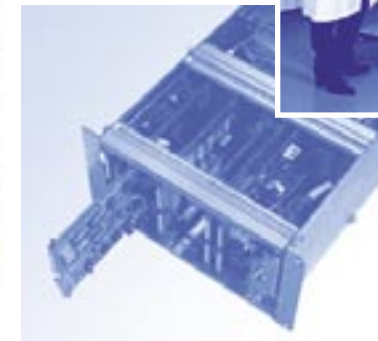
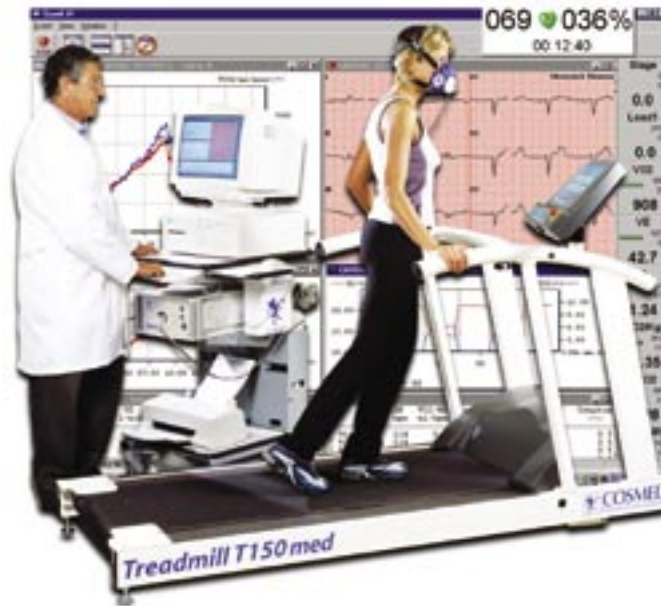


### Key Features

- △ **Breath by Breath Gas Exchange data analysis (VO<sub>2</sub>, VCO<sub>2</sub>)**
- △ **Integrated 12-lead ECG for Stress Testing**
- △ **Indirect Cardiac Output**
- △ **Resting Metabolic Rate**
- △ **Fastest analyzers in the market**
- △ **Integrated Oxygen Saturation (SpO<sub>2</sub>)**
- △ **Spirometry**
- △ **Windows XP™ Compatible**

The Gold Standard for accurate Pulmonary Gas Exchange analysis and integrated 12-lead Stress Testing ECG



### Overview

#### Reliable data... every time!

The Quark b<sup>2</sup> Pulmonary Gas Exchange system is an accurate, easy to use and dependable tool used to assess cardiorespiratory function with breath by breath resolution. The Quark b<sup>2</sup> can integrate state of the art metabolic data together with diagnostic quality 12-lead ECG output. Spirometry, oximetry, cardiac output and a PC based ergometer controller are optional features that can be utilized with the Quark b<sup>2</sup>.

#### Unsurpassed Accuracy

Quark b<sup>2</sup> is equipped with the fastest O<sub>2</sub> sensor available in the market. No shortcuts were taken. Superior specifications and quality design assure many years of accurate data. Quark b<sup>2</sup> exceeds the accuracy standards of the American Thoracic Society and the European Respiratory Society. Preeminent researchers were consulted to assure that the Quark b<sup>2</sup> gives precise data in a flexible, customized format.

#### Ultimate Software

Quark b<sup>2</sup> is provided with the well proven COSMED software family for CPET management. User-friendly interfaces, intuitive commands and icons make Quark b<sup>2</sup> the perfect tool for fast and reliable data collection in any research or clinical environment. The 24 month warranty on software includes free upgrades to new releases.

#### Applications

Quark b<sup>2</sup> has been designed with the clear aim to **meet Sport Science requirements**. However we have included features which will benefit any discipline that requires metabolic assessment. Exercise Physiology, Sports Science, Pneumology, Cardiac Rehabilitation, Occupational Medicine and Nutrition assessment are fields which will appreciate the functionality of the Quark b<sup>2</sup>.

#### EASY Technical Support

This is an important point for any application that can't afford significant downtime. Quark b<sup>2</sup> has been designed to be reliable and very easy to service. The quality of the components and the plug and play architecture make servicing simple. Each electronic board (sensors, valves, etc.) is factory calibrated and incorporates all components. **No technical expertise is necessary to service Quark b<sup>2</sup>!**

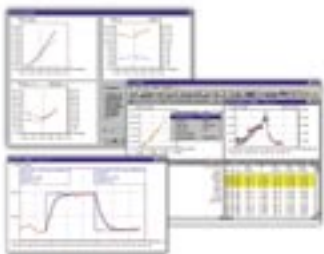


## Software Features - Cardio Pulmonary Exercise Testing

COSMED software is a true Windows™ program, offering familiarity, simplicity, and versatility. In addition to the ease of transferring data into other Windows™ programs, this powerful software offers the following features: Quark b² software allows users to have full access to the gas exchange data. Tests are stored in both Raw and processed format, thus enabling researchers to have full flexibility in the way they manage data.

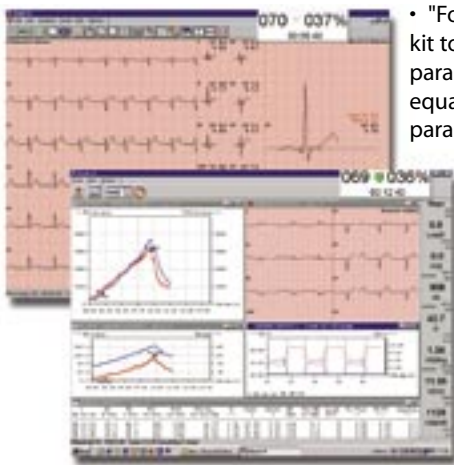
### Real Time View

- Data viewing in both tables and graphs format.
- Real time O<sub>2</sub> and CO<sub>2</sub> waveform display.
- Flow-Volume loops during exercise and overlapped on resting FVC to assess ventilatory limitation.
- Ergometer control, via RS-232 interface, allows user easy protocol setup and dynamic changes.



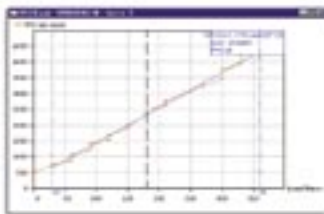
### Powerful Data Analysis

- Automatic and manual detection of anaerobic threshold according to the Modified V-Slope method (Wasserman).
- Access data in a spreadsheet format for advanced data elaboration (filtering, smoothing, etc.).



Software shows Gas Exchange data and continuous 12-lead ECG simultaneously

- Standard and custom Exercise protocols design.
- O<sub>2</sub> Kinetics feature automatically provides O<sub>2</sub> debt, O<sub>2</sub> deficit and tau values during any constant stage.
- The "Fitting" feature (both linear and exponential) increases data elaboration to levels obtained only with expensive statistical software packages.



Example of Linear Custom Fitting (VO<sub>2</sub>/Work Load)

- Each test can be exported in a single file available in different file formats (ASCII, Excel, Lotus etc.)
- Built-in "email test" feature for easy transfer of tests to different locations.

- "Formula Editor" toolkit to add user defined parameters and predicted equations to the existing parameters and norms.

### Stress Testing ECG

Only COSMED gives you the power to fully integrate 12-lead ECG with breath by breath metabolic data from portable or lab based systems. Developed in conjunction with a world leader in ECG technology, the PC card based **Quark**

**T12** and **C12** ECGs offer the following features:

- True diagnostic quality waveforms
- Continuous 12 lead viewing
- Single or multiple leads views including zoom and freeze features
- Current and reference ST analysis profiled for 12 leads
- ST depression and slope trends displayed during test
- Averaged QRS complexes overlapped on a reference ECG complex
- Real time laser printout

### Resting Metabolic Rate

RMR (Resting Metabolic Rate) is an important parameter to calculate the balance between intake and consumed calories within a day. The software automatically provides protocol, simple view and data analysis for RMR studies.

### Powerful Reporting

The software is provided with a powerful tool to generate various printout reports.

Standard reports following international guidelines are available and in addition users can modify or save different reports according to their needs.

- **9-plot Wasserman** report can provide single page report with the 9 graphs and additional test results for an easy clinical interpretation.
- **Anaerobic Threshold** printout with graphs and data reached at the AT point, Max values and % on the Max values.



Printed reports can be customized according to the user's requirements

- **Test-Summary Results**, provides data for a simple and easy interpretation.
- **RMR Report**, provides comprehensive interpretation for users interested in Nutritional studies.
- **ECG Reports** can be printed either on standard paper or by means of a preprinted grid paper.



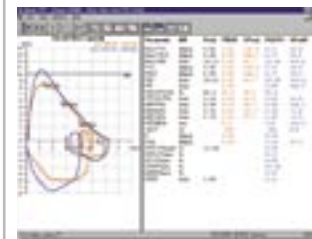
Software provides 12-lead, Summary and ST average reports

## Optional Software Features

### Spirometry

Spirometry software allows users to perform screening spirometry in a simple and accurate way.

- Complete database management for patients, diagnosis, clinical report, broncho-challenge protocols.
- Easy management of broncho-challenge test by means of user-defined protocols.
- Quality Control messages according to the latest ATS and ERS recommendation.
- Best Test selection and results reproducibility according to ATS 1994 standards.
- Detailed printing of F/V, V/t, broncho-challenge response graphics, PD 10, 15 and PD 20 calculation.
- Auto-calculation of key interpretive indices (ERS '93) for bronchodilator and broncho-constrictor tests.



- Pre-Post test with either bronchodilator or metacholine.
- Trend analysis on multiple parameters.
- Software encouragement tool for pediatric or non-cooperative patients.
- More than six selectable sets of predicted values and unlimited number of user defined sets.
- New NHANES III predicted equations included.

- FEV6 parameter and related calculations now measured.

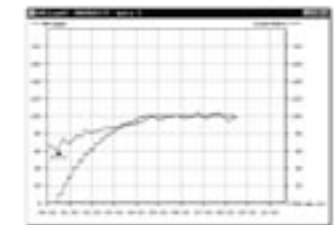
- Printout report according to the ERS-ATS requirements.
- Automatic Test Interpretation based upon ERS '93 and ATS '94 criteria.

### Physiotrainer

is an optional software module that can be integrated with Quark b² to dynamically control the work load of any ergometer in order to reach and maintain a desired value for most of the physiological "effort-dependent" parameters such as VO<sub>2</sub>, VO<sub>2</sub>/Kg, HR and VE.



This is obtained by controlling the work load according to a feedback algorithm based on the target value of the parameter, the actual value, and the dynamics of its change.



The plot shows an example of how the work load of the ergometer is automatically set by PhysioTrainer in order to reach and maintain the Heart Rate to 100 beats/min.

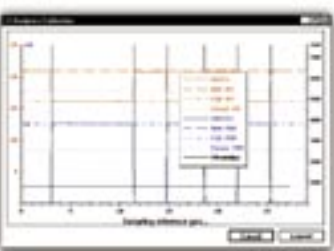
» New Features



## Hardware Features

### Gas Analyzers

Quark b<sup>2</sup> uses the most accurate, stable and fastest Zirconium Oxygen and NDIR Carbon Dioxide analyzers available. Both sensors are thermostated, while pressure and sampling rate are maintained constant by a feedback control system. A Nafion sampling tube minimizes maintenance and assures optimum humidity removal.



*Calibration procedure is fully software assisted. Diagrams and numbers are prompted to verify calibrations*

### Flow Volume Sensor

The COSMED digital turbine flowmeter ensures accuracy within a wide flow range (0-300 L/minute). Resistance to flow is less than 0.7 cmH<sub>2</sub>O/L/s@12 L/s. The Turbine design is not affected by changes in test conditions. The flow meter is connected to our innovative mouth/nose breathing face masks. To assure a good fit, Small, Medium and Large sizes are provided. The low



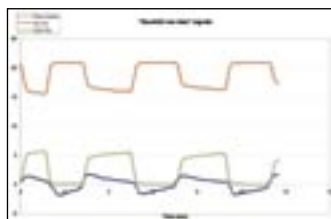
dead space volume reduces rebreathing while two one-way valves reduce inspiratory resistance and allow moisture removal. Mouthpiece with saliva trap can also be used and it's available as an option.

### Comprehensive Calibration

Analyzer and flowmeter calibration is easy, quick and fully software assisted. Comprehensive plots and numbers are also provided in order to understand system behavior and to avoid "fastidious black numbers" for the user. Warning messages are prompted to eliminate errors. Full calibration procedures can be carried out in less than a minute.

### Raw Data Analysis

Quark b<sup>2</sup> measures data at a sampling frequency of 100 Hz. Raw data can be exported in ASCII format for advanced elaboration.



*Example of exported O<sub>2</sub>, CO<sub>2</sub>, and volume waveforms in an ASCII file*

» The new flowmeter ensures maximum precision over a wide range of ventilation (0-300 L/min)

### Low Maintenance and Easy Servicing

Quark b<sup>2</sup> has been designed to be very reliable and easy to maintain. The quality of componentry and the Plug and Play architecture make servicing simple. No technical expertise is necessary!

Disinfect the masks and turbine and change the sample line periodically, That's it!



### Analog-Digital Interfaces

With eight analog inputs, an RS-232 port, and a digital input; the Quark b<sup>2</sup> is capable of integrating data from numerous sources.

*In alternative to masks, a mouth-piece w/ saliva trap can be used connected with the flowmeter*



*Quark T12. 12-lead Telemetry ECG*



*Quark C12. 12-lead ECG*

*For more information concerning the COSMED ECGs please refer to Quark T12 and C12 product brochure*

## Optional Hardware Features

Quark b<sup>2</sup> is available in different configurations, furthermore several options and accessories are available to complete your Quark b<sup>2</sup> upon request.

### COSMED 12-lead ECGs

is available in both telemetry and direct connect configurations.

- **Quark T12** (Telemetry)
- **Quark C12** (patient cable)

Options

- Arrhythmia analysis.
- Resting ECG interpretation.



*12-lead ECG technology is built in a PCMCIA card, preventing product obsolescence*

### Blood Pressure Measurement

Quark b<sup>2</sup> can be supplied with integrated equipment to program BP readings to automatically occur at specified times within a test protocol.

### Indirect Cardiac Output

An alternative to the standard Wasserman CO, users can also choose the well known CO<sub>2</sub> rebreathing method. The kit is provided as an option and requires the use of different CO<sub>2</sub> mixtures.

### Pulse Oximeter

Oxygen saturation may be monitored during exercise using a pulse oximeter (SpO<sub>2</sub>) provided with either finger or ear probes.



### High/Low FiO<sub>2</sub> Kit

Kit of accessories for Gas Exchange measurements using hypoxic and hyperoxic gas mixtures.

### Ergometers

COSMED provides a wide selection of treadmills and bikes. For more information please refer to the Treadmill and/or Bike product brochures.



*COSMED V500 Medical Bike*

Test Reference Table	Standard	Option
<b>Pulmonary Gas Exchange</b>		
"Breath by Breath" Pulmonary Gas Exchange	•	
Anaerobic Threshold	•	
Oxygen Kinetics	•	
Exercise Flow Volume Loops	•	
Kit for Hi/Low FiO2 tests		•
<b>Metabolism</b>		
Resting Metabolic Rate	•	
Substrate Metabolism	•	
<b>Cardiovascular</b>		
Integrated 12-lead Stress Testing ECG		•
Resting ECG Interpretation		•
Arrhythmia Analysis		•
Integrated Pulse Oxymeter		•
Indirect Cardiac Output (Wasserman)	•	
Indirect Cardiac Output (CO <sub>2</sub> Rebreathing)		•
<b>Spirometry</b>		
Forced Vital Capacity (Pre-Post)		•
Slow Vital Capacity		•
Respiratory Pattern		•
Maximum Voluntary Ventilation		•
Broncho-Challenge Test		•

### Measured Parameters

The system allows breath by breath measurements for the calculation of the following main parameters:

#### Breath by Breath Data

Time, Ti, Te, Ttot, Vt, Rf, End Tidal O<sub>2</sub> and CO<sub>2</sub>, VO<sub>2</sub>, VCO<sub>2</sub>, R, VE, HR, FeO<sub>2</sub>, FeCO<sub>2</sub>, VD/Vt, PaCO<sub>2</sub>, P(a-et)CO<sub>2</sub>, PAO<sub>2</sub>, VE/VO<sub>2</sub>, VE/VCO<sub>2</sub>.

#### Cardiorespiratory

HR, HR reserve, O<sub>2</sub> pulse. Plus the following options:

- 12-lead Stress Testing ECG
- Pulse Oximeter
- Cardiac Output
- Automated Blood pressure

#### Nutritional Assessment

RMR, EE (Kcal/day), EE (Kcal/min), EE (Kcal/h), EE/BSA, EE/Kg, FAT, CHO, PRO, npRQ, BMI, Steady State (VO<sub>2</sub>, VE and R stability thresholds)

#### Predicted Values

VO<sub>2</sub> max, VEmax, VO<sub>2</sub>@AT, VEmax, Rfmax, HRmax, BR, HRR, VO<sub>2</sub>/HRmax, Vtmax, Jones equations, REE (Harris Benedict equation).

The software also provides the powerful "Equation Editor" tool. You can create user defined equations for calculating unlimited parameters and predicted sets.

#### Data Elaboration Tools

- Anaerobic Threshold.
- Oxygen Kinetics (O<sub>2</sub> def, O<sub>2</sub> debt, Tau).
- Exercise Flow/Volume loops.
- Linear and exponential fittings.



## Technical Specifications

### Flowmeter

Bidirectional Digital Turbine Ø 28 mm  
Range: 0.03-20 L/sec  
Accuracy: ± 2%  
Resistance: <0.7 cmH<sub>2</sub>O s/L @ 12 L/s

### Gas Analyzers

Gas	O <sub>2</sub>	CO <sub>2</sub>
Type	Zirconia	NDIR
Range	0,1-100%	0-15%
t90:	<50 ms	<90 ms
Accuracy:	±0.01%	±0.01%
Life span	3-5 years	--

### Power Supply

Voltage: 100-240V ±10%; 50/60Hz

### Environmental Sensors

Temperature (range): 0-50°C  
Barometer (range): 400-800 mmHg  
Humidity (range): 0-100%

### Dimensions & Weight

17 x 30 x 45 cm/ 8 Kg

### Safety

Device Class I type B

### Quality Standards

Equipment complies with MDD (93/42 EEC) and FDA 510(k).

### Scientific References

**ERS task force:** Clinical exercise testing with reference to lung diseases: indications, standardization and interpretation strategies; European Respiratory Journal 1997; 10: 2662-2689

**ATS/ACCP:** Statement of Cardio Pulmonary Exercise Testing. (AJRC CM167, pp211-277,2003)



## More Information

### PC Configuration Required

- Pentium or faster
- Windows 95/98, NT, 2000, XP
- 32 Mb RAM or more
- RS-232 port available (two if used with an ergometer)
- Floppy disk 3.5"
- 20 Mb on HD space available
- Mouse and printer compatible with MS Windows™
- RS-232 > USB Interface adapter (option)

### Standard Equipment

- Gas Exchange Unit
- HR Polar belt
- 2 turbine flowmeters
- PC software
- 3 Adult face masks (S, M, L)
- 2 Adult Head caps
- Calibration syringe (3 liters)
- Cables and probes
- User manual

### Available Options

- Integrated 12-lead ECG
- Spirometry kit
- Indirect Cardiac output
- Integrated Pulse Oxymeter
- Blood pressure monitor
- Medical cart
- Bike and treadmill
- Kit for High/Low FiO2 test
- Calibration Gas cylinders
- Mask for equine exercise tests



The Quark b<sup>2</sup> unit is light and compact, it can be easily transported for mobile solutions



### COSMED S.r.l.

PO Box 3,  
Pavona di Albano - Rome  
I-00040 - ITALY  
Phone: +39 (06) 931-5492  
Fax: +39 (06) 931-4580  
email: info@cosmed.it

### COSMED USA Inc.

2758 N. Paulina Street  
Chicago, IL 60614  
UNITED STATES  
Phone: +1 (773) 528-8113  
Fax: +1 (773) 528-8116  
email: usa.sales@cosmed.it

**COSMED on the Net:** <http://www.cosmed.it>