FIREFIGHTER TOOLBOX

BUILDING BETTER FIREFIGHTERS & LEADERS

5 MINUTE Clinic Series™

MODERN FIRE BEHAVIOR

By Bryan T Smith

By now members of the fire service should be familiar with the term modern fire behavior, but what does it mean? What makes it modern? The term modern implies that information taught in the past and our understanding of fire behavior has changed, is this true? The answer is both yes and no!

The physical science of fire or rather combustion has not changed!

Fire and Combustion are terms often used interchangeably. Technically however fire is a form of combustion.

Combustion is defined as a self sustaining chemical reaction yielding energy or products that cause further reactions of the same kind.

Fire is defined as a rapid self-sustaining oxidation process accompanied by the evolution of heat and light of varying intensities.

The 3 components necessary for a fire to occur are;

1. **HEAT**- the energy component it supports combustion through pyrolysis.
2. **FUEL**-the material being oxidized or burned to support combustion.
3. **OXYGEN**-oxidizing agent that supports combustion when combined with a fuel.
   For many years the fire triangle was used to teach the components of fire. Although useful it was not technically correct. The fire triangle is a model of incomplete combustion or non-flaming combustion. For complete combustion or flaming combustion to occur a fourth component was necessary.
4. **SELF-SUSTAINED CHEMICAL REACTION-**once flaming combustion occurs
   It can only continue (grow) when enough heat energy is produced to sustain the development of fuel vapors or gases. (chain reaction)

These 4 components together are known as the fire tetrahedron. If heat, fuel or oxygen is removed from a fire, it will not burn. If the self sustained chemical reaction is inhibited flaming combustion will cease, but the process of pyrolysis may continue depending on fuel characteristics.

Although the physical science of fire has not changed each of the components found in the fire tetrahedron and there characteristics have changed as they apply to fire development and behavior For example;

FUEL- fuels found in the modern fire environment have changed DRASTICALLY. This is due to the petro-chemical based plastics used to make most consumer products. Another problem is the amount of fuels available to burn. As society has grown more affluent they have filled their homes with more stuff, increasing the heat energy and fire growth potential.

HEAT- low mass synthetic fuels (plastics) have high heat release rates and decompose rapidly during a fire. They produce large quantities of super-heated smoke and gases which rapidly fill the compartment. The average room and content fire will have temperatures well over 1,000° Fahrenheit before it reaches flashover

OXYGEN- The plastic and synthetic fuels burning today require more than 20.9% oxygen to burn efficiently. Energy efficient homes do not allow air infiltration from outside which limits the fires growth to the oxygen available within the space. Once the fire department arrives on scene we must be careful where and how much outside air we allow to enter the structure since it will have a major impact on the fires heat release rate and growth.

Typical fuel load found in today's household!