

Subject: FireBridge Purpose and Benefit to engage Wildland Fires.

It was asked what the purpose and benefit of the FireBridge concept would or could offer from the standpoint of Fire Behavior as well as Fire Suppression. FireBridge is as its name sounds, a Fire Bridge. That is the construction of a mathematical thermodynamic bridge between the Fire Behavior Analysts to the Operations side comprising Engines, Dozers, Aircraft etc. to supercharge efficiency and effectiveness.

In the 1970's Richard Rothermel was commissioned by the USFS to develop a series of equations that would better assist wildland firefighters in being able to determine fire behavior. Among this was the ability to allow one to determine a fire's Rate of Spread (ROS), Flame Length (FL), and Intensity as the Heat per Unit Area with a forward component (BTU per square foot & BTU per square foot per second respectively).

The S-390 Course titled *Introduction to Wildland Fire Behavior Calculations*, in its 2007 version is centered around 32 hours of instruction spanning 9 Units ranging from Topography, Atmospheric Stability, Winds, Wx Forecasts, Fuel Models, Fuel Moisture, Fire Nomograms, Spotting Models, Safety Zone Calculations, Fire Size and Shape, Briefings & Monitoring for Safety, and then Group Exercises.

The problem with this, and the follow up S-490 course, is the fact that neither one will explain what you the firefighter on the ground need in cooling capacity or resources to actually combat the fire itself. Thus, consider this:

The S390 and S490 courses do a very good job of teaching what is going on with a fire if we simply leave it at that. It does not teach anyone what to do with the thermal intensity figures once you have obtained them. By example, using the enclosed Fuel Model 4 Nomogram, Chaparral on the high wind side (much of what Southern California has), the course would have taught us to be able to plot out on a nomogram what the fire's Rate of Spread would be, its estimated Flame Lengths, the Heat per Unit Area in Btu per square foot, and Fire Intensity in Btu per foot per second. That is where it ends though. There is nothing beyond that.

Firefighters are then supposed to look at these numbers and somehow figure out what it means for trying to determine resources and types required.

FireBridge, however, takes the numbers generated and uses the thermodynamic properties of water to enable one to determine how much water we need to combat this fire. From here, we then have to determine the best delivery method, helicopter, SEAT, Lat, Nozzle etc. In order to determine what is needed, folks should be taught about the cooling properties of water. Every engine & aircraft carries and uses such constantly, yet this is an element never taught; how much fire their nozzles, buckets, etc. can handle.

Thus, FireBridge teaches folks the actual thermal cooling properties of water, and by using already scientifically established Nomograms, along with the scientifically established specific and latent heat properties of water we can determine how much water we need for a particular fire. We use this exact method to cool nuclear reactors or anything that requires a heat exchange process.

Using the Fuel Model 4 Nomogram figures (Last page) for an example fire that is say 1 mile long, 5,280 feet, we first obtain the area of the fire to determine the fires total intensity. Take the Rate of Spread figure of 7 feet per second and multiply this by 5,280 feet. This is an area being consumed every second and the area is 36,960 square feet, using the Nomograms HPA figure of 2,866 Btu, we can then determine we have 105,927,360 Btu/second being generated. From here we can divide this figure by 9,365 to obtain the total gallons required every second for the entire fire.

$105,927,360 / 9365 = 11,310$  Gallons. If we have 3 aircraft that carry 1300 gallons then we need either 9 aircraft or 9 loads. If we are able to use 3,000-gallon aircraft, then we need 4 aircraft/loads. Then you immediately follow up the cooled line with retardant, and should have a fire control line, i.e. Dozer line already in place, hence Cool it, Retard it, Doze it.

This now gives the firefighter on the ground the ability (once trained) to determine a better matched resource based on the thermal effect it can bring to the fire. Nomograms and Behave Plus software alone (S390 & S490) will not tell you this piece of information and to date there is no course under the NWCG that offers this information.

If one is going to be successful at fire suppression, they should first consider how much of a thermal effect they bring against the fire, and you can only determine that by knowing the thermal properties of water.

We would be far more efficient and effective, if we taught fire thermodynamics at the firefighter level early in their career, as opposed to teaching advanced fire behavior to senior level supervisors who are still not taught about fire thermodynamic properties and thus solely relying on a retardant based system that is completely incapable of absorbing heat. The follow up documentation explains the actual methods of how to use FireBridge.

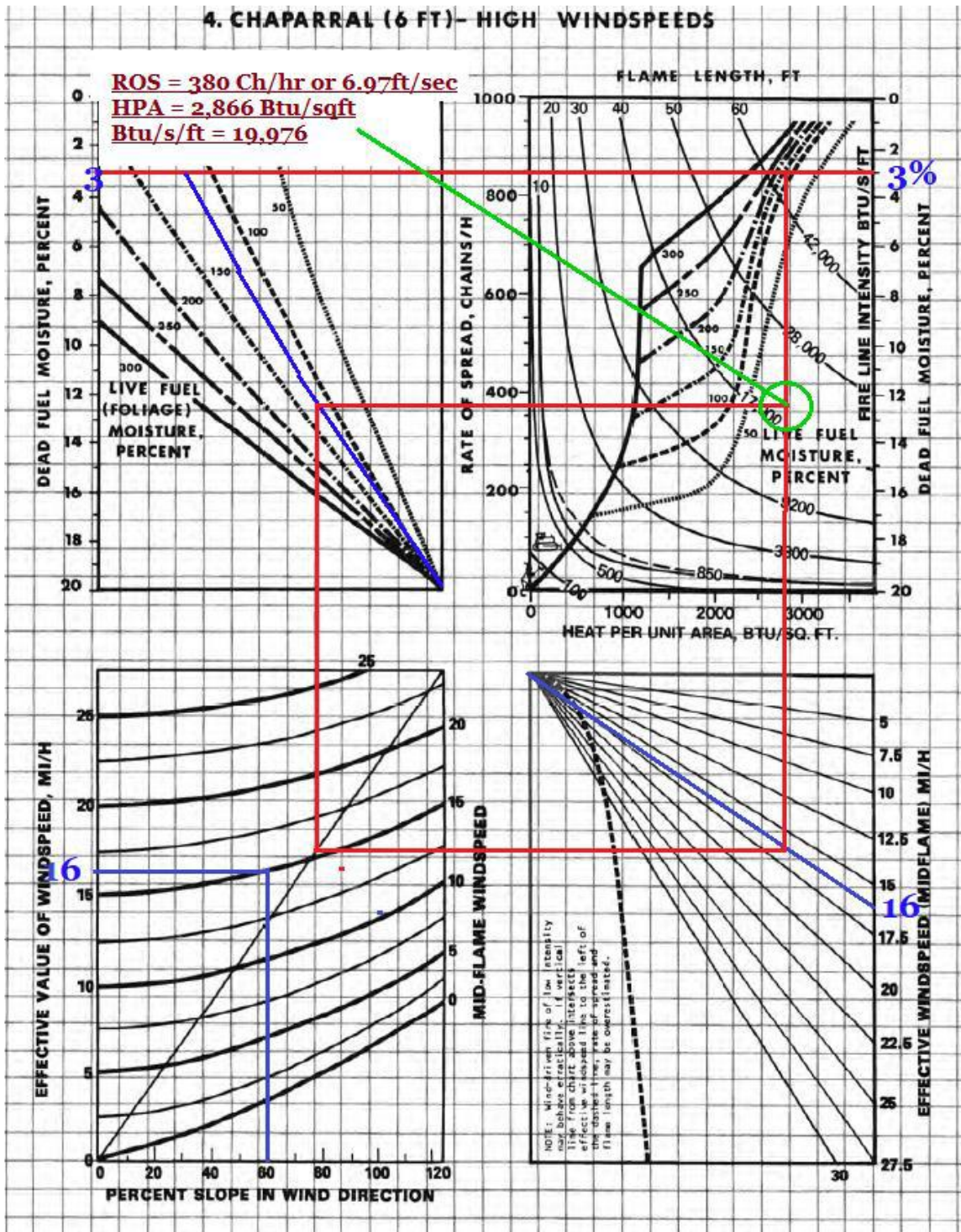
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19,976 Btu/second/foot = 1ft x 7ft and would require 2.1 gals/sec