

## A universal problem in Fire Stations

Diesel engines, used in fire apparatus, produce a mixture of toxic gases and particulates from the combustion process. The composition of the exhaust product depends on several factors such as fuel quality, temperature of the engine, condition of the engine among others.



### Diesel exhaust in general contains a variety of extremely toxic substances at significant concentrations

- **Nitrogen oxides.** Short term exposures can cause respiratory tract irritation and infections. Long term exposures result in lung tissue damage and difficulty in breathing.
- **Carbon monoxide.** Exposure to high levels of carbon monoxide causes death, at lower levels headaches, dizziness, weakness and neurological problems.
- **Volatile organic compounds (VOC),** a class of carbon-based chemicals i.e. benzene, toluene, phenol, and chlorinated solvents. Health effects are, headaches, nausea, neurological disorders, respiratory irritation and liver damage. VOC are also known to be or suspected to be carcinogen.
- **Polynuclear aromatic hydrocarbons (PNA:s).** These are relatively large, complex chemicals formed during the combustion process. They adhere to the soot particles. PNAs are documented to be carcinogen.
- Furthermore diesel exhaust can penetrate into and adsorb onto clothing, furniture and other items with which fire fighters have routine contacts and later can be released and absorb into the fire fighters skin.

The International Association of Fire Fighters (IAFF) list cancer as one of the major occupation hazards facing fire fighters today.

A study of Seattle fire fighters show a high level of mortality from diseases such as lung cancer, non-malignant respiratory disease and cardiovascular disease.

An analysis of fire fighters deaths in Boston area indicated a 3 to 1 increase in fire fighter cancers compared to the general population.

#### Available Solutions and their Merits

Various methods have been suggested for reducing diesel exhaust emissions at fire stations.

1. Engineering controls involve methods which reduce the amount of toxic substances released by the diesel engine.

2. Ventilation increases the flow of clean air to affected areas by adding apparatus room exhaust fans and make up air sources and may in some cases provide "positive pressure" make up air in the living and work areas.

3. Source capture entails placing hose collection devices directly on the apparatus tail pipe and venting the emissions harmlessly into the atmosphere.

The first solution is based on the use of cleaner burning fuels, better fuel ignition and improved particle traps.

Currently technology is not available and will be very expensive for the fire service to implement. The newer generation of diesel engines will still pro-

duce some exhaust containing hazardous chemicals. Interim solutions such as after market diesel exhaust filters added to the apparatus exhaust system may appear to clean exhaust by removing visible particulates but still allow hazardous gases to pass through and remain within the firehouse.

**Ambient "general" ventilation is the least desirable solution.**

1. Bay doors are left open for several minutes.
2. Additional ventilation control requires the use of mechanical make up air systems.
3. Self contained general ventilation filters, strategically placed over the apparatus does not remove all contaminants.



**All these three general ventilation approaches have several disadvantages:**

- They do not guarantee removal of all diesel exhaust because of "dead" air spaces in the fire station
- The rate of air exchange within the apparatus bay does not always keep pace with the generation of diesel exhaust
- There are often no precautions in place to know when the system is not performing as designed.
- Proper ventilation system requires extensive modifications to the station at very high cost.
- It does not keep exhaust from absorbing into clothing and equipment or other materials within the station.

**100% exhaust source capture is the most reliable means to significantly reduce or eliminate exposure of fire station occupants to diesel exhaust emissions.**

Just like truck and engine manufacturers are required to design and provide exhaust systems which are airtight for eliminating the chance of toxic exhaust contamination from spreading into the vehicle passenger compartment, exhaust source capture systems must be similarly designed.

The design of the system should entail:



- Airtight exhaust duct work starting at the tail pipe and through the entire exhaust ventilation system.
- A spark resistant exhaust system by using a spark resistant fan and grounded duct system.
- Automatic activation via an in-line sensor which monitor when the apparatus engine is started and stopped, ensuring that the exhaust is always running during the period apparatus are in operation.
- An automatic disconnect nozzle allowing vehicles to drive into and out of fire station with the hoses still attached to the exhaust system.
- The pick up of hose safely disconnects from the vehicle and is retracted into the building permitting automatic door to close.

**Regulatory Authorities**

The National Institute of Occupational Safety & Health (NIOSH) and Occupational Safety and Health Administration (OSHA) in the USA and many other counties has declared **HUMAN EXPOSURE TO DIESEL EXHAUST A POTENTIAL OCCUPATIONAL CARCINOGENIC HAZARDS.**