Your Health is at Risk: Hydrogen Cyanide and Carbon Monoxide Poisoning

Where do HCN and CO come from?
✦ HCN and CO are byproducts of combustion: flaming and smoldering, ventilation-controlled and fuel controlled.
✦ Plastic and synthetic polymers burn 2-3 times hotter and faster with quicker flashovers.

How do HCN and CO affect you?
✦ They are both cellular asphyxiants!
✦ HCN shuts down the aerobic pathway, creating lactic acidosis and other toxic substances in tissues and organs.
✦ CO hemoglobin bonds 200-300 times that of oxygen. Its half life is 2-5 hours as concentration decreases.
✦ Acute exposure can result in disorientation, weakness, headaches, or fainting.
✦ Chronic exposure can result in respiratory issues, cardiac problems, neurological syndrome, or thyroid gland enlargement.

How can you protect yourself?
✦ Be aware, use your air!
✦ Use atmospheric monitoring gas detection.
✦ Conduct post-fire decontamination (including Nomex hoods).
✦ Engage in department-wide education to promote awareness of the dangers of HCN and CO exposure.

Smoke Recognition

1. Turbulent smoke that fills a box:
   • Imminent flashover.
2. Fast brown smoke from structural areas:
   • Unfinished wood ready to ignite.
   • Warning sign of collapse in lightweight wooden buildings.
3. Same color/same speed from multiple openings:
   • Beware! Deep-seated fire in walls, floors or basement.
   • Early warning sign for smoke explosion.
4. Dirty white smoke with speed:
   • Hot fire but smoke has been filtered by distance or resistance.
5. Thin black fast smoke:
   • Flame-driven and well-ventilated.
6. Thick black fast smoke:
   • Heat event with limited ventilation.
   • Caution: Explosive environment!

How to Make Tactical Decisions in an Uncontrolled Environment

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Reading smoke is not absolute. Smoke is dynamic, usually changing from good to worse.

Reading smoke begins with the first-arriving apparatus.

Comparing smoke issuing from various openings of similar size is the key.

Read the smoke and not the flames. (Flames are end products of smoke.)

3-STEP SMOKE ASSESSMENT

1. Compare the volume, velocity, density, and color of smoke from various openings.

2. Factor in building and weather influences:
   - Consider container size and number of smoke vent points. A large building with multiple smoke exit points can indicate a large fire. Do not rely on “light smoke showing.”
   - Subfreezing temperatures can change dark smoke to white smoke. Cold air causes smoke to lose velocity and heat more quickly.

3. Gauge the rate of change:
   - Determine how fast smoke conditions are improving or worsening. Seconds vs. minutes are critical indicators.
   - If smoke density and color worsen, the chance of smoke ignition increases.
   - If smoke density is thinning, the fire may have found air and is burning off the smoke.

INVENTORY & COMPARE SMOKE ATTRIBUTES

READING 4 BASIC SIGNS OF SMOKE QUALITY CAN HELP PREDICT WHAT WILL HAPPEN NEXT

1. VOLUME tells very little about the fire, but tells much about how fuel has off-gassed within a given container.

   A small volume of smoke coming from a very large structure (e.g., a big retail store or warehouse) can indicate a serious fire.

2. VELOCITY/FLOW SPEED is the #1 warning sign of an impending flashover.
   - Laminar (smooth smoke) indicates the structure is absorbing heat.
   - Laminar smoke that falls outside is pushed by volume (not heat).
   - Compare various smoke velocities to determine the location of the fire.
   - Look for the fastest smoke coming from the most restrictive opening. That’s likely where the fire is.

3. DENSITY indicates the color of smoke, the quality of burning, and the severity of the event.
   - The thicker the smoke, the more likely a hostile spread event.
   - Air sucking into thick smoke means a vent-limited fire that is likely to grow explosively.

4. COLOR shows the stage of heating and helps find the location of the fire.
   - White smoke comes from clean white moisture from the early state of heating of any material (smoke should be slow and laminar).
   - Dirty white smoke can mean early pyrolysis of plastic (slow smoke) or a hot fire far away (fast smoke that has been filtered by distance or resistance).
   - Tan/brown smoke indicates unfinished wood that is pyrolizing just prior to ignition (e.g., wood framing and trusses).
     - Beware! This type of smoke is a collapse warning sign in lightweight wood construction.
   - Black smoke comes from materials heated to the fullest extent, regardless of the type of materials ignited.
     - Flat black means mostly carbon-infused smoke from serious heating.
     - Glossy or rich/deep black smoke is mostly hydrocarbon-infused smoke from the serious heating or burning of plastic and other petroleum products.