

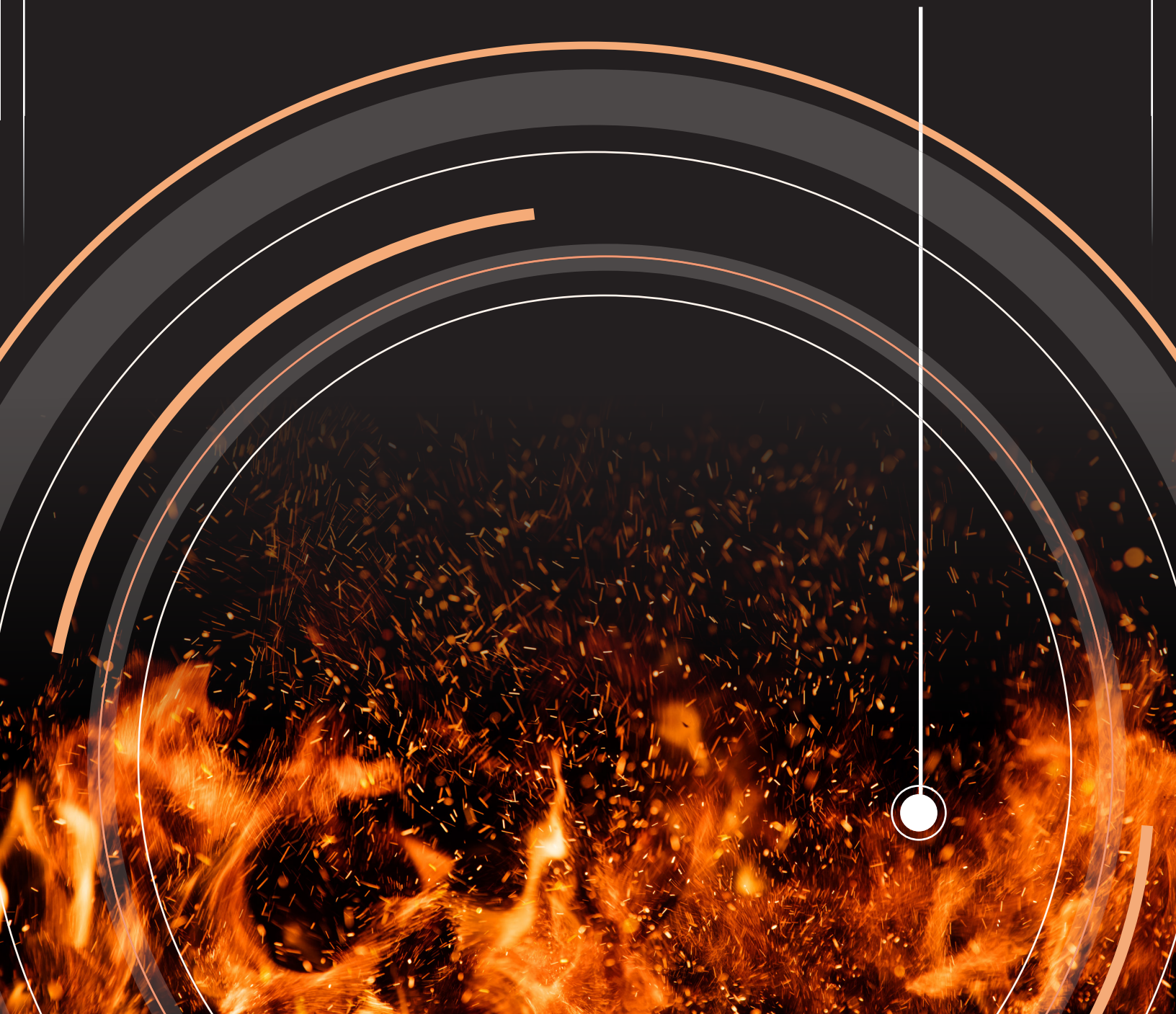


Built Environment Testing

a guide to

FIRE INVESTIGATION TESTING

& combustion by-products



What are Combustion By-Products?

Fire, either wildfire or structure burning, happens often in our world. It can impact property, the environment and public health. The residues of the fire, or **combustion by-products**, are *gases and small particles that are emitted through the incomplete burning of fuels such as oil, gas, kerosene, wood, coal, and propane*. The particulate matter components will include drops of condensed soot, char, ash, metal oxides and inorganic solids. These materials can be acutely hazardous to humans since they can contain heavy metals, and polycyclic aromatic hydrocarbons (PAHs).

Reasons for Fire Investigation Testing

1. Insurance Claims
2. Preventing adverse health impacts

The investigation of any fire damage should include the combustion by-products evaluation. It also becomes part of insurance companies' requirement in a typical fire damage restoration. Testing can be done after a fire event in order to determine what areas might have been impacted, or the testing can be used during or after a cleaning or remediation in order to guide professionals in their remediation efforts.

Sources of Combustion By-Products



Wood Stoves



Wildfires



Chemical Fires



Health Impacts

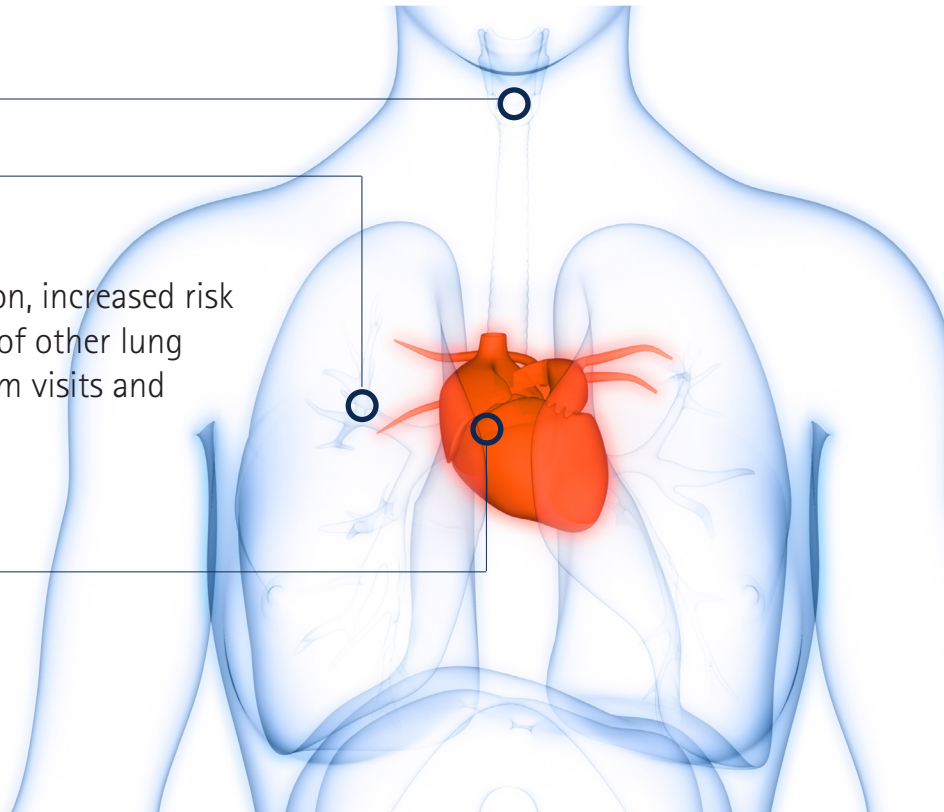
Although the smoke has mostly dissipated, the threat to human health lingers in the remnants of the fire investigation site. One breath of smoke could contain hundreds of air pollutants that can lead to life-threatening diseases. As you inhale, particles that are laced with toxic substances are making their way into the lungs where they can remain for months. This exposure can cause changes that lead to diseases and structural damage. These fine particles may contain harmful chemicals such as **benzene, formaldehyde, acetaldehyde, acrolein, and polycyclic aromatic**

hydrocarbons (PAHs). Although adults with good health have more resistance to effects of wood smoke, infants, children and the elderly are very vulnerable to the negative impacts.

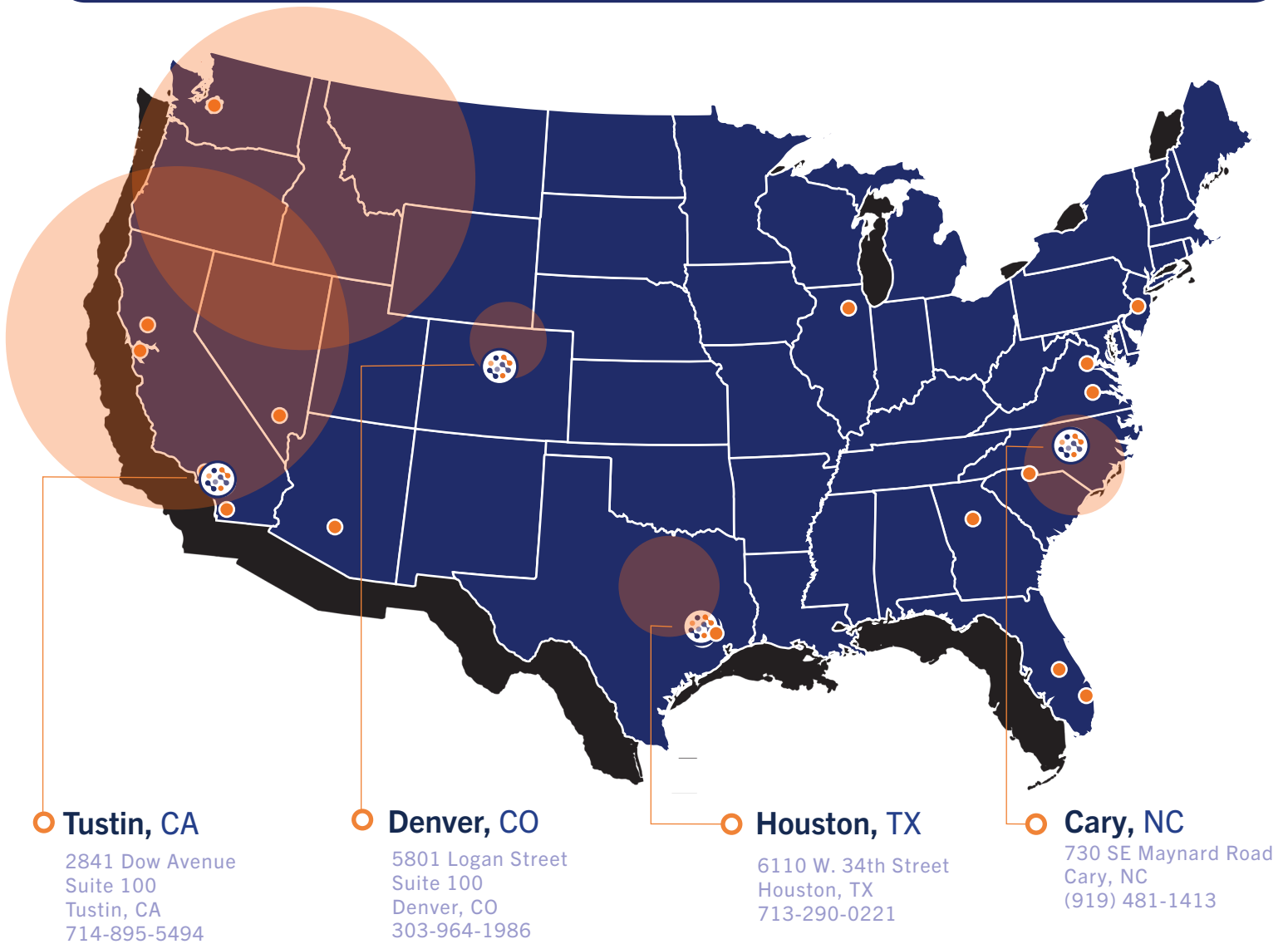
Fire Investigation Testing can provide a more accurate picture of the damage that occurred by evaluating combustion by-products. This testing has the potential to help protect humans from adverse health effects that could be life-threatening including cancer, respiratory impacts and cardiovascular impacts.

Understand the Risks

- **Cancer**
increased risk of cancer
- **Respiratory Impacts**
including bronchitis, reduced lung function, increased risk of asthma exacerbation and aggravation of other lung diseases, increased risk of emergency room visits and hospital admissions
- **Cardiovascular Effects**
including heart failure, heart attack, and stroke.



Eurofins Built Environment Locations are Central to High Risk Zones



Eurofins Fire Investigation Laboratory



Eurofins Built Environment Lab

Proximity Matters

Location is important. We understand that being able to respond quickly and receive results even quicker will enable you to plan your next steps and allow you to return to normal. It's why we have locations nationwide to support the high frequency of wildfires

on the West Coast and the variety of structure fires as well as chemical fires on the East coast. We provide **four labs that specialize in Fire Investigation Testing** along with over a dozen additional labs that can support any additional testing needs.

Sampling Options

Sampling Method	Advantages	Disadvantages
Tape Lifts	• Good collection efficiency for particles with typical dust loading • Defined sample area for analysis • Maintains particle integrity during collection • Little to no damage to captured particles	• Low collection efficiency for rough surfaces • Extremely fine particles (e.g., soot) can be obscured by the tape adhesive • TEM confirmation of soot cannot be applied • Limited sampling area per tape lift
Wipe	• Able to sample relatively large area • Efficient for relatively smooth nonporous surfaces with low or heavy loading • Can be used for TEM soot confirmation analysis and chemical analysis (e.g., PAHs)	• Not appropriate for porous surface • Physical separation of particles collected as agglomerates often results • Liquid agents may degrade or solubilize the particles • Can remove finishes (e.g., paint), affecting analytical results
Microvac	• Easy sample preparation in the lab • Effective for collecting particles from porous and uneven surfaces • Permits the confirmatory identification of soot by TEM • Permits chemical analysis of collected material	• Ineffective for collecting particles from relative smooth, nonporous surfaces with low loading • Does not preserve positions of particles on the original surface • Can induce damage to delicate structures or agglomerates such as char and ash
Air	• Easy sample preparation in the lab • Can determine if combustion by-products are airborne • Can have direct respiratory health implication • Can be used for soot confirmation by TEM	• Limited to airborne particles only • Can be significantly reduced if sampling is done after extensive period from the fire damage

CASE STUDY 1

HIDDEN COMBUSTION BY-PRODUCTS IN A 30-STORY BUILDING

THE SITUATION

A 30-story mixed-use structure suffered a fire that resulted in devastating damage on the 26th floor. It was concluded that the fire started on the 26th floor after evidence showed fire damage could be seen on the southwest side of this floor. Further evidence showed water damage on the ceiling and walls directly below the fire's origin which was attributed to firefighting. Smoke appeared to have traveled throughout the 26th floor as visible smoke damage was observed on the walls and ceilings throughout the 26th floor, along with sporadic fire debris on the ground. Despite clear damage to the 26th floor, fire damage on the 25th floor and 27th floor—or any other floors for that matter, seemed nonexistent.



THE CHALLENGE

Although the initial evidence didn't state that other floors felt the impact of the fire, Eurofins was able to test that theory using Fire Investigation to test for Combustion By-Products. Concrete and masonry brick construction with plaster finish is suspected to have served as a smoke barrier between the 26th floor and the 25th and 27th floors. With nowhere to go, the smoke from the fire likely traveled throughout the 26th floor with smoke probably traveling into the elevator shafts. Surface residues consistent with CBP contaminants were observed along the elevator doors on the 26th and 27th floor.

To determine if smoke had traveled beyond 26th floor, the inspector collected some surface samples from the 25th floor and the 27th floor, and even from the 30th floor elevator door.

THE RESULTS

Of the eight samples collected from the fire incident, seven of them found to contain CBP concentrations from greater than 1% to 10%. The results indicate that not only were CBP contaminants carried throughout the 26th floor, but the smoke managed to travel to the 27th floor via the elevator shaft as CBP contaminants were detected along the exterior wall and the hallway outside of the elevator on the 27th floor. The results also suggested that smoke traveled to the 25th floor as CBP contaminants were found along the exterior wall and outside of the elevator on the 25th floor. In fact, CBP contaminants were detected in the elevator shaft as far as the 30th floor. Based on the sampling results and visual observations, the inspector recommended removing smoke damaged porous materials and thoroughly clean hard surfaces on the 26th floor and recommended cleaning elevator shafts from the 25th floor to the 30th floor.

Services Packages

FIRE SOURCE

RECOMMENDED TESTING

WILDFIRES

Initial inspection and post cleanup verification

- PLM, Corrosivity, Anion panels

WILDFIRES

Structural impact assessments

- PLM, Corrosivity, Anion panel, Chloride

STRUCTURE FIRE

- PLM, Corrosivity, TEM/SEM confirmation, Chloride

DISASTER FIRES

- PLM, Corrosivity, Anion panel, Chloride

SMOKE IMPACT

from nearby fire (wildfire or structure fire)

- TO-13A, TO-15

FORENSIC INVESTIGATION

of fire origin

- Assemblage

Frequently Asked Questions

1 WHAT IS THE BENEFIT OF CORROSIVITY TEST FOR WIPE SAMPLES?

Fire residues are rich in cations and/or anions therefore can be corrosive. Wildfire residues tend to be alkaline (pH varies from ~ 9 to 14) due to the presence of cations such as Ca, Mg, K, etc. On the contrary, structure fire residues tend to be acidic (~3 to 6) due to the presence of anions such as Cl, S, P, F, etc. Corrosivity testing results can be used by consultants or remediation contractors to determine if items in a fire impacted building need to be cleaned and/or disposed with or without the presence of elevated combustion by-product particulates as corrosive residues can damage many household items such as electronic devices, leather furniture, and carpeting, etc.

2 IS LICENSING OR CERTIFICATION REQUIRED FOR COMBUSTION BY-PRODUCT SAMPLING AND ANALYSIS?

The simple answer is no. Sampling and analysis for combustion by-products is an emerging field, and there are currently no government regulations or certifications for either sampling or analysis, although training for fire damage inspection by private institutions or organizations is available. Presently, there is no accreditation program exist for laboratory testing for combustion by-products.

3 CAN THE DEBRIS RATING BE USED TO INFER GENERAL RISK TO HEALTH TO OCCUPANTS, OR CAN IT BE USED TO INFER PAST AIRBORNE COMBUSTION BYPRODUCT CONCENTRATIONS?

Debris rating is used to describe the levels of surface area obscured by particulates on a sampled surface under light microscopy, and it is not directly related to health or past airborne combustion by-product concentrations, although the same CBP concentration with higher debris rating may indicate more severe CBP contaminations.



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