



# What are?

## **MEASURES OF FIRE BEHAVIOR**

There are four main parameters used by fire managers to describe fire behavior.

Fire behavior can be characterized as the manner in which a fire reacts to the interaction of fuel, weather, and topography - the “fire behavior triangle.” The four main parameters used to describe fire behavior include: rate of spread, fireline intensity, flame length, and flame height.

### **Rate of spread**

The rate of spread measures how quickly a fire moves across the landscape, typically in chains per hour (1 chain = 66 feet) and is influenced primarily by the amount and arrangement of fine surface fuels, fuel moisture, wind and slope. For example, wildfires that burn through standing cured grass and shrubs can spread at a rate of 46 chains/hour (51 ft./min.) whereas wildfires burning through dense ponderosa pine with heavy surface fuels spreads at a much slower rate of 5 chains/hour (5.5 ft./min). The above rates of spread are based on: no slope, 4 mph midflame wind speed, and 4 percent fuel moisture. Increase slope percent and wind speed and decrease fuel moisture, rate of spread will increase proportionally and predictably.

The rate of spread is different for different parts of a fire (head fire, back fire, etc.) and is influenced by how fuel is heated and then combusts from convective and radiant heat and heat transferred from one fuel to another through conduction.

### **Fire intensity | Fireline intensity**

Fire intensity is an estimate of the rate or amount of heat energy released at a given time and is an important descriptor of fire behavior. Fireline intensity is the rate of heat energy released per unit time per unit length of the fireline (BTU/(ft-s)). Numerically, it is the product of the heat yield, the quantity of fuel consumed in the fire front, and the rate of spread. Flame length has been shown to be related to fireline intensity, and is used as a surrogate to estimate fireline intensity because it is easier to observe and measure in the field.

### **Flame length**

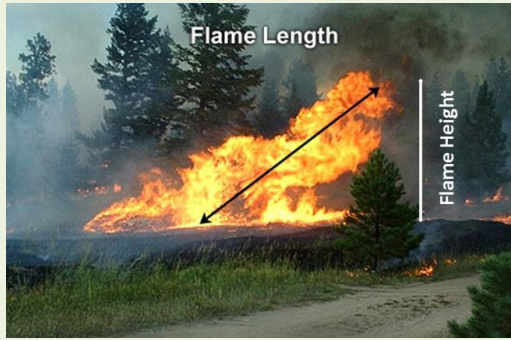
The flame length is measured as the distance between the flame tip and the base of the midpoint of the flame at ground level. Flame length is constantly

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fluctuating in response to fuels, topography, and weather. Large flame lengths can occur with steep slopes with tall vegetation (fuel), low fuel moistures, and high winds.

### Flame height

The flame height is measured at the leading edge of the front of the fire to the ground.



Flame length and height. Photo credit: NWCG

### For more information:

For more information on Fire Behavior, Fuels, Topography, Weather, Types of Fire, Parts of a Fire, and Fire Regime visit the [Northwest Fire Science Consortium's website](#).

Byram, G.M. 1959. Combustion of forest fuels. In 'Forest fire: control and use' (Ed. KP Davis). pp. 61-69, 554-555. McGraw-Hill: New York, NY.

Fire Science Core Curriculum. 2017. OSU Extension Service, EM 9172: 197p.

National Wildfire Coordinating Group. 1992. Fire Behavior Nomograms. PMS 436-3: 28p.

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