An Evaluation of Firefighters’ Diesel Exhaust Exposures During Simulated Medical Runs

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Goals of IH Survey

• To measure firefighters’ diesel exhaust exposures

• To compare effectiveness of different diesel exhaust control systems
Background

• Firefighters were concerned about diesel exhaust exposures from vehicles

• Firefighters are career & volunteer personnel with Oregon’s 2nd largest fire service provider

• Fire service provider has 75 vehicles, including 37 fire engines

• Almost all fire engines and other vehicles run on diesel fuel
Background

• Fire engines used for both fire and medical calls
• Dispatched to 30,277 incidents in 2004
• 75% of calls in 2004 were medical Incidents
• Fire engines have three person crews for medical calls
Exhaust Control Measures

• “MagnaTrack” exhaust collection system by Nederman Company

• “No Smoke” diesel exhaust filter system by Ward Diesel Filter Systems Company

• If engines have “No Smoke” system then “Magna Track” system isn’t used
Nederman MagnaTrack System

- Mounted on overhead tracks
- Vertical hose attaches to fire engine’s exhaust pipe via electromagnet
- Fan pulls exhaust through hose & blows it through exterior stack
- Electromagnet on hose nozzle detaches from exhaust pipe when engine leaves building
- Collects exhaust only when vehicle is inside building
Nederman MagnaTrack System

Hose Connected To Engine
Nederman MagnaTrack

Exhaust System Fan
Ward Diesel No Smoke System

- Ceramic filter mounted under engine catches diesel particulate (soot)

- Automatic pneumatic valve diverts exhaust through filter for 45 seconds during startup and reverse

- Filters returned to manufacture for regeneration
Ward Diesel No Smoke System

Underside of Engine with Filter & Exhaust Pipe
Ward Diesel “No Smoke” System

New Ceramic Filter
Diesel Exhaust Air Sampling

- Sampling done at two stations on different days with different crews

- One station had “MagnaTrack” system (and didn’t have “No Smoke” systems)

- Second station had engines equipped with “No Smoke” Systems (and didn’t have “Magna Track” system)
Sampling Strategy

• Area and personal air samples collected

• Samples collected for elemental carbon (EC), total hydrocarbons as toluene & benzene

• Same sampling strategy at both fire stations

• Samples collected to evaluate personal exposures and area chemical levels
Chemicals

- Elemental carbon (EC)
  - Currently no PEL or TLV
  - TLV withdrawn in 2003
  - MSHA has DPM standard for total carbon, requires size-selective sampler
  - Measured as indicator of exposure to solid particulates in diesel exhaust
  - Treated filter cassettes used for sampling with NIOSH method 5040
  - Gilian 3500 pump set at 2 LPM flow rate
Chemicals

- Total hydrocarbons as toluene
  - Oregon OSHA PEL – 100 PPM TWA
  - ACGIH TLV – 50 PPM
  - Measured as indicator of exposure to VOC component of diesel exhaust
  - Charcoal tube media used for sampling with NIOSH method 1500/1501
  - Gilian low flow pump set at 100 cc/min flow rate
Chemicals

- Benzene
  - Oregon OSHA PEL: 1 PPM
    - Action Level: 0.5 PPM
  - ACGIH TLV: 0.5 PPM
  - Measured in response to firefighters’ concerns
  - Charcoal tube media used for sampling with NIOSH method 1500/1501
  - Collected on same tube as toluene
Personal Air Samples

• Personal samples for total HC as toluene & benzene collected on two firefighters of three person crew
Area Air Samples

• EC & total HC as toluene samples collected in bay at each fire station
  – Done to evaluate diesel exhaust exposures of personnel in bay when engines are driven out or in

• EC sample collected on engine, next to EMS cabinet & above engine exhaust tail pipe
  – Firefighters retrieve EMS supplies from cabinet in vicinity of exhaust tail pipe
EC Sample on Engine
Tasks Sampled

- Firefighters did three simulated medical runs at each station
  - Two simulated residential calls, one vehicle extrication call
  - Engines started in station & driven out
    - MagnaTrack system automatically detached from Engine
    - No Smoke System activated when engine started
  - Engines driven on local streets for about five minutes then returned to station parking lot
Tasks Sampled Cont.

- Engines left running while crews retrieve EMS Supplies and enter building (Fire Station)
  - “No Smoke” system off
Tasks Sampled Cont.

- Crews in building for about 10 mins.

- Then return to engine, drive for about five mins and return to station
  - “No Smoke” activated during backup
  - “MagnaTrack” hose manually re-attached to engine by crew members
Re-Attachment of MagnaTrack Hose
Simulated Vehicle Extraction Call

- 3rd run was vehicle extrication call
- engine drove for five mins & returned to station parking lot
- Crew retrieved extrication equipment and EMS gear from engine
- Crew was in parking lot for 10 mins then drove for five mins & returned to station
Simulated Vehicle Extrication
Sample Results

- No EC detected on samples from bays or on engines
  - All Results <0.009 mg/m³ (No PEL / TLV)

- Nothing detected on all total HC as toluene samples from crews or in bays
  - All Results <1 PPM (PEL – 100 PPM, TLV-50 PPM)

- No benzene detected on samples from crews or in bays
  - All Results <0.08 PPM (PEL – 1 PPM, AL-0.5 PPM, TLV – 0.5 PPM)
Discussion / Conclusion

• Very little or no diesel exhaust exposures near EMS Cabinet even without exhaust control system
  – No EC detected on engine without “No Smoke” system

• Very little or no diesel exhaust exposures to personnel in bays

• Data indicates that firefighters have little, if any diesel exhaust exposures during these simulated medical runs