EMERGENCY VEHICLE OPERATOR
CLASS “A”
Session 1-3
Major Vehicle Systems
OBJECTIVES

• Identify the major vehicle systems and their component parts
• Determine methods and requirements for pre-trip inspection of vehicle systems
• Define maintenance requirements for vehicle systems
• Review MCFRS out-of-service criteria for fire department apparatus
• Review defect reporting and resources for apparatus operators
Motivation
Why Know the Components?

• Correctly identify defects and write accurate defect reports
• Determine and differentiate between normal, monitoring, and out of service conditions
• Identify critical safety issues before they cause injury or damage
• Ability to communicate with mechanics when describing conditions – “speaking their language”
• Make educated decisions about the vehicle you are driving!
DEFINITIONS

• Leakage
  o Class 1: seepage of fluid; not enough to form drops
  o Class 2: leakage great enough to form drops; drops do not drip
  o Class 3: leakage great enough for drops to drip

• Operational Test: A test to determine the operational readiness of a component on a fire apparatus by observing the actual operation of the component.
There are five primary vehicle systems that impact your ability to safely control the apparatus:

1. Tires
2. Wheels
3. Steering
4. Suspension
5. Brakes
Starting in January 2009, 1-inch round clear heat indicator near the stamp on the wheel

Blistering, charred, blackened, or cracked appears indicates excessive heat
STEERING SYSTEM
Pierce TAK4
STEERING SYSTEM
Pierce TAK4

Curb side

- Pitman Arm
- Tie Rod
- Drag Link
- Steering Box
- Steering Arm

24/10/2006
**SUSPENSION WEIGHT RATINGS**

- **Gross Vehicle Weight Rating (GVWR)**
  - Includes curb weight, additional equipment that's been added, the weight of cargo and the weight of passengers
  - Maximum total weight vehicle may ever be

- **Curb Weight**
  - Includes all vehicle components without passengers or cargo

- Axle weight rating:
  - 21,200lb
  - 29,000lb
  - 24,300lb
SUSPENSION
PIERCE TAK4 – STEERING AXLE

• Steering axle on Pierce units
  o Front axle
  o Tiller axle
  o NOT on All-Steers

• Uses a torsion bar system – no springs
  o upper and lower A-frame assembly
  o shock absorber for wheel control.
SUSPENSION
Pierce TAK4

- Torsion Bar
- Upper Frame
- Shock absorber
- Torsion bar
- Upper and lower frame
SUSPENSION
Pierce TAK4 – Steering Axle

• Model years 2004-2013
  - Ball joint failure
• Model years 2009-2013
  - Lower control arm failure
• Check these components thoroughly during pre-trip
Air Brakes
DOT Inspection

• Conducted in a specific sequence
  o Ensures all critical features are checked properly

• Incorrect sequence
  o Does not check operation of the system sufficiently
  o Will result in a failure during candidate exams - PAGS

• Requires a watch, phone, or other means to keep time

• Park on reasonably flat ground

• Place wheel chocks on both sides of a wheel

• Battery and ignition switches must be on for gauges and warning devices to operate
1. Release the parking brake  
   a. Push valve in  
   b. Charges the system with air  
2. Let pressure in storage tanks settle  
3. Observe the air storage gauges for 1 minute  
   a. <3psi loss (<4psi for TDA)  
4. Apply steady pressure to the brake pedal  
5. Let pressure in the storage tanks settle
6. Observe the air storage gauges for 1 minute
   a. <3psi loss (<4psi for TDA)
7. Press and release the brake pedal repeatedly to bleed down the air storage tanks
   a. Low air alarm must sound between 60 and 90psi
   b. Parking brake must automatically engage at 20psi – valve pops out
8. Stop pressing the brake pedal once the parking brake engages
9. Start the motor and increase throttle to 1,200rpm
   a. Pressure must increase from 50psi to 90psi in <3 minutes
   b. Pressure must not exceed 135psi
10. Ensure all systems and gauges are back to normal operating conditions
11. Remove the wheel chocks
12. Place the vehicle in forward or reverse gear at idle
   a. Parking brake should restrain the vehicle from moving
13. End the test by engaging the parking brake and returning the transmission to neutral
   • Report any defects to CMF as needed
     o Consult with CMF if the safety of the vehicle is in doubt
C=Cut in Pressure
- Indicates compressor is engaging properly
  - Motor running and fanning the service brake
  - Storage pressure drops until compressor engages >95psi
  - Cut-in pressure of <80psi is OOS criteria

O=Cut out Pressure
- Indicates governor is working properly and compressor is disengaging properly
  - Motor running and storage tank pressure rising
  - Compressor shuts off between 120 and 135 psi
  - Listen for the air dryer to exhaust air
  - Cut-out pressure of >135psi is OOS criteria
L=Low Pressure warning

- Verifying that the low air alarms are functioning
  - Motor shut down but ignition on
  - Fan the service brakes to bleed storage tanks
  - Low air visual and audible alarms should engage 60 to 90 psi
  - Alarms that do not engage <60 psi are an OOS criteria

A=Air Leakage rate

- Assessing the ability of the entire system to hold air
  - Motor shut down
  - Monitor storage air levels for 1 minute
  - Levels should drop <3 psi; or <4 psi for tractor drawn vehicles
Auxiliary Braking Devices

- Reduce need to apply service brakes
- Assist the service brakes in stopping the vehicle
- Systems in use in MCFRS
  - Jacobs Engine Brake
  - Telma Driveline Retarder
  - Allison Transmission Retarder
- Become familiar with the features of the specific apparatus you are driving
**Auxiliary Braking Devices**

**Jacobs Engine Brake**

- “Jake” brake
- Fully integrated into the motor cylinders
- Engages automatically when the accelerator is released
- Disengages when:
  - Accelerator is depressed, or
  - Motor speed falls below 1,000rpm
- Uses the motor to absorb energy instead of producing energy
  - Is most effective in higher rpm ranges; 2,100+ rpm
  - <1,700rpm effectiveness greatly reduced
- Newer models are much quieter than old due to emissions standards

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**Auxiliary Braking Devices**

**Jacobs Engine Brake**

- For dry weather and normal conditions, switch should be set to “high”
- For wet or slippery surfaces, gradually engage the engine brake starting at low and progressing to higher levels as wheel slip allows
  - Any fishtail or locking of the wheels mandates moving back to the last lower setting or turning the system off
Auxiliary Braking Devices
Telma Retarder

• Mounted on the drive shaft near the rear axle
• Slows the rotation of the drive shaft through electromagnetic force
• Generates heat that is dissipated by the cooling vanes on the device
  o Have a history of overheating on some units
• Operates in four stages
  ➣ Release the accelerator – stages 1 & 2
  ➣ Depress the brake lightly – stage 3
  ➣ Depress the brake hard – stage 4
• Slippery road conditions may require disengaging the device completely

Telma Introduction Video
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
  o Diesel Particulate Filter (DPF) captures soot and ash
  o 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:
  o Active Regeneration – aka “parked” regeneration
  o Refilling the DEF tank
### 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
Diesel Particulate Filter Passive Regeneration

- Occurs automatically as needed when driving over 40mph
  - 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
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
Diesel Particulate Filter
Active Regeneration – “Parked Regen”

• Regeneration will stop:
  o Automatically when the motor controls sense the particulate filter is cleaned
  o 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
  o High temperature light will illuminate
Example of active regen controls
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 in compartment inside left rear cab door

DEF Tank gauge located above 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
**Diesel Exhaust Fluid Supply, Handling, and Refill**

- Stocked in 2.5 gallon containers with filler tubes
  - 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
  - Always completely use a container to avoid storing opened containers
- Refill when the level indicator reaches 1/2 or less
  - The tank should accept one full 2.5 gallon container of DEF
  - No need to continuously top off the DEF tank
- 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.
Additional Resources

• MCFRS Operator’s Guide to Fire Apparatus Out of Service Criteria

• PSTA Driver Training Website

• MCFRS Apparatus Checkout Form
QUESTIONS?

End of Session 1-3