I. FINDING MAX HEART RATE

- Treadmill Test
- Using a Heart Rate Monitor.
- Do not guess by using 220 minus your age as the often suggested method; this can lead to errors in the calculation.
II. ALTERNATIVE METHODS TO MAXIMUM HEART RATE.

• Jack Daniels VDOT tables can be used.
• Take your 5K time, add a minute, divide by 5, and that will approximate your threshold pace per 1000m. This pace will be your aerobic training. It can be used in repeats of 1000m’s or 1200m’s, or repeat miles. Anything faster than this will be more like anaerobic work.
Historical Cycle
- 10 x 1k at 2:45 with 400 jog
- Based on Tradition and yearly improvement

1st Cycle
- 10 x 1k at 3:10 with 30 sec recovery
- Based on 90% max heart rate or about 87% of Vo2 max pace. The recovery is derived by 70% of max heart rate

2nd Cycle
- 10 x 1k at 2.57 with 45 sec recovery
- Still based on 90% of max heart rate

3rd Cycle
- 10 x 1k at 2.54 with 45 sec to 1 min recovery
- Still based on 90% of max heart rate
Heart Rate Correlation to Training

* = Using 200 MAX H/R, this can vary from athlete to athlete
Push Vs. Pull

Diagram:
- Max H/R
- 90% of Max H/R
- Pull Anaerobic Work (5K Pace)
- Push (15K Pace)
• **Push:**
  
  – **Positives:**
  – Non invasive type training. Therefore, the intensity is manageable and there is less chance of injury and less hemoglobin iron problems.
  – Recovery time is quicker after this type of a workout.
  – It builds oxygen carrying capacity essential for all distance running.
  – Very good indicator and predictor of racing times.

  – **Negatives:**
    It’s so counterintuitive to most athletes. How can running slower than race pace make you run fast? In the early stages of it’s application in training, you will need to explain the importance of doing it. Don’t ram it down their throats – explain why it is so important. Most athletes will buy into it this way.
    
    – Some athletes (particularly in young girls) can’t gain confidence in the early stages and you will have to work around the athlete. A few harder intervals along with the threshold will remedy this. However, constant communication and teaching is important.
• **Pull:**
  
  **Positives:**
  – It does increase VO2
  – It will give the athlete confidence
  – It is essential – but in small doses

• **Negatives:**
  – Invasive Training: These workouts take longer to recovery (sometimes up to 96 hours) and there is the chance that a second workout or a race too close to this workout will impede the seasonal performance of the athlete.
  – Can lead to low hemoglobin and iron depletion.
  – Can bring a peak on too early and consequently bring the season to a quick ending.
  – Can quickly deplete glycogen stores and bring the athlete into glycogen creep.
In Practice

• Tempo run (High school: a steady state run for about 20 to 25 minutes..... College: 4 to 8 miles): Keep Heart Rate at 85% of the maximum already established.

• Repeat 800’s (women) or miles: 90% of maximum but take enough rest in between for a recovery
Threshold Production Time

10 x 1K @ 3:30

3:00 - 45 secs = 2:15
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Total Work Time = 30:00
Total Productive Time = 22:30
Total Production %:
22:30/30:00 = 75%
## Threshold Production Time

<table>
<thead>
<tr>
<th>10 x 1K @ 3:30</th>
<th>6 x Mile @ 5:00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
<tr>
<td>3:00 - 45 secs = 2:15</td>
<td>5:00 – 45 secs = 4:15</td>
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</table>

**Total Work Time = 30:00**

**Total Productive Time = 22:30**

**Total Production %:**

\[ \frac{22:30}{30:00} = 75\% \]
## Threshold Production Time

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
<th>Total Productive Time</th>
<th>Total Production %</th>
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<tbody>
<tr>
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<tr>
<td>6 x Mile @ 5:00</td>
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<td>4:15</td>
<td>87%</td>
</tr>
<tr>
<td>5 x 2K @ 6:00</td>
<td>5:15</td>
<td>5:15</td>
<td>85%</td>
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</tbody>
</table>

**Total Work Time:** 30:00  
**Total Productive Time:** 26:15  
**Total Production %:** 26:15/30:00 = 87%
# Threshold Production Time

<table>
<thead>
<tr>
<th>Task</th>
<th>Time</th>
<th>Duration</th>
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<tbody>
<tr>
<td>10 x 1K @ 3:30</td>
<td>3:00</td>
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</tr>
<tr>
<td>6 x Mile @ 5:00</td>
<td>5:00</td>
<td>4:15</td>
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<tr>
<td>5 x 2K @ 6:00</td>
<td>6:00</td>
<td>5:15</td>
</tr>
<tr>
<td>2 x 5k @ 15:00</td>
<td>15:00</td>
<td>14:15</td>
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**Total Work Time:** 30:00

**Total Productive Time:** 28:30

**Total Production %:** 28:30/30:00 = 95%

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<table>
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<td>5:15</td>
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<td>2 x 5k @ 15:00</td>
<td>15:00</td>
<td>14:15</td>
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**Total Work Time:** 30:00

**Total Productive Time:** 26:15

**Total Production %:** 26:15/30:00 = 87%

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<td>5:15</td>
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<tr>
<td>2 x 5k @ 15:00</td>
<td>15:00</td>
<td>14:15</td>
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**Total Work Time:** 30:00

**Total Productive Time:** 22:30

**Total Production %:** 22:30/30:00 = 75%
<table>
<thead>
<tr>
<th>Person</th>
<th>marcus</th>
<th>Date</th>
<th>10/18/2002</th>
<th>Heart rate</th>
<th>163 / 234</th>
<th>Limits 1</th>
<th>80 - 160</th>
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<tbody>
<tr>
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<td>Running</td>
<td>Duration</td>
<td>1:00:43.0</td>
<td>Distance</td>
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<td>10/1/2002 3:40 PM</td>
<td>Time</td>
<td>3:40:13 PM</td>
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<td>Duration</td>
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<td>Distance</td>
<td></td>
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<tr>
<td>Note</td>
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<td>Selection</td>
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<td></td>
<td>0:00:00 - 0:33:30 (0:33:30.0)</td>
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Running in the pool-8x3min

<table>
<thead>
<tr>
<th>Person</th>
<th>marcus</th>
<th>Date</th>
<th>12/15/2002</th>
<th>Heart rate</th>
<th>148 / 165</th>
<th>Limits 1</th>
<th>80 - 160</th>
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<tbody>
<tr>
<td>Sport</td>
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<tr>
<td>Note</td>
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Running in the pool-20x1min

<table>
<thead>
<tr>
<th>Time</th>
<th>HR [bpm]</th>
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<td>0 bpm</td>
</tr>
<tr>
<td>0:05:00</td>
<td>125</td>
</tr>
<tr>
<td>0:10:00</td>
<td>150</td>
</tr>
<tr>
<td>0:15:00</td>
<td>175</td>
</tr>
<tr>
<td>0:20:00</td>
<td>200</td>
</tr>
<tr>
<td>0:25:00</td>
<td>250</td>
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</table>

Person: marcus  
Date: 12/12/2002  
Time: 4:58:59 PM  
Max. HR: 180  
Limits 1: 80 - 160  
Selection: 0:00.00 - 0:27.25 (0:27.25.0)
Languages

- The language of pace
- The language of heart rate
- The language of Vo2 Max
- The Language of Lactate
Top end of Anaerobic Threshold

- 90% of max heart rate
- 87% of Vo2 max pace
- 3.5 ml of lactate
- 15k to ½ marathon
Anaerobic Threshold

- Heart rate: 87% of Max heart rate
- Vo2 max: 85% of Vo2 max
- Lactate: Under 3.5 mls of lactate
- Pace: Closer to your marathon pace
Vo2 Effort line

- 120% 800m
- 102% 3k
- 97% 5k
- 87% Vo2 max ≈ 90% max heart rate
- 82% marathon
- 65% Aerobic Threshold
- 110% 1500m
- 100% Vo2 Max 2mile time trial
- 92% 10k
- 85% Anaerobic Threshold and long efforts
- 80% and above for Tempo
Example of a 10 min 2 miler. Use this value to calculate his anaerobic threshold

1. **Vo2 max**
   - 10 minutes in the 2 mile
   - This is 5 minutes a mile pace. This is the Vo2 max speed

2. **Convert**
   - Convert Vo2 max speed to seconds
   - 5 x 60 = 300 seconds

3. **Calculate anaerobic threshold**
   - Now calculate the anaerobic threshold by taking 85% of the Vo2 speed
   - This is done by dividing ... 300 ÷ .85 = 352 seconds = 5min 52 sec mile pace
Example of a 9 min 2miler. Use this value to calculate the anaerobic threshold

- 9 minutes in the 2 mile
- This is 4.30 a mile pace. This is the Vo2 max speed

- Convert Vo2 max speed to seconds
  - $4 \times 60 + 30 = 270$ seconds

- Now calculate the anaerobic threshold by taking 85% of the Vo2 max speed
  - This is done by dividing....... $270 / .85 = 318$ sec or 5min 18sec
Find Your Event and Look for the Balance

Lactate Threshold / Aerobic
Gas Tank with a Slow Leak

VO2 / Anaerobic
Engine

Leak in the gas tank caused by one of three things:
1) Speed work
2) Racing
3) Time-off from running
Push Vs. Pull

Max H/R

90% of Max H/R

Push (15K Pace)

Pull Anaerobic Work (5K Pace)
• **Push/Aerobic**
  • 6-8 x 1000m
  • @ 15K pace
  • with 60 sec. recovery

• 5 x mile
  • @ 15K pace
  • with 90 sec. recovery

• 16 x 400
  • @ 10K pace
  • with 100 steady jog

• **Pull/Aerobic**
  • 5 x 1000m
  • @ 5K pace
  • with 3-4 min.

  • 3-4 x mile
  • @ 5K pace
  • with 4 min.

  • 10-12 x 400
  • @ 5K pace
  • with 200-400 jog
Vo2 Effort line

- 120% 800m
- 102% 3k
- 97% 5k
- 87% Vo2 max ≈ 90% max heart rate
- 82% marathon
- 65% Aerobic Threshold
- 110% 1500m
- 100% Vo2 Max 2-mile time trial
- 92% 10k
- 85% Anaerobic Threshold and long
- 80% and above for Tempo
#3 Lactate System

- Carbohydrates/glycogen is required
- Lactic acid is no longer neutralized
- Lactic acid accumulates to form acidosis
- Oxygen fades from this system.

\[
\text{ADP + glycogen} \rightarrow \text{lactic acid + ATP}
\]

When is this system utilized?

- First 2-3 minutes of a race
- Surges & hills
- Final stages and sprint finish
• **Important Points:**
• (1) Acidosis will damage muscle cell walls and decrease aerobic capacity
• (2) It can take from 24-96 hours for things to get back to normal.
• (3) Acidosis in the muscles can increase the chances of injury.
• (4) Glycogen reserves can be heavily depleted.
Putting it all Together

The Key: Do not forget to periodically put tempo and lactate threshold training in this phase of training. The mileage can be lowered as it will not affect the base too much.
Transition

• Now that the build-up phase is complete (push strategy), a transition into the track season can be done with VO2 type workouts (pull strategy).

    Example:
    5 x 1000m  @ 5k pace with 3-3 1/2 min. recovery

    or   4 x 1200m  @ 5k pace with 4 min. recovery

    or   6 x 800m   @ 5k pace with 3 min. recovery

This transition will take about 4 weeks. One workout per week is ample. The transition can be enhanced by taking the workouts above and adapt them to the event you are training for.
• **Example 1:**
• 1600 meters
• 4 x 300 @ (pace: the athlete can race at that time)
• with 100 jog. After the set is complete, give the athlete 5 min. to recovery; i.e. the athlete who is in 4.40 1600 meter shape can run the following:
• or (4 x 300 @ 52-53 with 100 jog) x 3 with 5 min. recovery between the set.
• or (3 x 300 @ 52/53 with 100 jog) x 3-4 times with 5 min. recovery between sets.
Example 2:

- 800 m
- 4 x 200 (@ pace you think the athlete can race at that time) with 100 jog and 5 min. between the sets; i.e., an athlete who can run 2 min. for 800 can run the following:
  - or (4 x 200 @ 30 sec. with 100 jog) x 3 with 5 minutes between the sets.

  This transition will keep the athlete close to race pace while developing his or her VO2 capacity.

Note: Err on the side of caution when guessing what they can run for their event. Bear in mind that the transition will be done before the season starts and you will have to estimate their racing ability at that particular time of year.

Visual sign: The athlete should be able to complete Set 1 without difficulty. Half of Set 2 should be challenging and most if not all of Set 3 should be a challenge.
3k or 2 mile athlete

Example 3
3x400 with a 200 Jog @ 2 mile race pace
Repeat this 2 to 3 times with 5 min between the sets
So if the athlete runs 10 min for the 2 mile
Then you would do 3x400@75 pace with a 200 jog
Repeat 2 to 3 times depending on the athlete
The Mature 2 miler

8 x 800 @ 5k pace
or
6 x 800 @ 3k pace
or
4 x 800 @ sub 3k pace

All with full recovery
Be creative!

There is nothing set in Stone
The work out could be the following
Mile at 5k pace
4 min recovery
2x800 @ 3k pace
3 min between each
4x400 @ 3k to mile pace
400 jog between
Speed Work

• This will be introduced @ the end of the transition phase to continuing to develop VO2.

• It will be sub race pace with very good amounts of recovery.

Example:
Race type of speed work
5K – 8 x 400 @ 3K pace with 3 min. recovery.
3K – 6 – 8 x 400 @ 1600 – 3K pace with 3 min. recovery.
1600 – 4-6 x 400 @ just below 1600 pace with 3 min. recovery.
800 – 3-4 x 400 @ sub 800 race pace with 3 to 5 min. recovery.
• **Lactate Tolerance:**

Training to develop the ability to race with large quantities of lactate.

The workouts will be short

Split 600’s

Split 800’s

**Example:**

800 meter athlete with 2.00 ability:

(400 @ just slower than 800 pace – 20 second standing recovery with 200 very hard) x 2-3 times with a 5-6 min. recovery.

400 @ 62 with 20 second recovery followed by 200 @ hard as they can.

This can be done 2-3 times with 5-6 min. recovery.

(600 @ 1600 pace or a bit quicker – 20 second standing recovery with 200 meters very hard) x 3-4 times with 5-6 min. recovery.

(600 @ 1.36 – 20 second recovery followed by 200 meters hard) x 3-4 times with 6 minute recovery.
Lactate Diffusion

- To teach the body to diffuse lactate in a race.
- e.g., (300 meters very hard – 20 sec. standing recovery followed by 400-600 meters @ tempo to threshold) x 4 times with 5 min. recovery.
- This is a hard effort of 300 meters followed by a slow 400 to 600 meters. The athlete will have legs feeling like “jelly” when they set out for the slower portion; however, if it is done correctly, they should be recovering as the slower portion comes to a close.
Speed & Form

- Drills and short speed work – strides and 40 meter pick ups can be done throughout the year. This will aid in all transition moving from cardio build-up to VO2. This can be performed all year round with intervals and breaks with the regular season.

- 100 @ 17 sec.
- Walk back to 110 meters
- 110 @ 18 sec.
- Walk back to 120 meters
- 120 @ 19 sec.
- Walk back to 130 meters
- 130 @ 20 sec.
- Walk back to 140 meters
- 140 @ 21 sec............
- Continue to
- 200 @ 27 sec.
Speed Workout:

- Can be used as a secondary workout of the week – fun for the athletes. There is no need to go all the way to the 200 meter start. Any number of repeats is good. The key is to start the first interval (100 meters) at the correct pace. It’s harder to do than you think as the pace starts out relatively slow and gradually picks up with the additional second not matching the 10 meter increase in distance.

Note: Keep it away from all major races. It can leave the legs heavy for a couple of days.
Early in the season during the build up stage the emphasis will be on the aerobic components of training – mileage, tempo and threshold.
Keep it Balanced

It is safe when you have both anaerobic components and aerobic components

Anaerobic

VO2

Aerobic

Threshold

athlete
Modification for the athlete

If the athlete responds negative toward hard efforts (anaerobic/Vo2). Skew the workouts toward threshold and modify the amount of hard efforts. The races will become the anaerobic workouts.
Middle Distance Runners

Middle distance runners are certainly more receptive to anaerobic workouts. Therefore it is usually safe to stay balanced or skew the athlete slightly closer to more anaerobic training.
Danger Zone

Too much emphasis on the anaerobic workouts may lead to injury, iron deficiency, and overtraining.
During the season, the emphasis will be both anaerobic development and the continuation of threshold and tempo. You will skew it toward anaerobic but you never relinquish the aerobic component.
Toward the end of the season – it is not uncommon to skew the training back to Aerobic components and lessening the anaerobic components (at least de-emphasize the harder training) in the effort to preserving the racing form of the athlete.
NEVER ENDING CYCLE
NEVER ENDING CYCLE
Questions & Answers