

Threshold Training: Finding your T-pace

By [Jack Daniels, Ph.D.](#) Thursday, December 1, 2005,

NOTE: My notes – clarifications of Daniel's points and fixing one mistake are in bold brown font.

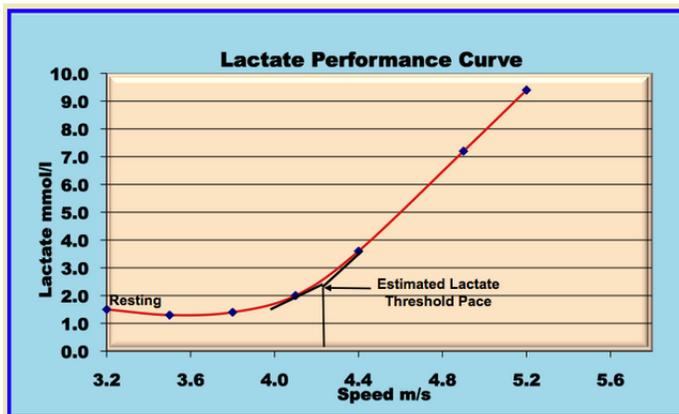
Threshold, or T-pace, running is one of the most productive types of training that distance runners can do. Training at this pace helps runners avoid overtraining and yields more satisfying workouts and better consistency.

The two types of threshold training that I discuss in *Daniels' Running Formula* are tempo runs and cruise intervals. Tempo runs—steady, moderately prolonged runs—have been around for some time*, but runners and coaches define them differently. Cruise intervals are a series of repeated runs with a brief recovery between runs. In my book, I address the differences and similarities between tempo and cruise-interval workouts. Here, I'll stick to tempo runs, including new information on extended tempo runs.

- *** Thus, Tempo runs, T-Pace and running at lactate threshold/pace all mean the same thing.**

Some runners and coaches use tempo runs for the broader purpose of just going for a fairly prolonged, steady, solid run—often, more for the psychological benefits (which can be considerable) than the physiological. **With threshold-intensity running**,* the physiological benefit is to improve endurance: the ability to endure a greater and greater intensity of effort for a longer and longer period of time.

- ***This is the single greatest concept above. It just means you matter what the sport is, you perform near, at, or just above lactate threshold pace – which is 'plastic'.**



You might perform some (longer) tempo runs at an intensity slightly below threshold intensity, which offers a good opportunity to boost psychological endurance.* Longer tempo runs that begin in the less intense area of the zone and progress to the higher end of the zone are accomplishing both the benefits of a longer tempo run and the benefits of true T-pace running.

***What is psychological endurance? I cover this later.**

Establishing Your Threshold Pace

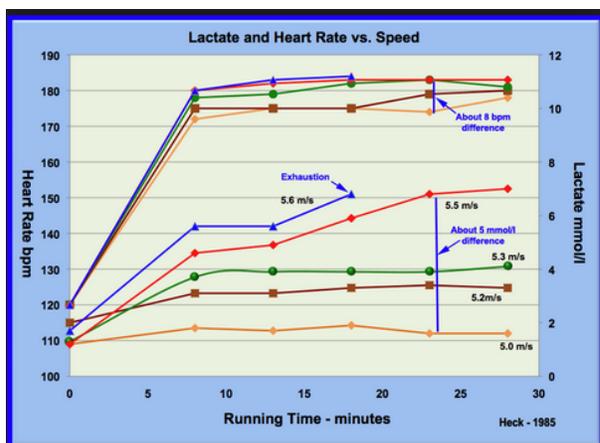
The proper pace for T-pace running is ~~about 83 to 88 percent of VO2 Max*~~, or 88 to 92 percent of vVO2 Max or maximum heart rate.

- The values above are for trained runners ONLY.
- *Since vVO2 max is the slowest speed VO2 max is – the crossed out part is wrong/makes no sense.

Back to Daniel's writing – I enlarge his words for emphasis and added graphs so you understand his points better.

You can establish your proper pace for threshold running fairly closely by running at a velocity that produces an elevated yet steady state of blood lactate accumulation. This pace is called maximum level steady state – MLSS – graph below.

- This pace is a little faster than a pace that you could maintain for two or more hours (marathon pace for most people) but slower than the pace you could maintain for 30 minutes (10K race pace for better runners).



As a person trains – ability to run faster over time equates to holding lactate steady – seen as running at 5.0 m/s and then at 5.5 m/s.

Notice increasing speed from 5.5 to 5.6 m/s bumped this person over 'lactate threshold'.

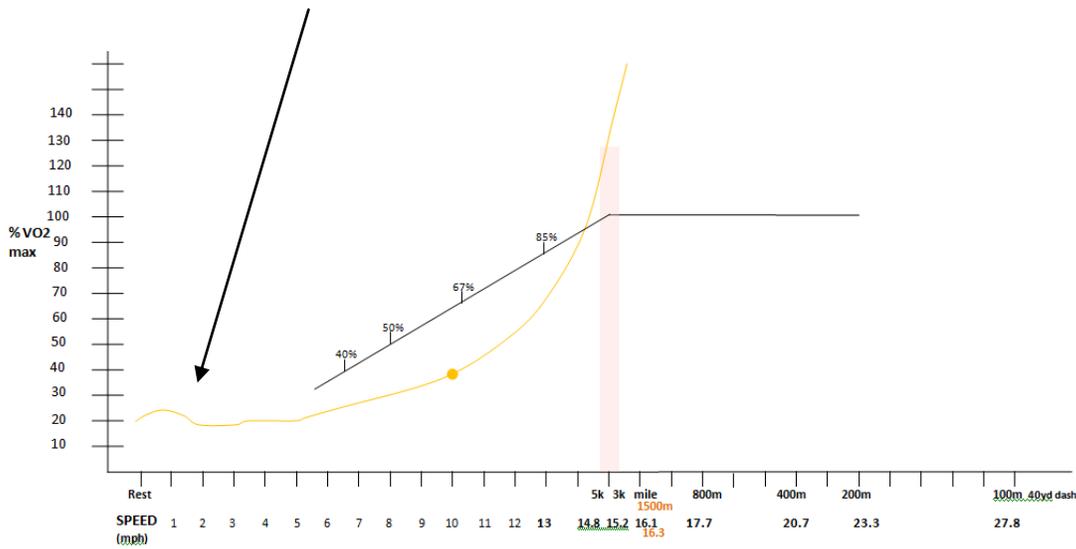
This progression occurs over months – and you can see how running at heart rates of 174bpm to 182 results in super high lactate levels; above 10.

- This pace is easy to discern because *at the latter pace* → (10kpace) blood lactate continues to rise over the course of the run.

The 5.6 m/s speed shows that type of pace... a slow increase of lactate over time

- Also, at the former pace, blood lactate slowly drops after an initial rise or after any elevated lactate resulting from race surges. (As seen in my [debunking video of Dean Karnez](#))

That's why I added the 'little bump' in the early surge phase of the graph below:



Most runners can figure that their threshold pace is equal to a pace they could race at for 50 to 60 minutes. In fact, for slower runners*, threshold pace might actually be 10K race pace because they are taking nearly an hour to "race" this distance. Intensity of effort, not necessarily distance of running or racing, is what determines the degree of stress being put on the body's systems.

***Many so-called slower runners are never running – that is – their mechanics are terrible; they are not sprinting but rather fighting themselves, doing damage in the long run.**

Think about it – I just did – running an hour at a very high pace (10k or faster) is about the same time – 50 to 60 minutes – as a stressful/intense weight/strength training session. This is OK if you can actually run with good sprinting 'mechanics'. Otherwise, if you can't develop 'it' – then the attempting to run 'faster/further' i.e. all races – competitively or 'for the cure' - is a not a good idea.

If you work HARD for an hour (with or without bad mechanics) you have stressed your physical and mental body. In the case of 'runners' and crossfit style training is they add bad mechanics to that which is already stressful or extremely stupid stressful.

Building 'psychological endurance' for many people equate to building a tolerance for taking punishment.

- Suggested reading on hitting the wall and psychological endurance
 1. [Hitting 'The Wall'](#)
 2. [The Wall is a Myth](#) by Kevin Leathers of 'Can't Stop Endurance'
 3. [Mathematical Model for Fueling with Carbs for Marathon Running](#) – source Harvard U.

All the above is a bad recipe – and one that I do not personally or professionally view as fitness or true athletic training. Thus, if you can't run, do not run.

- Remember that the purpose of the workout is to stress lactate-clearance capability, not to overstress that capability. I refer to threshold training as "comfortably hard" running. It shouldn't feel "hard," which is the pace of pure interval training.

Tempo Runs

- Ideally, a tempo run is nothing more than a steady 20-minute run at T-pace. Subjectively, the intensity of effort associated with T-pace running is comfortably hard. Again, your effort should be one that you could maintain for about an hour in a race.

Although the ideal duration of a steady threshold run is 20 minutes, your running time can vary somewhat to accommodate a particular course. For example, if your T-pace is 6:00 per mile, and you choose a three-mile course, this gives you an 18-minute tempo effort; or you might go four miles for a 24-minute tempo run. Of course, you could go exactly 20 minutes, using the mile markers to set proper pace, and stop between three and one-quarter and three and one-half miles. It's not a bad idea to do tempo runs on the track (or even a treadmill now and then) so that you can closely control the pace. Many coaches and runners do longer tempo runs at slower than true threshold pace, and this can yield positive results. Prolonged running at this intensity builds a good sense of maintaining a strong pace for an extended period of time, and as stated earlier, in some instances the demand can be as psychologically intense as a shorter run at true threshold pace. Also, some runners gradually build up the intensity of a longer "tempo" run until actually running at threshold pace. In any case, I believe in the benefits of tempo runs that are longer than 20 minutes and have designed tables that alter the speed of the run as dictated by duration (see the Variations table on page 20). Using these tables gives runners a better idea of what pace to expect of themselves when out on a tempo run that forces them to run slower than threshold pace and longer than the typical 20-minute duration. The adjusted paces are based on the natural drop off in maintainable intensity as the duration of a steady run increases.

[The Variations table](#) shows the mile pace times for tempo runs lasting 20 to 60 minutes, and how much slower the pace is per mile (in seconds) than T-pace. It also shows M-pace (marathon pace) times and how much slower or faster it is per mile than T-pace. If your VDOT falls between the displayed values, just add the appropriate number of seconds per mile or kilometer to your own T-pace for the desired run duration.

Be sure to perform your tempo runs under desirable weather conditions and on relatively flat terrain with good footing because the goal of this workout is to maintain a steady intensity of effort for a prolonged period of time. Hills, rough footing, and wind all affect the ability to maintain a steady pace and interfere with achieving the purpose of the workout. You can monitor your heart rate, but a steady rhythm under constant conditions is what you want in a tempo run.

Possibly the biggest challenge in doing tempo runs is to hold the proper pace and resist turning your tempo run into a time trial. Remember that the proper pace is more beneficial than a faster (or slower) one. This is a good workout for practicing your ability to concentrate on a running task and keep in touch with how your body feels while running comfortably hard.

- **This supports the contention to develop and train by FEEL, that is to run, train, lift weights, etcetera by feel and stop fixating on the quest to find a holy grail within the science.**

Begin a tempo workout with a good warm-up of at least 10 minutes of easy running and some light strides. Follow the tempo run with a cool-down, which should include some strides (four or five 20- to 40-second runs at about mile race pace). You'll be surprised how good you feel about 10 minutes after a tempo run.

My recommendation is that steady tempo runs should last 20 to 60 minutes, with pace adjustments as shown in the [table](#).

Using Tempo Runs

A few words of caution regarding **how often to repeat identical workouts*** and monitor progress in a particular type of threshold workout: It's human nature that runners often want to see progress in their workouts and sometimes try to perform a particular workout at faster and faster speeds* over the course of a fairly short period of time. Trying to compete against yourself in this way is inadvisable. It doesn't conform to the principle of letting your body react and adjust to a particular type of stress before increasing the amount of stress. It's better to perform the same workout quite a few times at the same speed, or until a race performance indicates that you've achieved a higher fitness level.

***Same mistakes made in strength/weight training**

One of the best ways to monitor how your training is progressing is to **see how much more easily you can perform a particular workout as time goes by**. If what used to be a tough workout becomes not so tough after several weeks of training, then that's a great sign that your training is paying off in a positive way. At this point, you're usually ready for an increase in intensity or amount of training. In contrast, always trying to see if you can go faster in a workout that you have done before (the "always hurt as much as possible" technique) can be very misleading in trying to determine how much progress you're making. With this approach, you always hurt the same (or more), and you never get to experience doing a standard workout with diminishing discomfort. Doubts begin to set in as you ask yourself, "Am I really getting better or just learning to tolerate more pain?" If you often hurt badly in practice, a race won't be anything special; you should be able to take on more discomfort in a race than you do in daily training.

A more sophisticated way to monitor the degree of stress of a workout is to check heart rates or blood-lactate values at various points during the effort or during recovery. Relying on these more scientific means of keeping track of your progress, however, can prevent you from learning how to do a good job of it on your own. Whether or not you use mechanical or electronic devices to monitor body responses, you should still learn to read your body's feelings and reactions to the types of workouts that you do.

Please remember not to run faster than the prescribed T-pace when doing tempo workouts. When you're having a good training day, it's not that tough to beat a previous time over a four-mile tempo course. It's very important, however, to let your ability, based on competitive efforts, determine your training intensities. When a workout begins to feel easier, use that feeling to support the idea that you're getting fitter. Then, prove that you are getting better in a race, not in a workout.

If you're in a prolonged phase of training, with no races scheduled, it's reasonable to increase training intensity without the supportive evidence of better competitive performances. In this case, a good rule of thumb is to increase [VDOT](#) one unit every four to six weeks. This is the same as improving your 5,000m race time by about 10 to 15 seconds, a substantial improvement in my opinion. If you're in a maintenance program, which is designed to require the least possible training stress that allows you to stay at a particular level of fitness, there's no need to increase training intensity (VDOT) or distances. In this case, the best goal is to see how easy standard workouts can feel over time.

When setting up the phases of training, the placement of threshold training might vary in the overall order of the program, based on the individual involved and the event being trained for. Unlike endurance runs, which almost always fall in the earliest phase of a program, threshold training might be emphasized early, at the midpoint, or late in a runner's training schedule.

During an interval workout, you can modify the training stimulus by altering the length, number and pace of your hard efforts. In this issue, we discuss the other critical factor during interval workouts: the optimal amount of recovery between intervals.

The appropriate amount of recovery between higher intensity running during an interval session depends on the goals of the workout. There are three basic types of interval workouts: 1) cruise or lactate threshold intervals (typically one to two miles) run at about 15K to 10-mile race pace; 2) VO2 max intervals (typically 600 meters to one mile) run at about 3K to 5K race pace; and 3) speedwork (typically 200 to 400 meters) run at about 800 to 1500m race pace. Most interval sessions are variations on one of these patterns.

The optimal ratio of hard running time to recovery time depends primarily on how intensely you run the intervals and only secondarily on the length of the interval. Thus, cruise intervals, which require only a modest amount of recovery time (e.g., 30 seconds to two minutes) because the intensity is only moderately high, have a relatively high work to recovery ratio, about 5:1 to 12:1. VO2 max intervals are shorter but faster than cruise intervals with relatively longer recoveries (e.g., 90 seconds to three minutes), resulting in a work to recovery ratio of 1:1 to 2:1. Because shorter repetitions to improve your speed are run at an even higher intensity, the recoveries are comparatively long, with a work to recovery ratio of 1:2 to 1:4.

Regardless of the goals of the workout, the objective of the recovery interval is to allow you to complete the planned session at close to the desired pace. During your workout, you may need to fine-tune your pace or your recovery time. It is more productive to slow down slightly or increase the rest between hard efforts to enable you to complete the session than to cut your workout short due to insufficient recovery.

I learned this lesson shortly after college, during a workout of 800s in 2:10 to 2:12 with Bill Rodgers and his Greater Boston Track Club colleagues. I had handled this pace before, with a slow 400 meter recovery jog. The difference this day was that Bill was doing a 200 meter jog between efforts. After the fourth repetition, I was toast because of the short recovery. The error I made was to do someone else's workout rather than to adjust the pace or the recovery to my personal ability.

Within your own limits, however, you will provide a stronger training effect from a session of VO2 max intervals or cruise intervals by keeping your recovery as brief as possible. The stimulus to improve your VO2 max (using VO2 max intervals) or lactate threshold (using cruise intervals) is provided by the amount of time that you accumulate in the optimal intensity range during a workout. Because it takes time for your oxygen consumption to increase to the correct range during an interval (over one minute during VO2 max intervals), you will accumulate more time in the most effective intensity zone by running longer intervals. Longer recoveries will allow you to run more intervals, but the more complete your recovery is the longer it takes to increase your oxygen consumption to the right level during the next interval. You need to find the optimal balance for you, between keeping the recoveries long enough to complete the workout versus short enough to provide the desired training effect.

Should your recovery time increase during the workout?

There are two schools of thought on whether your recovery time should increase as the workout progresses. The classic approach is to jog the same amount of time (e.g., two minutes) or distance (e.g., 400 meters) after each interval. The physiology-based approach is to start the next hard effort when your heart rate goes down to a certain level (typically 120 beats per minute), with the rationale that this is a signal from your cardiovascular system that you are ready for the next interval. This approach allows you to have more rest as you become more fatigued, which improves your ability to complete the workout, whereas the set recovery time approach is arguably better preparation for racing, in that the workout gets considerably harder toward the latter stages.

My view is that you should start the workout with a set recovery distance and time (e.g., 400 meters in two minutes), and allow yourself to jog your recovery more slowly, if necessary, to complete the workout. You control the recovery time, and will know if you are being too soft on yourself, just like in a race.

Why keep running during your recovery interval?

The benefits of keeping moving during recovery include: 1) increased clearance of lactate from your muscles and blood; 2) helping your muscles stay warm and loose; and 3) keeping your oxygen consumption somewhat elevated so less time is required to get up to the optimal zone during the next hard effort. If you are too tired to jog during your recovery, then you are probably running your intervals too hard. It is not unusual to need to stand or walk for a few seconds after a 1200 meter effort at 3K race pace, but you should try to break into a jog as soon as possible to enhance the recovery process.

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