

U.S. Fire Administration / National Fire Academy

*Coffee Break Training***Topic: Heated Air Flow**

Learning objective: The student shall be able to explain the difference between a laminar and turbulent flame.

Imagine standing on a bridge overlooking the Mississippi River in Iowa and watching Ol' Man River lazily flowing between its banks. Now, imagine standing in the Sierra Nevada and watching the Feather River churn into white water over rocks, downed trees, and sandbars on its way to the Pacific Ocean.

What do these mental images have to do with fire? They are simple examples of the dynamics of flow: the Mississippi River in Iowa is an example of smooth or "laminar" flow, while the roiling Feather River is an example of "turbulent" flow.

Free-burning flames perform the same way and are influenced by many of the same physical factors as water flowing from one point to another. Gases and liquids behave by following the laws of fluid dynamics.

A laminar flow is one where the diffuse or premixed flame behaves smoothly. A lighted candle or the burner in an oil-fired furnace are examples of laminar flow. Unless influenced by air currents, any flame up to about 1 foot (305 mm) will appear to have laminar characteristics.

Once the flame height increases, or air currents disrupt the smooth upward flow, the flame becomes turbulent. The seemingly chaotic behavior is the result of the buoyancy of the heated gases, and the influence of gravity upon them. While the heated gases try to rise, Earth's pull brings them back. The result is a distortion of the laminar flow.

The next time you light a candle, look closely at how it behaves. Unless it sits too closely to an open window, a fan, or other source of air currents, you should be able to observe a laminar flow. And, the next time you see a building fire, pay close attention to the moving flames and how they behave in the environment.

For additional information, refer to *Principles of Fire Behavior* by James G. Quintiere, Ph.D.



This shelf fire is an example of turbulent flame.