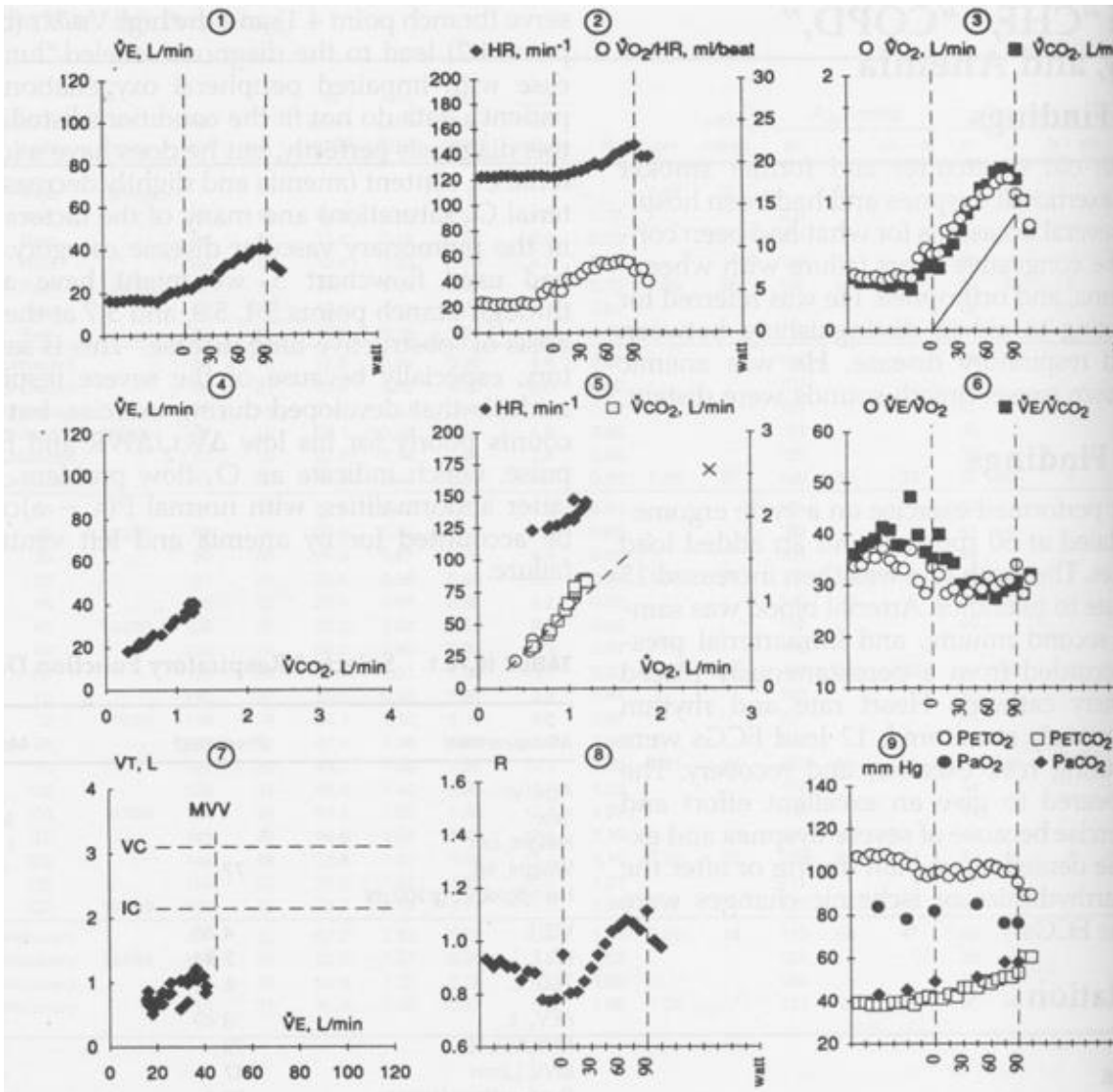


## The Original Wasserman 9 panel Plot, the New Wasserman 9 Panel Plot, the Whipp 9 Panel Plot and the ERS version of the Whipp Plot

Everybody in the world of cardiopulmonary exercise testing (CPET) is familiar with the 9-Panel Plot. Perhaps the question should be which version. There are certainly four in current use so perhaps it would be of interest to look at them and compare them. Certainly, graphical analysis was used back in the 1970's <sup>(1)</sup> but a book published in 1987 was the first to portray some 15 measured or derived parameters from a CPET in a graphical format of 9 graphs on one page. <sup>(2)</sup>

### The original Wasserman 9 Panel Plot



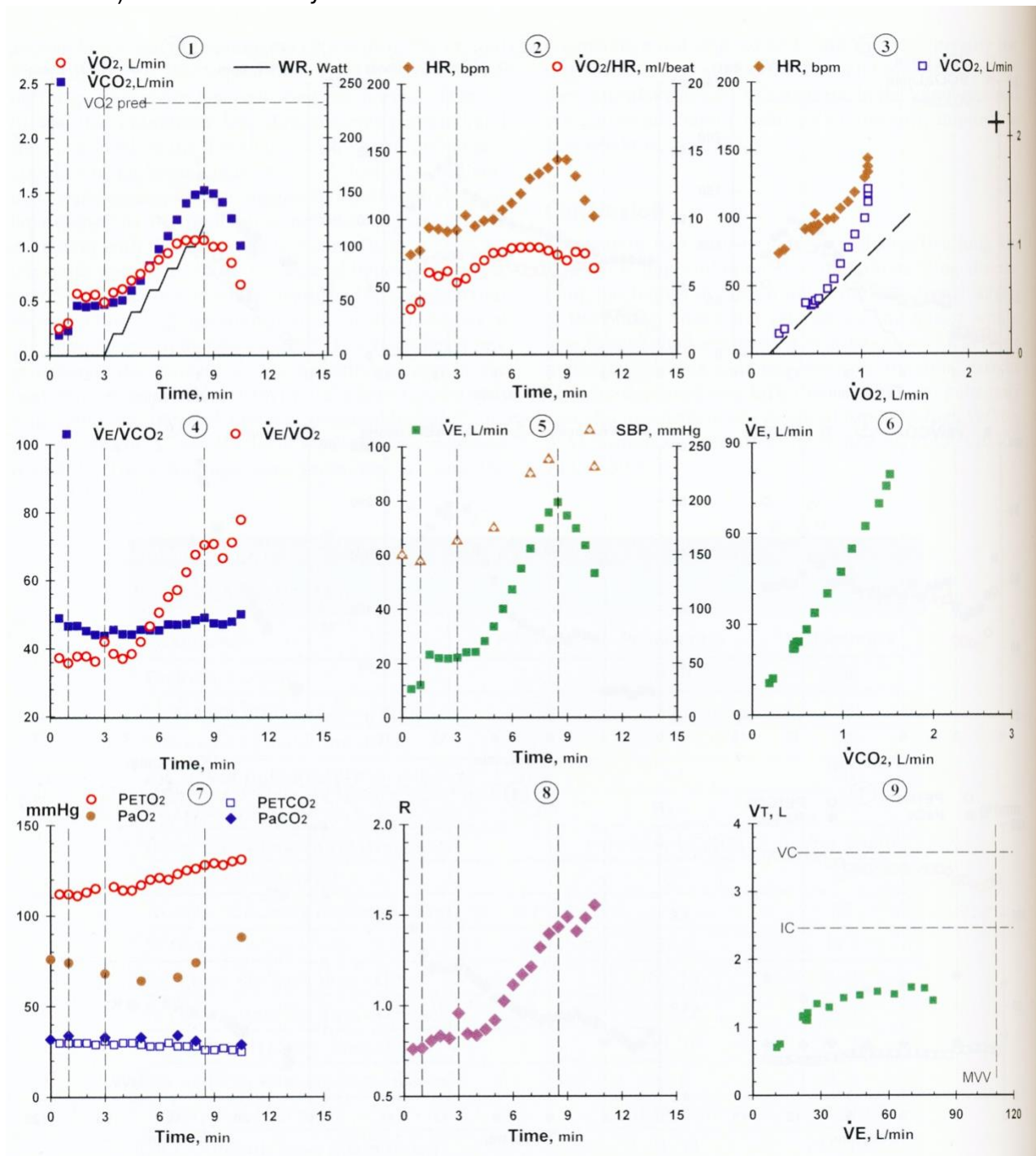
**Panel 1**  $\dot{V}_E$  vs. Watts **Panel 2** HR &  $\dot{V}O_2$ /HR slope **Panel 3**  $\dot{V}O_2$  &  $\dot{V}CO_2$  vs. Watts  
**Panel 4**  $\dot{V}_E$  vs.  $\dot{V}CO_2$  **Panel 5** HR &  $\dot{V}CO_2$  vs.  $\dot{V}O_2$  **Panel 6**  $\dot{V}_E/\dot{V}O_2$  &  $\dot{V}_E/\dot{V}CO_2$  vs. Watts  
**Panel 7**  $V_t$  vs  $\dot{V}_E$  **Panel 8** RQ vs Watts **Panel 9**  $PETO_2$ ,  $PETCO_2$ ,  $PaO_2$  &  $PaCO_2$

The plots were in black and white up to the fifth edition of the Wasserman et al. book in 2011 <sup>(3)</sup>.

In 2011 the new edition not only had a different positioning of the various panels but they were also printed in colour. The panels contents remained much the same.

## The new Wasserman 9 Panel Plot

The 3 vertical lines in first two columns are 1) onset of unloaded cycling 2) increase in work rate and 3) onset of recovery.

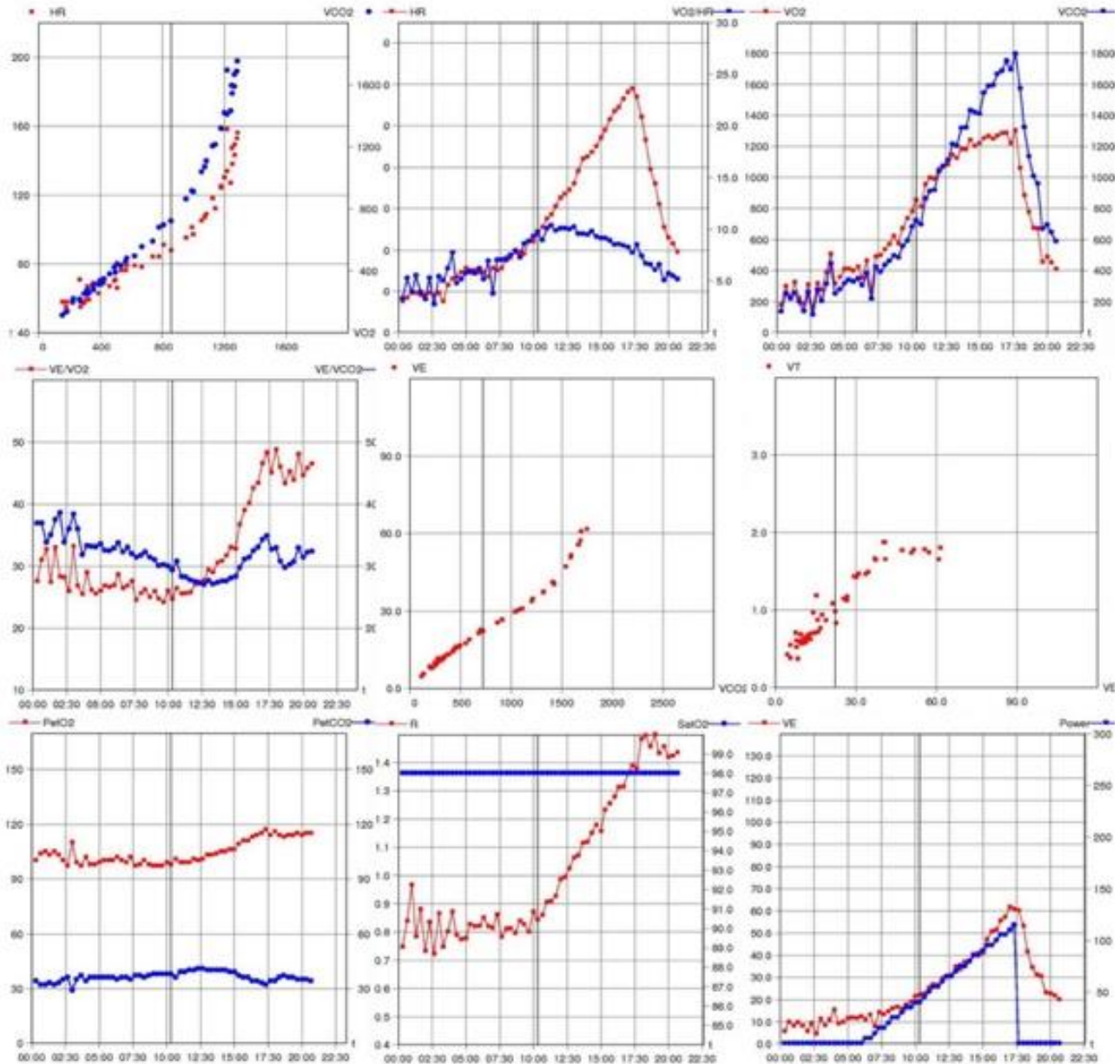


**Panel 1**  $\dot{V}O_2$ ,  $\dot{V}CO_2$  and Watts vs. Time **Panel 2** HR &  $\dot{V}O_2/HR$  vs. Time  
**Panel 3** Heart Rate &  $\dot{V}CO_2$  vs.  $\dot{V}O_2$  **Panel 4**  $\dot{V}E/\dot{V}CO_2$  &  $\dot{V}E/\dot{V}O_2$  vs. Time  
**Panel 5**  $\dot{V}E$  & SBP vs. Time **Panel 6**  $\dot{V}E$  vs.  $\dot{V}CO_2$   
**Panel 7**  $PETO_2$ ,  $PETCO_2$ ,  $PaO_2$  &  $PaCO_2$  vs Time **Panel 8** RQ vs Time **Panel 9**  $V_t$  vs  $\dot{V}E$

In this 9 Panel plot the Anaerobic threshold can be determined from panels 3, 4 and 7. The “+” in Panel 3 is predicted maximum HR. The horizontal lines in Panel 9 are the predicted “VC” & “IC”.

## The Original Whipp 9 Panel Plot

This plot by Professor Whipp was developed in 2008 (Personal communication). There is a slightly different version used by the European Respiratory Society but in essence it is very similar.



**Panel 1** HR &  $VCO_2$  vs  $VO_2$  **Panel 2** HR &  $VO_2$  vs. Time **Panel 3**  $VO_2$   $VCO_2$  vs Time  
**Panel 4**  $Ve/VO_2$  &  $Ve/VCO_2$  vs  $VO_2$  **Panel 5**  $Ve$  vs  $VO_2$  **Panel 6**  $Vt$  vs  $Ve$   
**Panel 7**  $PETO_2$  &  $PETCO_2$  vs  $VO_2$  **Panel 8**  $RQ$  &  $Satn$ , vs Time  
**Panel 9**  $Ve$  & Watts vs. Time

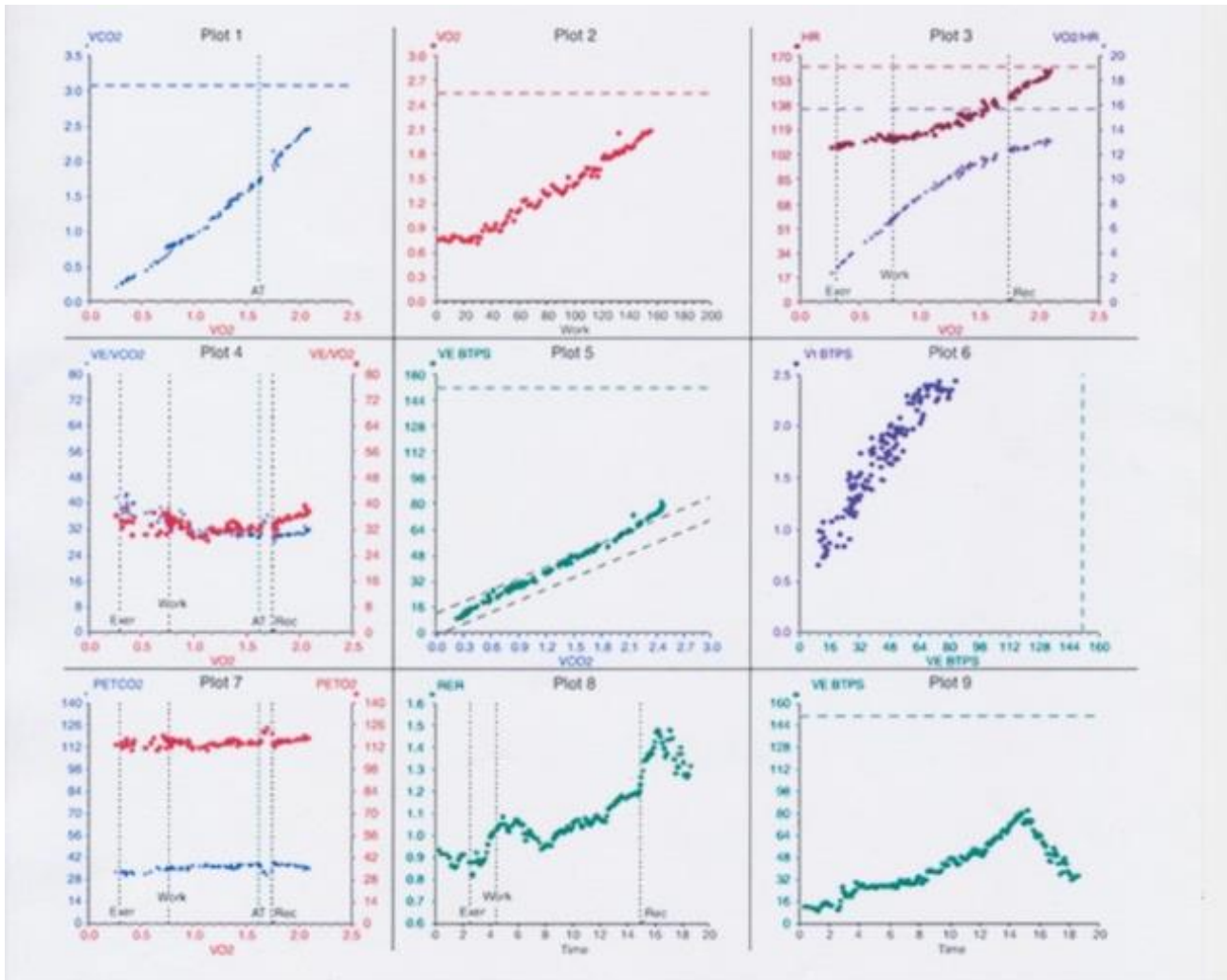
The Whipp plot differs in many important ways to the other plots in regards to the actual position of each panel in the page.

Column 1 (panels 1, 4 and 7) all allow for determination and confirmation of the anaerobic threshold (AT). This is marked by a vertical line through all three graphs with the X-axis being the  $VO_2$  at the AT.

Row 1 (panels 1, 2 and 3) displays other cardiovascular values.

Row 2 (Panels 4, 5 and 6) presents ventilatory data.

## The ERS Version of the Whipp 9 Panel Plot



**Panel 1**  $VCO_2$  vs  $VO_2$  **Panel 2**  $VO_2$  vs Watts **Panel 3** HR &  $VO_2/HR$  vs  $VO_2$   
**Panel 4**  $VE/VCO_2$  &  $VE/VO_2$  vs  $VO_2$  **Panel 5** -  $VE$  vs  $VCO_2$  **Panel 6**  $V_t$  vs  $V_e$   
**Panel 7**  $PETO_2$  &  $PETCO_2$  vs  $VO_2$  **Panel 8** - RQ vs Watts (or time)  
**Panel 9**  $VE$  vs Watts (or time)

The same information is available in this version as is in the original Whipp plot, but the placement of the panels is different.

The original Wasserman plot has been replaced in the latest book <sup>(3)</sup> by the new plot and is the version to be used. If you wish to use the Whipp plot and it is not already on your machine then contact your CPET machine supplier to obtain an upgrade. If you wish to use the European Respiratory Society version of the Whipp plot contact the ERS for access.

## Legend

ERS = European Respiratory Society; HR = heart rate; RQ = respiratory quotient;  
Satn = saturation; SBP= systolic blood pressure  
VC = vital capacity; IC = predicted inspiratory capacity

## Suggested reading

Graphical Data Display for Clinical Cardiopulmonary Exercise Testing  
D. Dumitrescu and S. Rosenkranz  
Ann Am Thorac Soc 2017 Vol. 14 Issue Supplement\_1 Pages S12-S21

## References

### 1. A new method for detecting anaerobic threshold by gas exchange

W. L. Beaver, K. Wasserman and B. J. Whipp  
J Appl Physiol (1985) 1986 Vol. 60 Issue 6 Pages 2020-7

### 2. Principles of Exercise Testing and Interpretation

K. Wasserman, C. Hansen, W. Stringer, K. Sietsema, C. Sun and B. Whipp  
Publisher: Lea & Febiger 1987 1<sup>st</sup> edn.

### 3. Principles of Exercise Testing and Interpretation

K. Wasserman, C. Hansen, W. Stringer, K. Sietsema, C. Sun and B. Whipp  
Publisher: Lippincott Williams & Wilkins 2011