Manhattan Fire Protection District

SOP #: 200-6	Effective Date: 02/28/17 Revised Date:
Section: Protective Clothing and Equipment	
Subject: Hydrogen Cyanide Monitoring	

PURPOSE:
The purpose of this standard operating procedure is to provide guidance for the use of the Hydrogen Cyanide monitor and monitoring the atmosphere for hydrogen cyanide at various types of fires/emergency scenes.

SCOPE:
This standard operating procedure shall apply to all suppression personnel and is intended to limit respiratory and skin exposure to hydrogen cyanide.

DEFINITIONS:
Hydrogen cyanide (HCN); is a deadly gas, vapor or liquid and bi-product of combustion present at nearly every structure fire. It is produced when materials such as insulation or synthetic materials are burned or heated. Victims of HCN exposure will experience symptoms that closely mirror those of carbon monoxide exposure; therefore personnel must be aware of its presence and potential hazards. The combination of HCN and carbon monoxide, commonly known as the "toxic twins" can be especially deadly.

GUIDELINE:
Safety

A. Safety of responders is the first priority, therefore SCBA and complete PPE are required until a safe atmosphere can be determined at all fires.

B. Hydrogen cyanide exposure may be difficult to determine because symptoms are similar to that of carbon monoxide exposure, which may include headache, nausea, fatigue and dizzy spells.

C. At high concentrations, hydrogen cyanide is a combustible gas and should be treated with caution.

Properties

A. NIOSH describes the appearance and odor of HCN as a colorless gas, or bluish-white liquid with a bitter almond odor. The odor threshold concentration for hydrogen cyanide is 0.58 ppm, although the warning properties of HCN will be severely masked by smoke.

B. HCN is lighter than air and will rise in the heated atmosphere of a structure fire. In an enclosed environment without ventilation vapors will linger.

C. HCN is present as a particulate or liquid and will released from burned materials or soiled gear following exposure.

Personal Protective Equipment

A. Self-Contained Breathing Apparatus (SCBA) – See SOP # 200-5

1. SCBA is the best preventive measure for HCN exposure, as inhalation is the primary route of entry for exposure.

2. SCBA is required on all structure fires that present a smoke condition, to include kitchen and cooking fires.

3. SCBA is required on all vehicle fires until completely extinguished and all smoke as dissipated.

B. Structural Turnout Gear

1. Turnout gear will help protect personnel from absorbing HCN through the skin, which is a secondary route of exposure.

2. Personnel are to wash turnout gear following structure fires that heavily soil and saturate gear with products of combustion. See SOP # 200-3.

3. Members will be issued two hoods and two sets of gloves. Members exposed to products of combustion are to launder their exposed hood following all structural, vehicle fires or fires involving materials know to produce HCN.

Monitoring

A. All structure fires are to be monitored by utilizing the HCN monitor once fire control is obtained. This is generally during the overhaul stages of a fire. Company Officer's/Acting Officer's are primarily responsible for this duty. The Incident Commander should also ensure HCN monitoring is being done. Monitoring for carbon monoxide is conducted concurrently with an appropriate monitor (4 gas or single gas CO).

B. If a company with a HCN monitor is not on scene the Incident Commander is to request a unit with a monitor to respond.

C. SCBA is not to be removed until the atmosphere can be monitored, and deemed safe.

D. The following conditions will warrant atmospheric monitoring.

1. When SCBA has been used during a working structure fire, ventilation is complete, and the removal of SCBA is requested.

2. Vehicle fires that have not cooled to ambient temperature or within a structure or in a parking garage.

3. Outdoor fires involving anything other than natural vegetation.

E. The following conditions will not warrant atmospheric monitoring.

1. When the fire is contained to the cooking container where food has burned, but no damage was caused to the container.

2. Vehicle fires in the open atmosphere that are no longer producing smoke, have cooled to ambient temperature, and have been ventilated.

3. When a burning odor is detected and there is no smoke visible or only a light haze.

Action Levels

A. Hydrogen cyanide is thirty-five times more dangerous than carbon monoxide. Because of this, the action level for HCN is lower than CO.

B. The action level recommended by NIOSH is 4.7 ppm. In order to operate without SCBA in an environment where HCN is present, HCN monitor readings shall be lower than 4.5 ppm.

1. The HCN monitor range is 0.0 to 50.0 ppm HCN reading in 0.1 increments. The department HCN monitor will provide a pre-warning at 2.5 ppm and a warning to don SCBA or evacuate at 4.5 ppm.

2. The Immediately Dangerous to Life and Health (IDLH) for HCN is 50 ppm.

Decontamination – See SOP 200-3

Reporting

A. The Company Officer completing the fire report will be responsible for recording any significant exposures during a structure fire in the narrative section of the NFIRS report. The Department Health & Safety Officer should also be advised of any significant exposures.

B. If a responder is exposed to HCN levels above 5 ppm without respiratory protection the Company Officer is to forward all information to the Deputy Fire Chief in reference to HCN exposures. The following information will be supplied.

1. Names of all members exposed.
2. The HCN levels during the time of operation.
3. The actions the members performing when exposed.
4. Areas monitored with corresponding reading.
5. How long personnel operated in the atmosphere.
6. Medical care provided.

C. Exposure documentation

1. Anytime personnel are operating outside the safe range (4.5 ppm HCN) without SCBA, a record is to be kept.

2. Anytime members were exposed to IDLH (50 ppm and above) with or without illness a record is to be kept.

Calibration

A. Meters are to be calibrated per manufactures recommendations, and by qualified personnel only.

B. If meters are exposed to a high concentration and register "out of range" on the LED display the meter will need calibration.

Exposure to levels of 50 ppm and above with illness or symptoms as noted below

A. 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.

B. 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; unconsciousness; often with convulsions, is followed almost immediately by death.

C. If personnel are found to have been operating in IDLH atmospheres (50 ppm and above) or experiencing signs and symptoms of exposure they shall be treated and transported by ALS ambulance for further medical evaluation. The following considerations will be applicable to firefighters as well as fire victims:

1. Smoke inhalation is the most common cause of cyanide poisoning. Carbon monoxide is a well- known toxin in smoke, cyanide is an underappreciated danger.

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

3. The hospital shall be advised of the HCN levels and duration.

4. The company officer shall document the exposure as outlined in section VII.

5. HCN is toxic by skin exposure. The use of SCBA does not eliminate the potential of HCN poisoning when a member is exposure to high HCN levels in excess of 50 ppm.

SAFETY CONSIDERATIONS:

HCN and CO monitoring shall take place once the fire hazard is reduced and/or when applicable. If defensive operations are underway, the IC should assign a S/D/G boss or a company officer to monitor the hazard zone.

SPECIAL CONSIDERATIONS:

Vehicle fires also generate a high level of HCN. When smoke is present the need for SCBA is vital for responder protection. After the fire is extinguished HCN may still be present or continue to be generated in vehicles that are still at elevated temperatures. If a HCN monitor is not immediately available do not enter the vehicle without SCBA if smoke is still present or the space is at an elevated temperature. The space should be ventilated and returned to ambient temperature prior to entry without SCBA.

Approved By:

Signature: ***Daniel Forsythe*** **Date:** ***02/28/17***