### 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

THRE & RESCUE

- Leakage
  - •Class 1: seepage of fluid; not enough to form drops
  - oClass 2: leakage great enough to form drops; drops do not drip

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.

### FIVE MAJOR SYSTEMS

### 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









EVOC-Class A

Rev. 12/14/16

## WHEELS Aluminum – Post-2009





- 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**





Rev. 12/14/16

EVOC-Class A

Session 1-3

### **STEERING SYSTEM PIERCE TAK4**



Drag Link Steering Arm Steering Box Pitman Arm Tie Rod 24/10/2006

Driver side





### **STEERING SYSTEM PIERCE TAK4**



Drag Link Pitman Arm Tie Rod Steering Arm **Steering Box** 24/10/2006

Curb side



**EVOC-Class A** 

# **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



## **SUSPENSION PIERCE TAK4 – STEERING AXLE**

- Steering axle on Pierce units

   Front axle
   Tiller axle
   NOT on All-Steers
- Uses a torsion bar system no springs

   upper and lower A-frame assembly
   shock absorber for wheel
  - control.



**EVOC-Class A** 

### **SUSPENSION PIERCE TAK4**







# 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



- Conducted in a specific sequence
   Ensures all critical features are checked properly
- Incorrect sequence

Does not check operation of the system sufficiently
 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 •Consult with CMF if the safety of the vehicle is in doubt







# AIR BRAKES C-O-L-A



### **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</li>

### **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 135psi

Listen for the air dryer to exhaust air

Ocut-out pressure of >135psi is OOS criteria

# AIR BRAKES C-O-L-A

### 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 90psi
 Alarms that do not engage <60psi are an OOS criteria</li>

### <u>A=Air Leakage rate</u>

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



# **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</li>
- Newer models are much quieter than old due to emissions standards

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
  - Have a history of overheating on some units
- Operates in four stages
  - ✓Release the accelerator stages 1 & 2
  - $\checkmark$  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

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

# 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

# **DIESEL PARTICULATE FILTER** ACTIVE REGENERATION – "PARKED REGEN"

- 1. DPF lamp illuminates or flashes
- Determine a suitable location to park the apparatus

   Away from combustibles or items that could be damaged by
   exhaust heat need at least 5 feet of clearance
   Outdoors and NOT connected to the PlymoVent
- After parking the unit, engage the manual regeneration
   May be a toggle switch, rocker switch, or other control
   Motor rpm should increase to approximately 1100rpm.
- 4. The driver must remain with the vehicle during regeneration

Duration varies by amount of soot in the DPF – 5 to 20 minutes



# **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

oHigh temperature light will illuminate



# **DIESEL PARTICULATE FILTER** ACTIVE REGENERATION – "PARKED REGEN"



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.

# DIESEL EXHAUST FLUID LEVELS & LOCATION



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

oDEF nozzles are 0.75"; diesel nozzles are 0.87"

- The diesel nozzle should not fit into the DEF tank
- oThe 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**

- THREE RESCUE
- MCFRS Operator's Guide to Fire Apparatus Out of Service Criteria
  - ohttp://www.montgomerycountymd.gov/frsql/resources/files/apparatus/MCFRSOOSCriteria12.pdf
- PSTA Driver Training Website
- MCFRS Apparatus Checkout Form

ohttp://www.montgomerycountymd.gov/frs-

<u>ql/resources/files/apparatus/checkout/ApparatusCheckout.pdf</u>

# **QUESTIONS?**

End of Session 1-3

