Heart Rate Zone Training Guide

Disclaimer (IMPORTANT that you read this before continuing)

While every reasonable precaution has been taken in the preparation of this document, neither the author nor Cycling-Inform Pty Ltd assumes responsibility for errors or omissions, or for damages resulting from the use of the information contained herein.

The information contained in this document is believed to be accurate. However, no guarantee is provided. Use this information at your own risk.

It is unconditionally required that before acting on any information contained within this document that you have read, understand and agree to the following:

1. "I" (the reader of this document) understand that I am fully aware of all the inherent risks involved in cycling. I understand, acknowledge and agree that there are inherent dangers and certain elements of unpredictability while cycling. I acknowledge and accept that cycling is a physically demanding recreational activity carrying with it considerable risk of injury and potential danger of accident or collision which may result in injury and the possibility of death. As such, I agree to indemnify and keep indemnified Cycling-Inform Pty Ltd from any claims whatsoever and agree that I shall not hold Cycling-Inform Pty Ltd, its owner/s, employees or agents responsible nor be held liable for any personal injury, mental anguish, loss of whatsoever nature or kind however caused or that may occur during or after the application of any information contained herein.

2. I assume full responsibility for any injury or loss that may occur or I may sustain or I may cause to others in connection with the application of any information contained here within this document, and I, on behalf of myself, my successors in interest, heirs, assigns, and representatives hereby fully release and agree to hold harmless Cycling-Inform Pty Ltd, their employees, officers, directors and agents from any and all liability, claims, rights, or actions for death, bodily injury, property damage or any other loss or inconvenience whatsoever, suffered by me or caused by me, at any time hereafter occurring as a result of my voluntary participation in the application of any information contained herein.

I understand that it is my responsibility to ensure my equipment including my bicycle, helmet and all other associated equipment is fit for the purpose of cycling and indemnify and keep indemnified Cycling-Inform Pty Ltd from any claims whatsoever and agree that I shall not hold Cycling-Inform Pty Ltd, it's owner/s, employees or agents responsible nor be held liable for any loss or damage caused to my personal possessions or equipment and further indemnify Cycling-Inform Pty Ltd from any and all liability of whatsoever nature or kind caused as a result of my use of my equipment whether to myself or third parties.

This release continues forever and binds my heirs, successors, executors, personal representatives and assigns.

Index

Foreword

Just like your heart rate monitor and power meters your indoor home trainer is a fundamental tool in improving your cycling fitness. During your building and peaking phases the humble home trainer becomes the most important piece of equipment to help you perform high intensity intervals and sprints. Sadly skipped by many cyclists these high intensity efforts are critical to your success as a cyclists and stop you from being spat out of the back of bunches when climbing hills, responding to vicious attacks and hammering into cross winds while riding in the gutter.

Not only that, training on an indoor home trainer is the most important key to improving you time trial performance for road races and triathlon events. It's is scientifically proven that a structured six week session on a home trainer can improve you average speed by up to several kilometres per hour, cutting minutes off your personal bests for these events.

Indoor home trainers are great at keeping you fit during the off season. They help you keep the weight off and maintain or even increase fitness over the cooler months. You can make your greatest fitness and weight loss improvements during the winter. If you can use your indoor home trainer throughout the off-season you will notice a big fitness improvement while keeping your weight stable or even shedding a few kg's. And if you are a summer rider it's not rocket science to understand that by keeping yourself fit during winter you'll be able to hit the summer season as a much stronger, slimmer and fitter cyclists than if you were slouching around over winter.

This improvement is accessible to anyone with a bike, a home trainer, a heart rate monitor and the desire to spend two - four hours on it a week.

Introduction

You've just chosen what is probably the fastest way to improve your performance on the bike. No matter what level you race or ride at, or what shape you're in right now, you're about to get a lot faster and a lot more powerful than you may have thought possible.

While riding on the road is important and enjoyable, there are many reasons why you should consider taking a significant portion of your training indoors.

Perhaps the single greatest benefit to riding the indoor trainer is that you can control the exact conditions of your training. Training indoors gives you greater control, which means better, higher quality training in less time. You can also measure it giving you instant insight into the status of your fitness and ability to compare your weekly progress.

You'll save time as well. Your sessions can be shorter than they would be if you were training on the road. You have no distractions or interruptions like traffic lights. No coasting and drafting. For that reason every minute spent on the trainer is quality training. It's so time efficient that we double any kilometre ridden on an indoor home trainer. That means a one hour session on a home trainer is equal to two hours on the road. In these times of being time poor it's nice to cut your training in half and still get the same if not better benefits with the time you invest. In our time poor sport it's great to give something back to your cycling widowed partner and/or family and friends by spending that time saved, as quality time with them.

The other single key to a home trainer is that you can go much harder on the trainer than you can do safely on the road. This is why the indoor trainer is so effective. You can perform interval training that is simply not achievable on the open road. It is possible to go so hard that you'll feel noxious, light headed and may even experience tunnel vision. You'll never get to train this hard in bunch rides for fear of being dropped after performing such an intense effort!

Training on an indoor trainer is safer not just because you're home away from road traffic but because during the winter months you don't have to spend time in the dark and dealing with winter conditions such as ice and snow. So, you can concentrate more on your session. You won't have to worry about injuries or sickness brought on by the cold either.

Introduction to Heart Rate Zones

If you do a search on heart rate (HR) zones you'll get a large selection of heart rate zones with different values and number of zones. Enough to get really confused. It seems that everyone has a different opinion on the matter.

As we are regularly coaching cyclists that just want to get on and train right without having to get a degree in medical science, we keep our zones simple. I've found that these zones are very effective for the training required for cycling. They are slightly different to the ones that normally come as default with the polar heart rate monitors. At the end of the day no one heart rate zone system is better than another. The important thing is to decide on one and then stick to it. In the table below are the heart rate zones that we use for our coaching programs and our own personal training.

The Heart Rate Zones

Description	Intensity	Code	Zone
VO2 MAX Boosting	Very Hard – Can't speak	VO2MAX	92 – 100 %
Anaerobic Threshold Endurance	Hard – Difficult to speak at all	E3	85 – 91 %
General Aerobic Endurance	Moderate – Talk in short sentences	E2	75 – 84 %
Base Aerobic Endurance	Easy – Able to carry out conversation	E1	65 – 74 %
Recovery	Easy – Able to carry out conversation	REC	50 – 64 %

Cycling Australia official Heart Rate Zones

Heart Rate Descriptions

Rest <50% MHR

Any training done lower than 50% MHR (Maximum Heart Rate) is rest. This zone is not really training at all and is normally associated with very light exercise such as walking. This zone can be used during the transition phase of the training year.

Zone REC (Recovery) 50-64% MHR

This zone can be used for recovery rides on the bike. It takes discipline to ride at this pace though!

Zone E1 (Aerobic Endurance) 65-74% MHR

This is the zone you will spend most of your time in. It is the zone used for base training and to build your aerobic base and your foundation for the season ahead. In practice you'll be training in this zone throughout the year as it builds aerobic power throughout the season. Training in this zone allows you to ride with a good average speed but without a great deal of perceived effort. If you're riding fast but not hard you'll most likely be in this zone. You should be able to maintain a conversation

without taking deep or extended breaths. For this reason, this training is very effective when done with one or two training partners and whilst having a sociable chat on the bike. This is the official "fat burning" zone in that with some degree of fitness you can train at this level all day without fatigue.

Zone E2. (General Aerobic Endurance) 75-84% MHR
Be careful with this zone. Because this zone is still just below your lactate threshold, it will do little to increase your VO2MAX or increase your lactate threshold. This zone is sometimes called the "no-man's land" training since it is too fast for an endurance ride and too slow to improve your maximum aerobic power or threshold. It is an important zone to train in but it's even more important that you manage the amount of time and how you train in this zone. This is because it is at the top end of the endurance zone and this it will tire you out if you train in it without proper control! Interestingly, it is the zone that you usually end up riding in when riding in a group! It's ok though in the specialisation period before the start of racing and can be used as an introduction to interval training.

Zone E3. (Anaerobic Threshold Endurance) 85-91% MHR
This zone is critical to your success in bike racing. Training in this zone develops your ability to ride at lactate threshold. Train in this zone and you will be able to tolerate lactic acid in your muscles whilst maintaining the muscle contractions necessary to produce sustainable power on the bike. Use this zone to train for bridging across to a break, working in a break or climbing for an extended period of time. Training in this zone is hard! Train in this zone to increase VO2MAX and Maximum Aerobic Power.

VO2MAX. (VO_2max Boosting) 92-100% MHR
In this zone you are riding flat out. These intervals are probably best done on a trainer. If you do them on the road take care to keep your head up and in control of the bike! Typically you will only last seconds in this zone as your muscles fill with lactic acid and force you to recover. Use this zone to train for sprinting.

How to accurately calculate your Max Heart Rate.

The basis of all HR zone calculations is to first determine your maximum heart rate (MHR), once this is known the HR zones can then be calculated. There are many ways to determine your MHR. Here are a few:

NOTE: The following tests should not be attempted unless you are fit, feeling well, fully rested, and in the right frame of mind (eager to work to your maximum). You should not have done anything strenuous for two days before the test and eaten nothing for at least two hours before the test.

MHR Flat out test

This test requires a Heart Rate Monitor and a home trainer. Warm up for 10 to 15 minutes and then ride as hard as possible – intensive time trial effort – for the next ten minutes. Ride the last minute flat out (maximum effort), and sprint the last 20 to 30 seconds. It should now be possible to read the MHR on the Heart Rate Monitor. Do not stop immediately but keep pedalling and warm down gradually for the next ten minutes. Repeat the test two or three more times, with a couple of days between each test, to establish your true maximum.

MHR RAMP test

This test requires a Heart Rate Monitor, home trainer and a computer (ideally with a cadence measurement). Your bicycle should have a close ratio rear block (e.g. 52 x 18/17/16/15/14/13). Have someone assist during the test, to encourage you when things get tough and to take the readings from your Heart Rate Monitor.

Warm up fully for 10 to 15 minutes. Use your large chain ring and choose the easiest gear (e.g. 52 x 18). Pedal at a steady cadence of 90 RPM for 2 minutes. Then change down to the next hardest gear (52 x 17) without pausing. Maintain the same cadence (90 RPM). Pedal this gear for 2 minutes and change down again still maintaining the 90 RPM cadence. Continue changing down to the next sprocket every two minutes, constantly maintaining 90 RPM. Your heart rate should rise constantly until you are no longer able to go on. Do not stop immediately but keep pedalling and warm down gradually for the next ten minutes.

Don't want to do the test or all too confusing? These tests noted above are rather hard and mentally challenging. So here are a few more ways that are easer.

Racing MHR

Another simple way is to record and download your data from races. You will generally reach your MHR in the final sprint in a race. Monitor your data regularly to ensure that you haven't posted a new higher MHR.

Predictive MHR

The other way, though less accurate, is to just take 220 and minus your age to get what is called the predictive MHR. This number will give you a target MHR to start working from.

Introduction to Power Zones

Training with power has been around for several years now. With the introduction of the SRM cranks, Cyclops Power tap hubs and other power measuring devices cyclists now have access to train with power.

Power zones are similar to the heart rate zones discuss previously but with two additional zones. The reason that there are two additional zones is that we can actually measure them. Let me explain. Here is a table measuring the mean maximal hear rate and power values for various intervals of time from data taken from an average masters road race. This data is produced using software like Training Peaks WKO+.

Duration	Mean Maximal Heart Rate Value	Mean Maximal Power Value
Peak 5 seconds	169 bpm	805 watts
Peak 10 seconds	169 bpm	631 watts
Peak 20 seconds	169 bpm	546 watts
Peak 30 seconds	169 bpm	487 watts
Peak 1 minute	168 bpm	406 watts
Peak 2 minutes	167 bpm	384 watts
Peak 5 minutes	161 bpm	306 watts
Peak 10 minutes	158 bpm	273 watts
Peak 20 minutes	155 bpm	248 watts
Peak 30 minutes	154 bpm	237 watts
Peak 60 minutes	148 bpm	220 watts

Mean Maximal Heart Rate and Power values.

As you can see from this chart the heart rate values from 5 seconds right down to the two minutes change by just 2 heart beat per minute. However, the power data is able to provide a more granular view of this range with power values starting at 805 watts and then progressing down to 384 watts.

While heart rate zones are based on a percentage of max heart rate, power zones are based on a percentage of threshold power. Threshold power (THP) is your personal 60 minute mean maximal power value or if that is not available 1.05 x your 30 minute mean maximal power value.

The Power Zones

Description	Intensity	Code	Percentage of Threshold Power
Neuromuscular Power	Maximal - Can't speak	NEU	> 151 %
Anaerobic Capacity	Maximal - Can't speak	ANC	121 – 150 %
VO_2max	Very Hard – Can't speak	VO2MAX	106 – 120 %
Lactate Threshold	Hard – Difficult to speak at all	E3	91 – 105 %
Tempo	Moderate – Talk in short sentences	E2	76 – 90 %
Endurance	Easy – Able to carry out conversation	E1	56 – 75 %
Active Recovery	Easy – Able to carry out conversation	REC	< 55%

Power Zones from "Training and racing with a power meter" by Hunter Allen and Andrew Coggan

Because heart rate zones are based on a percentage of max heart rate, power zones are based on a percentage of threshold power it means that these two systems are incompatible with each other. It is therefore recommended that you stick to training with either the heart rate zone system or power zone system but not both to avoid confusion.

Power Zones Descriptions[1]

Level 1 (Active Recovery) <50% THP
"Easy spinning" or "light pedal pressure" (i.e., very low level exercise, too low in and of itself to induce significant physiological adaptations). Minimal sensation of leg effort/fatigue. Requires no concentration to maintain pace, and continuous conversation is possible. Typically used for active recovery after strenuous training days (or races), between interval efforts, or for socializing.

Level 2 (Endurance) 56-75% THP
"All day" pace, or classic long slow distance (LSD) training. Sensation of leg effort/fatigue generally low, but may rise periodically to higher levels (e.g., when climbing). Concentration generally required to maintain effort only at highest end of range. Continuous conversation is still possible. Frequent (daily) training sessions of moderate duration (e.g., 2 hours) at Level 2 is possible (provided dietary

[1] *The power zone descriptions are sourced from "Training and racing with a power meter" by Hunter Allen and Andrew Coggan.*

carbohydrate intake is adequate), but complete recovery from very long workouts may take more than 24 hours.

Level 3 (Tempo) 76-90% THP
Typical intensity of fartlek workout, "spirited" group ride, or briskly moving paceline. More frequent/greater sensation of leg effort/fatigue than at Level 2. Requires concentration to maintain, especially at upper end of range to prevent effort from falling back to Level 2. Breathing deeper and more rhythmic than at Level 2, such that any conversation must be somewhat halting, but not as difficult as at Level 4. Recovery from Level 3 training sessions are more difficult than after Level 2 workouts, but consecutive days of Level 3 training are still possible if duration is not excessive and dietary carbohydrate intake is adequate.

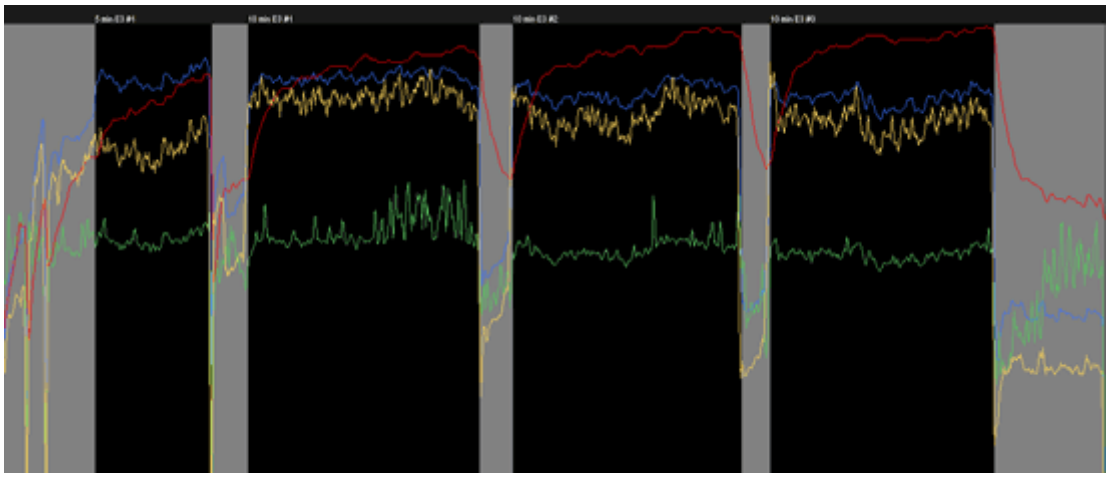
Level 4. (Lactate Threshold) 91-105% THP
Just below to just above TT effort, taking into account duration, current fitness, environmental conditions, etc. Essentially continuous sensation of moderate or even greater leg effort/fatigue. Continuous conversation difficult at best owing to depth/frequency of breathing. Effort sufficiently high that sustained exercise at this level is mentally very taxing-therefore typically performed in training as multiple "repeats," "modules," or "blocks" of 10-30 minutes in duration. Consecutive days of training at Level 4 are possible, but such workouts are generally only performed when cyclist is sufficiently rested/recovered from prior training so as to be able to maintain intensity.

Level 5. (VO_2max) 106-120% THP
Typical intensity of longer (3-8 minute) intervals intended to increase VO2max. Strong to severe sensations of leg effort/fatigue, such that completion of more than 30-40 minute total training time is difficult at best. Conversation not possible due to often "ragged" breathing. Should generally be attempted only when adequately recovered from prior training. Consecutive days of Level 5 work not necessarily desirable even if possible.

Level 6. (Anaerobic Capacity) 121-150% THP
Short (30-second to 3-minute), high-intensity intervals designed to increase anaerobic capacity. Heart rate generally not useful as guide to intensity due to non-steady-state nature of effort. Severe sensation of leg effort/fatigue; conversation is impossible. Consecutive days of extended Level 6 training usually not attempted.

Level 7. (Neuromuscular Power) 151+% THP
(Maximal) Very short, very high-intensity efforts (e.g., jumps, standing starts, short sprints) that generally place greater stress on musculoskeletal rather than metabolic systems. Power is useful as a guide, but only in reference to prior similar efforts, not TT pace.

Watch for Cardiac Drift



The picture above shows a classic textbook E3 strength endurance cycling indoor workout to power.

This one starts with a build into E3.

The (the first black band) is a 5 min E3 effort. This is followed by 3 x 10 min E3 efforts. In between all these cycling indoor interval workout efforts there is a 2 min recovery (the grey bands between the black bands).

The green line is cadence. The yellow line is power. The blue line is speed and finally, the red line is heart rate.

The lines we are interested in are the power and the heart rate. Your notice straight off that the power (yellow) line is fairly stable throughout all the efforts where as the heart rate line (red) slowly climbs throughout this classic E3 strength endurance cycling indoor workout. This heart rate drift upwards (red line) is called cardiac drift and is clearly shown in this chart.

Let's take a little more detailed look at this.

The intent of this E3 strength endurance cycling indoor workout is for the cyclist to ride in their E3 power zone for the required interval efforts. In this case it starts with a 5 min effort, followed by 3 x 10 min efforts.

The first 5 min E3 effort the average power is 227 watts and the average heart rate is 147 beats per min. This is considered part of the E3 warm up build before the three 10 min E3 efforts.

Then this is followed by the first 10 min E3 effort where the average power is 252 watts and average heart rate is 155 beats per min.

Due to a shortness of the recovery duration (2 mins) fatigue starts setting in. This influences the data resulting in a cardiac drift and a small loss of power. We will see this in the next two 10 min efforts.

The second 10 min effort produces an average power of 244 watts and an average heart rate of 159 beats per min. While the third and final 10 min effort produces almost the same average power, 241 watts, but with an increased average heart rate of 161 beats per min.

There are many factors that affect heart rate during exercise but these same influencing factors have very little affect on the cyclist power output. Power is definitive, where heart rate is not.

If the cyclist was asked to ride in E3 based on their heart rate alone the work effort for these efforts would slowly drop off as they progressed throughout this cycling interval workout. They would be none the wiser as their heart rate would stay the same while their power gradually dropped off.

This is one of the main reasons why we prefer to train with power.

In an advanced version of this E3 strength endurance cycling indoor workout we would ask the cyclist to continue this 10 min E3 effort with a 2 min recover until they could no longer maintain their power in the E3 zone. In this case the cyclists would ride to a measurable fatigue level. This is something that we could never be able to measure accurately with heart rate.

There are many factors that affect heart rate during exercise. These factors are (to name a few): general fatigue, ambient temperature, the amount of sleep the athlete has had over the last few days and how hydrated they are.

Got a question?
What to provide feedback on this book?
Have a success story?

E-mail me at sales@cycling-inform.com

Please visit our web site for up-to-date cycling performance information:

www.cycling-inform.com

Cycling-Inform® Pty Ltd
PO Box 119, Highett, VIC 3190
Australia