system. In the event of a computer failure in the ABS, they are designed to simply behave like a conventional braking system and will continue to stop the vehicle. If a mechanical failure occurs in an ABS equipped vehicle apply steady firm pressure to the brake pedal. Pumping the brakes on an ABS equipped vehicle may actually lengthen stopping distance. Leave any auxiliary braking systems engaged and down shift to allow the

transmission to slow the vehicle. As a last resort once the vehicle has slowed, rub the tires against a curb for additional friction. For vehicles equipped with hydraulic service brakes, but an air parking brake another last resort is to apply the parking brake. Beware that applying the parking brake can lock up the wheels abruptly and cause the vehicle to skid.

- **Brake Failure (Air brakes) –** Failure of air brake systems can be the result of loss of air, contamination in the air system, or overheating of components. A catastrophic loss of air will result in the spring (parking) brake applying abruptly and potentially locking up the rear wheels. A partial system failure is more common and causes poor brake performance. Contamination of the air system may result in decreased performance of parts of the system if air lines become clogged or air capacity is reduced. Overheating of the brake pads or shoes occurs when the system is stressed by repeated heavy braking, such as an emergency response through traffic or in long downhill runs. Overheated brakes have a unique odor that most heavy apparatus operators recognize. Overheating results in brake “fade” and the vehicle will not slow down as efficiently because the friction applied by the pads or shoes is reduced. In severe cases braking ability is essentially lost and the pads or shoes can be permanently damaged. If an air brake system is experiencing a failure, use similar approaches as for an ABS equipped hydraulic brake vehicle. Do not pump air brake systems; this will only reduce the air supply. Leave any auxiliary braking systems engaged and down shift to allow the transmission to slow the vehicle. As a last resort once the vehicle has slowed, rub the tires against a curb for additional friction.
- **Transmission Malfunctions –** Complete transmission failures are rare unless the driver shifts between reverse and forward gears without allowing the vehicle to stop first. Most electronic transmissions have built-in features to prevent such damage. Vehicle operators need to recognize and address early indications of trouble in the transmission (e.g. slipping, thrusting etc.).
- **Steering Malfunctions / Failures –** The most common failure in a steering system involves the hydraulic power steering assist. A power steering failure occurs when the engine stalls, fluid in the system is low, or when the belt that drives the system flips or brakes. In a power steering failure the mechanical steering remains functional, however turning the steering wheel will require considerably more effort. Sudden mechanical failure of steering system components seldom occurs when proper pre-trip checks are conducted. If a failure occurs in the steering, slow the vehicle and stop as quickly and smoothly as possible.
- **Accelerator Sticks -** If the accelerator sticks, the driver should attempt to release the pedal by tapping on it with their foot. The next move is to pull the pedal up with their foot. Do not attempt to reach down and pull the pedal as this is likely to result in loss of control of the steering. If the pedal cannot be reset, shift the transmission to neutral and slow the vehicle to a stop. Avoid shutting the motor down until the vehicle is stopped as braking and steering will be more difficult.

- **Wheels off the Road –** Numerous roadways within the County do not have curb and gutter, therefore the pavement transitions to a soft shoulder of gravel or dirt. The shoulder may be immediately adjacent to the white line or the pavement may extend to offer a hard shoulder beyond the white line. Roadways with no hard shoulder pose a significant hazard to large vehicles. Many roll-over crashes involving fire apparatus are the result of over-correction after a set of wheels has dropped off the paved portion of the road and onto a soft shoulder. When the wheels have left the road, the vehicle will tend to pull toward the shoulder. The driver must hold the steering wheel firmly and avoid the temptation to countersteer in panic. The driver should release the accelerator and attempt to bring the wheels back onto the pavement through small steering inputs. These inputs would be similar to those used for a gradual lane change. A large steering input could cause the vehicle to lose control and enter a sideways skid.
- **Dashboard Warnings –** Apparatus operators must be familiar with the various warning lights and messaging screens associated with vehicle monitoring systems. In general, amber or solidly displayed dashboard warnings are advisory while red or flashing dashboard warnings require immediate action. Consult the manuals for your specific apparatus for detailed instructions. Operators should also know what normal operating ranges apply to the gauges and recognize when a vehicle is displaying abnormal “vital signs”.

PARKING PRECAUTIONS

Position of an emergency vehicle on an emergency incident is crucial. While apparatus is often positioned based upon function and assignment the operator must also consider traffic hazards. Utilize onboard cones and flares to enhance the work zone around the apparatus. Park the apparatus to serve as a barrier between oncoming traffic and dismounted personnel. EMS and smaller units should be protected by heavy apparatus whenever possible. When parking on a shoulder or a curb lane, even slightly angling the apparatus helps to keep the crew from opening their doors into open traffic lanes.

When apparatus is exposed to an open lane of traffic or while on an incident, all warning lights should be illuminated per standard procedures. When a unit is parked during a non-incident situation, drivers must exercise good judgement when selecting a parking spot and attempt to adhere to all applicable traffic laws. Apparatus operators need to avoid blocking travel lanes or reducing sight distances near intersections with their parked unit. Parking lots are typically very difficult for apparatus to navigate. If using parking lots, consider staying on the outer fringes of the traffic area to reduce exposure to confined areas and higher levels of vehicle traffic. Do not park in fire lanes or other areas that expose the apparatus to civilian vehicles backing out of parking spaces.

When positioning apparatus, some additional considerations must be taken into account:

- Reduced sight distances due to terrain, vegetation, buildings, vehicles, road configuration may require additional cones or other apparatus to position ahead of the scene.
- Control all avenues of approach around the apparatus. Recognize where intersections or driveways allow civilian vehicles to approach from multiple directions.
- Beware of blinding oncoming drivers with apparatus headlights or scene lights.
- Use a mix of traffic cones and flares as necessary to keep civilian vehicles out of the scene. Flares help illuminate adjacent cones at night, but also can serve as effective barriers during daylight hours.

Safety Reminder – When operating outside the protective shadow of a blocking unit you greatly increase your risk of being struck by a vehicle. **Never** turn your back on approaching traffic. Always face traffic when setting up and removing traffic control devices.