



The Art of Reading Smoke for Rapid Decision Making

Dave Dodson teaches the art of reading smoke. This is an important skill since fighting fires in the year 2006 and beyond will be unlike the fires we fought in the 1900's. Composites, lightweight construction, engineered structures, and unusual fuels will cause hostile fires to burn hotter, faster, and less predictable.



● **Concept #1: “Smoke” is FUEL!**

Firefighters use the term “smoke” when addressing the solids, aerosols, and gases being produced by the hostile fire. Soot, dust, and fibers make up the solids. Aerosols are suspended liquids such as water, trace acids, and hydrocarbons (oil). Gases are numerous in smoke – mass quantities of Carbon Monoxide lead the list.

● **Concept #2: The Fuels have changed:**

The contents and structural elements being burned are of LOWER MASS than previous decades. These materials are also more synthetic than ever.

● **Concept #3: The Fuels have triggers**

There are “Triggers” for Hostile Fire Events. Flash point triggers a smoke explosion. Fire Point triggers rapid fire spread, ignition temperature triggers auto ignition, Backdraft, and Flashover.

Hostile fire events (know the warning signs):

Flashover:

The classic American Version of a Flashover is the simultaneous ignition of fuels within a compartment due to reflective radiant heat – the “box” is heat saturated and can't absorb any more. The British use the term Flashover to describe any ignition of the smoke cloud within a structure. Signs: Turbulent smoke, rollover, and auto-ignition outside the box.



Backdraft:

A “true” backdraft occurs when oxygen is introduced into an O₂ deficient environment that is charged with gases (pressurized) at or above their ignition temperature. Warning signs include yellow smoke from seams (sulfur compounds that have the carbon filtered), black stained windows, no visible flame). Backdrafts are rare in large scale – but probably happen often in small, confined areas. A backdraft can’t occur if air is present – that ignition would be more like a too-rich to burn environment that has flashed (British flashover).

Smoke Explosion:

The over-simplification of texts has led to some miss-understanding here. A smoke explosion is the brief “flash” of a pocket of gas that is at its flash point. This causes a rapid surge (expansion) of the remaining gases. It can be forceful enough to lift firefighters. Signs include trapped gases that mix with air and continue to be heated – they just need a spark or flame to ignite (flashpoint).

Rapid Fire Spread:

Hot smoke flowing quickly through hallways and stairways rapidly spreads the fire. Smoke ignition also causes rapid fire spread.

The 4-STEP Process to READING SMOKE:

STEP 1: INVENTORY KEY FACTORS:

- **Volume** = Amount of fuel off-gassing, fullness of box
- **Velocity** (How fast is the smoke leaving?) = Indicates pressure build-up. Only volume and heat can cause pressure. Volume-caused pressure will immediately slow down, heat-caused pressure slows gradually. Turbulent smoke is heat-caused. Comparing velocities help you figure WHERE the actual fire is.
- **Density** = Quality of Burning, Potential for event - PERHAPS THE MOST IMPORTANT FACTOR – the thicker the smoke, the more dangerous it is.
- **Color** = Degree of Black/Grey = Stage of heating and distance to fire. Brown Smoke = Unfinished wood. Carbon can be FILTERED – taking away blackness.



STEP 2: WHAT is INFLUENCING THE KEY FACTORS?

- Container – can change the meaning of volume, velocity, and density



- Thermal Balance – if the fire isn't in balance, velocity is messed up
- Firefighting Efforts – all four attributes should change: Volume increases; velocity surges then slows down; density immediately decreases; color goes white
- Weather – hot/humid gives a narrow, defined column; hot/dry gives a cone shape column; cold/humid causes the smoke to crash and hangout near; cold/dry causes the smoke to crash but disperse easily.

STEP 3: DETERMINE THE RAE OF CHANGE

- Getting Better or Getting Worse?

STEP 4: PREDICT THE NEXT FIRE EVENT !!!

Some other little Tricks:

1. When you open a door, watch what the smoke does
Finds balance = fire on same level
Smoke rises and door becomes a fresh air intake = Fire above
Smoke thins but still fills door = fire below
2. If visibility is bad, stop and shine a light – what is the smoke doing?
Use the light beam to establish direction of smoke flow
IF no movement, you are in a dead-end or below the fire
3. A 5-second change in smoke conditions means an event has happened



When you read smoke – you are basically trying to ascertain:

- **The EXACT location of the fire**
- **The SIZE of the fire**
- **The PATH of the Fire**
- **The likelihood of a HOSTILE FIRE EVEN**