



NIST Fire Fighting Research and Overhaul

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NIST Fire Fighting Research

- Firefighter Tactics
 - Ventilation
 - Training
- Firefighter Equipment
 - Self Contained Breathing Apparatus (SCBA)
 - Turnout gear
 - Electronic safety equipment
 - Radios
 - Firefighter locators / Radio Frequency Identification (RFID)
 - Personal Alert Safety Systems (PASS)
 - Thermal Imaging Cameras



Fire Incident Overhaul - Areas of Study

- Particulate Measurement
- Gas Measurement
- Turnout Gear Contamination



First Responder – Particulate Monitoring Needs Workshop*

- Representatives
 - Fire service
 - Manufacturers
 - Public health professionals
 - Researchers
 - Standards organizations
- Workshop Priorities Identified Include:
 - Particulate characterization in overhaul
 - Multi-hazard detection



*R. Bryant, et al. “Real-Time Particulate Monitoring: Detecting Threats for First Responders, Workshop Proceedings,” NISTIR SP 1051.



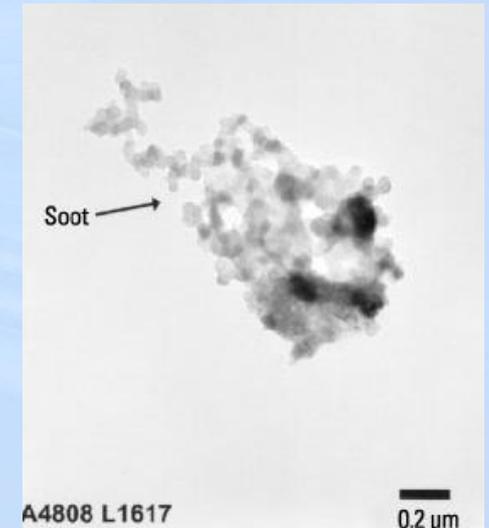
Particulates in Overhaul

- Potentially hazardous non-IDLH environments
 - Fires produce gases, vapors, aerosols, solid debris
 - Fire fighters routinely employ hand-held gas monitors
 - Particulate detectors not routinely used
- Is SCBA needed? Is alternative respiratory protection appropriate?
- Transfer of technology for detecting respiratory threats in the industrial environment to the firefighting environment.
- Develop performance metrics and protocols for standards development.



Particulate Measurement Challenges

- Particulate detectors for first responders
 - Direct reading optical instruments
 - Measure particle size, mass, occurrence with light scattering
 - Aerosol / dust monitor
 - Total mass concentration of particles
 - Particle counter
 - Number concentration of particles
- Smoke particulates encountered during training and overhaul are not reference standard dusts or spheres
 - Smoke characteristics
 - Small particles dominate (0.2 μm to 2 μm mass median diameter)
 - High particle concentrations
 - Wide range of particle shapes, densities, and refractive indices
 - Correlating instrument readings to smoke concentration

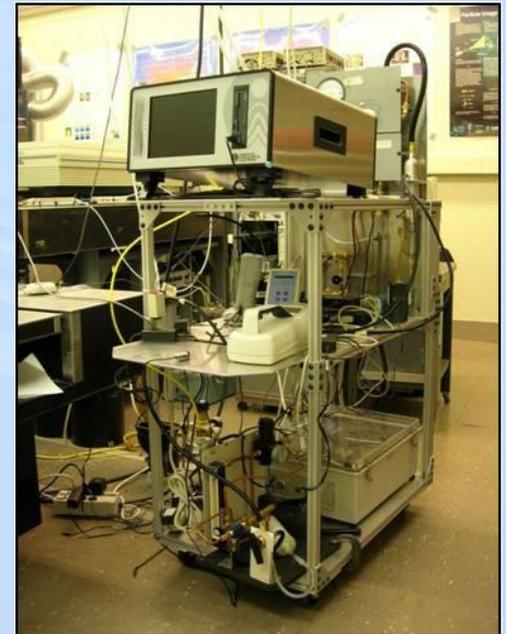


P.J. Liroy et. al. (2002)



Particle Measurement Progress

- Market survey of existing off-the-shelf instruments performed
- Particle dilution system developed
- Future
 - Expose instruments to smoke from smoldering fires involving common household materials and building materials
 - Develop guidance for performance metrics and testing protocols based on the analysis of smoke from smoldering fires



Training Fires - Fire Gas Measurement



- Firefighter trainer
- Flashover simulator
- Instrumentation:
 - Heat release rate
 - Temperature
 - Heat flux
 - Gas concentration
 - Infrared thermography



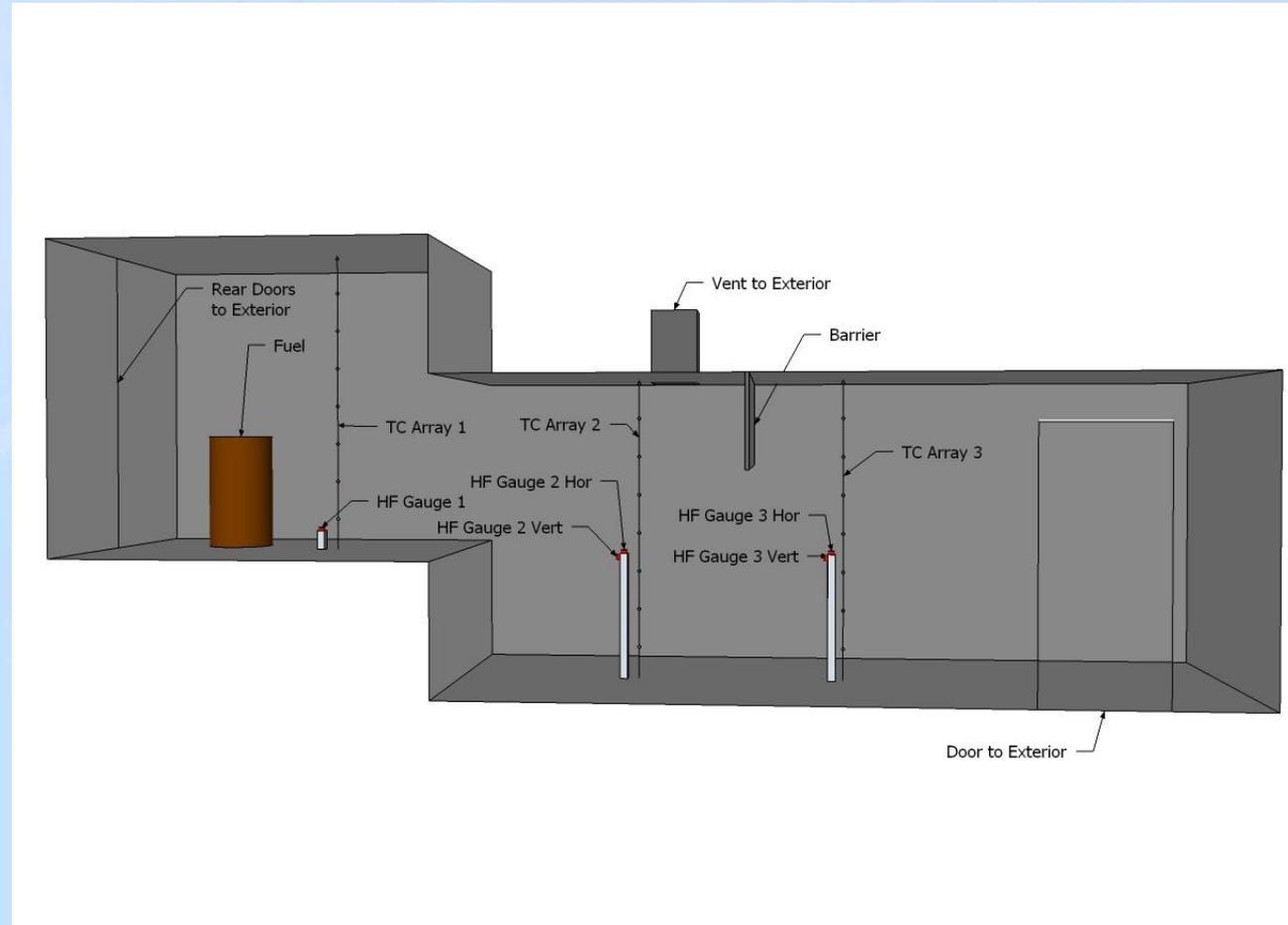
Flashover Simulator Fuels

- Fire sources
 - Natural gas burner
 - Excelsior and broken down wood pallet
- Lining materials
 - Particle board
 - Oriented strand board (OSB)
 - Pressed board
 - Hardboard



Fire Gas Analysis

- O₂, CO₂, CO, total hydrocarbon
 - Sampling tubes
 - Gas analyzers
- FTIR (Fourier Transform Infrared Spectroscopy)
 - Sampling tube
 - Hydrocarbons, HCN, formaldehyde, acids



Turnout Gear Contamination

- Firefighter present in flashover simulator during experiments
- Firefighter manikin
- Samples of turnout gear fabric
 - Upper layer
 - Lower layer
- Fabric sample analysis for contamination from fire exposure



Future Work - Overhaul

- Complete analysis of particulate sampling technologies
 - Expose the instruments to smoke from smoldering fires involving common household materials and building materials
 - Develop guidance for performance metrics and testing protocols based on the analysis of smoke from smoldering fires
- Complete analysis of fire gases in firefighter training environment (flashover simulator)
- Complete analysis of contaminants on firefighter turnout gear materials
- Full scale and large scale fire experiments provide opportunities for the study of overhaul hazards



NIST - National Fire Research Laboratory

Arriving 2012

