

Sustained Crew Hikes and Aerobic Capacity Explained

Aerobic capabilities in the human are a function of getting O₂ to the working muscle to support aerobic activities that can be sustained for long periods of work. The more aerobically fit an individual is, the higher the intensity is that they can sustain or keep at for long chunks of time. In short, they can tolerate a faster pace of running and a faster pace of moderate uphill hiking.

Continuous running, cycling, or carrying a pack for 30+ minutes requires that the aerobic system support most of the effort. Over the last say 4 decades, the metabolic demands of various fireline tasks have been quantified using a series of measurement techniques. The most common is to collect expired air samples and measure gas concentrations and volumes of the expired air. This allows for the calculation of O₂ consumption or VO₂ (the volume of O₂ consumed by the body). The unit of measure that is most commonly used for VO₂ is ml of O₂ per kg of body weight per minute of activity (ml/kg/min). You don't need to get into the weeds to understand some of these basic thoughts :)

Important take home message right here! Over the last 4 decades, the VO₂ values or aerobic demands of various fireline tasks hovers right around 22.5 ml/kg/min. The rationale for the 45-minute cut off in the work capacity test (pack test) is because sustaining a 15 min/mile pace while carrying a 45 lb load is right around 22.5 ml/kg/min. Therefore, if you can complete the pack test in just under 45 minutes, you have an aerobic capacity that allows you to complete most of the regular fireline tasks without creating undue fatigue. It is also important to mention that the pack test was not developed as a performance trial. There are no extra points for going as fast as possible. Save your performance show for other events (1.5 mile run, etc). Faster pack test finish times do not guarantee better firefighters.

We can also measure these values quite easily in the lab. However, we can also do a measure that provides a metric of sustainable VO₂ or what level or aerobic capacity can you maintain for long periods of time. If you can easily pass the 45 min pack test cut off, it demonstrates that your sustainable VO₂ is at least 22.5 ml/kg/min (which is great in that it demonstrates that you will be able to do most fireline tasks without undue fatigue). However, we have also measured this value both at the beginning and at the end of the season. At the beginning of the season, the diversity of values within a crew are all over the map. Some crewmembers come into the season as aerobic animals having trained a great deal in the off season. Others are less well trained and demonstrate lower sustainable aerobic capacities. What is interesting to see is that by the end of the season, entire crews are almost identical on their individual values for sustainable VO₂. The crew values actually come together over the season. This is likely because all ingress hikes to fireline are completed together and everyone migrates to nearly the same pace over and over and over. This bodes well for the less trained as the season increases their sustainable VO₂. However, for those that are highly trained pre-season, it typically means they will lose aerobic fitness over the season.

The values that crews migrate to by the end of the season is a sustainable VO₂ right around 34 ml/kg/min (which is higher than the demands of the pack test). However, it is difficult to get to

these values on flat ground because the speed has to increase above 4 mph and a regular walking gait takes on a different pattern. Moreover, hiking with a load on flat ground at those higher speeds increases the ground reaction forces and threatens increased risk for lower leg injuries. So, don't do it! Save your higher VO₂ activities for unloaded runs on softer surfaces and loaded hiking up gradual or varied hillsides. By adding a vertical component, you will be able to slow down the hiking speeds to minimize lower leg stress while increasing the aerobic demands of the task. Besides, hiking uphill with a load is the common denominator for all wildland firefighters, you gotta be able to do it!

I want to evaluate crew hikes because I want to see where crews automatically migrate to in terms of the sustained VO₂ required to complete the hike in the cut off times established. In order to do this, I have to use prediction equations that estimate the VO₂ of the hike based on the speed of hiking, the % grade, the load you are carrying and your own body weight. Another factor that is considered is the type of ground (for these calculations, I am assuming packed dirt). I am also considering a load carriage of 45 lbs. The values would be slightly lower (but not much) if the load carriage weight was lower. The values may be slightly higher than calculated if the load carriage also includes a saw but sawyers know that shit (they also probably like to remind you of it too) :)

Here are some examples that folks sent in...

Rogue River Hotshots

Cedar Trail

1.1 miles, 26.7% grade, cut off time goal = 45 min

Estimated sustained VO₂ for this pace is **29.1 ml/kg/min** for a person 180 lbs (a bit higher for lighter weight, a bit lower for higher weight folks).

As training progresses, consider a finish time range of about 41-45 minutes to better match the expected high end 34 ml/kg/min.

Golden Eagle Hotshots

The Tip

0.45 miles, 46.3% grade, cut off time goal = 23 min

Estimated sustained VO₂ for this pace is **36.6 ml/kg/min** for a person 180 lbs

Consider a slightly slower speed in the early phases of pre-season training (23-25 minutes) to better match the expected high end of 34 ml/kg/min.

Klamath Hotshots

Redline

0.9 miles, 19.8% grade, cut off time goal = 24 min

Estimated sustained VO₂ for this pace is **35.2 ml/kg/min** for a person 180 lbs

Consider a slightly slower speed in the early phases of training (24-25 minutes) to better match the expected high end of 34 ml/kg/min. However, this is damn close to being a perfect pace!

Klamath Hotshots

Repeater

1.5 miles, 19.9 % grade, cut off time goal = 45 min

Estimated sustained VO₂ for this pace is **31.4 ml/kg/min** for a person 180 lbs

Consider a slightly faster speed as training progresses (43-45 minutes) to better match the expected high end of 34 ml/kg/min.

Klamath Hotshots

The Wall

2.6 miles, 16.8 % grade, cut off time goal = 70 min

Estimated sustained VO₂ for this pace is **31.1 ml/kg/min** for a person 180 lbs

Although you might be tempted to suggest a slightly faster finish time to achieve a sustained VO₂ closer to 34 ml/kg/min, this go to hike is longer than typical ingress hikes that have been monitored on assignments. This is an excellent test of readiness. If everyone on this crew can do this hike at that goal cut off time, this crew has just demonstrated an exceptional level of kick ass readiness! This level of aerobic capabilities also greatly lowers the risk of heat injury during assignments as well.

Conclusion:

The target cut off times for these established “go to” hikes demonstrate exceptional targets that require very little adjustment to hit the target sustainable VO₂ of 34 ml/kg/min. The Klamath Hotshot hikes especially hit the target! Aerobic readiness is job readiness, increased performance, and lowered risk of heat intolerance.

Shameless plug part of this...check out www.wrangoandbanjo.com. Discover how Tex and Huckleberry change the aerobic demands for Banjo and Flapjack (the two rookies) as the Zootown Hotdogs does one of their early season training hikes!

Stay safe out there this season!

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