

**Aerobic Units and Calorie  
Expenditure Exercising for your  
Heart**

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Research done at the Cooper Institute in Dallas resulted in the establishment of the concept of **“aerobic” exercise** – a word which was coined by Dr. Cooper. Aerobic exercise increases your heart’s ability to use oxygen, increases your endurance and improves your health.

Subsequent research established the concept of **“aerobic unit”** which is a function of oxygen consumption during exercise at various levels of stress. Finally, Cooper established a standard of measurement of aerobic training as follows:

**Recommendations for Cumulative Weekly Aerobic Units**

Fitness Classification	Men	Women
Very Poor	less than 10	less than 8
Poor	10 - 20	8 - 15
Fair	21 - 31	16 - 26
Good	32 - 50	27 - 40
Excellent	51 - 74	41 - 64
Superior	75+	65+

Presently, SETMA’s exercise prescription calculates the aerobic points for various activities and exercises. Because Cooper has approximated that one **aerobic unit** is achieved by the expenditure of 20 calories in exercise at 50% of your maximum heart rate and above, we have added a “calorie expenditure” function to our exercise prescription.

The function is not complete, but here is what is present now. If you go to the exercise prescription, you will find the work **“calorie”** next to the title **Current Exercise Activity Running/walking/jogging**. When you click on the word “calorie” a pop-up is launched which allows you to enter the following data:

- **patient weight** (this will shortly be auto posted),
- **speed of exercise in miles per hour,**
- **incline of treadmill**
- **time of exercise**

There is an option for calculating the calories expended for walking or running based on the assumption that 4.5 miles per hour and above is jogging or running. The following are interesting relationships revealed by analyzing the data on the basis of which these functions are built:

1. Walking or running faster burns more calories than increasing the incline of the treadmill at lower speeds.
2. Increasing the incline of the treadmill while walking increases the calorie expenditure more than increasing the incline of the treadmill while running.

Once these data points are entered, the depression of the button entitled “**Calculate**” will result in the display of how many calories are expended for that activity and that incline. Soon, we will have the calorie calculations for cycle ergometer and when the equations are available for other activities as well.

### **Converting Calories Expended into Aerobic Units: An Approximation**

When the number of calories expended is displayed, you can **divide by 20** (this will eventually be done for you automatically) which will approximate the **aerobic units** achieved in that exercise episode.

**(By the way, my personal numbers are, age 62, weight 206, 60 minutes, 4.5 miles per hour at an average incline of 10%, approximately 1092 calories, or 54 aerobic units per session. Average 4 sessions per week.**

**If you do not have access to SETMA’s EMR and want to know your values send me your data and I’ll send you your results.)**

**Add to this new function concepts which are presently in the EMR and you can give a patient an intelligent, valuable exercise program.**

The **wellness continuum of health** consists of three areas of physical well-being

- Health,
- Fitness
- Performance.

Everyone is not going to have the same goals. This is why your friend, who's a veteran marathoner, might complain about what kind of "shape" he or she is in, while you would kill to look the way they do and be so fit and healthy. The health area covers those training zones that promote health but don't primarily improve physical fitness and certainly not performance.

- To measure **improvements in health**, we seek positive changes in blood pressure, body fat, cholesterol, etc.
- To measure **improvements in fitness**, however, its positive changes in oxygen utilization, lactate concentrations and heart rate points we're looking for.
- To measure **improvements in performance**, positive changes in completion times, accuracy of movement skill, mental attitude, and other indices are used.

## The Wellness Continuum and the Five Heart Zones

Zone	Name	Perceived Exertion Difficulty	Heart Rate Range	Goal
		(see Borg's scale_		
1	Healthy Heart	10-11	91-109 bpm	Health
2	Temperate	2-13	110-127 bpm	Health
3	Aerobic	14-15	128-145 bpm	Fitness
4	Threshold	16-17	146-163 bpm	Fitness
5	Redline	18-20	164-182 bpm	Performance

The heart rate ranges displayed here are for a 38 year old. You can determine your own by subtracting 60 from 220 and then multiplying by:

Zone 1 50% of maximum heart rate  
 Zone 2 60% of maximum heart rate  
 Zone 3 70% of maximum heart rate  
 Zone 4 80% of maximum heart rate

Zone 5 90% of maximum heart rate

Zones use time, not distance, as their measurement tool. That is, the amount of time you spend in the zone is the way you measure your workout, not in miles run, or the number of strokes per minute cycled or rowed. This measurement is called "time in zone" and is measured in the minutes that you spend in each zone. For example, one day you decide to run for 30 minutes in the Aerobic zone; the following day you might choose to walk for 50 minutes in your Fat Burning zone (Zone 4). Varying your workouts, both in activity and zone, allows you to get multiple benefits from your training.

At the lower zones--or "cruise" zones as they are sometimes called--you can train in zone for longer periods of time. But, as you move up to higher intensity zones, you need to decrease the amount of time that you spend in that zone, particularly in the top two, the Anaerobic and Redline zones. This simply makes sense--you can walk farther than you can sprint, and overdoing it is nearly a guarantee of injuries or burnout.

**Comment:** There are those who would argue with this simple method of calculating heart rate zones. The maximum heart rate can be measured with SETMA's Cardiopulmonary Exercise Test function. Measurement is most desirable because there is a large variation between individuals in their maximum heart rate at any given age. Another formula which has been tested is 210 minus one-half your age; minus 5 percent of your body weight (in pounds); plus four (for men) or zero (for women). Most exercise machines which have a cardio fitness option use the 220 minus 60 to determine the estimated maximum heart rate and set the machine for 80% of your calculated maximum heart rate which would be Zone 4. Based on Borg's Perception of Exertion standards (see below), the more complicated formula is probably more accurate.

## Exercise Zones for your exercise goals

- Zones 1 and 2 will improve your health;
- Zones 3 and 4 will improve your fitness and
- Zone 5 will improve your performance.

**Each heart zone burns a different number of calories per minute based on how fit you are.**

Zone 5	20+ calories per minute
Zone 4	17-20 calories per minute
Zone 3	12-17 calories per minute
Zone 2	7-12 calories per minute
Zone 1	3-7 calories per minute

You'll burn a different ratio of fat to carbohydrates in each of the heart zones.

## Heart Rate Zones

**Zone 1 (50 - 60% of MHR)** - The lowest level you can exercise in and still increase fitness levels. For beginners or people who have not exercised for a long period of time. This zone can be for just improving your overall health. It can also be a good recovery zone for people who are over- training and need to take a break. This mode is also good for people who want to lose weight as the main source of fuel used by the body is fat stores.

**Zone 2 (60 - 70% of MHR)** - This is the zone where the heart begins to benefit. Training in this zone will begin improve your hearts ability to pump blood and improve the muscle cells ability to utilize oxygen. In this zone stored body fat is the primary source of energy utilized hence this zone is referred to as the weight management zone. This is a good zone for long slow distance exercise as the body becomes more efficient at feeding the working muscles more efficiently especially with fat as the main fuel source.

**Zone 3 (70 - 80% of MHR)** - This zone is the most effective for overall cardiovascular fitness and is often called the "aerobic zone" or "target heart rate zone". This is the optimal zone to workout in to increase your cardio-respiratory capacity or the body's ability to transport oxygenated blood to the muscle cells and carbon dioxide away from the cells. After a while you will be able to cover more distance during workouts in less time. Your body will burn less glucose and more stored fat as fuel thereby working more efficiently. This zone is also effective for increasing overall muscle strength.

**Zone 4 (80 - 90% of MHR)(85-90%= Anaerobic Threshold)** - this level is where you cross over from aerobic training to anaerobic training which is called the anaerobic threshold or AT. This is the point where the body cannot effectively remove lactic Acid from the working muscles quickly enough. Lactic Acid is a by product of glycogen consumption by the working muscles. This zone is primarily for people who want to increase their performance levels. You would characterize this zone as hard. During this zone your muscles are tired, your breathing is heavy and you're fatigued. The benefit of training in this zone is you can increase your body's ability to tolerate and deal with lactic acid for a longer period of time as the enzymes in your muscles responsible for anaerobic metabolism are increased. For competitors it is good to know your anaerobic threshold as many fit athletes can compete at or about their anaerobic threshold.

**Zone 5 (90 - 100% of MHR)(VO2 Max)** - You will only be able to train in this zone for short periods of time. You should not train at this level unless you are very fit. In this zone lactic acid develops very quickly as you are operating with oxygen debt to the muscles the value of training in this zone is you can increase your fast twitch muscle fibers which increase speed. You will not be able to stay at this level very long and should be used in intervals or sprinting work at the track.

### **Perception of Exertion**

During the exercise you are to rate your perception of exertion. Use this scale where 6 means no exertion at all and 20 means a totally maximum effort. The 13 on the scale is a somewhat heavy exercise but capable of being performed at steady state (i.e., anaerobic threshold). When at a level of 17 the effort level requires you to push yourself hard even though it is possible to continue for some time.

Try to appraise the feeling of exertion as honestly as possible. Do not underestimate nor overestimate it. It is of no value to underestimate the level to produce an impression of being "brave" or "tough". Your own feeling of effort and exertion is all that is of interest. Look at the scale and wordings and decide on the word that best describes your effort level and the number alternative associated with that description.

### **Borg's Ratings of Perceived Exertion (RPE)**

6	No exertion at all
7-8	Extremely light (very, very light)
9-10	Very light (warm-up/recovery)
11	Light
12-13	Moderate
14-15	Hard (400 m swimming pace)
16-17	Very hard (200 m swimming pace]
18-19	Extremely hard (very, very hard, 25-50 m pace)
20	Maximum all-out effort with absolutely nothing being held in reserve

Exercise needs to be judged by the exercising of the heart. Any activity, structured or not is valuable, but all activities are not heart healthy. This presentation explains why.

Remember, it is your life and it is your health.