



Columbia Fire Department

Standard Operating Guideline OPS-036

Hydrogen Cyanide Monitoring

Effective: January 11, 2010

Issued by Wm. Bradley Anderson, Fire Chief

Rescinds: No Previous

Purpose: To establish a guideline for monitoring the atmosphere for hydrogen cyanide at structure fires.

Scope: This guideline applies to all suppression personnel.

Guideline: Hydrogen cyanide (HCN) is a deadly gas 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. HCN has been known to be a product of combustion, but just recently has its significance been acknowledged. The symptoms closely mirror those of carbon monoxide exposure; therefore personnel must be aware of its presence.

Vehicle fires also generate a high level of HCN, but because they normally occur in an open environment the products of combustion dissipate quickly into the atmosphere. However, when smoke is present the need for SCBA is vital for responder protection.

I. Safety

- A. Safety of responders is the first priority, therefore SCBA are required until a safe atmosphere can be determined.
- B. Hydrogen cyanide exposure may be difficult to determine. Its symptoms are similar to that of carbon monoxide exposure, which may include headache, nausea, fatigue and dizzy spells at low levels and respiratory problems, unconsciousness, and cardiac arrest for high levels.
- C. Hydrogen cyanide is a combustible gas and should be treated with caution.

II. Properties

- A. NIOSH describes the appearance and odor of HCN as a colorless gas or bluish-white liquid with a bitter almond odor. An air odor threshold concentration for hydrogen cyanide of 0.58 ppm has been reported.
- B. The most common environment likely to possess HCN is a structure fire. Therefore the common appearance and odors associated with hydrogen cyanide will be severely masked in the smoke.
- C. 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.

III. Personal Protective Equipment

- A. Self Contained Breathing Apparatus (SCBA)

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 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.

IV. Monitoring

- A. All structure fires are to be monitored by utilizing one of the approved HCN meters. This will not replace the current monitoring for carbon monoxide levels, but is to be conducted concurrently.
- B. If a company with a HCN meter is not on scene the Incident Commander is to request a unit with a meter to respond.
- C. Meters will be located on Haz-Mat-1, all Haz-Mat support companies, and all Rescues
- D. SCBA is **not** to be removed until the atmosphere can be monitored, and deemed safe.
- E. 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. When personnel are found operating inside the structure without SCBA.
 - a. The HCN meter is to be used immediately in the area where crews were found to be operating.
 - b. The HCN level is to be communicated to the Incident Commander along with the personnel who were found to be operating in the area.
 - c. The Incident Commander must then determine the length of time the personnel were operating in the environment without SCBA, and the reported readings.
 - d. If readings and operating time period is of sufficient length personnel are to be transported to the hospital for immediate evaluation (see section IX.A.)
 3. Vehicle fires within a structure or in a parking garage.
- F. 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.
 3. When a burning odor is detected and there is no smoke visible or only a

light haze.

- G. If an operational HCN is not available at the scene a reading of 20 ppm or lower of carbon monoxide is required in order to operate without SCBA. If personnel will be operating for an extended period of time SCBA are recommended.

V. Action Levels

- A. Hydrogen cyanide is twenty-four times more dangerous than carbon monoxide. Because of this the action level for HCN is lower than CO.
- B. The action level in order to operate without SCBA in an environment where HCN is present will be **5ppm** (4.7ppm). This is the Short Term Exposure Limit (STEL) for HCN as recommended by NIOSH.
 - 1. STEL as defined by NIOSH is a 15-minute TWA (Time-Weighted Average) exposure that should not be exceeded at any time during a workday.
 - 2. Immediately Dangerous to Life and Health (IDLH) for HCN is 50 ppm.
- C. The action level for carbon monoxide will remain the same at 35ppm. The atmosphere must meet both the action level for HCN and CO in order for personnel to operate without SCBA.

VI. Decontamination

- A. Personnel should practice good personal hygiene by washing hands prior to drinking and eating in rehab.
- B. Once call is placed under control a random selection of personnel known to have operating in the structure should have their PPE monitored.
- C. If turnout gear has a reading higher than 5 ppm a hose line is to be used to decontaminate the gear.
 - 1. Briefly rinse with a soft fog pattern to prevent saturation.
 - 2. All personnel operating inside the structure should be decontaminated.
- D. Gear should be washed as soon as possible in an approved gear extractor.
 - 1. Turnout gear, flash hood, and helmet ear flaps should be washed in extractor per NFPA 1851
 - 2. Gloves should be washed by hand with hose or in sink.
- E. If a gear extractor is unavailable, then a garden hose and a brush can be used.

VII. Reporting

- A. The reporting officer will be responsible for recording any significant exposures during a structure fire.
- B. The Incident Commander is to forward the all information to the Haz-Mat 1 Officer via email in reference to HCN exposures. The following information will be supplied.
 - 1. The HCN levels during the time of operation
 - 2. Areas monitored with corresponding reading
 - 3. How long personnel operated in the atmosphere
 - 4. The personnel operating in the hazardous atmosphere

5. Specifics concerning the call
 - a. location
 - b. major materials that burned or were greatly heated
 - c. units that responded
- C. Exposure reporting
 1. Anytime personnel are operating outside the safe range without SCBA a notation is to be made in the Firehouse (NFIRS) report under the Fire Personnel Casualty section.

VIII. Calibration

- A. Meters are to be calibrated every 30 days by Haz-Mat 1 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.

IX. Exposure

- 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 [Hathaway et al. 1991]. These levels are not uncommon during routine structure fire as documented in a recent Columbia Fire Department study.
- 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 [Hathaway et al. 1991].
- C. If personnel are found to have been operating in an IDLH atmospheres or experiencing severe health effects it is strongly recommended they be transported for advanced medical evaluation.
 1. HCN has a half life of one hour, therefore it is imperative that the exposed personnel be given immediate medical attention to include a blood work and tested for HCN levels in the blood.
 2. Because this is somewhat new information it is likely test results will be delayed, but personnel will still be treated and monitored by advanced medical personnel.
 3. It is important that when transported the hospital be advised that the firefighter was operating in a known hazardous environment containing hydrogen cyanide.