



**City of Winchester  
Fire & Rescue Department  
STANDARD OPERATING PROCEDURE**



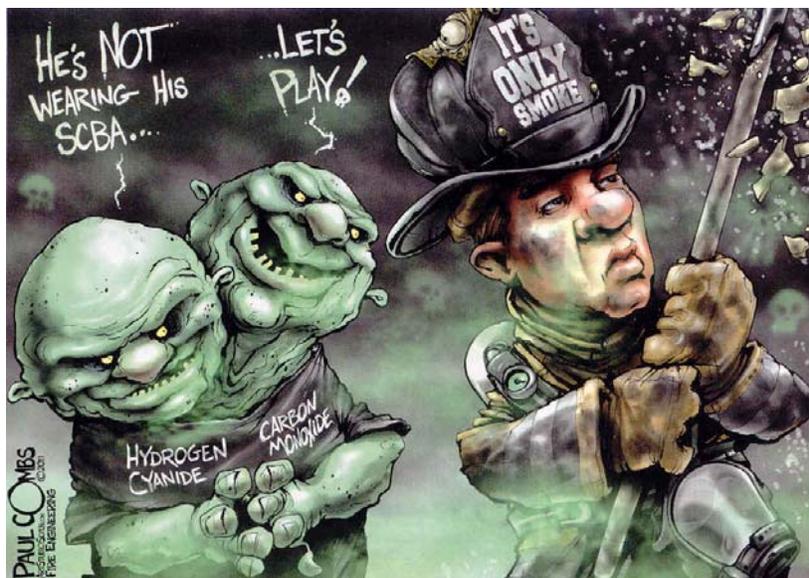
<b>Section:</b> Fire Suppression Operations	<b>SOP:</b> 8.7
<b>Subject:</b> IDLH Air Monitoring	<b>Executed:</b> November 1, 2011 <b>Revised:</b>
<b>Approved:</b>   Scott Cullers, Fire Chief	

**PURPOSE**

To develop a procedure to ensure the air quality of Immediately Dangerous to Life and Health (IDLH) environment prior to any personnel removing their self contained breathing apparatus (SCBA) face pieces.

**RESPONSIBILITY**

It shall be the responsibility of all personnel operating at an IDLH incident to comply with this procedure.



**DEFINITIONS**

**Hydrogen Cyanide (HCN)** – At room temperature HCN is a colorless or pale-blue liquid that turns into a gas with a bitter almond or fruity floral sweet odor. It can be classified by DOT as a Class 3 (Flammable Liquid), Class 6 (Poisonous Infectious Substance) material and is recognized as a WMD Blood Agent. It is found as a byproduct of incomplete combustion during fire incidents.

Short Term Exposure Limit (STEL): 4.7 ppm  
Immediate Danger to Life and Health (IDLH): 50 ppm  
Lethal Dose: 300 ppm  
Vapor Density: .94  
Flash Point: 0° F

**Carbon Monoxide (CO)** - A colorless and odorless gas that is produced by various sources. It is one of the most readily found fire gases. It can be classified by DOT as a Class 2.1 or Class 2.3 material. The most readily available source of CO is incomplete combustion.

Time Weighted Average (TWA): 35 ppm  
EPA action level: 9 ppm  
IDLH: 1200 ppm  
Vapor Density: .96

**Lower Explosive Limit (LEL)** - Lowest concentration (percentage) of a gas or vapor in air capable of producing a flash of fire in presence of an ignition source. Concentrations lower than LEL are 'too lean' to burn. A sensor that is standard in a four gas meter for determining the lower explosive limits of flammable substances. This is typically set to alarm at 10% of the LEL of the calibration gas.

**Hydrogen Sulfide (H<sub>2</sub>S)** - Is a colorless gas that has a smell of rotten eggs and/or sulfur. Typically is not considered to be a major fire ground gas. A hydrogen sulfide sensor is standard in a four gas meter.

TWA: 10 ppm  
STEL: 15 ppm  
IDLH: 100 ppm  
Vapor Density: 1.189

**Oxygen (O<sub>2</sub>)** - Normal oxygen atmosphere is 20.9%, an oxygen enriched atmosphere is 23.5% and an oxygen deprived atmosphere is 19.5%. Remember that for every 0.1% of oxygen displaced from the atmosphere, 5,000 ppm of some other gas has replaced it. An oxygen sensor is standard in a four gas meter.

**Hydrogen Chloride (HCL)** - A byproduct of combustion gas from the burning of PVC style material. It has an IDLH of 50 ppm.

**Phosgene (CCL<sub>2</sub>O)** - A byproduct of combustion gas that is produced when refrigerants contact flame. It has an IDLH of 2 ppm.

## **PROCEDURE**

1. There will be a HCN meter located in the Battalion Officer's vehicle for the purpose of monitoring HCN. A second HCN meter can be obtained from the Frederick County Fire and Rescue Department on the BAT-10 unit.
2. Upon the arrival of the Battalion Officer, the HCN meter and the four (4) gas

meter shall be turned on in a fresh air environment.

3. The Incident Commander (IC) shall assign the Incident Safety Officer or his designee the task of monitoring the outside of the structure to determine the warm and cold zone for dangerous gases. For personnel that need to operate in the warm zone, SCBA apparatus shall be utilized until meter reading levels fall within acceptable limits.
4. All monitoring results shall be recorded.
5. SCBA shall be utilized until all of the following conditions no longer exist:
  - a. HCN readings of any amount on the HCN meter
  - b. Oxygen atmosphere greater than 23.5%
  - c. Oxygen atmosphere less than 20.8%
  - d. CO reading of 35 ppm or greater
  - e. H<sub>2</sub>S reading of 10 ppm or greater
  - f. LEL reading of 10% or greater
6. Once the above conditions are at satisfactory levels, the IC will make the announcement that personnel can operate without the use of SCBA.
7. Periodic monitoring shall take place to ensure that the atmosphere remains safe for the firefighters.
8. If personnel are found working in an area without SCBA and without prior monitoring; the area is to be immediately surveyed with the meters to see if the person has been exposed to the toxic gases.
9. Personnel that are exposed to HCN, H<sub>2</sub>S and CO should be sent to the established rehab area for monitoring. Personnel shall be closely monitored for illness and transported to the hospital if necessary. The IC shall determine the length of time personnel were potentially exposed and record the meter readings from their working area. This information shall be conveyed to the Incident Safety Officer and documented as a firefighter casualty report in the department's reporting software.

## **MEDICAL SYMPTOMS**

1. Hydrogen cyanide can cause rapid death due to metabolic asphyxiation. Death can occur within seconds or minutes of the inhalation of high concentrations of hydrogen cyanide. Sources report that 270 ppm is fatal after 6 to 8 minutes, 181 ppm after 10 minutes and 135 ppm after 30 minutes [Hathaway et al. 1991]. These levels are not uncommon during routine structure fires as documented in recent studies across the United States.
2. Acute exposure symptoms including weakness, headache, confusion, vertigo, fatigue, anxiety, dyspnea, and occasionally nausea and vomiting. Respiratory rate and depth are usually increased initially and at later stages become slow and gasping. Coma and convulsions occur in some cases. If cyanosis is present, it usually indicates that respiration has either ceased or has been

inadequate for a few minutes. If large amounts of cyanide have been absorbed, collapse is usually instantaneous, followed with unconsciousness, convulsions and then almost immediately by death [Hathaway et al. 1991].

3. HCN has a half-life of one hour in the body, therefore it is imperative that exposed personnel be given immediate medical attention to include blood work and tested for HCN levels in the blood.

## **SPECIAL NOTES**

1. This procedure is applicable to all products of combustion. It should be understood that lethal levels of CO and HCN have been detected at vehicle fires, dumpster fires and other outside rubbish fires. It is imperative that PPE and SCBA are worn at all times.
2. Levels of HCN have been detected from PPE and equipment at firehouses that have recently been on structural fires. It is imperative that all PPE and equipment that is worn/exposed to products of combustion are gross decontaminated prior to leaving the incident scene. Proper washing of this equipment shall take place at the station as set forth by the manufacturer. At a minimum this shall consist of the removal of visible debris from all PPE with water. Items that are sensitive to water shall be wiped clean as soon as practical upon returning to the station.
3. All HCN monitors shall be bump tested prior to each use and calibrated on a monthly basis as prescribed by the manufacturer. This shall be documented on a yearly log.
4. All four gas meters shall be calibrated on a monthly basis. This shall be documented on a yearly log.