Riding Your Physiological Thresholds

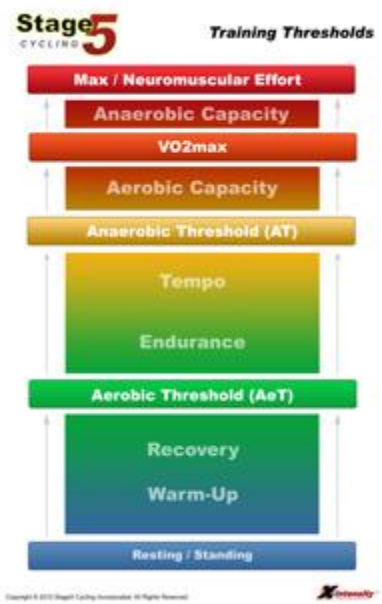
A Testing Protocol that Identifies Training Zones and Promotes Awareness

Focus of this Article

This article is designed for the indoor cycling instructor who desires to help riders become more aware of their physical and emotional response to training and intensity. We will explore the relationship between perceived exertion and physiological thresholds, and how to conduct an indoor "test" to identify each level of intensity and promote awareness.

Your Physiological Thresholds

There are **3 physiological thresholds** that coaches look at when considering aerobic fitness: Aerobic Threshold (AeT), Anaerobic Threshold (AT) and VO2max.



For the purposes of this article, we are not going to discuss other factors such as determining muscular endurance, power, lactate threshold and explosive neuromuscular efforts. In many circles anaerobic threshold (AT) is considered a good predictor of lactate threshold (LT), but there are numerous variables and controversy over the terms and their relationship.

What about Maximum Heart Rate?

Maximum heart rate (MHR) is a poor metric to base a rider's training zones on for a number of reasons. The main reason as it concerns this topic, is that knowing one's MHR does not provide insight into one's physiological thresholds. For example, two riders can have the same maximum heart rate and very different anaerobic thresholds. These differences can be caused by a number of factors including genetics, conditioning and the type or specificity of training.

First let's put a definition to each of these thresholds:

Aerobic Threshold (AeT)

Exercising at, or below, the aerobic threshold relies solely on the "aerobic" energy pathway. Now it is important to understand that energy pathways, as well as, types of fuel and muscle fiber recruitment, etc. do not function in an "on" or "off" state, but rather act similar to a dimmer switch. For example, one is not "totally" aerobic or anaerobic, but some percentage of both. Keep this "dimmer" or "blending" concept in mind moving forward.

In order to effectively recover, a rider should ride at or below their aerobic threshold (AeT). Once a rider's exertion exceeds their aerobic threshold, the anaerobic pathway begins to contribute to the energy production placing greater stress on the body. For this reason, the aerobic threshold is usually associated with a perceived exertion of 60%.

Anaerobic Threshold (AT)

As a rider's intensity continues to rise above their aerobic threshold, the anaerobic pathway progressively supplements a greater percentage of energy. The point at which the anaerobic pathway becomes the dominate energy source is often considered the anaerobic threshold (AT). The body is still generating energy aerobically, but is now reliant on anaerobic energy to sustain a more intense effort. Anaerobic threshold is generally associated with a perceived effort of 80%. However, well conditioned riders/athletes may find their anaerobic thresholds closer to a perceived exertion of 85%. Other physical/emotional indicators of anaerobic threshold are the beginning of breathlessness or the beginning of redline.

VO2max

VO2max of often mistaken for maximum heart rate (MHR). MHR can fall 5-10% above a person's VO2max depending on many of the factors described earlier (i.e. conditioning and genetics). VO2max is the point when the body has reached its capacity to consume oxygen and is heavily reliant on anaerobic energy. This usually falls close to a perceived effort of 90% and can be described as breathlessness.

It should also be noted that it is not just knowing where these thresholds are (specifically the heart rate at each one), but where these thresholds fall in relation to each other. For example, knowing a person's AT is good, but also knowing their VO2max paints a more complete picture of the rider's fitness, capacity and how they should be trained. For a deeper study, examine the concept of Fractional Utilization.

Perceived Exertion is the Key to Awareness and Appropriate Training

We (Stage5 Cycling) use perceived exertion (PE) with all of the athletes we coach and train, and believe it is one of the best and simplest ways to help riders learn and become aware of their body's response to training, particularly in an indoor cycling class. We have found that using a **percentage of their maximum effort** (NOT maximum heart rate) is the most useful indicator, particularly when aligned with physiological thresholds. Using various scales such as 1-4, 1-10 or 1-20 can be useful but often fall short because they are just arbitrary numbers without physiological significance. These scales do not teach the rider about their body. On the other hand, learning how to determine a percentage of one's maximum effort teaches them an emotional/physical response to intensity which can be used in any sport. A perceived exertion of 80% is the same regardless of whether cycling, running, playing soccer, etc.

Aligning the percentage of perceived exertion with physiological thresholds is the key because it helps riders become aware of "real" changes in their body.

NOTE: You will find a full chart displaying perceived exertion and a chart of each percentage individually defined at the end of this article. It may be helpful to use this as a reference as we discuss how they are related to physiological thresholds. You will also find other valuable information such as how long one can last at each intensity, the fuel ratio, energy zones and specific training effects (focus).

60% is the First Target

A perceived exertion of 60% generally aligns with a person's aerobic threshold (AeT). When coaching an athlete, we often consider this marker the top of their warm-up / recovery zone. So the goal of the beginning of the warm-up is to bring them to 60%. It is a point when they feel their heart rate increase slowly and progressively, when they feel heat or warm in their muscles (often breaking a sweat), but their breathing is still relaxed and almost undetected.

70% is Considered the Endurance Zone

A perceived exertion of 70% is usually marked by the change in breathing – from undetected to a noticeable rhythmic pattern. They have moved above the aerobic threshold (AeT). No specific physiological threshold is associated with this level of intensity. It is between their aerobic threshold (AeT) and anaerobic threshold (AT). Endurance athletes can work at a perceived effort of 70% (just below their AT) for hours. Hence, the endurance zone.

80% is Hard and the Beginning of Breathlessness

A perceived exertion of 80% often equates to a riders Anaerobic Threshold (AT). Untrained (unconditioned) riders will fall closer to 80% where trained riders and athletes will fall closer to 85%. For the sake of simplicity in a large group setting, 80% will suffice. This is a hard, obtainable, sustainable but uncomfortable level of effort. That feeling when breathing starts to become strained or uncomfortable, is an indication they are at or approaching their Anaerobic Threshold (AT).

90% is Close to Aerobic Capacity

A perceived exertion of 90% falls near one's VO2max. The rider should be at their capacity to breathe. Approaching breathlessness. An effort that can generally only be maintained for 2-3 minutes depending on the conditioning of the rider.

100% is All You've Got

It is important to stress that a 100% "Perceived Effort" or maximum intensity is NOT a 100% "heart rate". A true maximum effort can only be sustained for 20-30 seconds. This can be an eye-opener for some. I've heard instructors on numerous occasions demand that riders push at 100% for the majority of a 60-minute class. Not only is this impossible, but does little to train riders to be aware of anything but total fatigue.

Let's Ride Our Thresholds

It is important to stress that rider's come to class rested before this ride. We recommend announcing the ride a couple of weeks in advance. For the sake of safety (and covering your butt), you may want to require a Physical Activity Readiness Questionnaire (PARQ) and an Informed Consent form (most health clubs have these). Riders that are well-rested will get the most accurate results. If a rider is not rested before taking the test, they may perceive efforts as harder than they actually are, which will hinder their ability to properly gauge their intensity. Heart-rate monitors are obviously needed, so it may also be helpful to provide options and resources for those interested in purchasing a heart-rate monitor before the ride.

Riders will need time to warm-up and prepare the body for their best effort. We recommend a 10 minute warm-up followed by 1 or 2 drills designed to raise the heart rate to approximately 80% perceived exertion. Then allow riders to recover (at 60%) for 5 minutes. Encourage riders to drink and stay hydrated during the warm-up and drills. After the test, cool-down riders for 10-15 minutes including a time to stretch. Encourage them to listen to their bodies and let you know if they are not feeling well or exhibit any unusual aches, pains or discomfort. It is good to leave some extra time at the end of class to talk with riders and help them use what they have learned (see below).

The Thresholds Protocol

The protocol is divided into three 4-minute sections totaling 12 minutes. It is very important that rider's get "coached" through the entire test to stay engaged, focused and NOT push too hard too soon. This is something instructors will need to practice. A cadence of 80-90 rpm should be maintained during the entire 12 minutes. Music that is timed for the cadence and duration is strongly recommended.

Simple Description:

- Maintain an 80-90 rpm cadence for the entire 12 minutes
- Section 1 (4 minutes): Add resistance every minute – 60% - 70% PE
- Section 2 (4 minutes): Add resistance every 30 seconds – 70% - 80% PE
- Section 3 (4 minutes): Add resistance every 15 seconds – 80% +

Full Description:

Section 1: Identify the Aerobic Threshold (AeT)
Riders should start on an easy road (~60%) and asked to add a small bit of resistance every 60-seconds. NOTE: Avoid telling riders to add a "1/4 turn" or "1/2" turn. One bike may be more worn out than another making a ¼ turn on one bike feel like a full turn on another. Riders should be cued to observe the heart rate when they first notice their breathing (aerobic threshold). Encourage riders to be patient when adding resistance – just a little bit at a time. This test (and the resistance) will sneak up on them in the end.

Section 2: Identify the Anaerobic Threshold (AT)
Riders now begin adding resistance every 30 seconds with a goal of identifying the heart rate when their breathing becomes uncomfortable and they can no longer maintain a steady breathing rhythm. This is their anaerobic threshold (AT).

Section 3: How long can they last
The final 4 minutes has riders adding small amounts of resistance every 15 seconds. The key during all of the sections (and particularly this one) is to make sure riders are not slowing down their legs. They must maintain their cadence regardless of the amount of resistance. If their legs slow down, they are using too much resistance. If they can, have them identify the heart rate when they become breathless (VO2).

Keep Your Riders Encouraged
Not everyone will be able to complete the last 4 minutes. Let them know that they may need to perform the test a number of times (not in the same week) in order to learn how to gauge their effort. Either way this information is invaluable. Instructors have found this test very easy to do and fun because it is structured, and there are numerous landmarks and intermediate checkpoints to keep rider's engaged.

How do Riders Use what They've Learned?

After the test, riders will hopefully walk away with 3 heart rate numbers: **1.** when they felt their breathing become noticeable (aerobic threshold), **2.** when their breathing became labored and uncomfortable (anaerobic threshold), and **3.** the point at which they were breathless (VO2max).

Obviously these are all approximations. Riders should be urged to take an actual VO2 test if they are serious about using these thresholds to monitor and develop a training program.

So what do we use these thresholds for? There are numerous observations, assessments, approaches to training, nutrition and performance indicators that can be drawn from knowing these thresholds and where they are in relation to each other. Here are 3 simple, but valuable ways to use this information:

Real Recovery
Many riders don't recovery correctly or enough. Often times this may be due to instructors that do not incorporate the proper amount of recovery between efforts. However, even if proper recovery is given, many riders don't know at what point they are receiving the benefit of recovery. Remember, you cannot achieve top performance without full recovery. If a rider knows their aerobic threshold (AeT), they now know how to recover. After an intense effort they need to return to, or just below, their aerobic threshold (heart rate) to reduce the stress on the body. This gives them a "real" recovery zone based on "their" body. It also keeps them from dipping too low after an effort. If a rider allows their heart rate to drop too low during recovery, they may start to cool-down which begins to reverse some of the physiological effects of the warm-up. Once a rider enters the cool-down, it can be tough to get the body back to higher intensities again if the workout continues.

Target Proper Intensity (Zones) for Training
Mapping perceived exertion and training thresholds together gives riders 5 simple training zones that actually mean something to "them". This is also extremely useful to instructors because now they can design workouts and cue proper intensity to target specific types of training. Here are the 5 percentages of perceived exertion (during exercise) and how they relate to training:

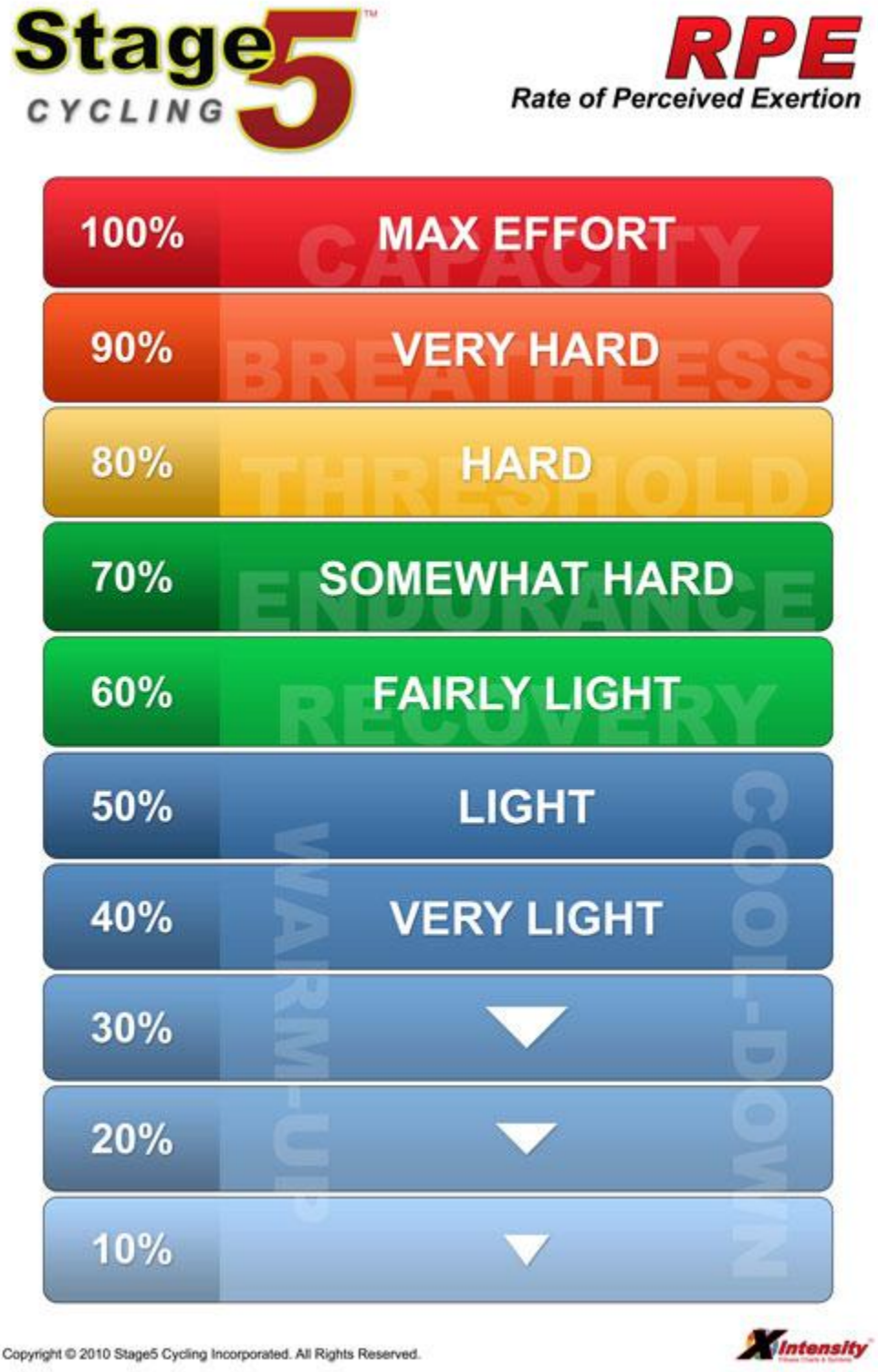
60% - Recovery
70% - Endurance
80% - Threshold (Lactate, Anaerobic or Interval Training)
90% - Aerobic Capacity
100% - Anaerobic Capacity (Sprints)

Know When to Increase Training or Rest
Mapping perceived exertion and physiological thresholds together allows riders to learn about their bodies and make educated decisions based on how they are responding to the workout. For example, let's say Joe Rider did an indoor cycling class focused on aerobic endurance and maintained an average heart rate of 140 bpm. Joe felt that the ride was somewhat hard and close to a perceived effort of 70%. Now a week later, Joe Rider is doing a similar indoor cycling class but notices that his perceived effort is closer to 80% for the same 140 bpm heart rate. Last week 140 bpm felt good and this week it feels really hard. What happened? Well, there could be a number of reasons for what Joe is feeling. Did Joe have a particularly stressful week? How are his sleeping habits? Has he been eating well? Is he properly hydrated? Did he not get enough recovery from an earlier workout? Joe will need to consider

all of these factors and can make an educated decision as to what to do in response. Joe may need to take a number of days to rest and fully recover before continuing. The reverse can also be true. Joe may notice that his heart rate at anaerobic threshold (AT) doesn't feel that hard anymore. This is good news and could indicate that he is adapting to the training and can begin increasing the intensity or volume of his workouts.

In Conclusion

Combining physiological thresholds and perceived exertion is one of the best ways to target appropriate intensities for different types of training while providing physical and emotional feedback. It is important that instructors use consistent cuing and continually encourage riders to listen to their bodies. This will convert your indoor class from an unfocused set of drills to a coached training session. Not only will this provide sound training for your riders, but will teach them to be aware of their body's response to different intensities so they can train right and train smart.


Stage5 CYCLING
RPE
Rate of Perceived Exertion
100%
MAX EFFORT
CAPACITY
90%
VERY HARD
BREATHLESS
80%
HARD
THRESHOLD
70%
SOMEWHAT HARD
ENDURANCE
60%
FAIRLY LIGHT
RECOVERY
50%
LIGHT
40%
VERY LIGHT
30%
20%
10%
WARM-UP
COOL-DOWN
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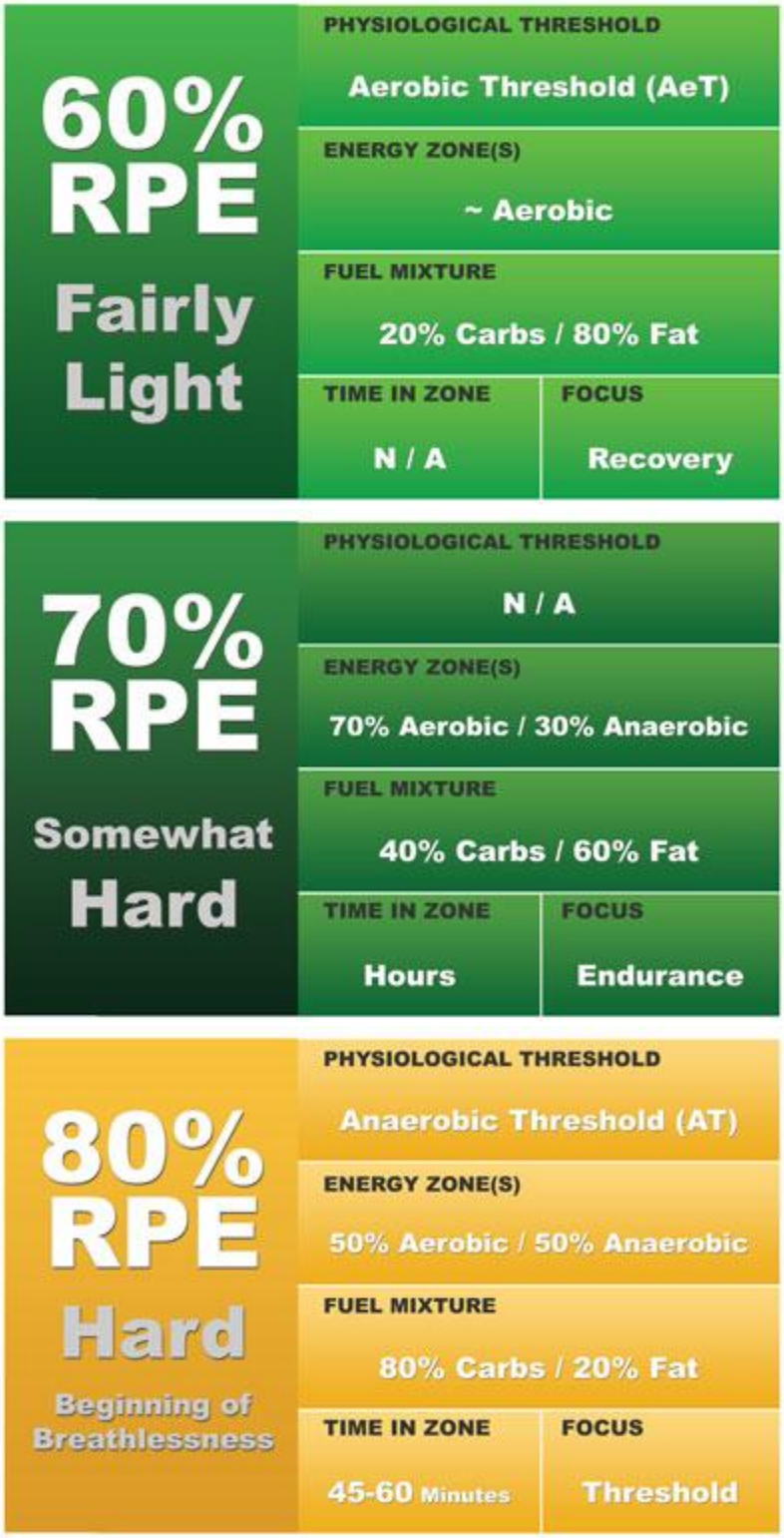
Intensity

The following are general guidelines for each percentage of perceived exertion. Many factors such as genetics, conditioning and types of training, can greatly influence each of the variables indicated.



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