

# Monitoring Personal Chemical Exposures of Structural Firefighters with Silicone Passive Samplers

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## Background

- Firefighters face disproportionately high cancer and cardiovascular disease rates compared to the general population. Occupational exposure of firefighters to complex chemical mixtures contribute to these health impacts.<sup>1</sup>
- Chemicals of interest in this study include...
  - Flame retardants (FRs)** – a use-based chemical category; sources include house goods (e.g., upholstered furniture, electronics) and are useful in the firefighting field
  - Polycyclic aromatic hydrocarbons (PAHs)** – combustion byproducts
  - Polychlorinated biphenyls (PCBs)** – historically added to building materials and electrical equipment (<1979 in US)<sup>2,3</sup>
  - Volatile organic chemicals (VOCs)** – found in solvent-based products and combustion byproducts (defined by high volatility)<sup>4</sup>
- Studies have linked chemicals from all of these classes to a variety of chronic and acute health effects including cancer and cardiovascular disease.

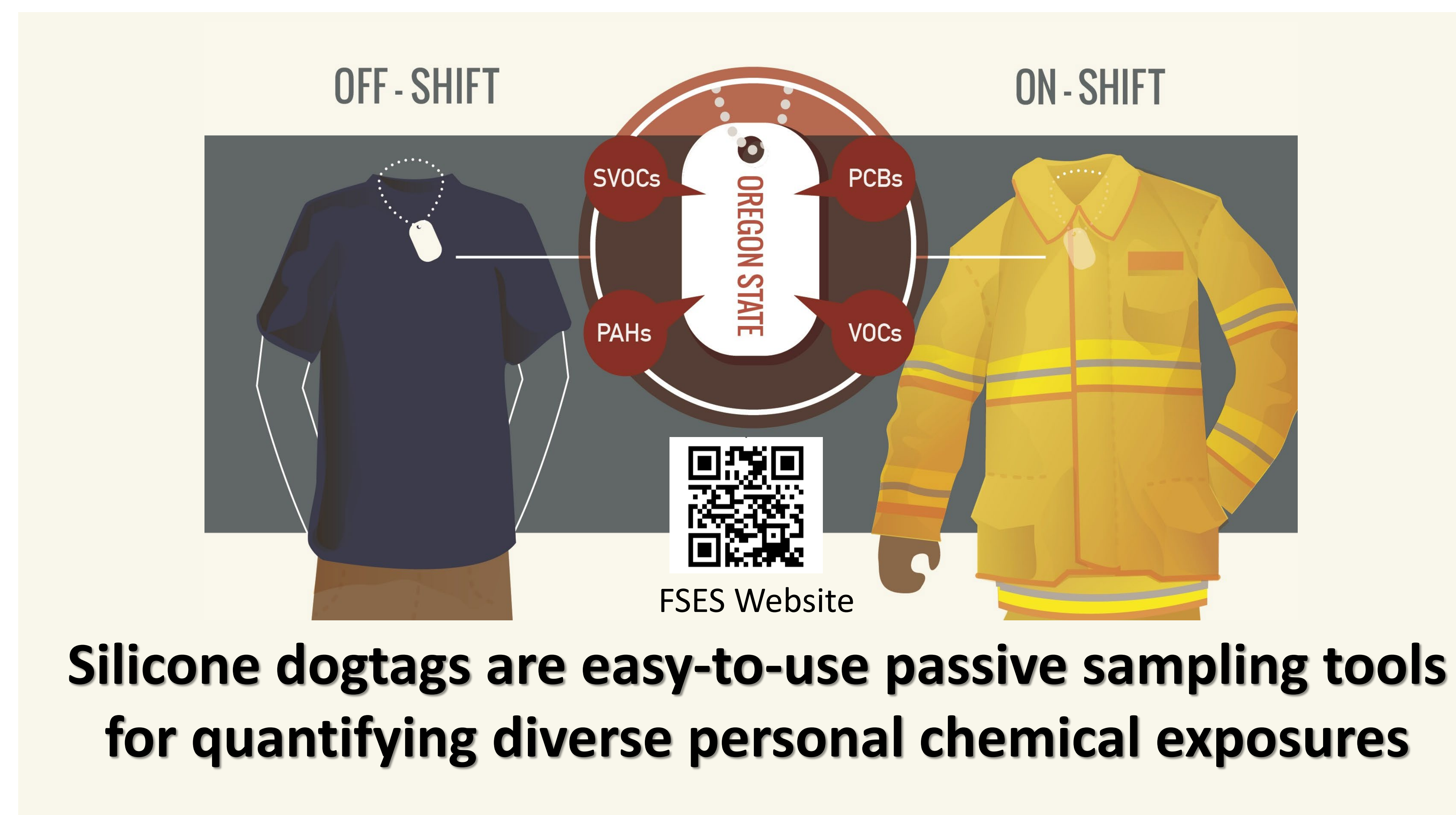
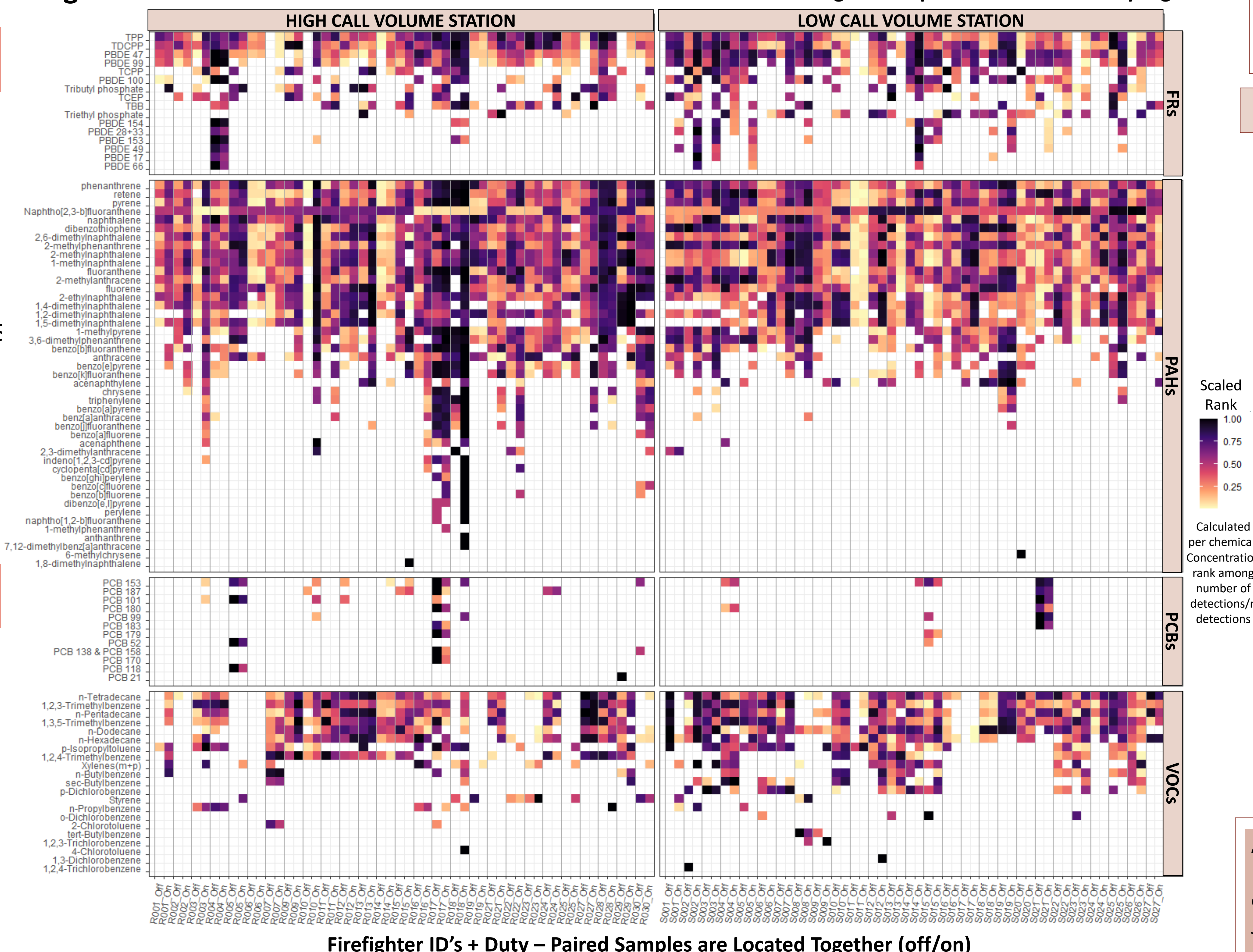


Fig 1. Scaled rank for concentrations of detected concentrations for individual firefighters in paired off- and on-duty tags



## Methods

- 57 firefighters recruited from a high and low call- volume department in Kansas City
- Silicone dog-tags – one tag worn while on-duty, and another while off-duty. Each tag worn for 30, 24-hour shifts.
- Silicone samplers were solvent extracted and cleaned up with solid phase extraction
- Analyzed for 43 FRs, 63 PAHs, 43 PCBs, and 21 VOCs with GC/MS
- Questionnaire data demographics and lifestyle data include:

House conditions

# of Fire Attacks

Rank (e.g. captain)

## Aims

- Assess contributions of occupational factors to firefighter chemical exposures (on- vs. off-duty status, fire department, rank, fire attacks)
- Compare chemical profiles within (paired on- and off-duty samples) and between firefighters.
- Discuss the value and limits of silicone passive sampling to quantify diverse occupational and personal exposures

## References:

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## Results

	Detected Compounds	Most Frequently Detected	Other Observations
FRs	16 flame retardants were detected in >1 sample (43 in method)	Triphenyl phosphate (TPP)	<ul style="list-style-type: none"> <li>Abundance and concentrations of organophosphate FRs were largest.</li> <li>Sign tests indicate PBDEs 100, 47, and 99 are greater in on-duty samples</li> </ul>
PAHs	46 PAHs were detected in >1 sample (63 in method)	Phenanthrene	<ul style="list-style-type: none"> <li>Greater concentrations of PAHs were found at the high call volume station and in on-duty tags<sup>5</sup></li> </ul>
PCBs	12 PCB congeners detected in >1 sample (43 in method)	PCB 153	<ul style="list-style-type: none"> <li>Only 28% of participants had any detectable PCB exposures</li> <li>PCB detection profiles are highly individual (and often overlapping between on- and off-duty)</li> </ul>
VOCs	17 VOCs were detected in >1 sample (21 in method)	n-tetradecane	<ul style="list-style-type: none"> <li>VOC concentrations are highly variable</li> <li>Alkane analytes generally had the greatest detections in the highest concentrations</li> </ul>

91 total chemicals were detected in at least one sample

## Discussion

- Observations in this dataset indicate that PAHs and flame retardants are more influenced by on- vs. off-duty status than VOCs or PCBs.
- Large variance in VOC data – difficult to quantify with this methodology; may be better suited for SVOCs.
- Some individuals have obvious high (or low) exposure across the board in one or both samples.

## Conclusions

- Chemical exposures are highly individual, with likely a mixture of occupational and personal sources.
- Personal passive sampling can help answer questions about these *individual* exposures to complex mixtures, without significant burden to the participant.

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