

Composition of Fire Smoke:

Smoke from fires comprises suspended liquid and solid particulate matter, gases, and vapors that result from the combustion or pyrolysis of material.

- **ALL** types of fire release toxic and carcinogenic substances.

Overall Evaluation: The agent is described according to the wording of one of the following categories, and the designated group is given. This categorization of an agent is a matter of scientific judgment that reflects the strength of evidence derived from studies in humans and in experimental animals and from mechanistic and other relevant data.

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|----------|--|
| Group 1 | Carcinogenic to humans |
| Group 2A | Probably carcinogenic to humans |
| Group 2B | Possibly carcinogenic to humans |
| Group 3 | Not classifiable as to its carcinogenicity to humans |
| Group 4 | Probably not carcinogenic to humans |

| Carcinogens Found in Smoke at Fires | |
|--|----------------|
| Chemicals measured in fires | Classification |
| 1,3-Butadiene | 1 |
| 2,3,7,8-tetrachloro dibenzo- <i>para</i> -dioxin | 1 |
| Arsenic | 1 |
| Asbestos | 1 |
| Benzene * | 1 |
| Benzo[<i>a</i>]pyrene | 1 |
| Cadmium | 1 |
| Formaldehyde | 1 |
| Polychlorinated biphenyls | 1 |
| Radioactivity (γ activity) | 1 |
| Radionuclides (α -particle-emitting) | 1 |
| Radionuclides (β -particle-emitting) | 1 |
| Silica (crystalline) | 1 |
| Trichloroethylene | 1 |
| Dibenz[<i>a,h</i>]anthracene | 2A |
| Dichloromethane (methylene chloride) | 2A |
| Lead compounds, inorganic | 2A |
| Tetrachloroethylene (perchloroethylene) | 2A |
| Acetaldehyde | 2B |

| Carcinogens Found in Smoke at Fires | |
|-------------------------------------|----------------|
| Chemicals measured in fires | Classification |
| 2-Nitroanisole | 2B |
| Benzo[<i>a</i>]anthracene | 2B |
| Benzo[<i>b</i>]fluoranthene | 2B |
| Benzo[<i>k</i>]fluoranthene | 2B |
| Benzofuran | 2B |
| Carbon black | 2B |
| Chrysene | 2B |
| Ethylbenzene | 2B |
| Furan | 2B |
| Indeno-1,2,3-[<i>cd</i>]pyrene | 2B |
| Isoprene | 2B |
| Lead | 2B |
| Naphthalene | 2B |
| Polychlorophenols | 2B |
| Styrene | 2B |
| Toluene diisocyanates | 2B |
| Trichloromethane (chloroform) | 2B |
| Lead compounds, organic | 3 |
| Silica (amorphous) | 3 |
| Triphenylene | 3 |

Several studies have been conducted with the purpose of identifying the chemicals and known carcinogens found **during the overhaul phase of a structure fire**.

- Characterization of Firefighter Exposures During Fire Overhaul (Phoenix FD and the University of Arizona Prevention Center and Arizona State University).
- A Study on Chemicals found in the Overhaul Phase of Structure Fires using Advanced Portable Air Monitoring available for Chemical Speciation (Tualatin Valley Fire & Rescue – Oregon)

| Chemicals measured in overhaul environment | IARC Classification |
|--|---------------------|
| 1,3 Butadiene | 1 |
| Arsenic | 1 |
| Asbestos | 1 |
| Benzene * | 1 |
| Benzo(a)pyrene | 1 |
| Coal Tar Pitch | 1 |
| Diesel Exhaust | 1 |
| Formaldehyde | 1 |
| Vinyl Chloride | 1 |
| Dibenz(a,h)anthracene | 2A |
| N-Nitrodimethylamine | 2A |
| 1,2 Dichloroethane | 2B |
| Acetaldehyde | 2B |
| Benz(a) anthracene | 2B |
| Benzo(b)fluoranthene | 2B |
| Benzo(k)fluoranthene | 2B |
| Benzo(furan) | 2B |
| Ethyl benzene | 2B |
| Furan | 2B |
| Indeno(1,2,3-cd)pyrene | 2B |
| Lead | 2B |
| Napthalene | 2B |
| Styrene | 2B |
| Mercury | 3 |
| Hydrochloric Acid | 3 |
| Toluene | 3 |
| Acrolein | 3 |
| Furfural | 3 |
| Acenaphthene | 3 |
| Anthracene | 3 |
| Benzo(ghi)perylene | 3 |
| Fluoranthene | 3 |
| Fluorene | 3 |
| Phenanthrene | 3 |
| Pyrene | 3 |

Diesel Engine Exhaust:

On June 12, 2012, the International Agency for Research on Cancer (IARC), part of the World Health Organization and the authority on cancer, classified diesel engine exhaust as a Group 1 Carcinogen, meaning that it causes cancer in humans.

Diesel engine exhaust in fire stations has been and continues to be a serious health problem for firefighters. This exhaust is generated whenever a fire apparatus leaves or returns to the station. If not properly captured and removed, it will remain in the apparatus bay as well as enter the firefighters' living quarters. As a result, firefighters can be exposed to diesel engine exhaust for a considerable portion of their shift.

Diesel exhaust contains multiple cancer-causing chemicals such as (Source IARC Monograph 105):

| Metals | IARC Classification |
|---|---------------------|
| Antimony Compounds | 2B |
| Arsenic and inorganic arsenic compounds | 1 |
| Beryllium and beryllium compounds | 1 |
| Cadmium and cadmium compounds | 1 |
| Chromium (VI) | 1 |
| Cobalt and cobalt compounds | 2B |
| Lead compounds (inorganic/organic) | 2A/3 |
| Nickel (metallic/compounds) | 2B/1 |
| Organic Chemicals | IARC Classification |
| 1,3-Butadiene | 1 |
| Acetaldehyde | 2B |
| Benzene * | 1 |
| Bis(ethylhexyl)phthalate | 2B |
| Ethylbenzene | 2B |
| Formaldehyde | 1 |
| Propylene oxide | 2B |
| Halogenated and other chemicals | IARC Classification |
| Dioxin/dibenzofurans | 1 |
| Polycyclic aromatic hydrocarbons | IARC Classification |
| Benz(a) anthracene | 2B |
| Benzo(b)fluoranthene | 2B |
| Benzo(k)fluoranthene | 2B |
| Benzo(a)pyrene | 1 |
| Chrysene | 2B |
| Dibenz(a,h)anthracene | 2A |
| 3,7-Dinitrofluoranthene | 2B |
| 3,9-Dinitrofluoranthene | 2B |
| 1,3-Dinitropyrene | 2B |
| 1,6-Dinitropyrene | 2B |
| 1,8-Dinitropyrene | 2B |
| Indeno(1,2,3- <i>cd</i>)pyrene | 2B |
| Napthalene | 2B |
| 3-Nitrobenzanthrone | 2B |
| 6-Nitrochrysene | 2A |
| 2-Nitrofluorene | 2B |
| 1-Nitropyrene | 2A |
| 4-Nitropyrene | 2B |
| Styrene | 2B |

Soot:

Soot is a byproduct of the incomplete burning of organic (carbon-containing) materials, such as wood, fuel oil, plastics, and household refuse.

Soot particles absorb many hazardous chemical vapors that are released during fires, holding them in place on surfaces including firefighter's personal protective equipment (PPE), clothing and skin.

As firefighters work, their body temperature rises and they begin to sweat. Skin becomes more permeable and soot particles are more easily absorbed into the body.

- For every 5° increase in skin temperature, absorption increases by 400%.

The International Agency for Research on Cancer, part of the World Health Organization, lists soot in the Group 1 category meaning that the agent is ***“Carcinogenic in Humans.”***

In their *13th Report on Carcinogens* which was released on October 2, 2014, the U.S. Department of Health and Human Services continues to list **soots** as a substance under the category of ***“Known To Be Human Carcinogens.”***