Fundamentals of Fire

Basics of Fire, Fire Behavior, & Flow Path

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Learning Objectives…

In order to understand how the FireFlex FR House Wrap works and the safety it can provide to homeowners, you first need to know the characteristics of fire itself. **Learning Objectives** are the goals you should be able to accomplish by the conclusion of this module.

Learning Objectives:

- Understand the requirements necessary for fire to exist
- Understand the basic principles of fire behavior
  - How differences in construction affect fire behavior
- Understand what Flow Path is and why controlling it is important
- Understand the reasons behind the “Close Before You Doze” campaign
- Be able to effectively communicate the “Why” & “How” FireFlex FR House Wrap is important by combining knowledge of fire and knowledge of the product

Fire Triangle/Tetrahedron

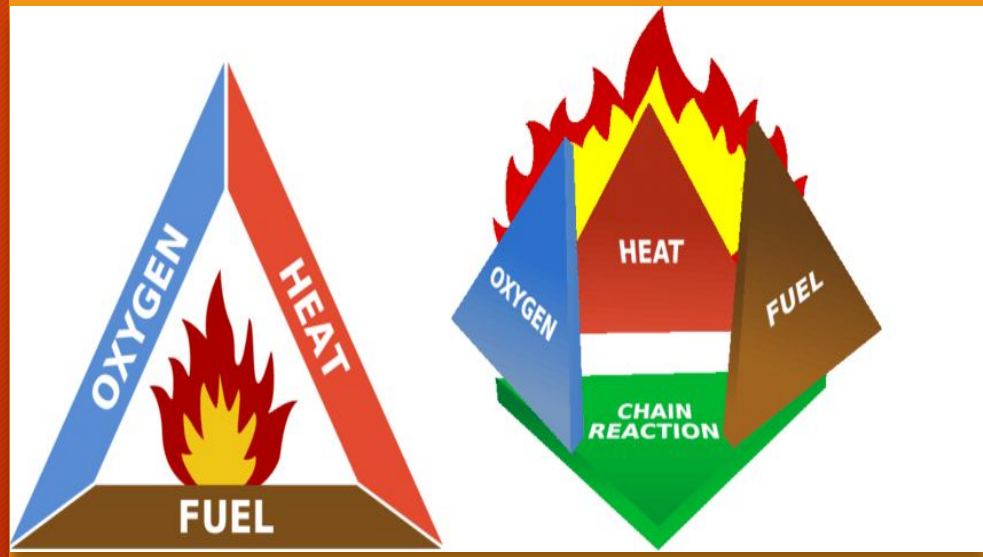
It is understood that 3 things must be present at the same time in order to produce fire:

- Enough Oxygen to sustain combustion
- Enough Heat to raise the material to its ignition temperature
- Some sort of Fuel or Combustible Material

Recently, a 4th component has been added:

- The chemical, exothermic chain reaction that is fire

Oxygen, heat, & fuel are frequently referred to as the "***Fire Triangle***". Add the 4th element, the chemical reaction, and you end up with a "***Fire Tetrahedron***".



Important Thing To Remember:
Take any of the 4 elements away, and you will not have a fire, or the fire will be extinguished

Classifications of Fuel

- According to International Standards, there are 6 classes of fire
- Most common causes of a house fire according to NFPA 2019 Home Fire Research are Class A, Class F, and Class E

Classification	Fire Risk
 Class A	Solid Combustible Materials i.e. Paper, Wood, Textiles.
 Class B	Flammable Liquids i.e. Petrol, Diesel, Oil.
 Class C	Flammable Gases i.e. Natual Gas, Propane.
 Class D	Combustible Metals i.e. Sodium, Potassium, Lithium.
 Class F	Cooking Oils/Fats i.e. Deep Fat Fryers
 Class E*	Electrical Fires i.e. Short Circuiting Equipment

Traditional (Legacy) Content Fire Behavior…

- Traditional Fire Growth in a room can be divided into 4 distinct stages:

1. Incipient Stage
2. Growth Stage
3. Fully Developed Stage (Free-Burning)
4. Decay Stage (Smoldering)

Incipient Stage

- This stage of fire development is defined as a small fire that has not yet significantly impacted the environment outside the compartment (i.e. heat, toxicity, visibility)
- During this initial stage, radiant heat warms adjacent fuel and continues the process of fire growth. A plume of hot gases and flame rise from the fire and mix with the cooler air in the room to develop 2 layers: one hot layer (top), and one cool layer (bottom).
- As hot gases reach the ceiling, they begin to spread across it horizontally. This energy transfer begins to increase the overall temperature of the room. The layer of hot gases becomes more defined and increases in volume while the cooler layer shrinks.
- The fire is now an immediately dangerous to life and health (IDLH) threat

Growth Stage

During the Growth Stage: Fire increases in size from small flames to full fire that involves the entire room, may take several seconds to several hours for this to occur.

Fire Growth is dependent on:

- Combustible Content (fuel/fire load)
- Oxygen Supply (ventilation openings)
- Size of Room
- Insulation of Room

Growth Stage Continued…

As the fire progresses through the growth stage into the fully developed stage, the potential for Flashover exists. Flashover is the sudden involvement of a room or area in flames from floor to ceiling caused by thermal radiation feedback. Typically requires temperatures between 932.0°F and 1112.0°F.

Thermal radiation feedback from the ceiling & walls heats the smoke and gases given off by both the burning materials and combustible contents of the room. When the contents have been heated to their ignition temperature, sudden & simultaneous ignition of all combustible contents (Flashover) can occur.

Flashover represents the transition between the Growth Stage and the Fully Developed Stage.

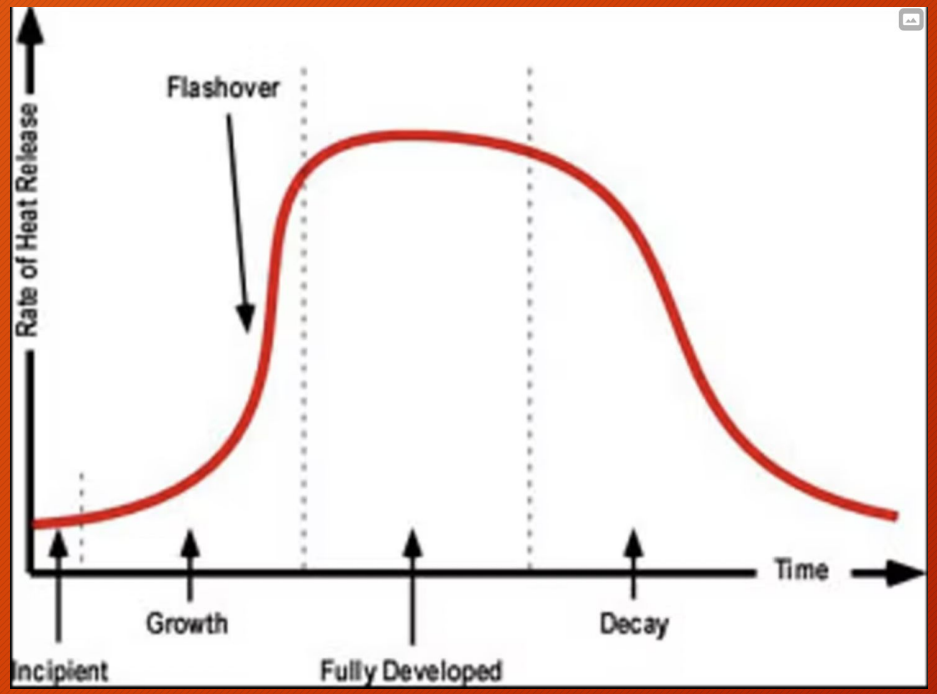
Fully Developed Stage (Free-Burning)

In the Fully Developed Stage, the entire room and contents are involved in fire. Energy release is at its greatest and the fire will continue to burn until the available fuel and/or oxygen in the room is consumed. Unburned gases accumulate at the ceiling level and frequently burn as they leave the compartment, resulting in flames showing from doors or windows. Average temperature within a compartment range from 1292.0°F to 2192.0°F in this stage.

Most structure fires are air-regulated, not fuel regulated at this point. This means that fires will move into the decay stage due to insufficient oxygen, rather than insufficient fuel.

Decay Stage (Smoldering)

As available fuel/oxygen is consumed, fire moves into the Decay Stage. Although some oxygen remains in the fire area, visible flames have started to diminish and the fire continues to smolder.



Summary of Fire Behavior

- **Incipient Stage**: Small fire; expansion of heat and gases makes it an IDLH threat.
- **Growth Stage**: Fire continues to grow within a room, increasing heat and gases raises the temperature of the room and eventually a flashover will occur, involving the entire room in fire.
- **Fully Developed Stage**: Entire room is on fire; energy release is at its highest; oxygen is not sufficient enough to maintain rate of combustion so fire becomes air-regulated rather than fuel-regulated.
- **Decay Stage**: Available oxygen is consumed and visible flames are greatly diminished; fire continues to smolder.

Modern Content Fire Behavior…

- Modern content fires are largely comprised of hydrocarbons and synthetics which rapidly consume the available oxygen in the air as they burn at a greater rate than traditional (legacy) content fires
- Modern content fires quickly become air-limited fires due to their higher fuel loads, therefore they enter the Growth and Decay Stages much faster than legacy content fires
  - Additional contributing factor is the energy efficient construction of buildings which limits the amount of available oxygen within the fire area

Flow Path…

- Flow paths can be described as the movement of heat and smoke following the path of least resistance, from the higher air pressure within the fire area to all other lower air pressure areas both inside and outside of a fire building.
- It contributes greatly to the spread of smoke, hot gases, and fire throughout a structure.
- Controlling the flow path means you must control the movement of pressurized air within a home