

Written Transcript  
On The Line Episode 2.1 "Pack Test"

Copyright: On The Line. All Rights Reserved. This transcript cannot be transferred, quoted, or shared without written authorization.

Charlie Palmer: We are back on the line, hard to believe season 2, show number one, joined by a couple of the usual suspects, Dr Brent Ruby from the University of Montana's Center for work Physiology and Exercise Metabolism and Dr. Matt Bundle from the University of Montana as well based on where we're at in the season right now, kind of for a lot of crews either getting ready to come on and so as part of that process they're looking at taking the Pacl test or crews that have been on and have just taken that the work capacity test. We're going to loosely label this episode, that pack test, WTF? Let you fill in the acronym. Brent talked to us about this pack test and what we know from exercise testing as far as the forest service goes. With that quick little backdrop on the history since 1975, the forest service has been testing firefighters to check where they're at from a physical fitness standpoint. Dr Brian Sharkey instituted the step test at that point of five minute test. If we have any older listeners, they'd be familiar with that process. Uh, and then that transitioned in about 1994 to the work capacity test or what generally people recognize as the Pack test. So Brent fill us in on this thing and what we know about it and where we might be able to go in the future based on some research that Matt's been doing.

Brent Ruby: Well, the Pack test is funny because it's a really unique job, specific work capacity test. So when you look at all the stuff that Brian did to build this thing systematically over the years to look at relationships between, well really he started by measuring simple tasks simulated on the line. Like what are the metabolic demands of all the different tasks that make up wild land, fire suppression. And by far the most variable component. Like we've mentioned in some of these previous episodes, the most variable component that's going to create the largest swing in metabolic demand is hiking with a load because the terrain changes, the grade changes. Perhaps the self-selected speed or the speed of the crew changes that drives up or down the metabolic cost. But when you factor in all of the expected intensities, digging, sawing, throwing, brush off the line, spending time on the fire line, those metabolic demands essentially equal what the Pack test measures.

Brent Ruby: So at four miles an hour with a 45 pound pack in general, the metabolic demand is very similar to what we see when you look at the overall tasks on the fire line. So it is a very specific test. But Brian came up with that number because he had measured all these simulated tasks and then through trial and effort in the lab, this load, that load, this speed, that speed came with this average four miles an hour, 45 pound pack equals the metabolic demand of most tasks on the line. So that's the theory. And then the other part is if you look back to the other work capacity testing program, either the mile and a half run or the step test, the goal was always that firefighters have to have a peak. VO2 estimated about 45 mls

per kg per minute. And if you slice that in half with the theory that in order to maintain work for long periods of time, you're going to be able to do that if that task is about 50 percent of your Max.

Brent Ruby: And so that's where 22 and a half comes into play and that's approximately the intensity of the work capacity tests as we're sitting now. So the Pack test was never ever designed to be a let's hit the stopwatch and see who does it faster and if you do it faster, you're going to get this firefighter badge or that firefighter badge of courage or performance. It's not a performance test, it's just can you do it and you should be able to do it and you should be able to do it in such a way that that intensity can be sustained for much longer perhaps than what the test takes, which is 45 minutes or just shy of that. So to summarize that, basically what the test is trying to approximate is about 50 percent of what your Max capacity capacity is. And that through various research has pretty much held true. Is that A. Yeah, it's surprisingly consistent. It very, very much is, but it's impractical to measure somebody's maximum capacity because you'd have all kinds of health concerns about trying to Max test everybody, but doing a submaximal test and putting in a checkmark at the intensity that most commonly represents the average of what they actually do on the line. That's sort of the history. Okay, so,

Charlie Palmer: So that good segue then into Matt and your study that has been really going on all year and you're kind of in the process of trying to crunch the numbers and make sense of it, right? That's right.

Matt Bundle: Yeah, and that's exactly where we're at.

Charlie Palmer: Fill us in on what you know so far.

Matt Bundle: Well, so, and this is work that Brent and our other colleague, Chuck Dumky have been a part of and what we did was recruit about 60 people, young adults to come and do the Pack test and then take part in some additional lab measurements subsequent to that so that we could really have an idea as to what the maximums, where Brent was just talking about people's maximum respiratory fitness or aerobics fitness. And so we measured that, we measured what their energy costs were, walking speeds close to the Pack test, and then we had them do a pack test as well and all the while they were wearing heart rate monitors and the goal of this work, at least with respect to a deliverable for wild land firefighters, is to be able to provide guidance on what level of fitness they're at.

Matt Bundle: Just based on having done a submaximal test. His brand was describing where you are not intended to go out and give us an absolute all full level effort, but rather be able to come in under control. And that provides a reasonable challenge on a physiology standpoint. Because most of the time we're used to measuring people right at the limits of what they can do. But in this event, what we want them to do is come in in a relatively comfortable status. And then for us to be able to gauge how ready they are to join various different crews.

Whether it's a hot shot crew, whether it's a type two or an engine crew. We'd like to be able to provide the various different candidates with ahead of time, uh, an assessment of where they might be relative to what is now a very considerable body of data that different faculty and investigators at the University of Montana who have collected over decades.

Charlie Palmer: So the end state hope with that project then is to have some sort of a, an equation or a...

Matt Bundle: well, yeah. So the way it would work I think is that we would have, um, a method where people could measure heart rate. Probably the most easy way to do that is with a chest strap and they're relatively economical. There are other phone based apps that you can use to measure heart rate reasonably accurately as well. And then people would put on a 45 pound pack, walk for five or 10 minutes. Hopefully not much longer than that. Otherwise, it prediction of how fit you are. It doesn't make much sense. If the guidance is why don't you go out and do the pack test. And so what we'd like to do is be able to, based off of a small amount of exercise, give people an accurate assessment as to where they are with readiness to pass the Pack test, which I think everybody recognizes most people do, right around 80 percent is the historical number of, of passers versus non passers, but more importantly, how ready they are to, or what their level of fitness is with respect to the particular crew that they're hoping to join during the upcoming season.

Charlie Palmer: Okay. So kind of stay tuned. Is the message on that one?

Matt Bundle: Right. And it's something that I, I would imagine that we will, we've discussed trying to make this happen through the black program that we've been working and I've referenced in many of our episodes so far.

Charlie Palmer: Right? So with that being said, what, what do we know about load carriage? I mean if there's anything that defines wildland firefighting and the job that's got to be a key component of it is just that a big part of what you do is going to be putting weight on your back and moving that weight around. So what do we know from a research standpoint or even an applied perspective about that process of of humans carrying weight?

Brent Ruby: Well Matt can speak to the specifics of the biomechanics of it and how it varies from one person to another perhaps because you put a 45 pound pack on one person and you're going to get a certain response. You put a pack on another person that may be the same height and weight. You might get a different response. And so the Pack test and load carriage load carriage in general is one aspect of the job that is never gonna go away. Like in wild land fire, digging will always be a part of it and hiking will always be a part of it and hiking with supplies. With the mandatory supplies like the fire shelter and your provisions, water and food for the day along with some of the other supplies, fuel or whatever else you're carrying all the essentials. I mean those pack weights can vary. I mean it's not the average pack weight is always 45 pounds, but load

carriage is certainly never gonna not be part of the job. And so because of that load carriage in the training environment, particularly the early season and maybe the pre or off season window, should be a part of the training program. It's not enough to just say, Gosh, you know, I think I'll just become an ultra runner in the off season. I mean that will prepare the aerobic system, but it's not going to give you the fitness that's specific to the job. So integrating load carriage into that preseason training window provides the best training specificity that you can capture. And it's interesting here around Missoula, just in the last few weeks up on Mount Sentinel, I've seen multiple individuals carrying a pack and it's obviously they're not going camping up there. They've just got rocks in their backpack or whatever, just to put a load on and, and puts them incline between them and their vehicle. And uh, just to get into some specific training...

Charlie Palmer: Its firefighters that you're seeing though?

Brent Ruby: Yeah. Yeah. guys that are hoping folks that are hoping to get on or are already on a particular crew. Yeah. But it's, I think that load carriage, I mean for one person carrying a 45 pound pack might require x percent from aerobic capacity and x percent from a muscle strength perspective and you have a different body size that shifts. So now all of a sudden somebody with a different body size is going to have to rely a little bit more on absolute muscle strength and a little less on a robot capacity. And so depending on the body type, and I think Matt can speak to that because the data is not uniform. It's not like you put a 45 pound pack on and you measure the gas data and it's the same for everybody. There is some variety.

Matt Bundle: I think one of the elements that was the most surprising out of our pack test study was just how expensive it was on an energy standpoint for some of the people to walk. So Brent gave us a nice rundown of Brian Sharkey's original formulations as to how the Pack test came about. And one of the critical parts of that is that the sustainable level of effort would be somewhere around 22, 23 mils per kg minute. We've certainly have quite a number of people who their energy expenditure is right around that level. And we also have maybe another 30 people who are well above that and what we're trying to do is tease out what are the individual factors that are causing some of these subjects to have very, very high, much higher than anybody would anticipate 50, 60 percent more energy expenditure, which means that if you were going to be at the 50 percent level, which is a level that you can sustain for hours, you would have to have a very big engine indeed if your ability to carry load was what some of these subjects were as when we saw them. And so we're trying to figure out what accounts for some of this variability, there is an effect of size. So the taller you are, the more economical and faster you're able to perform the test. There doesn't seem to be much of an effect of gender. We had quite a number of female subjects in our group when we do male female comparisons at equal weights, we don't see any difference in terms of what the energy costs are, so we're really looking at trying to understand a little bit better what accounts for some of this variation that we see, especially we think based on either

individual's fitness levels or stature and other elements associated with their body proportions.

Charlie Palmer: Okay. So say I'm a firefighter and I'm just sitting out there and I'm listening to this and going, all right, the science is great and interesting, but give me something that I can use. Give me, give me some tidbits or training tactics or, or things that I can take home and use myself or apply to the, crew that I work with. What do you guys have for that?

Brent Ruby: (Laughing) Well, if you're listening, welcome. Um, no. I think if the... most of these characters that are either getting ready to be on a crew for the first time or they're coming back, this is a highly competitive group of folks and so they, I think they crave an assessment that stacks them up or allows them to compare their capabilities right now across other crews, other crews across the country and certainly within their own crew. They want to know how do I stack up? Am I good enough or am I better than and there's no hot shot rodeo out there, so there's no way to do this. It's not like ABC wild world of sports. Now we're going to see who's the best wild land firefighter. Maybe that'll happen in the future, but we don't have that now and so the important thing is to never try to use the Pack test as that assessment tool. The Pack test is there solely to simulate a small amount of the working environment and if you want to know what your performance is in the Pack test, doing the Pack test should feel like you could continue doing that pack test over and over and over. If you do the Pack test and that's the, that's your perception, that's your rating of perceived exertion, good job, but don't use it as a way of bragging to say that you did it in 35 minutes because it was never designed for that. I think that if it's hard for you, then there's obvious training tidbits or training things that you can do to make it better. One is certainly get some more aerobic fitness. Continue to carry a load. You could do some, hiking for aerobic fitness, some jogging, some load carriage. You don't need to carry a load all the time, but carrying it specifically in certain training segments would be great. But if you want to establish a performance metric, that's a whole different ballgame and there are certainly those, the BLM challenge is available for that. Or just sign your whole crew up for the local five k and then you can brag about who's best.

Charlie Palmer: Yeah. After taking a few pack tests, there's always fascinated by those folks who just felt like they had to be on that borderline between running and walking. Obviously for the test you have to walk, you can't run, but they felt just compelled and I just got to ride, ride that wave of almost running, but having a foot on the ground all the time because I want to do this thing in 35 minutes...

Matt Bundle: yeah, we saw some of that, some like very unusual gates that were borderline run walk. Especially among some of the subjects who were wild land firefighters. Really trying to set a record. If you were to ask me if I were to maybe offer advice for within the Pack test, one of the things that we found was that small differences in speed can make a very big difference in the amount of effort and energy you need to bring to bear to complete the task and how that might work from within the Pack test is if people are changing their speed a lot.

If they're not consistent, if there's increasing and then slowing down. That kind of selected pacing can really cause you to use a lot more energy than is necessary. If you were at a consistent four miles an hour or just slightly above four miles an hour pace, so if you happen to be on the other end of the fitness spectrum from what Brent was describing, that might be something that you could focus on immediately. Just be very careful about how you're pacing. Even small differences in in this can extend beyond the Pack test, but in all instances where you have load carriage, small differences in the speeds that you're moving at can really have a lot of influence on how comfortable everybody is, what their energy expenditure is, their exertion levels are, and so by keeping a constant in the Pack test or dialing it back a little bit in operational settings, you can really alter the readiness of everybody to either engage in a new task when you get to the line or in the case of the Pack test, be more in control, able to maintain an overall faster speed.

Charlie Palmer: Okay, so the take home from that. To summarize that, just to make sure I'm clear, is you're best off finding a speed and trying to maintain that speed?

Matt Bundle: Be Steady at and as Brent was saying, there's no extra points for coming in in 35 minutes, right, so if you pick 44 minutes, gives you a nice cushion and you're nice and consistent, then you'll likely pass and the energy amounts that you need are going to be as low as possible and then if you're super strong then you can walk a little faster, but recall as Brent saying there is no extra marks for passing in 10 minutes. It's a pass fail type of situation and so this is not the event that people need to be using to create a gradation of how great of a firefighter you're going to be.

Charlie Palmer: Okay. And then there's just watching people take them. Some folks choose the weighted vest. Some folks will put a pack on, some folks will wear boots, some will wear tennis shoes or walking shoes. Any thoughts you guys have on the variations in how you can take the test and if there are any ways that are better than others?

Brent Ruby: Well that like the weighted of have become popular because they're convenient. You don't have to pre weigh everything. If a group comes and the whole crew shows up and everybody's got their pack and they've been told the loaded them up with 45 pounds with that means they've used 20 different scales probably, and so now you've got to take the time to weigh all the packs, certify that the packs are all 45 pounds. If not, they got to be adjusted and so... That makes that part of it a little bit less convenient than a weighted vest that is certified 45 pounds, but a weighted vest is not the way you carry your load on the line. The weight is all located in the back, which is where the line gear packs, right? A little lower than a traditional backpack, but so to be most specific, at least in the training. I would certainly suggest wearing your line gear or something closest to that just so you get a knife deal for how that rides where it rides. If you need to adjust anything in your underlying clothing from where your pants set to what kind of belt you're wearing, how comfortable is it? The last thing you need is abrasions on your back because that line gear pack, but it

also makes it more job specific with training. Training's going to work the best, the more specific and make it for whatever the final task of interest may be or whatever the competitive situation in this case, carrying a load on a slope, on uneven ground, digging periodically. Anything you can do in training mimics that is going to be the most applicable. So in addition to just simply practicing carrying a load, you need to practice carrying a load on uneven ground on perhaps a slope. Nice thing about that is you don't have to walk at the Pack test speed to get the same metabolic demand because you've added in an incline and that's probably a nice break for the lower leg as well because it changes the stress that's in the lower legs because walking for miles and hour on a flat is not super comfortable, but walking at three miles an hour up an uneven grade. You can get the same metabolic load and thus the benefit. But take some of the stress out of the limbs. Shoe wise, I don't know. I mean Matt might be able to speak to that better, but you don't get extra points just for hiking and brand new whites and so it might...

Charlie Palmer: You get some other things...

Brent Ruby: (Laughing) Yeah, you might get a little bite in the front or some nice blisters, but. And it might look cool, but to where your exact uniform and wear your boots, the pack test does not say you have to do that, so be comfortable when you're doing it, get it out of the way and then get onto the specific training that you need to do even later that day. I mean that's. That's probably not the only physical training that a lot of crews will do in that particular day. They'll do the Pack test, check done, okay, now we're going to do our PT and it's going to involve this and this and this and this.

Charlie Palmer: Yeah. So Matt, the military has obviously researched this a lot because those folks are carrying loads as part of what they do and it seems like some of the things they found is that the closer that weight is to the body, the more efficient it is. The more that weight can get put on the hips and distributed evenly, the more efficient and effective that carriage can be. What do you have is our kind of biomechanist, on staff here that that's going to be helpful?

Matt Bundle: Well, I would agree with everything you said and that really accounts for the popularity of the weight vests. So in other load carriage experiments and studies that people have conducted when you can wear or split the weight from the front and the back, the energy costs usually go down and people have heard us talking over the course of the episode with respect to energy costs. Energy is related to the exertion, the level of exercise. So the higher it is, the harder it is. Just in case that's not a terminology that people are hearing a lot. So the less the energy requirement is that the easier it is on the individual to meet that demand and that's what we see with weight vests, which are tight. You don't want the weight moving independently of the body, and then if you can have, I think the split 60 slash 40, 60 on the back, 40 on the front is the ideal amount for keeping the energy costs down, allowing sustainability. So that's why those I think are popular in events where you have a choice which pretty much excludes the operational setting.

Charlie Palmer: All right, so closing thoughts, final, perspectives you guys have on this whole pack test and load carriage topic.

Brent Ruby: Well I think my closing thoughts is hot shot crews, experienced firefighters don't give up on the Pack test. Don't set it aside and say this is a joke because there's an enormous amount of research behind it. There's an enormous amount of work and thought put into it. Reinterpret the Pack test. So I've told lots of hot shot crews that I think we're on the verge of collecting enough data so that they can use the pack test more as a diagnostic tool to see where they are in the training realm or preseason training. And I always tease him. I said our goal is to make the pack test great again, like bring back the pack test. Just don't give up on it. Don't, don't set it aside and say that it's useless because it is useful. It mimics what the job requires. But crews also have their go to hike. Oftentimes like right here in Missoula, the Lolo hot shots tackle Mount Sentinel and that's their go to hike and for years they've used the same ridge trail and they say we need you to be able to get from here to the top in this many minutes. And they picked that not based on some equations that Matt has given them or that they've pulled out of the literature. They base that intensity and that time on what they perceive as operationally relevant. And so, we should not dismiss that either. That intensity probably happens about 10 percent of the time, but nonetheless they have to be able to do it, but the Pack test has its place. It has its potential for being a little bit more specific in terms of diagnostics and guiding individuals towards where their early season weaknesses might be. At least that's our goal. Like Matt mentioned, I think we're really close to developing formulas and perhaps a free app of sorts that you can do some load carriage, figure out where you are and then get some fitness assessment information out of that along with some preseason training tips specific to where your weaknesses are. And the whole goal is improved readiness at the start of the season. The more ready you are for the beginning of the season, the easier the pack test is going to be and the safer the job's going to be starting from day one. That's my takeaway.

Matt Bundle: Yeah, and I think that's a great summary of, of what we've been trying to do with this recent work and I think I would just maybe only add that we believe that, that kind of feedback will be especially relevant to new firefighters and we hope also that as Brent was saying, that we were able to extract useful information for the veterans as well so that they know without having to give heavy efforts where they are with respect the norms of their crew type, where they may potentially where they've been in previous years and to be able to do that off of a test or a trial or data that they collect as part of their training programs in the early spring, late winter as people are getting ready for the upcoming season.

Charlie Palmer: All right gentlemen, thank you very much. We're excited to be back doing season two here and I think a great topic to kind of kick the season off with something that everybody's going to have to do or has done real recently. So again, thanks for your time and we will catch you next time On The Line

Outro: You've been listening to On The Line, a podcast for today's wildland firefighter. Our audio engineer is Mike Matthews, production assistant Joey Moore, and I'm your host, Charlie Palmer. Thanks for listening and we hope to connect with you in the future, On The Line.

Copyright: On The Line. All Rights Reserved. This transcript cannot be transferred, quoted, or shared without written authorization.