



Adapted from: Ventilation Controlled Fires - **Author:** Chief Ed Hartin

Reflecting on Ventilation Controlled Fires

When fuel burns in an open environment (e.g. outdoors) the **heat release rate** is dependent on the physical and chemical characteristics of the fuel. However, when fuel burns in an enclosure, the oxygen available for combustion is limited by the volume of the enclosure and the extent of normal ventilation.

As oxygen is used in the combustion reaction, the fire may become **ventilation controlled**, with heat release rate depending on the availability of additional oxygen.

1 What are the stages of fire development?

- Ignition / Incipient • Growth • Fully Developed • Decay

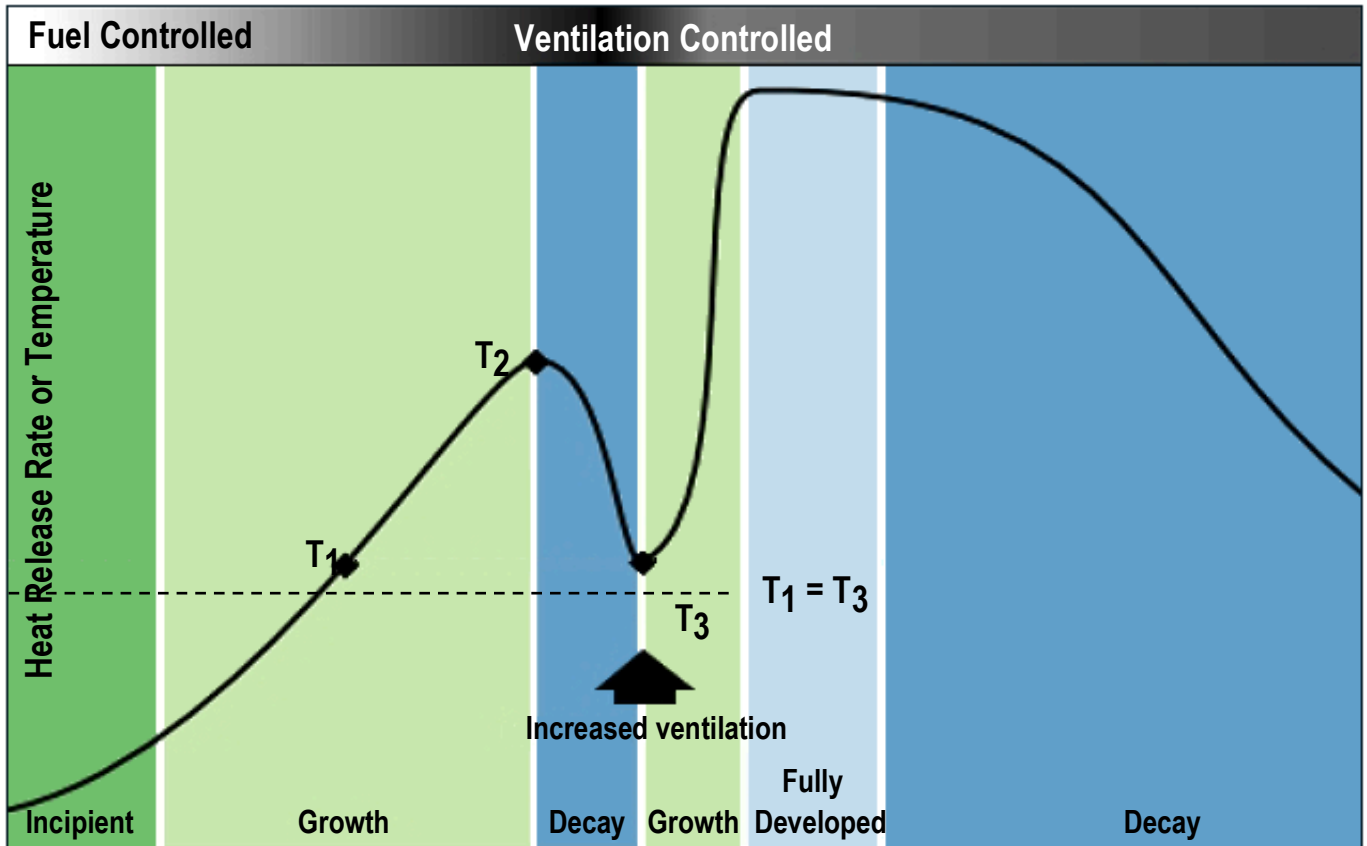
2 Do the stages of fire development always occur in the same sequence?

No. While ignition and progression through the incipient stage occur first and a fire that is sustained will enter the growth stage, it may progress to the fully developed stage or it may not. If the fire does not have sufficient fuel or if there is insufficient oxygen available the fire will decay (and may self-extinguish).

3 How does burning regime (fuel or ventilation controlled) impact compartment fire behavior?

When a compartment fire becomes ventilation controlled, heat release rate is decreased (as the energy released is dependent on the mass of oxygen consumed in the combustion reaction). As heat release rate decreases, temperature in the compartment decreases.

The following diagram describes the heat release rate (or temperature) curve over time in a typical compartment fire in the modern fire environment illustrating how the heat release rate changes if ventilation is increased after the fire enters the decay stage due to limited ventilation



- 4 Why is it important for firefighters and fire officers to recognise burning regime as part of their size-up?

Increasing ventilation to a ventilation controlled fire will increase heat release rate and temperature. As such, changes in ventilation may result in rapid growth and progression through **flashover** to a fully developed fire or if there is sufficient gas phase fuel (think mass of fuel in the smoke) in the compartment, a backdraft may occur.

- 5 How does decay due to limited ventilation influence visible B-SAHF (Building, Smoke, Air Track, Heat, and Flame) indicators?

Visible smoke and air track indicators are dependent to a large extent on pressure inside the building. Pressure is developed when the temperature of the confined gases inside the building increases. However, pressure also decreases as temperature of the confined gases decreases. When a fire becomes ventilation controlled, temperature decreases and visible smoke and air track indicators may diminish or disappear. What appears to be an incipient stage or early growth stage fire may actually be significantly ventilation controlled and in the decay stage (this is extremely important for Crew Leaders to size up correctly)