

OX FX by Laura Sachs

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Heart Rate Training

Exercise results can be improved with proper use of a heart rate monitor.

Our heart's physiological response to changes in exercise intensity during physical activity can be both monitored and measured to better manage a cardiovascular training (CVT) experience. A heart rate monitor is an accurate tool for measuring these changes. According to cardiovascular expert Sally Edwards of Sacramento, California, author of *The Heart Rate Monitor Guidebook to Heart Zone Training* (Heart Zones Publishing 2010), "You only need two pieces of gear to work out: a good pair of athletic shoes and a heart rate monitor."

Why is it important that clients use a heart rate monitor? And more important, how do you guide them in its use?

Heart Rate Monitor Benefits

If an athlete wants to train rather than just to work out, using a heart rate monitor to zone in on the right intensity can help track the workout in an intelligent way. Quantifying an activity makes it possible to plan a course of action based on the outcome measurements *and* the monitoring of that activity. Clients can use a heart rate monitor to gain an accurate picture of workout intensity, putting absolute numbers such as 160 beats per minute (bpm) into relative numbers or percentages of maximum or threshold.

For example, if the number for a client's low threshold (the first metabolic shift from increased intensity) is 140 bpm and the maximum heart rate (HRmax) from a field test measurement is 160 bpm, then the relative number (or percentage) is about 88% of HRmax (also referred to as Zone 3: Aerobic Zone). "Low threshold," or "first threshold," is referred to as T_1 (Foster & Procari 2010).

Edwards has identified five heart rate zones, providing a simple way to set training zones based on participants' specific response to exercise intensity.

For decades, fitness enthusiasts have used the 220-minus-age formula (age-adjusted maximum heart rate formula) to mathematically calculate HRmax and thereby derive cardiovascular training zones. According to Carl Foster, PhD, FACS, professor of exercise and sports science at the University of Wisconsin, La Crosse, and past president of the American College of Sports Medicine, "The formula's 220-minus-age is useless. There is no scientific validation for it." To replace this generalized formula, Edwards has developed a half-dozen user-friendly field tests to determine both maximum and threshold heart rates that result in personalized zones for each individual. "The only way to safely and accurately es-

timate maximum heart rate," she says, "is to take a submax field test. We can no longer rely on equations that were fabricated and invalid."

The Five Cardiovascular Training Zones

- **Zone 1: Healthy Heart.** At 50%–60% of HRmax, this zone is low-intensity training and provides primarily metabolic and emotional health benefits. Training in this zone can lower cholesterol, reduce emotional stress and improve blood pressure.
- **Zone 2: Temperate.** At 60%–70% of HRmax, this zone is low to moderate exercise intensity and burns more calories from fat and more total calories than does Zone 1. People training in this zone may start to sweat, yet they are able to carry on a conversation without any difficulty. Sometimes, Zone 2 is also known as the "recovery zone."
- **Zone 3: Aerobic.** At 70%–80% of HRmax, this is the zone that drives endurance capacity—the ability to sustain exercise over a long period of time without fatigue. The aerobic zone provides improvements in fitness level by increasing mitochondrial density and enhancing fat utilization, resulting in more total calories expended per exercise minute.

This zone is more challenging. For a trained exerciser, this zone is considered "somewhat hard," with a rating of perceived exertion (RPE) of 5–6.

- **Zone 4: Threshold.** At 80%–90% of HRmax, this zone was once thought to be only for athletes and competitors. However, it is for anyone who wants to get fitter and faster. It is named the Threshold Zone because it is for more fit individuals or those whose fitness goals are to improve speed for performance. The reason to spend time in Zone 4 is to create training changes that lead to improved aerobic capacity. When the muscles' ability to tolerate lactic-acid concentrations increases, endurance can improve.
- **Zone 5: Red Line.** At 90%–100% of HRmax, this zone requires a near all-out effort and can be sustained for only short periods of time. For competitive athletes, low Zone 5 heart rate numbers can be sustained for 20–35 minutes (5K race). For less fit individuals who enjoy hard training, Zone 5 places a very high metabolic stress load on the body and can be sustained for 2–5 minutes.

Physiological Biomarkers

A biomarker is a measurable physiological change in response to exercise intensity. One important application of biomarkers is to set training zones. Using biomarkers as anchor points provides a way for individuals to measure and train at relative intensities (Foster & Cotter 2005).

Different tests are used to assess physiological biomarkers such as lactate concentration, ventilatory thermal responses and power output—all biomarkers of exercise intensity. Using a heart rate monitor—a portable cardiac tool—to measure changes in heart rate is one of the easiest testing methods. Interestingly, HRmax alters little with age, which makes it a static, relatively unchanging anchor point.

There is a direct relationship between ventilatory threshold and blood lactate levels. "Increased lactate production occurring exclusively during high-intensity exercise is natural" (Robergs & Roberts 1997). The first threshold is "when lactate first begins to rise above the steady-state baseline level" (Foster & Cotter 2005).

According to Edwards, "Regardless of how different physiological biomarkers are measured, the first lactate threshold LT_1 and the first ventilatory threshold VT_1 happen at almost the identical intensity and therefore can be used as surrogates or substitutes for each other." At the high threshold, T_2 —"when lactate is one millimole per liter above the baseline level" (Edwards 2010)—a person can no longer comfortably speak because the effort is so strenuous. Knowledge of clients' HRmax and the two thresholds allows trainers to design a training approach that uses these two threshold heart rates. Training above steady state for an event or to improve speed takes place between these two heart rates: T_1 and T_2 .

Fitness professionals used to refer to this second threshold as the "anaerobic

Case Study: Submaximal Testing

Client: Peter, age 53.

The two submax tests (see the sidebar "Heart Rate Monitor Field Tests") were administered to Peter, who cycles outdoors 4 days a week. Even though he is consistent with his riding, Peter was one of the last finishers in a 100-mile road race. He wanted to increase his speed. He had used a heart rate monitor for years but did not know how to interpret the information from it.

The results of his submax tests were as follows:

- "2 x 4 minutes" test: 153 and 154 bpm, for an estimated HRmax of 185 bpm (with fitness factor added). The chart shows the zones; the test gave us 166 as his high threshold, T_2 . $166 + \text{fitness factor (FF) of } 20 = 186$; rounded to HRmax of 185. This also identified his low threshold, T_1 , as 154. Peter can train with this anchor.
- "Can You Speak Comfortably?" test: 183 bpm (with fitness factor), which matched his other test results. Estimated maximum cycling heart rate: 185 bpm. Peter answered "uncertain" at a heart rate of 166, T_2 .

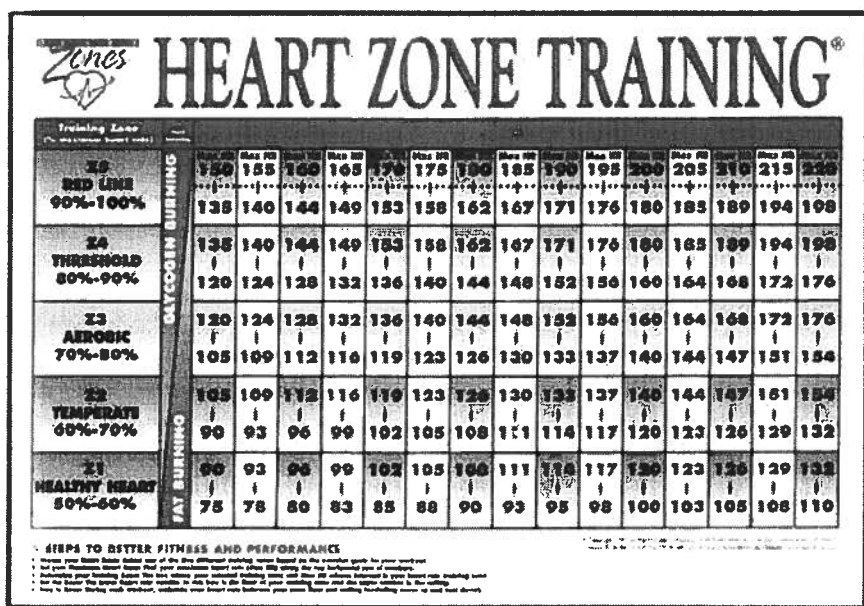
With Peter's estimated HRmax, zones and two thresholds in hand, the trainer recommended that Peter add interval training to his workouts. To increase his speed, he had to ride faster, even if this was uncomfortable. He needed to spend more time in Zone 4.

Exercise Prescription for Peter. Warm up 1 day per week until he attains a heart rate of 153 bpm. Interval train by attempting to go above 153 bpm by 3–5 points and hold for 30 seconds, 60 seconds and 90 seconds at least 3 times during his ride.

Results. Peter progressed to holding the 3–5 points for 2 minutes, recovering and repeating the interval. He is currently able to pass other riders without being "winded."

As shown in this example, Peter was able to ride at and slightly above his low threshold, T_1 , to improve his speed. Working out in Zone 4 increases the lactate threshold and, through practice, Peter improved in his ability to hold the higher numbers. Increasing his lactate tolerance and improving his speed.

For Peter, determining his maximum heart rate, identifying his zones and changing his training load and workout types resulted in improved performance. Without the data (his heart rate numbers), he would have been just "working out," not training.



Source: Heart Zones 2008.



Source: Heart Zones 2008.

threshold.” However, exercise scientists no longer use this phrase, as “anaerobic” refers to a lack of, or insufficient, oxygen. To say that at either of the two thresholds exercisers no longer have enough oxygen to continue at that pace is inaccurate. According to Foster (2010), “A metabolite

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called pyruvate is produced in greater and greater amounts during higher and higher intensity exercise. It is not the lack of oxygen that causes the fatigue but rather the production of pyruvate. As you exercise harder, your ability to remove lactate decreases.” A buffering process takes place, which produces water and carbon dioxide. “You breathe it out, which leads to a relatively sudden increase in the amount of breathing, which we typically call the ventilatory threshold, VT₁ or T₁.”

Physiological Markers and Their Application

By coupling heart rate with these key physiological markers through simple field tests, you can design cardiovascular training that improves clients’ metabolic fitness levels (i.e., endurance and/or

speed) (Foster & Procari 2010).

While everyone is born with a set HRmax, a number of factors—including altitude, emotional stress, training status (overtraining or fatigue), medications and drugs—can affect both HRmax and the exercise heart rate. If HRmax decreases owing to one or more of these conditions, it is important to adjust clients’ training zones to accommodate the change. ■

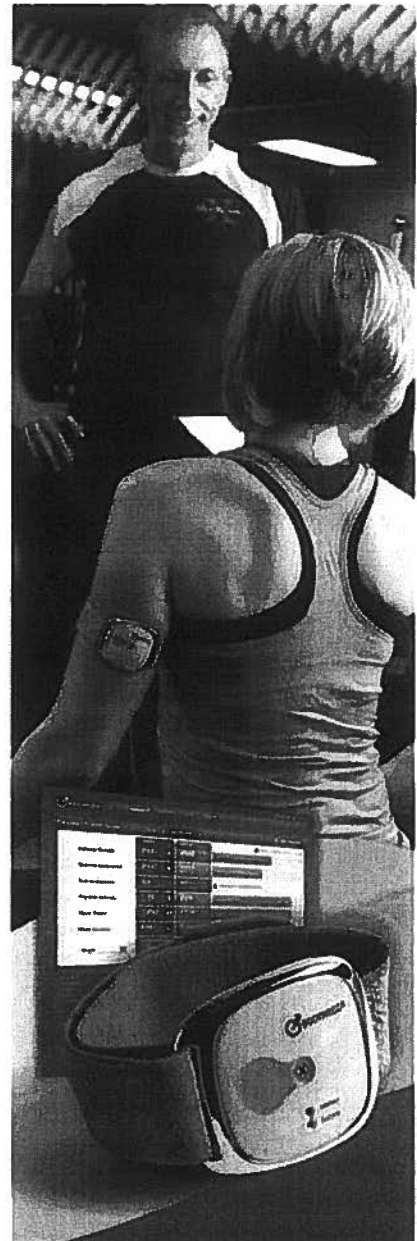
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