Calculating Swim TSS Values

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TrainingPeaks WKO+ automatically generates training stress scores (TSS) for bike rides uploaded from a power meter and for run workouts uploaded from a speed and distance device. Triathletes who use WKO+ and appreciate this feature often wish that the program could do the same for swim workouts. Unfortunately, the swimming equivalent of a bike power meter or run speed and distance device does not yet exist. However, you can calculate TSS for your swims manually using a method we'll describe in this article.

Why not simply use the same calculation for swim TSS that is used for running, in which the metric of pace is also used to quantify the training load? Because water presents more resistance than air, so the physiological stress of swimming increases with increasing swim speed faster than the physiological stress of running increases with increasing running speed.

The simplest, if not the most accurate, way to account for this difference in calculating TSS scores is to weight the "intensity factor" of swim workouts differently than it is weighted for run workouts. Specifically, we suggest, it should be cubed as opposed to squared.

Determining Functional Swimming Threshold Speed

Training stress score calculations in running and cycling are scaled according to the individual athlete's current functional threshold pace (running) and functional threshold power (cycling), which correspond roughly to the lactate threshold running pace or cycling power. The lactate threshold can only be determined through laboratory testing, while the functional threshold is determined through field tests that are known to yield roughly equivalent results.

Similarly, the functional swimming threshold pace is a stand-in for the laboratory-determined swimming lactate threshold pace. There are two approaches that are most appropriate for the determination of swimming FTP. The first is the straightforward timed effort, where you swim as far as possible in a given time (e.g. 30 or 60 minutes). So, if you swim for 30 minutes and cover 1000 meters, then you can use the value of 33.3 m/min. as your FTP. Since the actual FTP is closer to the one-hour effort, it might be more advisable to perform a 60-minute test, or to take the value obtained for 30 minutes, multiply by two and subtract 2.5 percent (as most trained swimmers swim roughly 2.5 percent slower in a 60-minute maximal effort than in a 30-minute maximal effort). So again, if you cover 1000 m in 30 minutes, your 60-minute FTP would be 1900 m/hr or 31.7 m/min. This may seem like a minor difference, but due to the resistive aspect of swimming, small differences can have a substantial impact.

If you are not inclined to perform such long, exhaustive efforts in the pool, you may alternatively perform a critical velocity (CV) test. This method consists of two test efforts at different distances (200 m and 400 m) separated by a complete rest. Because complete rest is required for the results of a CV test to be valid, it is best to perform the first all-out effort at the beginning of one workout (after warming up, of course) and the next at the beginning of another. Record the time required to complete each effort and simply plot the results on a graph as distance vs. time. The slope of that line is your critical speed. Alternatively, a simple equation yields the same result:

Critical speed = (Distance of longer test swim – distance of shorter test swim) divided by (Time of longer test swim – time of shorter test swim)

For example, suppose you swim your 200m test swim in 2:02 (2.04 minutes) and your 400m test swim in 4:21 (4.35 minutes). Your critical velocity, then, is (400m – 200m) ÷ (4.35 min. – 2.02 min.) = 86.6 meters/min.

The results of your critical speed determination should yield a result that is very close to a 60-minute test or a laboratory-determined lactate threshold pace. Either of these results can then be used as the FTP for determination of TSS and performance modeling.

Calculating swim TSS

Now that you know your swim FTP, you can easily calculate the TSS for any swim workout using the following procedure:

1. Measure total distance covered for the workout

2. Determine time to cover total distance (not including rest periods)

3. Express distance vs. time in m/min to obtain normalized swim speed (NSS), which is analogous to the normalized power and normalized graded pace in cycling and running, respectively

4. Divide NSS by FT to obtain IF

5. Swim TSS = IF^3 x hours x 100

For example:

Once you have determined the swim TSS, you can manually input values in Training Peaks WKO+ and then use the program's analysis features for swimming as you do with running and cycling. Let's look at an example of a specific workout. First, let's suppose that your swim FTP is 75 m/minute. Next, let's suppose you complete the following workout (remember, rest periods are not counted):

Warm-up: 200 m @ 3:20, 30 sec. rest (3:20 total)

Drills: 4 x 50 m @ 1:00, 10-sec. rest (4:00 total)

Main set: 10 x 100 m @ 1:15, 20-sec. rest (12:30)

Cool-down: 200 m @ 3:20 (3:20 total)

Total workout distance: 1,600 m

Total workout time: (23:10)

The average pace for the complete workout is 1,600 m divided by 23:10 (23.16 minutes) or 69 m/min. The intensity factor for the complete workout is the average pace (69 m/min.) divided by the athlete's functional threshold pace (75 m/min.) or 0.92. So the TSS for the workout is 0.77^3 x 0.386 hours x 100 = 30.1.

There are some important limitations of our do-it-yourself method of swim TSS calculation to bear in mind. First of all, although this simplistic approach can be effective, it should be noted that by simply tracking distance and time swum, the effects of rest periods on the sustainable efforts are neglected, whereas in cycling and running they are not, because power meters and speed and distance devices capture coasting and non-movement as part of the workout.

Similarly, our rough-and-ready method of calculating swim TSS lacks the exponential weighting of higher intensities that is done automatically with pace and power in the digital calculation of normalized cycling power and normalized graded pace, and which is an important means of capturing the exponentially greater stress imposed by higher intensities. That being said, the cubed weighting of the IF counterbalances this limitation to a certain extent.

These calculations ignore the differences between different swim strokes and the rather substantial differences in efficiency that result from good or poor technique. Finally, the impact of flip turns and push-offs is essentially neglected using this approach.

Still, it’s a lot better than nothing, which is what triathletes interested in logging their swim workouts on WKO+ have had up to this point!