Endurance Training Guide

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"Everything should be made as simple as possible but no simpler." Albert Einstein

I have been writing exercise programming for more than 30 years. The programming spans the spectrum from powerlifting to ultra-endurance athletes. Whenever I venture into a new area of programming I notice a trend. My programs start out very simple, because my knowledge in the area is not fully developed. Then, as I learn more, I begin to add to the complexity of the programming. Finally, when I feel like I have begun to really understand the sport, my programming gets really simple again. Almost all good coaches and trainers I have encountered go through the same evolution. When I write programs now the first thing I do after writing the program is to review it carefully and begin to remove things. Then I carefully review it and remove some more. When I get to the point that I am convinced that I cannot possibly remove any more and still keep the integrity of the program, I am finished. This always results in a better program. Simple can be very effective. Simple means that you are focusing on quality rather than quantity. It means that you are content to do a few things well, rather than lots of things at a mediocre level. Simple is easy to assess, easy to modify, easy to understand.

Complex programs almost always look more attractive. The novice athlete will often evaluate a program based on its complexity with the assumption that more complexity means that the trainer must really know something special. The fact is that it is easy to make a training program more complex. However, it takes real expertise to make a simple program that is effective. People are almost always surprised when they see the programming used by elite athletes. It is so simple! But not easy!

I wrote this book to provide guidance on designing simple, bare bones, but effective endurance training programs. I provide two types of programs.

- **The first program is aimed at improved health.** This is simply endurance programming to help you live a healthier, longer life. This program can also improve performance, but that is not the primary focus. The advantage of the health focused program is that the workouts can be brief and there is a lot of flexibility built into the program.
- **The second program is for fitness.** Fitness is defined as the ability to do a task (i.e., run a 10K race in under 40 minutes). This program will also provide the same health benefits as the health program, but it is focused primarily on fitness. The disadvantage of this program is that it is more structured, with less flexibility. There is a price to pay for performance.

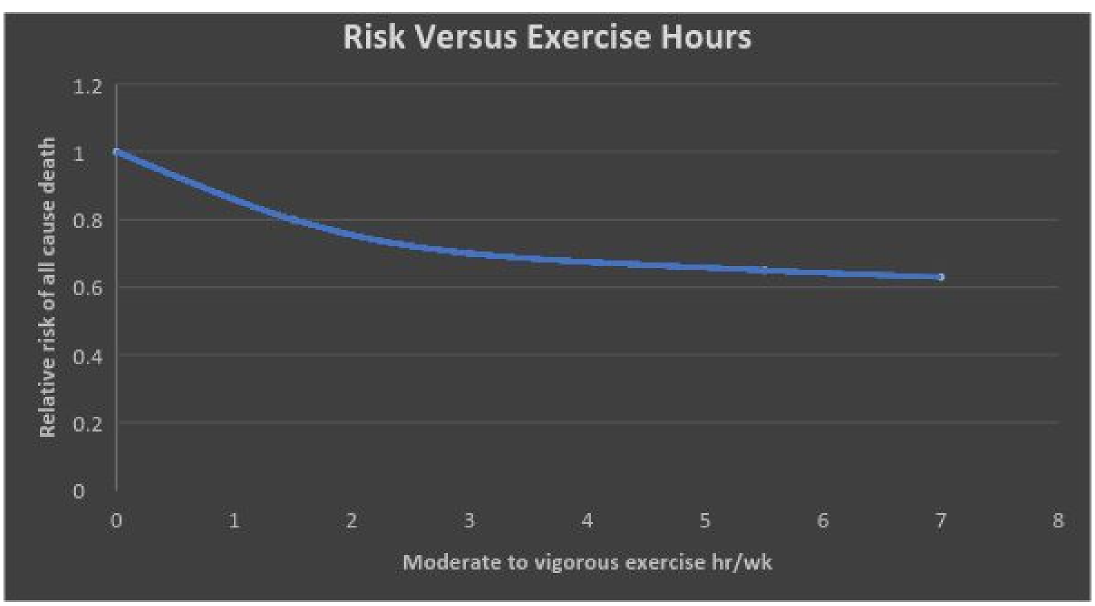
Of course, there is some degree of overlap, so both programs will improve health and fitness. Which program you should choose depends on whether your goals are more aligned with health or with fitness.

Endurance Training for Health

For decades now, the American College of Sports Medicine (ACSM) has produced a position paper that outlines the quantity and quality of exercise that is recommended for improving health and reducing risk of disease and death. Each position paper is crafted after a careful review of the current research by a panel of experts. It provides a solid, evidence based foundation for exercise programming for those who are training primarily for improved health. The recommendations in this chapter are based on the 2011, *Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults: Guidance for Prescribing Exercise*.

For the purposes of our discussion, we'll define aerobic exercise as any exercise that is rhythmic in nature and can elevate and sustain the heart rate in the appropriate range. Examples are walking, running, cycling, swimming or various exercise equipment like an elliptical device or a rowing machine. A non-traditional approach to aerobic exercise is to use stop and go activity, but ensure that the rest periods are short enough that the heart rate stays in the appropriate range. An example might be doing X number of kettlebell swings every minute, on the minute. Both of these would be considered aerobic exercise as long as the heart rate reaches the target zone and stays there for the length of time prescribed. For the purpose of simplicity, we will focus this document on the continuous, rhythmic type of aerobic conditioning.

There is a dose/response relationship between physical activity and risk of death from all causes (all cause mortality). The figure below illustrates the relationship.



Note that the biggest improvement comes from the shift from doing nothing, to doing just a little bit. However, more seems to be better, but the returns start to diminish beyond 6 hours per week. This data is based on moderate to vigorous activity, so we should take this opportunity to define what we mean by those terms. The table below provides a simple 5 zone system for classifying exercise intensity.

Intensity Zones

Zone	% Max Heart Rate	Intensity
1	60-72	Moderate
2	72-82	Vigorous
3	82-87	Somewhat Hard
4	88-92	Hard
5	93-100	Very Hard

Accuracy of Max Heart Rate Equations

The most widely used equation to predict maximum heart rate (the highest heart rate that a person can achieve) is: Max Heart Rate = 220-Age in Years. For example, predicted maximum heart rate for a 20 year old would be 220 – 20 = 200 beats per minute. How accurate is that formula? Not very. An excellent review of this issue in the Journal of Exercise Physiology (https://www.asep.org/asep/asep/Robergs2.pdf) shows the surprising history of this formula. Maximum heart rate varies quite a bit by age. In fact, this formula (and any other formula to predict maximum heart rate), can either over or underpredict maximum heart rate by more than 12 beats per minute! Below is a real world example from two very fit athletes I tested personally in the U S Naval Academy Human Performance Lab.

	Athlete 1:	Athlete 2:
Age:	19	20
VO2 max:	72 ml.kg-1.min-1	73 ml.kg-1.min-1
Predicted max heart rate:	201 BPM	200 BPM
Actual max heart rate:	212 BPM	178 BPM

These are both elite endurance athletes, with very similar fitness levels and age, and their predicted max heart rates should be within 1 BPM but their actual measured max heart rates differ by 24 BPM!

If I am prescribing workouts for both athletes using their predicted maximum heart rate, I will have a big problem. Consider what would happen if I were prescribing a 2 hour zone 2 (steady/easy pace) run for both athletes using their predicted max heart rate. That would be an intensity that results in a heart rate of 144-164 BPM. For athlete 1, who has a higher than predicted max heart rate, this would result in running much too slowly. For athlete 2, who has a lower than predicted max heart rate, this would result in him running at a pace that is way, way too hard. It is unlikely that athlete 2 could sustain that pace for more than 40 minutes! In reality, both of these athletes should be completing the same 2 hour run at about the same pace, but at VERY different absolute heart rates.

However, because we know their ACTUAL maximum heart rates, we can do a better job of prescribing heart rate zones, and therefore training intensity for both athletes.

Actual Zone 2 Heart _	Rates	Predicted Zone 2 Heart Rate
Athlete 1: 153 - 176	BPM	144 – 164 BPM
Athlete 2: 128 – 136	BPM	144 – 164 BPM

A thorough review of the scientific research concerning the use of mathematical equations for estimation of maximum heart rate concluded that, “Currently, there is no acceptable method to estimate heart rate max.”

Does this mean that using heart rate to gauge exercise intensity is worthless? No. It is useful, but caution must be exercised in interpreting the numbers. If the session feels too hard, it probably is (and vice versa). A really hard interval session (i.e., Tabata protocol) or a sprint at the end of a shorter race (i.e. 1.5 mile or 5K) will generally get you within 5-7 BPM from your maximum heart rate.

Robergs, RA, and Landwehr R, The surprising history of the HRmax = 220 – age equation, Journal of Exercise Physiology (online), 5(2), 2002.
https://www.asep.org/asep/asep/Robergs2.pdf

Finding Heart Rate Zones

We just discussed how innacurate maximum heart rate equations can be. We also introduced a 5 zone heart rate system based on % of maximum heart rate. So, how do we get our maximum heart rate accurately in order to set up our training zone heart rates? There are several ways. I’ll list them below in order of best to worst.

1. Graded Exercise Test: In this case you are performing a graded (increasing work rate) test until you reach exhaustion. If cleared by your doctor to do so, you can get a very good estimate of your maximum heart rate with this method. It is best to do this as a treadmill run test. Other modes (i.e., bike) will likely result in muscular fatigue before you reach maximum heart rate. The test is simple. Start with the treadmill set to a 2-3% grade (incline) and 3 miles per hour (MPH). Every minute, increase the speed by 0.5 MPH until you can no longer continue. Record your heart rate at the end of each minute. The highest recorded heart rate (generally during your last stage) is a very good estimate of your maximum heart rate.
2. One mile – 5K race effort: If you run a hard 1 mile – 5K race effort, with a hard sprint to the finish line, you will be very close to your maximum heart rate when you reach the finish line. You can use that heart rate number as your maximum heart rate with confidence.

3. Racing Heart Rates: If you record heart rate during races, you can get a workable estimate of your heart rate training zones from the table below.

Zone	Race Distance
1	Recovery pace. Slower than marathon race pace.
2	Marathon race. Take HR during mile 2-20ish.
3	½ marathon race. Take HR during mile 2-10.
4	10K race. Take HR during mile 2-5.
5	5K race. Average HR during entire race.

Note: We are excluding the first and last portion of the race to ensure that we are getting a steady state heart rate, rather than a heart rate that is still accelerating at the beginning of the race, or the heart rate during your final sprint to the line. In the case of the 5K, the race is too short to do this, so just use the average for the whole race. The HR that you end up with for these race distances is near the middle of the heart rate zone.

4. Rating of Perceived Exertion (RPE): RPE is an estimate of how hard an effort feels. The RPE method is pretty good for experienced runners, but is less reliable for absolute beginners. This method will not give you calculated zone numbers but will tell you when you are approximately in the zone. Use the table below.

Zone	Race Distance
1	Easy. I could go this pace for a long time.
2	Steady. I could go a long time but it would be work to do so.
3	Moderately hard. Not suffering, but I am definitely working.
4	Hard. It takes real effort to maintain this pace.
5	Very hard. I am suffering right away.

5. 220-Age in years: This is going to be hit and miss. It is better than nothing but some people are going to end up with an estimate that is way off. If you use this method, double check it with the RPE scale above.

Therefore, in the ***Risk Versus Exercise*** graph, we were referring to activities that resulted in a heart rate between 60-82% of your maximum heart rate, or zone 1 and 2. These are the definitions used by the ACSM. However, most people would not describe zone 1 as moderate. Athletes would normally consider a zone 1 pace to be an easy recovery pace. Zone 2 would often be described as being moderately easy to "steady." Just remember that the ACSM wrote the position paper with sedentary or less active adults in mind. Using a heart rate monitor will help you to stay in the right zone. Keep in mind that most of the research on improvement in health and reduced risk of death have focused on zone 1 and 2 efforts. My recommendations will include the option of all 5 of the zones. In doing so, I am not making an "educated guess." It is a stronger basis than that. I would call it an "informed opinion, based on the science."

Here are the specific recommendations from the ACSM:

Variable	*Recommendation*
Frequency	Moderate exercise: 5 or more days per week Vigorous exercise: 3 or more days per week
Intensity	Moderate = Zone 1 Vigorous = Zone 2
Time	Moderate = 30-60 minutes/day Vigorous = 20-60 minutes/day
Type	Continuous and rhythmic

If you pair this with the intensity zone table, you start to get a clear picture of what they recommend. The text of the ACSM position stand mentions that higher intensity aerobic training can be substituted for some of these sessions but they declined to make a specific recommendation. What they are talking about in that statement is zone 3, 4 and 5 training. The recent ACSM position statements have been more inclusive of higher intensity training and I suspect that the next position stand will include some specific recommendations. However, there is enough research for us to get out ahead of the position stand and make some well-informed recommendation for the use of zone 3, 4, and 5 training when programming for health.

Let's take our intensity zone chart and expand it a bit to include the typical time that endurance athletes spend training in each zone.

Time Spent Training in Each Zone by Endurance Athletes

Zone	% Max Heart Rate	Typical Training Time in Zone During a Workout for *Max Performance*
1	60-72	1-6 h
2	72-82	1-3 h
3	82-87	50-90 min
4	88-92	30-60 min
5	93-100	15-30 min

You might notice that the ACSM recommendation prescribe a dose that is in the ballpark of 30% the time in zone that athletes would train to maximize performance. That makes sense because the chart above is for endurance athletes looking to maximize performance. Much less training is necessary to improve health. So let's modify the chart to include the ACSM recommendations, and reasonable time in zone recommendations for zones 3, 4 and 5 ***for the purposes of improving health***.

Time In Each Training Zone for Health/Longevity

Zone	% Max Heart Rate	Typical Training Time in Zone During a Workout to *Improve Health*
1	60-72	30-60 min
2	72-82	20-60 min
3	82-87	15 – 30 min
4	88-92	10 - 15 min
5	93-100	4-6 min

I would consider each of these to be roughly equivalent in terms of impact on improving health and reducing risk of all-cause mortality, however the benefits from zone 3-5 training have not been as well studied as zone 1-2. These are estimates and should not be taken rigid requirements. Nobody knows yet what the optimal combination of these workouts might be (for a mix and match plan). Future research might find unique health benefits from a particular zone but current evidence does not strongly support this yet. Also, you can get all of the health benefits you need from only zone 1 training, with no need to do the harder stuff if you don't want to (or if you cannot due to injury). ***A word of caution.*** All good endurance training programs spend a period of time building baseline fitness using lower intensities before including higher intensity work, and you should too. If you are starting out sedentary, choose only zone 1 and 2 for at least 6-8 weeks before venturing into zones 3, 4 and 5. Remember, if your goal is health, you don't need to do the hard stuff. The advantage of the hard stuff (zone 4 & 5) is time. You can get a big impact in a short workout.

Simplified Endurance Training Program for Health

Pick a row from the **Time In Each Training Zone for Health/Longevity** table and perform it 3-5 times per week (5 times per week is better) or mix and match to perform 3-5 workouts per week. That is all there is to it. Just stay in your heart rate zone for the required time. For example:

Example 1

Monday	60 minutes zone 1
Tuesday	60 minutes zone 1
Wednesday	60 minutes zone 1
Thursday	60 minutes zone 1
Friday	60 minutes zone 1

Example 2

Monday	60 minutes zone 1
Tuesday	5 minutes zone 5
Wednesday	40 minutes zone 2
Thursday	12 minutes zone 4
Friday	60 minutes zone 1

Using a Heart Rate Monitor

I highly recommend using a heart rate monitor. Most people are not going to get their intensity right without one. The tendency is to make zone 1 and 2 too hard and zone 4 and 5 too easy. With a heart rate monitor, you can ensure that you are in the right zone. You have lots of choices in heart rate monitors today. The “gold standard” for athlete heart rate monitoring is the chest mounted heart rate device. These are usually an elastic strap with a sensor/transmitter on them. Popular brands are Polar, Garmin and Suunto. Most of these transmit the data via either a company proprietary signal, a Bluetooth signal or an ANT+ signal. You should choose your heart rate monitor based on the device you are going to use to record your heart rate. Personally, I prefer a heart rate monitor that is both Bluetooth and ANT+, so that I am covered for a wide variety of devices. The advantages of a chest mounted device are accuracy, and the ability to do heart rate variability measurements. Be sure to wet the sensors on the chest strap before you start to exercise and make sure that the sensors are in contact with your skin and in the right location. You may get an erratic reading for a minute or two at the beginning of exercise. Once you start to sweat, the readings will be much more stable. An occasional errant spike is normal but they should not happen often with a quality heart rate monitor.

The other option are the optical sensors that use light reflectance to detect the pulse. The only current optical sensor I would recommend is the Scosche Rhythm. It has a quality sensor from Valencel and has the advantage of being able to be placed on various locations (i.e., forearm or upper arm). The wrist is a poor location for optical sensors. Wrist placement often leads to poor heart rate accuracy. I have had good success with the Scocshe Rhythm on my forearm and upper arm.

Using a heart rate monitor to gauge zone 5 intensity is a bit tricky. The problem is that it takes 2-3 minutes for your heart rate to reach zone 5. So you may be just about done with the session by the time you hit your target heart rate. That is OK. The goal for zone 5 training is just to get to or near your zone 5 heart rate, not to spend the entire time at that heart rate.

It is important to reiterate here that we are discussing training to improve health outcomes and reduce mortality. Performance is a whole different ball game. When training for performance, these zones are in no way equivalent. Each has its own unique physiological adaptations (though there is plenty of overlap). These zone differences will be discussed in the chapter on training for performance.

Endurance Training for Fitness

The vast majority of elite endurance athletes use a training model called the polarized model. The polarized model consists of a training distribution that is about 85% easy pace, and about 15 percent hard paced efforts. The polarized training model works well, but it requires a significant amount of volume to be effective. Don't bypass this important point. How much volume is required for the polarized model is the subject of debate. My educated guess is somewhere in the neighborhood of 40 miles per week or more (running). The term "polarized" is used because most of the training occurs in the bottom and top of the training intensity zones. Surveys of elite endurance athletes have shown that this is by far the most common training zone distribution among elite athletes. Elites spend most of their time accumulating lots of training volume at low intensities, some time at the higher intensities, and very little time in between. We generally describe pacing or effort level by referring to "intensity zones." For a quick snapshot at the typical 5 zone system, skip ahead a couple of pages to the table, "Norwegian Olympic Federation Intensity Zones." The typical distribution of training intensity in the polarized model is about 85% in zone 1 or 2 (easy to steady pace) and 10% in zone 4 or 5 (hard to very hard), with a little (5%) in the moderately hard zone. The very popular Dr. Phil Maffetone (MAF) training program is similar to the polarized model. The MAF pace is typically in the lower half of zone 2 for most athletes. To repeat, this approach, the polarized model, is ideal for athletes who are able to commit to high volume training. Unfortunately, this approach is often misapplied to busy intermediate athletes who do not have the time for high volume training. This leads to suboptimal performance.

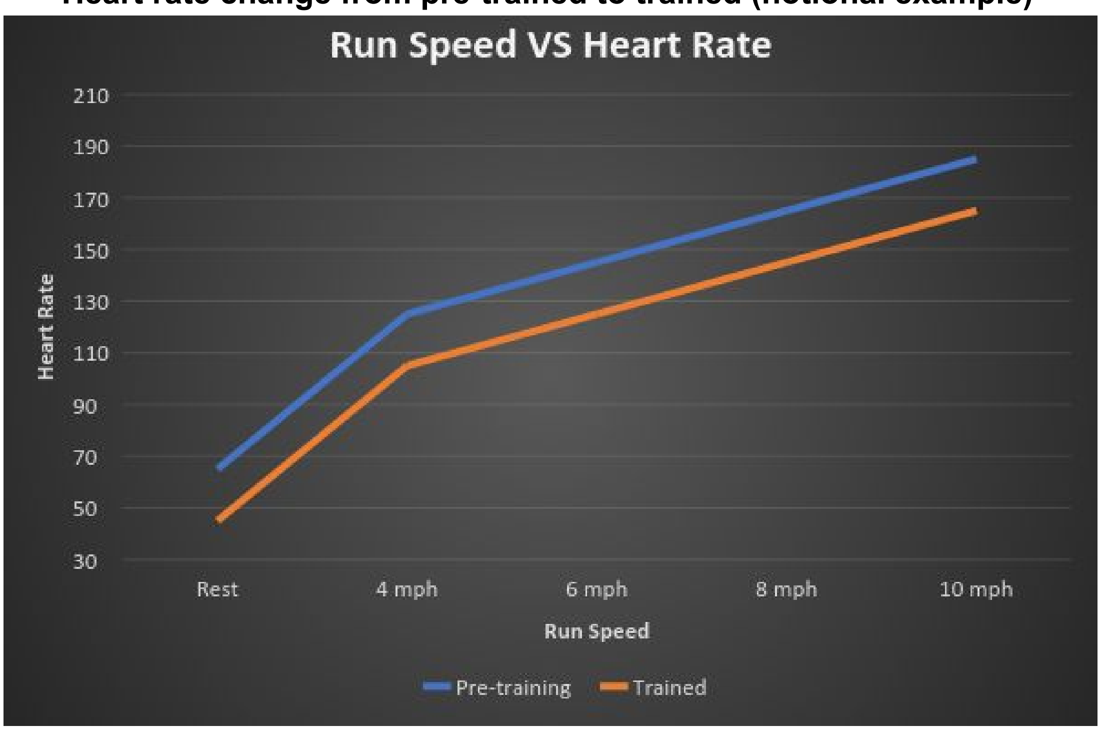
The primary difference between training elites and intermediate athletes is the sheer volume of zone 1 and 2 training. As a result, intermediates may spend less than 50% of their training volume in zone 1 and 2. Elites may run 120 miles per week or more in zone 1-2, an unreasonable amount for a intermediate athlete. For those who cannot commit to an elite volume of running, the threshold model is a better choice than the polarized model. In this case, because the athlete's time is limited, we trade some volume for intensity. The threshold model is the basis of the **3 Tools / 3 Phases** approach that follows. This is a more ideal model for most people. For novice/intermediate athletes who are training for longer distances (marathon or longer), the **3 Tools / 3 Phases** approach still works, but as you will see in the following discussion, some tools and phases become less relevant and can be eliminated.

All good endurance training programs have a similar foundation or structure. This document strips down the typical endurance training program to bare bones simplicity. One advantage of a simple program is that it is easy to understand and execute. When working with athletes, this can be vitally important. In this section, I will lay out a simple template for planning an endurance training program. This works for any endurance mode (i.e., run, bike, swim, ski) and for any endurance distance from 1 mile to 100 mile ultra-marathons. For simplicity, I will use running as an example. Remember, simple does not mean easy! We'll start by discussing the 3 tools, then the 3 phases. Then I'll put it together in a typical timeline. Finally, I will discuss some modifications for different race distances and provide sample programs.

Intensity Zones

Most training programs use an intensity scale or zone system in order to ensure that athletes are training at the correct intensity. The most common way to specify intensity is with heart rate. This is because heart rate increases linearly with exercise intensity. As you become fit, your heart rate response to the same work rate (run speed) will be reduced. In other words, your heart rate will go down at a given run speed. However, if you use heart rate zones (intensity zones), what you will find is that as you get more fit, your run speed will get faster and faster in a given heart rate zone. This is what makes heart rate such a great tool for prescribing and monitoring training intensity. By training in fixed heart rate zones, you have built in automatic progression as you get more fit. From the example below, prior to training, running at 6 mph produced a heart rate of 145 beats per minute (BPM). After training, the heart rate response was reduced to 125 BPM. In this case, if the runner continues to train at 145 BPM, they will have to increase their training pace to approximately 8 mph. Training in a given heart rate zone provides a natural progressive overload as you become more fit. If you simply maintain the appropriate heart rate zone as you become more fit, you will have to gradually increase your pace in order to sustain your heart rate in the appropriate zone. This provides a way to auto-regulate your increase in pace. That way you increase pace when you are ready for it, when fitness improves. Simple, maintain your heart rate in the appropriate zone and let pace take care of itself.

Heart rate change from pre-trained to trained (notional example)



There are many intensity zone systems. It does not matter which zone system you use, as long as the training program you are using matches your zone system. Many people assume that there are rigid boundaries between zones and that these boundaries correspond to some physiological adaptation or process that is unique to that zone. This is not correct. There is a smooth continuum of exercise intensities, with very little difference in physiological adaptation at nearby intensities. For example, if 155 beats per minute puts you in zone 3 and 157 beats per minute put you in zone 4; some would assume that you have crossed some kind of threshold, where you will get a different physiological training effect because you are now training in a different zone. In reality, there is virtually no difference between these two intensities because intensity is a continuum, and these two intensities are very close. Below is a typical 5 zone system. This is the system used by the Norwegian Olympic Federation. It is very similar to most intensity zone systems used by coaches, so it is a good choice.

Norwegian Olympic Federation Intensity Zones

Zone	% Max Heart Rate	Typical Training Time in Zone During a Workout	Example of Approximate Pace (min/mile) in Zone for a 6:00 min mile athlete	Race Distance Corresponding with Zone
1	60-72	1-6 h	8:00	Ultra
2	72-82	1-3 h	7:33	Marathon
3	82-87	50-90 min	7:14	½ Marathon
4	88-92	30-60 min	6:55	10K
5	93-100	15-30 min	6:00	5k – 1 mile

Note: The pace example is for an athlete with a 42:00 min 10K. This is only an example.

You should determine your heart rate zones using the one of the methods previously discussed. With your zones in hand, and a heart rate monitor, you have all the tools you need to effectively apply an endurance training program for fitness.

What is My VO_2 Max?

VO_2 max is a measure of maximum aerobic fitness. It is a maximum fuel burn rate. In this case the “fuel” is oxygen. VO_2 max is a good measure of cardiorespiratory system function and capacity. VO_2 max is often seen as a measure of endurance performance potential. VO_2 max can be improved with training. The unit of measure is milliliters of oxygen per minute, per kilogram of bodyweight. Because body weight (in kilograms) is in the denominator of this fraction (with milliliters per minute in the numerator), losing weight will improve the VO_2 max value. Losing weight will improve VO_2 max in direct proportion to the amount of weight lost (i.e., 50% weight loss results in doubling of VO_2 max). Training also improves the delivery and extraction of oxygen, which can further improve VO_2 max even without weight loss (typically 10-25% improvement). The average novice runner has quite a bit of room for improvement of VO_2 max. The table below is what I used at the U. S. Naval Academy Human Performance Lab when conducting run VO_2 max testing. It gave us an idea of what to expect prior to the test. After testing hundreds of athletes and non-athletes, the table has proven to be quite accurate. The table predicts VO_2 max based on max effort 1.5 mile run time.

Predicted VO_2 Max Based on 1.5 Mile Run Time

Predicted VO_{2max} ($mL \cdot kg^{-1} \cdot min^{-1}$) for the 1.5 mile Walk/ Run Test (min:s)

TIME	VO2max		VO2max	TIME	VO2max
6:10	80.0	10:30	48.6	14:50	34.0
6:20	79.0	10:40	48	15:00	33.6
6:30	77.9	10:50	47.4	15:10	33.1
6:40	76.7	11:00	46.6	15:20	32.7
6:50	75.5	11:10	45.8	15:30	32.2
7:00	74.0	11:20	45.1	15:40	31.8
7:10	72.6	11:30	44.4	15:50	31.4
7:20	71.3	11:40	43.7	16:00	30.9
7:30	69.9	11:50	43.2	16:10	30.5
7:40	68.3	12:00	42.3	16:20	30.2
7:50	66.8	12:10	41.7	16:30	29.8
8:00	65.2	12:20	41	16:40	29.5
8:10	63.9	12:30	40.4	16:50	29.1
8:20	62.5	12:40	39.8	17:00	28.9
8:30	61.2	12:50	39.2	17:10	28.5
8:40	60.2	13:00	38.6	17:20	28.3
8:50	59.1	13:10	38.1	17:30	28.0
9:00	58.8	13:20	37.8	17:40	27.7
9:10	56.9	13:30	37.2	17:50	27.4
9:20	55.9	13:40	36.8	18:00	27.1
9:30	54.7	13:50	36.3	18:10	26.8
9:40	53.5	14:00	35.9	18:20	26.6
9:50	52.3	14:10	35.5	18:30	26.3
10:00	51.1	14:20	35.1	18:40	26.0
10:10	50.4	14:30	34.7	18:50	25.7
10:20	49.5	14:40	34.3	19:00	25.4

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Using Heart Rate and Pace During the Spring - Summer Transition

I generally spend 3-4 months per year running in zone 1 and 2. For me, that involves keeping my heart rate below 130 beats per minute (BPM). During that training phase I have no particular run goals in mind other than building some leg durability and "keeping in touch" with decent run fitness so that if I decide to do an event, I can train up quickly. I typically do this phase in the winter. This presents a challenge when the weather starts to change in the late spring because the hot weather typically arrives suddenly, providing little time to adapt. It is not uncommon in many locations to go from running in a long sleeved shirt one week to sweating a gallon the next week. During that time of the year, many of us have not heat acclimatized yet. What this typically means for me during that transition is that I simply cannot keep my heart rate below 130 on the second half of the run. I end up closer to 145 at an easy pace. Why? Because heart rate is an output and not an input. Heart rate responds to work rate (pace), which is why it is used as a gauge of exercise intensity. However, heart rate responds to other factors as well. Heat is one of them. In hot weather, the body shunts some blood away from working muscles and to the surface of the skin for cooling. Also, as you sweat, blood volume is reduced, so the heart has to pump more often to pump the same amount of blood. Both of these factors result in an increased heart rate for the same work rate (pace). If you have the ability to track pace and heart rate, you can manage this transition period effectively and ensure that you get quality sessions, despite the changes in heart rate response. This brings up 4 questions:

1. Should I simply maintain a pace that keeps me in my heart rate zone during this time of the year? No. If I did that this morning, I would have had to run too slowly. In that case, my leg muscles would not have received an adequate training stimulus. Aerobic fitness is primarily in the muscles.

2. If I train at an elevated heart rate in this case am I overworking the heart? No. You don't slow down because your heart is tired. Except for cases of clinical heart disease, cardiac fatigue is not the reason you cannot go a faster pace. Fatigue is due to biochemical fatigue in the muscles, not the heart.

3. So, should I train at an elevated heart rate all summer then? No, not exactly. Over time (approximately 2 weeks, with most adaptation happening in the first week) your heart rate will settle back down. This happens due to heat acclimatization. The primary response is that your body increases blood volume. However, if you train in the heat, you will probably have to accept a slightly higher heart rate (approx. 5 BPM).

4. So, how should I manage this until I heat acclimatize?

- The first thing you should do is pay extra attention to hydrating before you start your runs. Then, hydrate during the run. Both of these will help to preserve blood volume and result in keeping your heart rate closer to where it should be.

- Second, if you can monitor pace, as well as heart rate, try to keep your pace close to where it was before the hot weather hit. If you slow down too much in order to maintain your target heart rate range, you will not adequately train the muscles, which are the primary target for training. However, there is a cost to training at the same pace, but a higher heart rate. The higher heart rate is driven primarily by a higher central nervous system (CNS) sympathetic drive. Over time this can result in a bit more CNS fatigue. As a result, you will probably need to dial back pace just a little bit. I would accept a slightly higher heart rate, by about up to 10 BPM higher by the end of the run. More than that would be excessive and might be a sign that you need to be more aggressive with hydration.

- Third, acclimatization is going to happen fast. If you pay attention to hydration, you should be back to within 5-8 BPM of normal within 2 weeks. Because of the heat though, you are probably going to have to adjust your HR zones up by just a bit. 5 BPM is probably about right.

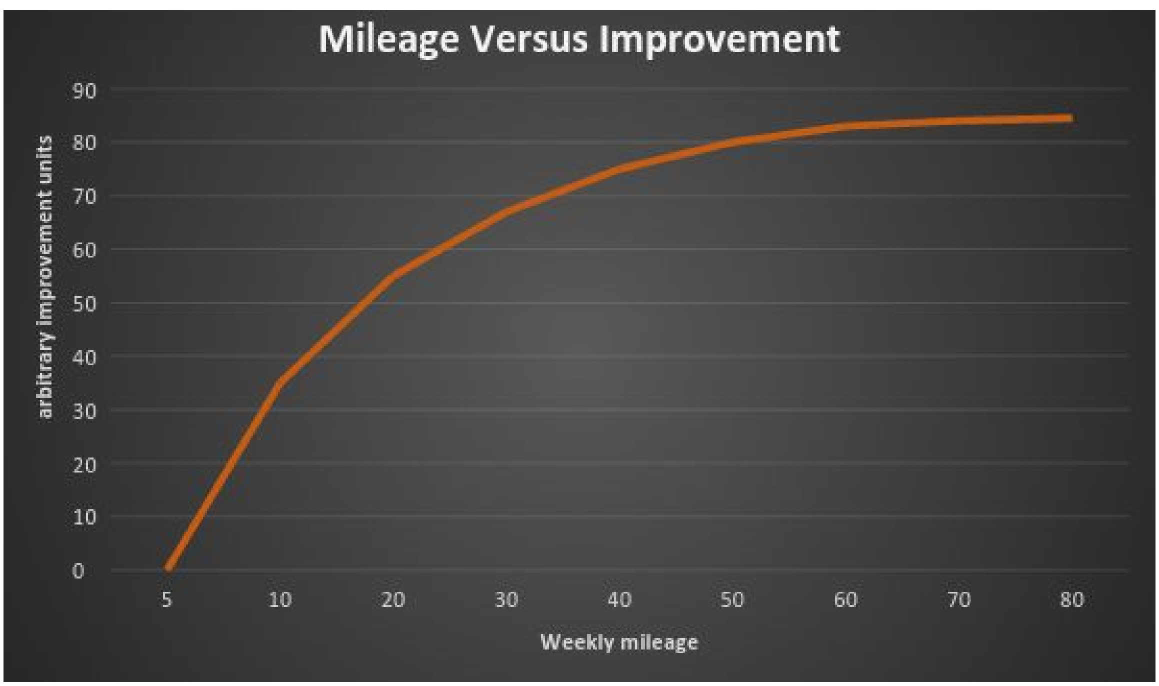
- Fourth, if you are using a software analysis tool like Training Peaks or others to compute training load and training stress balance, the higher heart rate for a given pace is going to lead to inaccuracies. It will overestimate training stress. Training stress is determined primarily by work accumulation. HR is not a great estimate of work rate if it is elevated due to heat stress and lack of heat acclimatization. Remember, HR is an output, not an input.

In summary, keep your pace close to where it was in cooler weather. Dial it back just a little and temporarily accept a higher heart rate. You should see your heart rate come down to within 5 BPM or so of normal in about 2 weeks. This is an indication that you have heat acclimatized. During the summer, adjust your HR zones up by about 5 BPM if training in the heat. Ensure that you have a good hydration strategy to include hydration during a run. Monitor pace and heart rate to ensure that you are getting it right.

Three Tools (Steady, Tempo, VO_2 Max Intervals)

In our simple program we have only 3 tools: steady pace (zone 2) , tempo (zone 4), and VO_2 max pace (zone 5). That is all we need. There is no need for more complexity. Our 3 tools, along with the principle of progressive overload are the keys to a simple, effective program. Let’s discuss the 3 tools.

1. Steady paced running (zone 2): This is a steady pace effort. It is not hard and it is not easy. It is the natural pace you would fall into if you went out for a medium distance comfortable run. If you were running with a partner who was slower than you and you had to constantly hold yourself back you would be running at an easy pace. Zone 2 (steady pace) is one gear higher. Steady is comfortable but you would not describe it as easy. For those who train with a heart rate monitor, steady would be approximately 72-82% of your maximum heart rate (zone 2). Fitness improvement is due to progressive overload. We achieve progressive overload during steady runs by increasing volume, ***not intensity***. Increasing volume means running more mileage (or time) at a steady pace. You will find that your run pace improves over time during steady runs. You don’t run harder over time, you run faster at the ***same effort level***. You can do this by keeping your heart rate in your target “steady” zone (zone 2). As you become fit, you will have to run faster to achieve the same heart rate. If you don’t have a heart rate monitor, you will have to pace based on effort. Take a look at the ***Rating of Perceived Exertion Table*** that follows this paragraph. Keep the effort “steady” and eventually your “steady” pace will get faster and faster. Remember; do not increase the effort of steady runs, only the volume (mileage). Remember the rule of thumb; do not increase mileage more than 10% per week. However, absolute beginners will have to violate this rule when they start because their starting mileage is so low. Once you can manage 12-15 miles per week, stick to the 10% rule. The key to this tool is "steady" effort and increasing mileage over time. There is quite a bit of fitness to be gained over time from steady paced running. The type of fitness you get from steady paced running does not seem to plateau, even after years of training. This is an important point. The longer we train using zone 2 effort, the more we will improve. More mileage per week is almost always better (if you can tolerate it). There is a point of diminishing returns however. Take note of the ***Notional Improvement with Weekly Running Mileage*** graph. Note that any mileage increase when your weekly run mileage is low pays big dividends. Increases up to about 30 miles per week result in significant improvements. Beyond that value, bang for the buck starts to taper a bit. For most athletes, 50-60 miles per week seems to be the point where further increases in mileage start to show greatly diminishing returns. In this case, there is still improvement associated with running more mileage, but the improvement is relatively small. These small improvements are worth it to elite athletes, where seconds can mean the difference between 1st and 10th place, but for the recreational athlete, it is less important. For a recreational athlete, there is little benefit in running more than 50-60 miles per week. Also keep in mind that excessive run mileage will negatively impact your maximum strength and ability to build muscle. Low to moderate mileage should have minimal/no impact however.



Rating of Perceived Exertion

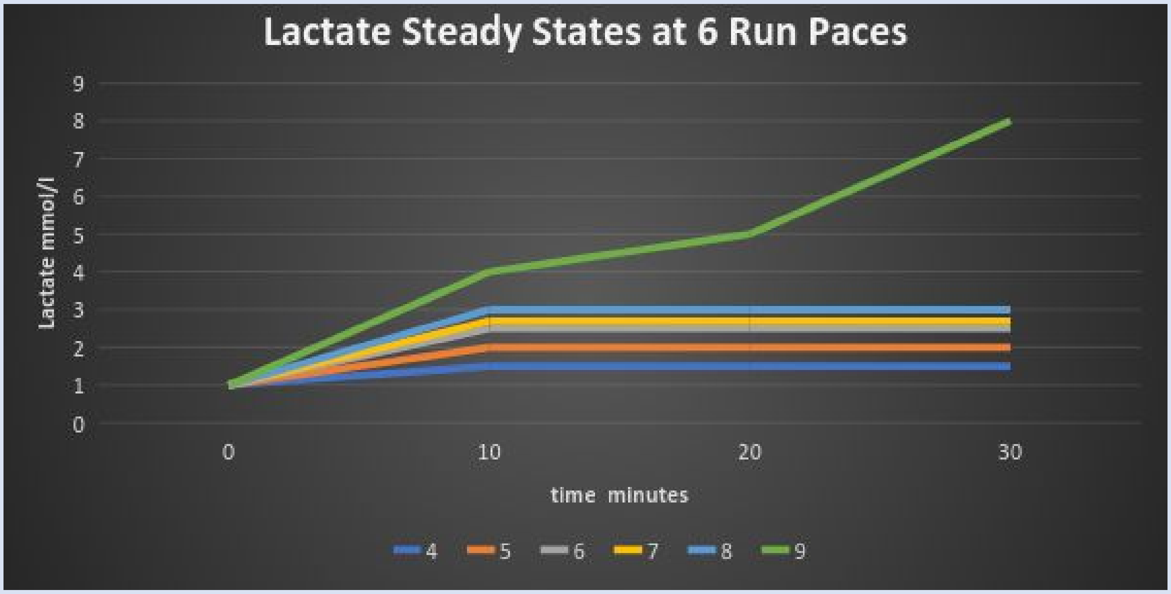
Zone	% Max Heart Rate	Perceived Effort Level

1	60-72	Easy. I feel like I should be running harder.
2	72-82	Steady. Not easy, but definitely not hard. I could go harder but this pace feels good.
3	82-87	Somewhat hard. I could go harder for sure but this pace takes concentration to hold.
4	88-92	Hard. This is a hard effort pace. It is not my max pace but I am really working.
5	93-100	Very Hard. This hurts. I am going to have to dig deep to hold this for more than a few minutes.

Going Long: why it is ok to break up your long run

When we start to run it takes time for your heart rate, respiration, and metabolism to gear up. If you use a heart rate monitor you see this every time you tra90in. The same thing happens when you shift gears while training. If you are doing a tempo session, for example 5 minutes easy - 10 minutes tempo, it will take 1-2 minutes for your heart rate to settle at the new intensity when you make the shift from "easy" to "tempo". This is called reaching steady state at the new intensity. It turns out that at some run intensities you can reach a steady state, where lactate no longer increases and heart rate remains relatively stable (although a small amount of heart rate drift occurs). Let's take a look at a concept called maximal lactate steady state (MLSS) to explain this concept in more detail.

The graph shows notional data during a typical maximal lactate steady state test. This is representative of the kind of data I have seen in the lab dozens of times. A typical test would consist of several stages. Each stage lasts 30 minutes and we do only one stage per testing session. We have the athlete run at a steady pace and measure blood lactate levels every 3 minutes. We start at 4 miles per hour, and increase by 1 mile per hour each session. We might get a graph like the one above. What you can see from this graph is that at each speed the subject reaches a steady state, although at higher and higher lactate levels, until 9 miles per hour. At 9 miles per hour, the subject cannot maintain a steady state and lactate continues to climb, despite the speed staying the same throughout the test. However, at 8 miles per hour, the subject reached a steady state, with lactate stabilizing around 3 mmol/l, even after 30 minutes of running. In this case, the subjects maximal lactate steady state (MLSS) occurred at 8 miles per hour. For most people, MLSS pace is sustainable anywhere from 30 minutes to one hour. If you look at a person's physiology (heart rate, lactate, respiration etc..) at 5 minutes, 10 minutes, or 25 minutes into a run at MLSS, there is very little difference. Think about what this means in terms of splitting a run that is slower than MLSS. It takes 3-4 minutes to hit steady state. So 5 minutes into a run or 40 minutes into a run, physiology is going to look very similar. So what is the difference between 2 X 10 minutes at MLSS or simply 20 minutes straight at MLSS pace? Not much. Because physiologically, most of it is spent at steady state in both cases.



MLSS is a zone 4 effort. Long runs are typically run at a zone 2 effort (refer to the training zones chart shown earlier). Zone 2 is well below MLSS. So the entire run is going to be run in a relatively steady state. For our run subject in the chart above, this might be at 5-6 miles per hour. Heart rate would increase very little during the run and lactate would be steady at approximately 2 mmol/l. Your physiology is not going to be much different 5 minutes into a zone 2 effort run vs 1 hour into the run. So, what is the difference between doing a 2 hour run vs 1 hour run in the morning and 1 hour run in the evening of you are running in zone 2? Again, not much.

This also explains why during Base of a periodized run program that it does not matter much how you structure your runs. 3 runs of 10 miles have about the same fitness impact of 5 runs of 6 miles when all of your running is zone 2.

More and more ultra-runners and marathoners are splitting their long runs and are finding that they recover better and fitness is not negatively impacted. For example, rather than doing a 30 mile run on Saturday, an ultra-runner might do 10 on Saturday and 20 on Sunday. Or 10 on Saturday, 10 on Sunday morning and 10 on Sunday evening. In each case, the runner accumulated 30 miles of running on the weekend. The fitness building impact of those 3 different options is very similar.

Before we completely throw out long runs, it is important to state that long runs do have their place. They are important for mental toughness training, for trying out race strategies, and to build confidence and check pacing strategies. However, because of what we discussed so far, you don't need many of them.

2. Tempo paced running (zone 4): This is 10K race pace (zone 4). This is definitely harder than steady pace but not your max pace. It is also sometimes described as threshold pace. It is about at 88-92% of your max heart rate (zone 4). Because we are using a fixed effort level, we achieve progressive overload by increasing the amount of tempo. You might start with 10 minutes of tempo (i.e., 2 X 5 min) and eventually build up to 30 minutes of tempo (i.e., 3 X 10 min). You can either use heart rate to pace your tempo intervals, or you can periodically race a 10K and use the pace that you achieved during your race. Warm up a bit before your first tempo interval and give yourself at least a few minutes of easy or steady pace between tempo intervals. Also, cool down with easy or steady pace after your tempo intervals. Ten minutes is enough tempo work to be effective but would be considered a light tempo dose. Forty minutes is a heavy tempo dose for a single session. Tempo training is a powerful tool. Like steady training, we gradually increase the amount of time we spend at tempo pace, and we eventually run faster tempo pace at the ***same effort level***. Your tempo pace will get faster over time as you get more fit. Again, if we use heart rate as a guide, we can keep the same effort level as we go faster. We generally do not exceed two tempo training sessions per week. Tempo training fitness tends to plateau after 2-3 months.

Treadmill Vs Outdoor Running

Running on a treadmill costs less energy than running outdoors if the treadmill is level. However, you can make your treadmill workout equivalent to an outdoor workout by adjusting the incline of the treadmill. According to study in the Journal of Sports Science, a 1% grade is what you should use. The term % grade is a mathematical term that means rise over run. Most treadmills report incline in % grade. Be aware that your treadmill has to be leveled appropriately for this to work. You can check your treadmill's level with a carpenter's level. If you really want to be accurate, you can rig a protractor and a carpenter's level to measure rise and run and compare that to your treadmill's display. Also, you should check the accuracy of your treadmill's speed indicator. Put a chalk mark on the treadmill and count revolutions. With revolutions, and knowledge of the belt length, you can calculate treadmill speed.

The study used 9 male distance runners with an average VO_2 max of 65 ml/kg/min. They were pretty fit. They ran for 6 minutes at each velocity and at % grades of 0, 1, 2 and 3%. Then they ran outdoors while expired air was collected in a Douglas bag. You have to appreciate the lengths to which researchers will go to gather data. The researcher had to bicycle along with the runner and hold the large weather balloon type bag, while keeping the runner on target speed. I hope he was wearing a helmet. Science is not always easy! They measured oxygen consumption and heart rate in all conditions. Outdoor running was only tested during calm wind conditions. The heart rate data for outdoor running and 1% grade treadmill are below. Note how similar they are.

<u>Heart Rate: 1% Treadmill VS Outdoors</u>

MPH	1%	Outdoors
6.5	119	119
7.4	128	128
8.4	140	140
9.3	153	153
10.2	164	165

Jones AM and Doust JH, A 1% treadmill grade most accurately reflects the energetic cost of outdoor running, J Sports Sci, Aug: 14(4): 321:327, 1996.

3. VO_2 max Intervals (zone 5): Most people call these track intervals or just intervals. They are usually done on the track. Heart rate is a poor way to pace these intervals because they are too short. It takes your heart rate 2-3 minutes to reach steady state at a new run pace. As a result, you will be done with your interval before your heart rate catches up. That is why it is best to do these on the track or on a course with marked distances and use pace to deliver the right intensity. The most common interval distances are ¼ and ½ mile repeats. These are done at your 1 mile race pace. This is zone 5 training. They are not max effort but they are tough! VO_2 max intervals are typically done with a 1/1 work to rest ratio. This means that if your run interval takes 2 minutes, you rest 2 minutes. What should you do during your rest interval? You should rest! Seriously, you can jog slowly or walk or whatever it takes for you to recover. If you have lots of experience with heart rate based training, you can use heart rate recovery as a guide to the rest interval. For example, when I am running ¼ mile intervals, I wait until my heart rate drops to just below 100 BPM to start my next interval. As I become more fit, the rest interval gets shorter. This is one method to "autoregulate" your rest interval. The point is to recover. Unless you are an elite athlete, you don't need more than 8-10 ¼ mile intervals. Six would be fine for most people. For ½ mile intervals, aim for half of that. Half mile or 800 meter/yard intervals are the most popular choice because they work. Run these hard and push the pace. However, the ideal session would have your pace on your first and last intervals the same. If you are fading in your last intervals, you are going too hard. Always leave a little gas in the tank and finish feeling like you could have done another one or two. VO_2 max intervals are potent medicine. You don't need many. The type of fitness produced by these tough intervals happens quickly, but plateaus quickly (4-6 weeks).

Three Phases (Base, Build, Peaking)

Along with our 3 tools, we have 3 phases. Each phase has a slightly different focus and includes the use one, two, or all 3 of the tools. This simple 3 phase layout mirrors the type of classic periodization used by all effective endurance training programs. Each phase has a different timeframe, based on the rate of adaptation that occurs for each of the 3 training tools.

1. Base Building Phase (as long as you can): The Base Building Phase (Base) involves all steady running (zone 2) with no intensity or intervals at all. The goal of Base is to build up mileage. Simply keep your heart rate in zone 2 and gradually build mileage over time using the 10% rule. That is all there is to Base. Remember, fitness happens through progressive overload and overload in Base is volume overload (not intensity!). Why no hard running during Base? Any hard running has too much of a recovery cost and prevents you from adding mileage. Total mileage for the week is more important than how you arrange the mileage in Base, and short runs count. It is less stressful on the body to spread your run mileage over more runs than fewer runs. For example, 3 runs of 10 miles is harder to recover from than 10 runs of 3 miles. Both would provide a similar volume training stimulus however. Even if you are training for a longer race (i.e., marathon), there is little need to exceed ¾ of race distance in your longest run. Ideally, your longest run should not exceed 25% of your total run mileage. Some people find that splitting the long run into a morning and evening session allows them to still get in a lot of mileage that day without violating the 25% guideline. Most people find that this phase is easier on the body with frequent running. It is much easier to recover from six 5 mile runs than three 10 mile runs, even though the total mileage is the same. Remember the 10% rule for increasing volume but early in your program, when you are running low volume, you may need to exceed 10% in order to progress at a reasonable rate. Steady paced training effects do not plateau, even after years of training, so there is definite benefit in staying in Base as long as you can. Bottom line, add mileage, keep it steady, no hard stuff, try to spread out the mileage over more frequent runs, rather than just a few runs. We'll discuss when to start and finish each phase below. For now, we can say that the longer your Base, the better. Some people stay in Base for years.

Sample Base (sample 4 day/week run plan)

	Base Early				Base Late			
Day	**Mon**	**Tue**	**Thur**	**Fri**	**Mon**	**Tue**	**Thur**	**Fri**
Zone	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1	Zone 1
Miles	3	3	3	3	6	6	6	6

Note: This is just a sample with notional data to illustrate the concept.

Adding Strides to Your Program

I have done lots of run gait observations during treadmill VO_2 max testing. What I found interesting is that run gait (run form) always improves at faster speeds. It is hard to run with loose, poor posture when you are running fast. This simple observation is why so many run coaches recommend strides. Strides are prescribed for run gait training, not for fitness improvement, so the goal is to stay fresh, not to destroy yourself. Strides are sprints done at 75-90% max speed with PLENTY of rest in between. The rest allows you to recover significantly between sprints so that the overall metabolic impact of the sprints is reduced. The rest interval should be long enough to get your heart rate down significantly and to feel recovered. The reason that we do this is to stay fresh so that run form does not degrade, and in order to be able to accumulate a reasonable volume of fast paced running without overtraining or risking injury. Strides also provide high force, run relevant muscle loading. The best time to do strides is after a walk or a run when you are warmed up. Begin with just a few and go easier than you think. Start each stride slowly and build up to the sprint pace. 25-30 yards is plenty to start with. Strides should be done no more that 1-2 times per week. A few sample workouts are below:

Beginner
3 X 25 yards with 1 minute rest between sprints
Intermediate
5 X 30 yards with 1 minute rest between sprints
Advanced
10 X 40 yards with 1-2 minutes rest between sprints

Strides can be inserted into any phase of a running program but they are best done in the Base phase when you are otherwise doing no fast running. Remember to recover well between strides. This is not about conditioning but rather is about running with strong, stable form. It is best to do the strides at the end of a normal run when you are warm.

2. Build (2-3 months): Build is mostly steady (zone 2) running, with some tempo added in (zone 4). In the first half of Build start with substituting one of your steady runs with a tempo run. In the second half of Build, we generally substitute an additional steady run for a second tempo run (two tempo runs per week). Progressive overload in this phase involves increasing the amount of tempo pace run each week. For example, you might start with 20 minutes of tempo (i.e., one tempo run of 2 X 10 minutes) and progress to 40 minutes of tempo per week (i.e., 2 runs or 2 X 10 minutes at tempo each). You should generally start with 1 tempo session per week and progress to 2 sessions if you training structure allows it. No more than 2 sessions per week are necessary. The rest of your running will be steady paced runs. After the first 2 weeks of Build, you might continue to increase your steady paced mileage as well, because your total mileage probably dropped as you substituted shorter tempo runs, for longer steady paced runs. Be cautious and conservative with the increase though. As you progress, you may need to re-test your 10K race pace to readjust your tempo pace. Alternatively, you can use your heart rate monitor and just stay in the 88-92% max heart rate zone. Because your heart rate will decrease with increasing fitness, staying in your heart rate zone is a way to progressively run faster as you become more fit. Tempo run training effects tend to plateau after 2-3 months. Therefore, we generally plan on a 2-3 month Build. For this reason, we generally start Build about 2-4 months prior to our race. So, substitute a steady run with a tempo run, gradually increase the amount of tempo, then eventually substitute a second steady run with an additional tempo run later in Build (2 tempo runs, plus some steady running).

Sample Build (sample 4 day/week run plan)

Build Early					Build Late				
Day	**Mon**	**Tue**	**Thur**	**Fri**	Day	**Mon**	**Tue**	**Thur**	**Fri**

Zone	Zone 1	Zone 4	Zone 1	Zone 1	Zone	Zone 1	Zone 4	Zone 1	Zone 4
Miles or Minutes	6	:20 min	6	6	Miles or Minutes	7	:20 min	7	:30 min

3. Peaking (4-6 weeks): In Peaking, we substitute a steady run with a VO_2 max interval run (zone 5). We are also still doing tempo (two) and steady, so Peaking includes all 3 tools (steady, tempo, VO_2 max). We only do ***one*** VO_2 max session per week. It is plenty. VO_2 max intervals are potent medicine, so just enough is all we want. If you are running 3 times per week in Peaking you would have 1 VO_2 max session, 1 tempo session, and 1 steady session. If you are running 4 days per week, you might have 2 tempo sessions one steady session and one VO_2 max interval session. You will find that this simple program is easier to manage and structure properly with at least 4 runs per week. Five or six would be better and would allow more steady paced running (zone 2). Your total run mileage will probably decrease in Peaking because you are replacing a steady run with a much shorter VO_2 max interval run. That is OK. In this case we are achieving progressive overload by adding intensity, so we can decrease volume a bit. Elite athletes will decrease volume less than novices in this case. The type of fitness we get from VO_2 max intervals tends to plateau quickly. Therefore, we put them last, right before our event. We generally start VO_2 intervals 5-6 weeks prior to the race.

Sample Peaking Plan (sample 4 day/week run plan)

Day	**Mon**	**Tue**	**Thur**	**Fri**
Zone	**Zone 4**	**Zone 4**	**Zone 2**	**Zone 5**
Minutes or Miles	**:20**	**:30**	**10**	**8 X 1/4 mile**

This is not a polarized training plan (as opposed to the recommendations for elites). Novice and sub-elite runners typically do not run enough volume to benefit optimally from a polarized plan. There will be differences depending on race distance and training experience. If we put all three phases together in a notional 8-month program for a 10K race, we get the example below.

<u>Example</u>: 8 Month Periodized Cycle for 10K

2 months				**2 months**				**1 month**				**6 weeks**				**6 weeks**				**1 week**	
Base Early				**Base Late**				**Build Early**				**Build Late**				**Peaking**				**Taper**	**Race**
S	S	S	S	S	S	S	S	T	S	S	S	S	T	S	T	T	S	T	V		
3	3	3	3	6	6	6	6	6	6	7	:20	7	:30	:20	7	:20	10	:30	8 x ¼ Mile		

S=steady, T=tempo, V=VO_2 max, R=Race. :20 = 20 minutes of tempo (i.e., 2 X 10 min), number = miles. The numbers in the cells represent miles or minutes. This example is a 4 day per week run program.

In this example, we simply backed up 5 weeks from our taper week and started Peaking. Peaking is five weeks long because we will plateau quickly with VO_2 max intervals. Then we planned approximately 2 months of Build. We can generally push tempo paced improvements for a couple of months. Beyond that, we start to plateau. Any remaining time we have is Base. Ideally, we want as much of Base as we can get. If this were a 6 month plan, we would probably chop off a couple of months of Base. So, our structure is pretty simple. Plan for 5-6 weeks of Peaking, about 2 months of Build, and as much Base as you can. Increase mileage in Base. Increase time spent at tempo pace in Peaking (and perhaps continue to increase steady mileage as well), then add VO_2 intervals in Peaking. Then taper and race. Note that this plan is set up to peak for a specific race. If you had multiple races, you could simply set up the plan to peak for your most important race and use the races leading up to that goal race as tempo (zone 4) training efforts (even though you will race them for maximum performance). It is common to race less important races in Base and Build. You may need to lighten up your mileage around those race weeks if you do this, then get right back to your plan. An occasional race during Base or Build will not compromise the program.

Novice Runners and the Minimum Effective Dose

When doctors prescribe medication to cure a disease they strive to prescribe the minimum effective dose. The minimum effective dose is the minimum dose that successfully treats the disease. The reason that they do this is because all medications have side effects. Prescribing more than the minimum effective dose does not provide more “cure,” but it does result in more side effects. Exercise is similar. Exercise is a physiological stressor that induces compensation (fitness). More stress than is necessary does not increase fitness. In other words, the body accumulates fitness (compensation rate) at a maximum rate when the optimal dose of exercise is provided (the minimal effective dose). More exercise at that point will not result in more fitness or a faster rate of improvement, but will result in “side effects,” most often injury or illness.

The military has studied this phenomenon extensively. With novice runners (recruits) there is a minimum effective dose, beyond which injury rates start to increase significantly. The table below is data from the US Army on run fitness and injuries over a 12 week period for two groups of recruits. The group that ran less (74 mile reduction or more than a 50% reduction in mileage) actually ran faster (more fitness) and had a lower injury rate. Certainly, in this population, exceeding 56 miles over a 12 week period did not increase fitness but did increase the injury rate. Recruits who ran 130 miles exceeded the minimum effective dose. Sometimes more is not better.

Table 6. Mileage, Injury Incidence, and Average Final 2-Mile Run Times Among Two Groups of Male and Female U.S. Army Recruits

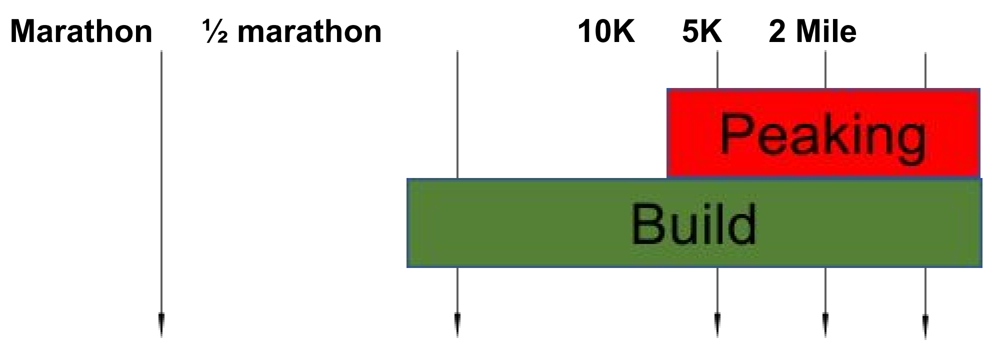
Running Mileage	Injury Incidence	Final 2-Mile Run Time (min:sec)
(High) 130 miles	54%	13:45
(Low) 56 miles	41%	13:28
74 mile reduction	24% reduction	Not a statistically significant change

Distance Considerations

The longer the race distance, the less important is Peaking. At some point, Build becomes less important as well. The figure "**Training Tools by Distance Raced**" illustrates a notional distribution of each training phase by race distance. For example, a novice who is training for a marathon may not need any Build or Peaking at all. Certainly for ultra-distance races (i.e., 30K and above), Build and Peaking would not be appropriate for a novice athlete. People in this category would simply stay in Base until taper, using progressive overload to increase fitness by increasing mileage. For most people, Peaking is not important for half marathon training. These individuals would progress from Base to Build, then taper and race. Once we get to shorter distances like 10K and 5K, a normal Base, Build and Peaking progression becomes more appropriate.

Most selection or periodic physical fitness testing for tactical athletes involves running distances of 1.5 to 3 miles. For distances in this range, all 3 tools and phases would be important. If we consider the principle of specificity we can conclude that for a 1.5 mile test, Peaking would be most important and if time is short, a full Peaking should be considered, even at the expense of other phases. For a 3 mile race, Build is most important although 3 miles is short enough to be on the border of Build and Peaking specificity. Ideally, a full Base, Build and Peaking would be performed for any of these tests. Though Build and Peaking are more specific, improvements in Build and Peaking are much greater if preceded by a significant Base. Injury risk is also greatly reduced, which may be an even more important consideration. Easy paced Base training lowers the injury potential of the harder paced training in Build and Peaking.

Training Phases by Distance Raced

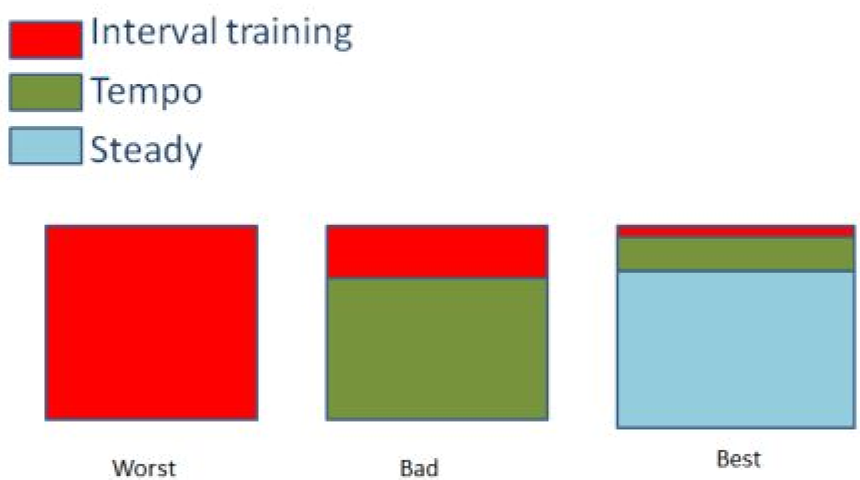


Base

- **Novice marathon**: stay in Base, increasing mileage by approximately 10% per week. No Build or Peaking is necessary. Spread the runs over several sessions. In the section on Base we stated that your long run (ideally) should not exceed 25% of your weekly mileage. If you do the math, you'll see that if your long run is 20 miles (approximately 3/4 of race distance as recommended) that would put you at an 80 mile run week! While this is perfectly normal and not excessive for advanced marathoners, a novice is not going to be able to manage an 80 mile run week. The reality is that a novice cannot ***properly*** train to ***race*** a marathon, because a marathon is an advanced event! Yes, novices can train to race or to complete a marathon, they just don't have the durability to train ***properly*** to ***race*** the marathon yet. Although it would not be considered ideal training, if a novice structures their training so that the long run does not exceed 50% of their weekly run mileage that should allow them to get through the marathon in one piece. Obviously any event longer than a marathon would require only Base training as well. Expert marathoners might want to include a build period as well. In this case, expert is an experienced runner, but not quite elite/advanced. Expert refers to the level of experience, not performance. This approach involves a lengthy Base, but transition to Build prior to race taper. No Peaking is necessary. An abbreviated Build is appropriate (approximately 4 weeks). No need for Peaking. In the **Training Tools by Distance Raced** graph, this would correspond to what is depicted for ½ marathon training (novice).
- **½ marathon:** lengthy Base, transition to Build prior to race taper. No Peaking is necessary. A full Build is appropriate (approximately 2 months).
- **10K – 5K:** Normal Base, Build, and Peaking. In this case Build (especially for the 10K) and Peaking (especially for the 5K) are the most important phases. If you only have a short time to train, make sure you get a full dose of the appropriate phase prior to the race. Ideally you should do a full Base, Build and Peaking.
- **2 – 1 mile:** In this case the most important phase is Peaking. If time permits, a full Base, and Build should precede Peaking. If not, Peaking is still the critical phase for performance at these short, fast distances. If you had only 6 weeks to prepare for an event of this distance, you would start in the Peaking phase.

There is one last consideration to talk about. The assumption made above is that you are planning for a race on a specific date or perhaps for a run based fitness test or for selection training. If that is the case, then a classic periodized model like we lay out above is ideal. What if you had no planned race or test date but wanted to deliver pretty good performance on any given day? If that is the case, you are best served by staying in Peaking. If all you did was tempo and VO_2 max workouts only, you would plateau after 2-3 months and see no further improvement. Maintaining some steady training, in this case, would be a better option (see the "Any Given Day" figure below). This is the world of the typical tactical athlete (i.e., police, military) who is not training for a specific race but instead needs top performance on any given day. This is the optimal approach for day to day endurance training for these athletes. "*All hard all the time*" falls short for longer endurance challenges (i.e., long ruck march). Staying in Peaking delivers a balanced approach that preserves endurance, speed, and threshold pace. Most tactical athletes should be training in Peaking day in and day out. This applies to rucking, running, and swimming.

Training Tool Distribution for Good Performance on "Any Given Day"



It can be very beneficial to insert periods of Base training for recovery if you are following a Peaking "Any Given Day" approach. Two weeks, inserted every couple of months would be ideal.

So there you have it. Three tools and 3 phases are all you need. Remember to apply progressive overload to each phase and plan an appropriate taper. Training frequency can vary from phase to phase. Training more frequently does make the load more manageable, as discussed, and makes planning the phases easier, but this plan can be worked with frequency as low as 3 X week (but it is not optimal). Just keep the big picture in mind. Remember progressive overload and the goal of each phase and you will be fine. What about hill repeats, strides, extensive versus intensive tempo, zone 5a and 5c training, recovery pace runs? To be honest, if you try to complicate things more than the 3 tools/3 phases, you are more likely to mess things up than you are to improve on this simple approach. Yes, there are much more complex plans than this but more complexity is not necessary. If you really need that level of complexity, you are elite and somebody is paying for a coach to guide your workouts, so you should not be reading this anyway!

Selecting Running Shoes based on Foot Shape

The Marine Corps took a look at more than 720 recruits to determine if prescribing shoes based on foot shape would decrease the incidence of running injuries. They classified the feet as either high arched, normal arched, or low arched. Low arched got a motion control shoe. High arch received a cushioned shoe. Normal arched recruits received a stability shoe. These are the most common prescriptions used by running shoe stores who prescribe shoe types based on foot shape. they followed the recruits throughout recruit training and assessed instances of running injuries in each group, compared to one another and compared to a control group. Their conclusion was, “This prospective study demonstrated that assigning shoes based on the shape of the plantar foot surface had little influence on injuries even after considering other risk factors.” This is common practice in many running shoe retailers and it does not appear to be effective even when executed by well-trained experts.

Knapik, JJ, Trone DW, Swedler DI, Vilasenor A, Bullock SH, Schmied E, Bockelman T, Han P, and Jones BH, Injury reduction effectiveness of assigning running shoes based on plantar shape in Marine Corps Basic Training, Am J Sports Med, 2010, Sep, 38(9):1759-1767.

Sample Programs

These are notional programs. The mileage recommendations are reasonable but in reality appropriate miles will vary depending on experience and tolerance to injury. The total timeframe allows for optimal training. If you have less time, you can compress some of the phases. In this case, try to keep intact the phase that is most specific to your race distance (i.e., Build for 10K, Peaking for 5K). These samples are provided to provide examples of how we can use the 3 Tools / 3 Phases approach to programming for specific events.

<u>Example</u>: 6 Month Periodized Cycle for Marathon

1 months				2.5 months				2 months				2 weeks	
Base Early				Base Middle				Base Late				Taper	Rac e
S	S	S	S	S	S	S	S	S	S	S	S		
3	3	3	3	6	6	6	8	7	7	7	1 5		

S=steady. The numbers in the cells represent miles or minutes. This example is a 4 day per week run program.

<u>Example</u>: 6 Month Periodized Cycle for ½ Marathon

1 months				2 months				6 weeks				6 weeks				1 week	
Base Early				Base Late				Build Early				Build Late				Taper	Race
S	S	S	S	S	S	S	S	T	S	S	S	S	T	S	T		
3	3	3	3	6	6	6	8	6	6	9	:20	7	:30	:20	10		

S=steady, T=tempo. :20 = 20 minutes of tempo (i.e., 2 X 10 min), number = miles. This example is a 4 day per week run program

<u>Example</u>: 5 Month Periodized Cycle for 10K

1 month				1 month				1 month				1 month				3 weeks				1 week	
Base Early				Base Late				Build Early				Build Late				Peaking				Taper	Race
S	S	S	S	S	S	S	S	T	S	S	S	S	T	S	T	T	S	T	V		
3	3	3	3	6	6	6	6	6	6	7	:20	7	:30	:20	7	:20	10	:30	8 x ¼ Mile		

S=steady, T=tempo, V=VO_2 max, R=Race. :20 = 20 minutes of tempo (i.e., 2 X 10 min), number = miles. This example is a 4 day per week run program

<u>Example</u>: 4 Month Periodized Cycle for 5K

3 weeks				3 weeks				3 weeks				3 weeks				3 weeks				1 week	
Base Early				Base Late				Build Early				Build Late				Peaking				Taper	Race
S	S	S	S	S	S	S	S	T	S	S	S	S	T	S	T	T	S	T	V		
3	3	3	3	5	5	5	5	6	6	6	:20	6	:30	:20	6	:20	6	:30	8 x ¼ Mile		

S=steady, T=tempo, V=VO_2 max, R=Race. :20 = 20 minutes of tempo (i.e., 2 X 10 min), number = miles. This example is a 4 day per week run program

About the Author

Mike Prevost earned a PhD in exercise physiology from Louisiana State University in 1995. He specialized in muscle physiology and metabolism. Throughout his college years (10 years total) he worked as a personal trainer and coach in various gyms and fitness centers. He has trained athletes for many different sports including triathlon, ultra-running, surfing, powerlifting, bodybuilding, mixed martial arts, football, basketball and more. After finishing his PhD, he received a commission in the U. S. Navy as an Aerospace Physiologist in the Navy Medical Service Corps. While serving in the Navy he developed human performance training material for the U. S. Special Operations Command. He developed new fitness standards for Navy rescue swimmers. He served as a consultant to the USMC in evaluating the safety of the USMC Combat Fitness Test. He also served on a Navy committee tasked with proposing alternatives to the Navy physical fitness test. He trained thousands of aviators and aircrew on survival techniques, physiology, and human performance. He also served as the Director of the Human Performance Laboratory at the U. S. Naval Academy, where he performed physiological testing of athletes to improve performance, developed the Principles of Strength and Conditioning Course for all Midshipmen, and served as the director of remedial fitness training programs. He taught Exercise Physiology, & Strength and Conditioning and Anatomy and Physiology Labs at Loyola Marymount University in Los Angeles. He has over 25 years of experience in working with athletes.