Student Performance Objective

• After completing this lesson, the student shall be able to identify safety considerations for operating emergency vehicles. In addition, students will be able to demonstrate skills in safely operating and driving an apparatus.
Overview

- Apparatus Rider Safety
- Starting, Idling, and Shutting Down Apparatus
- Driving Apparatus
Apparatus Rider Safety

• Driver/operators must always ensure safety of all personnel riding apparatus.
Personnel must not mount or dismount moving apparatus.
- Officers and drivers are responsible for passengers being seated and/or restrained before moving
- Riding the tailboard is forbidden

All personnel in MCFRS vehicles must wear seatbelts
- Unit officers are responsible for authorizing movement of the vehicle
Apparatus Rider Safety

Hose-loading

• Train all members
• Have one member assigned to observe and communicate with the driver/operator
• Close the area to traffic
• Only drive forward at no more than 5 mph (10 km/h)
• Ensure no members are standing on apparatus in motion
Apparatus Rider Safety

• Firefighters should never be allowed to ride tailboard, front bumper, or running boards of any moving apparatus.

Safety procedures that require seatbelt in safe, enclosed position

Safety bars and gates intended to prevent falling out of jump seat.
Crew Security
Pre-Departure

• Is the crew ready for the truck to move?
• All crew members seated and restrained
• Members having trouble
  o Practice getting dressed
  o Practice buttoning up while seated and belted
  o Practice donning SCBA from the seat
• 76% of firefighters killed in vehicle crashes were unrestrained
Apparatus Rider Safety

- Tiller training can be problematic due to the lack of a second seat in the tiller operator’s enclosure.

Single seat in operator enclosure
- No place for instructor to have contact with operator

NFPA® allows for detachable seat
- Seat firmly attached
- Instructor belted in

- Helmet and eye protection required
- Newer apparatus may have operator and instructor seats
Starting, Idling and Shutting Down Apparatus

• Starting the apparatus
  – Vehicle manufacturers provide specific details regarding features of their apparatus in operator manuals.
  – When preparing to start apparatus, whether for an emergency response or routine trip, the driver/operator must first know:
    • Destination
    • Route of Travel
CIRCLE CHECK - 360°
PRE-DEPARTURE

• Sides
  o Compartment doors
  o Patient compartment door
  o Running boards – loose items
  o Portable radio straps

• Front & Rear
  o Bumpers/steps
  o Loose items and people

• Below
  o PPE
  o Obstructions or forgotten equipment
  o Wheel chock

• Take seconds to save minutes
Starting, Idling and Shutting Down Apparatus

• Driver/operators should be aware of destination and route of travel, as well as road closings and traffic congestion.
Starting, Idling and Shutting Down Apparatus

• Driver/operators should follow the manufacturer’s recommendations on idling engines.

- Allowing diesel engine to idle unnecessarily
  - Damages internal engine components and emission systems
  - Wastes fuel
  - Leads to build up of carbon

Leads to

Wastes

Damages

Build up

Fuel

Carbon

Engine

Components

Emission

Systems
Starting, Idling and Shutting Down Apparatus

Diesel particulate filter

- Diesel particulate filter burns soot from exhaust more completely
- Frequent, short runs or operation in cold climates won’t allow soot to burn
- Active regeneration occurs in automatic and manual modes
- Diesel particulate filter regeneration increases temperature
ENGINE AFTERTREATMENT

- Enables compliance with EPA emissions standards – emergency vehicles are NOT exempt
- After 2006, all diesel exhaust systems have a particulate filter and associated regeneration system
  - Diesel Particulate Filter (DPF) captures soot and ash
  - Regeneration burns off the soot and ash that accumulates
- After 2009, aftertreatment systems include Diesel Exhaust Fluid (DEF) for additional treatment of exhaust gases
- There are two operator interventions necessary with these systems:
  - Active Regeneration – aka “parked” regeneration
  - Refilling the DEF tank

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EVOC-MCFRS Addendum
**Diesel Particulate Filter Indicator Lamps**

### Aftertreatment Diesel Particulate Filter
- Indicates a regeneration is needed – passive or active
- When flashing, regeneration is more urgently needed

### High Exhaust System Temperature
- Does not signify any need for service – regeneration occurs at high temperatures
- Keep the exhaust pipe outlet away from combustibles

### Flashing DPF Light + Check Engine
- Regeneration is needed immediately
- Active regeneration is required

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Diesel Particulate Filter
Passive Regeneration

• Occurs automatically as needed when driving over 40mph
  o Does not require any action on the part of the driver
• It is unlikely that MCFRS apparatus will drive enough highway miles for Passive Regeneration to complete it’s cycle
DIESEL PARTICULATE FILTER
ACTIVE REGENERATION – “PARKED REGEN”

1. DPF lamp illuminates or flashes

2. Determine a suitable location to park the apparatus
   o Away from combustibles or items that could be damaged by exhaust heat – need at least 5 feet of clearance
   o Outdoors and NOT connected to the PlymoVent

3. After parking the unit, engage the manual regeneration
   o May be a toggle switch, rocker switch, or other control
   o Motor rpm should increase to approximately 1100rpm.

4. The driver must remain with the vehicle during regeneration
   o Duration varies by amount of soot in the DPF – 5 to 20 minutes

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**Diesel Particulate Filter**

**Active Regeneration – “Parked Regen”**

- Regeneration will stop:
  - Automatically when the motor controls sense the particulate filter is cleaned
  - Manually if the brake pedal is depressed
- Unit may remain in service during regen
- Regen will not engage when other vehicle functions are in use, i.e. pump, PTO, hydraulics
- Vehicle exhaust components will remain very hot following the regen process
  - High temperature light will illuminate
The regeneration switch is located in the center of the dash below the Light Test switch.
Example of active regen controls

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Starting, Idling and Shutting Down Apparatus

- Diesel Exhaust Fluid Tanks (DEFs)
  - Driver/operators are responsible for keeping the DEF tank filled at all times.

- Failure to keep DEF tank full
  - May derate apparatus engine
  - May limit speed
DIESEL EXHAUST FLUID (DEF)
WHAT IS IT & WHAT DOES IT DO?

• 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 NOx emissions into nitrogen and water
• DEF is not a fuel additive and never comes into contact with diesel
• DEF is stored in a separate tank, typically with a blue filler cap.
DEF Tank located rear of the batteries on the driver’s side of the unit.

DEF Tank gauge located above or below fuel gauge on dash.
**Diesel Exhaust Fluid Contamination – Fuel vs. DEF**

- **Nozzle sizes**
  - DEF nozzles are 0.75”; diesel nozzles are 0.87”
  - The diesel nozzle should not fit into the DEF tank
  - The cap for the DEF tank is blue and will be clearly marked

- **Diesel in the DEF tank**
  - Diesel will float on top of DEF
  - Small amounts of diesel can damage the exhaust system
  - If any fluid except DEF is poured into the DEF tank, contact CMF immediately and do not drive the vehicle.

- **DEF in the fuel tank**
  - The motor will stop running almost immediately, and the vehicle will require repair
• Stocked in 2.5 gallon containers with filler tubes
  o requested as needed through normal supply procedures
• DEF crystallizes when stored for prolonged periods as the water evaporates
  o Do not use DEF that shows signs of crystallization
  o Always completely use a container to avoid storing opened containers
• Refill when the level indicator reaches 1/2 or less
  o The tank should accept one full 2.5 gallon container of DEF
  o No need to continuously top off the DEF tank
**Diesel Exhaust Fluid Supply, Handling, and Refill**

- Filler tube is supplied with the case
- 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.
Starting, Idling and Shutting Down Apparatus

• Shutting down the engine
  – A hot engine should cool to normal operating temperature before being shut down.

Premature shut down may result in

• Immediate increase of engine temperature
• Oil film “burning” on hot surfaces
• Damage to heads and exhaust manifolds
• Damage to turbocharger that can result in seizure
Starting, Idling and Shutting Down Apparatus

• Remember the following considerations when shutting down an apparatus.

Never shut down the engine when apparatus is in motion

Always follow the manufacturer recommendations
Driving Apparatus

• Adjusting Mirrors
  – It is imperative that apparatus mirrors are well-adjusted in order to minimize blind spots.

Adjustment

• At the start of each shift
• When the driver changes

Blind spots

• Have partner walk around to identify blind spots
• Adjust mirrors, then compensate while driving
Driving Apparatus

- Transmissions
  - Most apparatus are equipped with automatic transmissions.

  - There is no decision about when to shift gears.

  - Engine damage from lugging is less likely.
Transmission Selector

• All frontline apparatus have automatic transmissions
• Note the absence of “P”
  o Park in “N”
  o Pull the parking brake
• Generally no reason to use the up/down arrows
Driving Apparatus

• Potential Points of Contact—aerial apparatus have several points of contact that must be considered when turning or parking the vehicle.
UNDERBODY CLEARANCE

- Angle of approach
- Angle of departure
- Underbody clearance
- Clearances can vary
  - Unit to unit
  - Same unit; different conditions
  - Prior damage
• Apparatus components may drag when transitioning between surfaces
  o Parking areas
  o Driveways
  o Curbs
  o Medians – paved or unpaved

• Damage prevention
  o Signs of prior damage on pavement
  o First due knowledge
  o Approach or depart at an angle
Driving Apparatus

• Weight Transfer/Center of Gravity—driver/operators must understand weight transfer in order to safely operate the apparatus.

- Weight transfer follows the law of inertia.
- Weight transfers occur when the vehicle changes speed or direction.
- Rollover or skidding is caused by lateral weight transfer.
- Fast turns, harsh steering action, or driving on steep slopes can result in hazardous situations.
- Water tanks can be a concern to drivers.
- Minimum steering will minimize weight transfer.
Energy of Motion

• Kinetic energy is the force that keeps the vehicle moving

Kinetic Energy = \( \frac{1}{2} \) (weight of vehicle)(starting speed\(^2\) – final speed\(^2\))

• Kinetic energy doubles as the weight doubles
• Kinetic energy quadruples as speed doubles
• Kinetic energy is dissipated as heat by the brakes during application of breaks
Friction

- Friction – resistance to motion between two moving objects that touch.
- Frictional force opposes the motion of the vehicle
- Frictional force occurs between:
  - the tire and the road surface when wheel rotation is locked by brakes
  - the brake pad/shoe and the rotor or drum
- The ability of a vehicle to stop depends on the coefficient of friction between the contacting surfaces.
Friction

- Maximum useable coefficient of friction occurs between the tire and road surface.
- The amount of energy that can be absorbed by the brakes depends upon
  - the coefficient of friction of the brake materials,
  - brake diameter,
  - brake surface area,
  - shoe geometry, and
  - the pressure used to actuate the brake.
- Stopping a vehicle suddenly means very high friction, resulting in high brake and tire temperature.
When the vehicle is in motion:

- Sudden steering, braking and/or acceleration change vehicle balance and traction dramatically.
- Sudden loss of vehicle balance causes traction loss and traction loss compounds crash results.
TRACTION VS. VEHICLE MOVEMENT

• **Stationary (static)** – A stationary vehicle parked on a flat surface with brakes set has greatest resistance to movement. A stationary tire has more traction than a sliding tire.

• **Rolling (controlled dynamic)** – A rolling tire has more traction than a sliding tire, thus it is important to not lock the brakes when trying to steer or stop a vehicle.

• **Sliding (uncontrolled dynamic)** – A rolling tire can transition into a sliding tire under a variety of circumstances. The circumstances may or may not be predictable or controllable by the driver. A sliding tire offers little ability to change the path or speed of a vehicle.
Traction

• Tire condition is critical to maintaining traction
  o Tread depth
  o Inflation

• Only about 10% of the tire’s surface is in contact with the road at any time

~40 square inches of area
Driving Apparatus

• Poor weight distribution can make vehicle handling unsafe.

  Too much weight on steering axle
  Hard steering
  Damage to axle and tires

  Under-loaded front axles
  Axle too light to steer safely

  Too little weight on driving axles
  Poor traction

Weigh apparatus *after* loading with equipment and personnel
**Excessive Weight Transfer**

- Transfer occurs every time the vehicle accelerates, slows, or changes direction
- Amount of transfer is dependent upon weight, height of the center of gravity, and the rate of acceleration/deceleration
  - Which factor do you control?
- Effects of weight transfer
  - Too little weight and the rubber doesn’t stick to the road
  - Too much weight causes it to stick too hard and creates excess heat
  - Damage to suspension
- Slope or grade of road surface
- Water tanks
Driving Apparatus

• Driving downhill
  – Use the service brake and manually shift gears to lower speed going downhill.

Limit engine speed to lower than maximum rpm

Speed faster than maximum rpm can result in engine damage
Driving Apparatus

• Engine Lugging

- With a diesel engine, more fuel is injected than can be burned
- Excessive amount of carbon particles in exhaust can occur
- Oil dilution can occur
- Additional fuel consumption can occur

Keep engine rpm above peak torque speed
Driving Apparatus

• Bridges and Railroad Crossings

Bridges and overpasses
- Low overpasses
- Incompatible bridges
- Placard requirements

Railroad tracks
- Remember aerial apparatus are longer than other commercial vehicles
- Ensure that there is adequate room between tracks and stop light to fit apparatus
- Survey local roads and be prepared
**RAILROAD CROSSINGS**

- MCFRS policy requires stops at unguarded crossings
  - Approach guarded crossings with skepticism
- Stop, look, and listen in both directions
- Trains may travel in either direction on all tracks
- Wait a moment to proceed after a train passes
- Never park or stop on train tracks
- More than one railroad or agency may operate on a set of tracks
  - Halting train traffic may be difficult
Driving Apparatus

• Adverse Weather
  – Adverse weather conditions must be factored in while driving apparatus.

Rain  Snow  Ice  Mud
TIGHT CLEARANCE

• Public roadways are typically 9 to 12 feet wide dependent upon speed and traffic volume
• Apparatus widths are:
  o 2008 Crimson – 9’ 9”
  o 2016 Freightliner EMS Unit – 9’ 6”
  o 2016 Pierce Arrow – 9’ 8”
  o SUV – 7’
• Private driveways, alleys, and other non-public roadways have no standard
Tight Clearance

Connecticut Avenue – Chevy Chase

9’ 8”

?????
TIGHT CLEARANCE TURN LANES

10’

8’ 1”

9’
TIGHT CLEARANCE

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Tight Clearance

Your margin for error with a 10-ton vehicle can be inches.
• How fast should you be going?
• How important is it to squeeze through?
• Will the situation clear if you wait?
Tight Clearance
When you Must Go

• Expand your “look ahead” distance
• Use spotters to assist the driver
• Crowd or change lanes
  o Must know what is going on around the vehicle and have complete situational awareness
  o Do not run other vehicles out of their lane
• Use appropriate speed
  o Time to identify obstacles, decide options, and execute the maneuver
• Best visibility for the driver is the driver’s side of the apparatus
  o keep the driver’s side of the apparatus as close as reasonable to the fixed objects
  o Use mirrors to watch clearances as fixed objects are passed.
Night Driving

- All of the same hazards as daytime driving, but with less visibility
- Most drivers use the same approach to driving day or night
- Night-time driving problems are not recognized or understood
- Fatal collision rates are 3x higher at night
- More encounters with impaired drivers
- Prime time for road closures or work
Night Driving Challenges

- Difficulty with visual perception
- Eyes adapting to changing levels of brightness
  - Other drivers blinding you
  - You blinding other drivers
- Visual “cues” at darkness are eliminated
- Shorter and narrower fields of vision
- Limited or no visibility in mirrors and to the rear
- Reduced level of alertness (fatigue)
- Seniority
The human eye takes about 7 seconds to fully recover from being blinded by bright light.

In 7 seconds, a vehicle traveling 60mph will travel 616 feet.
Night Driving Precautions

- Know the range of your headlights
- Reduce speed and increase following distances
NIGHT DRIVING PRECAUTIONS

• Avoid driving while fatigued whenever possible
• Keep your eyes moving to avoid glare and fixating
• Recognize that your warning lights and floodlights will create glare for other drivers
• Reduce glare inside the cab by using red overhead lights, dimming the MDT screen, and dimming the panel lights
  o Communicate to the crew when lights in the rear of the cab are a problem
• Keep your windshield, headlights and warning lights clean
Parking Lots

• Immediately limited clearance
• Physical Hazards
  o Tight corners
  o Landscape trees overhanging lanes
  o Protective bollards
  o Light poles
  o Landscape rocks
  o Illegal parking – fire lanes

• Pedestrians
• Distracted drivers
• Adjust time of day if possible
• Avoid entering parking lots whenever possible
• Choose your parking spot
• Should you park?
LEAVING THE BAY
- Complete a visual check
- Disconnect shorelines
- Verify the door is fully open
- Verify the crew is ready
  - Seated, belted, doors closed
- Leave slowly
- Engage any traffic control

OVERHEAD DOORS
- When the door is in motion you should be stationary
- Do not rely upon collision sensors
- Sensors are for human safety
  - Too slow to avoid apparatus
- Know how your doors work!
Student Performance Objective

• After completing this lesson, the student shall be able to identify safety considerations for operating emergency vehicles. In addition, students will be able to demonstrate skills in safely operating and driving an apparatus.
Review

• Apparatus Rider Safety
• Starting, Idling, and Shutting Down Apparatus
• Driving Apparatus