



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!

Source: Dodson, David W. *Fire Department Incident Safety Officer*. 2nd Edition. Delmar Learning, 2007.

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.



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READING SMOKE

How to Make Tactical Decisions in an Uncontrolled Environment

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.

A. Laminar (smooth smoke) indicates the structure is absorbing heat.

B. 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.

A. The thicker the smoke, the more likely a hostile spread event.

B. 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.

A. **White smoke** comes from clean white moisture from the early state of heating of any material (smoke should be slow and laminar).

B. **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).

C. **Tan/brown smoke** indicates unfinished wood that is pyrolyzing just prior to ignition (e.g., wood framing and trusses).

➡ Beware! This type of smoke is a collapse warning sign in lightweight wood construction.

D. **Black smoke** comes from materials heated to the fullest extent, regardless of the type of materials ignited.

i. **Flat black** means mostly carbon-infused smoke from serious heating.

ii. **Glossy or rich/deep black smoke** is mostly hydrocarbon-infused smoke from the serious heating or burning of plastic and other petroleum products.