Extreme Modularity for the most innovative diagnostic equipment for Pulmonary Function Testing

- Spirometry
- Lung Volumes
- Lung Diffusing Capacity
- Respiratory Mechanics (P0.1, MIP-MEP)
- Airway Resistance (Rocc/Rint)
- Forced Oscillation Technique
- Integrated Dosimeter
- Cardio Pulmonary Exercise Testing & Nutritional Assessment
Application fields

Quark PFT is the ideal equipment for applications in Pulmonary Departments, Sport Science, Cardiology and any field where the study of the Cardio-respiratory system is necessary.

Unsurpassed accuracy

Quark PFT uses COSMED’s innovative technology to ensure great accuracy exceeding ATS and ERS criteria. Automated calibration, warnings and messages are prompted to avoid errors and simplify testing procedures.

Rapid Response CO-CH₄ Analyzers

The new “diamond-like carbon” infrared technology allows for performing accurate and reliable DLco tests. The fast response CO-CH₄ multisensor allows real time analysis and accurate measurement even on Patients with reduced Vital Capacity

Paramagnetic O₂ Sensor

Quark PFT is provided with the most accurate and fast-response Paramagnetic O₂ sensor. This technology does not require periodical maintenance and prevents user from unexpected down-time due to sudden failures.

Choose Your Ideal Flowmeter

Quark PFT is the only PFT lab offering 3 different flowmeter configurations:

The bi-directional digital Turbine flowmeter ensures utmost accuracy within a wide flow range (up to 20 l/sec) requiring virtually no maintenance. The perfect choice for accurate flow/volume measurements during exercise in any application (patients to elite athletes)

The multi-use Pneumotach X9 provides high accuracy at very low flow rates and extremely low thermal capacity (so avoiding condensation during expiration). Easily maintainable, it guarantees high reliability through many tests. Perfect for clinical applications during lung function.

The new disposable Pneumotach Flowsafe prevents patients from the risk of cross contamination and provides superior accuracy at very low flow rates. It can be used even during Lung Volumes and DLco tests. The ideal choice for continue/heavy testing load spirometry.

New Breathing Valve

The newly-designed breathing valve (patent) offers incomparable ease-of-disinfection and reliability over the time. An extra number of valves helps user simplifying the operating procedures.

Ultimate Software

The operating software designed for Windows XP and compatible with VISTA and Windows 7 (32 bits), provides easy operations through the intuitively designed Windows™ software. User-friendly interface, intuitive commands and icons are the perfect tools for fast and reliable data collection in any hospital department or doctor office:

► Complete management of patient archive, diagnosis database and clinical reports
► Fully custom design and user defined plots, parameters and printout reports
► Integrated patient database between all PFT modules and products
► Instant test data export in different file formats (Excel, ASCII files)
► User-defined parameter and predicted equations
► Database of diagnosis
► Automatic generation of PDF files according to consistent user-defined file names
► Printout batch of multiple tests
► Compatible with any LAN running under MS Windows.

Breeze through the innovative software of Quark PFT.
True Modularity !!

Quark PFT has been designed to meet the needs of the modern physician who invests before spending. The system incorporates “plug and play” circuitry for instant upgrades. Save your money and choose your best product configuration at the most competitive price in the market. Quark PFT available modules are:

**Spirometry Module (standard)**
The basic PFT module includes all features and hardware for spirometry testing (FVC, SVC, MMV and bronchial-challenge tests).

**Lung Volumes Module**
Adds Functional Residual Capacity testing via Nitrogen Washout and Closing Volume (single breath with 100% O₂).

**Body Plethysmography Module**
Body Plethysmography is considered the Gold Standard for measuring lung volume (TGV, TLC, FRC) and resistance (RAW, GAW). The COSMED plethysmographic cabin guarantees accuracy and fast test execution. Ultimate pressure sensor transducers (resolution). Ensure maximum sensitivity with sever patient’s response.

**Dlco Module**
Brings Lung Diffusing Capacity testing (single-breath, intrabreath, membrane diffusion and 3eq Dlco). The single breath dilution technique can also be used for measuring lung volumes, becoming an affordable and clinically accepted1 alternative to body plethysmography and nitrogen washout.

**Dosimeter Module**
The integrated dosimeter for automatic bronchial challenge tests delivers aerosols solution according to either predefined or user protocols.

- Multi-step protocol with a single drug concentration
- Pressure control during drug delivery to ensure maximal accuracy
- Inspired air filtration for both user and environment safety
- Requires compressed air gas

**Respiratory Mechanics Module**
Upgrade your PFT right on the field with all features you need for Respiratory Mechanics including P0.1, MIP-MEP and optionally Airway Resistance by occlusion technique (Rocc/Rint). This feature is standard with either Qbox standalone or module.

**Quark i2m Forced Oscillations**
Add Forced Oscillations to your PFT lab by integrating Quark i2m unit. Featuring new Input Impedance measurements by Pseudo-Random-Noise signal, a non-invasive method for recording and monitoring the lung mechanics of the total respiratory system.

**CPET Module**
Expand your Pulmonary Function Testing with a fully integrated Cardio Pulmonary Exercise Testing using “breath by breath” Pulmonary Gas Exchange (VO₂, VCO₂, etc.).

Nutritional Assessment

Labs interested in Nutritional Assessment and Resting Energy Expenditure Measurements of confined-to-bed patients or for weight loss programs, may benefit the complete integrated Nutritional Module for indirect calorimetry. The module includes necessary hardware for both ventilated canopy and/or face mask assessment.

Service and Maintenance

COSMED has done everything to protect customer’s investment by keeping the running costs as low as possible. The design architecture has been made to eliminate the procedure of ordinary maintenance and to easily and rapidly solve any technical problem by replacing a board.

Spirometry

- Forced Vital Capacity
- Slow Vital Capacity (In-Ex)
- Forced Vital Capacity post BD
- Quality Control messages according to the latest ATS/ERS recommendation
- Best Test selection and reproducibility criteria according to the ATS/ERS standards
- Automatic test interpretation according to the latest ATS/ERS criteria
- Simplified management of bronchial challenge test with user defined protocols
- Auto-calculation of key interpretive indices (ERS ‘93) for bronchial dilator and metacholine tests
- Calculation of PD10, PD15 and PD20
- Lung age
- Fall FEV1 plot
- Trend analysis on multiple parameters

Lung Volumes

- FRC, RV, TLC
- Real time N2 Wash-Out plot together with several indicators for the control of the respiratory pattern
- Quality control messages during test maneuver (Wash-out pattern)
- User defined Multi axis graphs during and after test execution
- Visual leak detection by real-time FetN2 plot.
- Possibility to perform SVC separately.

Body Plethysmography

- Large cabin volume (873 litres) (Constant-Volume technique)
- Lung Volumes (TGV, TLC, FRC etc.)
- Absolute and Specific Airways Resistance (RAW, SRAW)
- Conductance of Airways (GAW/SGAW)

PFT use a unique breathing valve to perform different testing manoeuvres.

Real time graphic and numeric visualization of FVC and Nitrogen Wash Out tests.
Lung Distribution

- Closing Volume with pure O2 Single Breath technique
- Automatic/manual detection of the 4 phases composing the washout curve
- Automatic/manual detection of the Dead Space according to the Fowler method
- Automatic calculation and display of the linear fitting on the alveolar plateau
- Data elaboration tools for Lung Distribution Analysis
- Calculation of LCI (Lung Clearance Index) and AMDN (Alveolar based Mean Dilution Number).

Lung Diffusing Capacity

- DLco Single-Breath with Apnea
- Visual inspection of CO and CH4 traces
- DLco intrabreath, without breath hold
- Dm, Vc, DLco 3 equations and DLco steady state
- Continuous measurement and display of CO and CH4%
- Ability to change the rejection and sampling volume for accurate measurement of patients with reduced vital capacity
- Possibility to split the membrane diffusion capacity and capillary volume
- Breath hold time settings according to different standards (Jones, Ogilvie and ESP)
- DLco compensation for hemoglobin, carboxyhemoglobin and environmental pressure
- Graphical leak detection during breath hold time
- View and change dead space detection by the Fowler method.

DLco by 3 Equation Method

The method of calculating DLco developed by Graham, Cotton and coll. based on separate equations that analytically account for the differences of CO uptake during the three phases of the test (inhalation, breath holding, exhalation). This makes the measurement of the single breath DLco independent from the maneuver and increases the accuracy of the test.

Respiratory Mechanics

- Measurement of respiratory muscle strength (MIP/MEP)
- Respiratory drive (P0.1).

Airway Resistance

- Rint, Rocc, RoccEX, RoccIN, Gav etc.
- Dedicated low-flows Pneumotach
- Respiratory resistance with interrupter technique.
Forced Oscillations

Quark PFT can be fully integrated with Quark i2m the forced oscillation system for measuring total respiratory system impedance:
- Pseudo random noise signal
- Tidal Breathing analysis
- Fast and easy testing procedure (8 seconds tidal breathing only)
- No patient collaboration required ideal for pediatric applications
- Frequency range from 4 to 48Hz
- Adjustable arm for maximum comfort during testing
- Great accuracy and reproducibility.

Exercise Testing

- Breath by breath or Mixing Chamber pulmonary gas exchange (VO₂, VCO₂)
- Real time visualization of O₂ and CO₂ waveforms
- Automatic and manual detection of anaerobic threshold (modified V-slope)
- Advanced data elaboration (filtering, smoothing, spreadsheet features)
- O₂ Kinetics (O₂ deficit, O₂ debt and time constant)
- Estimation of Cardiac Output from measured VO₂max
- Extrapolation of VO₂max during a sub-maximal test
- Custom fittings (linear and exponential)
- Exercise Flow-Volume loops
- Ergometer control by RS232 interface
- Instant test data export to Excel, TXT, ASCII and in XPO (COSMED proprietary) formats
- User defined parameters
- Customized graphical and numerical data presentation (display, report and printout)
- Test data and predicted values editing
- Compatible with any LAN running under MS Windows.

Nutritional Assessment

- Indirect calorimetry VO₂, VCO₂, RQ, REE and related parameters
- Available with Canopy or facial mask
- Individuation of energy substrate utilization (%FAT, %CHO, %PRO)
- Available with High FiO₂ kit for enriched O₂ mixture use
- Suitable for mechanically ventilated patients (ICU) (option)
- Long lasting measurements while sleeping
- Canopy blower flow rate directly measured with digital turbine flowmeter
- Automatic re-calibration procedure during test
- The ethanol kit for the respiratory quotient control.

12-lead Stress Testing ECG

Only COSMED gives you the power to integrate a 12-lead ECG with the breath by breath metabolic data. Developed in conjunction with a world leader in ECG technology, the PC card based Quark T12x and C12x offer the following features:
Accessories & Options

Available flowmeters
- Disposable pneumotach “Flowsafe”
- Multi-use pneumotach “X9”
- Digital Turbine (28 mm)
- Digital turbine (18 mm)

Pulse Oximeter
- An integrated monitor of oxygen saturation (SpO₂) at rest and during exercise available with finger, reflectance or ear sensors

Mixing Chamber
- Special technology that allows gas exchange analysis of low and high ventilation ranges

12-lead stress test ECG
- Available in both wireless and direct patient cable configurations

Ergometers
- Wide selection of treadmills and bikes for any applications

Anti-Bacterial Filters
- High filtration efficiency filter barrier to avoid cross contamination

Dosimeter
- Integrated dosimeter for accurate bronchial challenge tests

Medical Cart
- Medical graded Cart with isolation patient transformer required for medical environments

Arm support
- An adjustable arm holding the breathing valve

Gas cylinder & regulator
- Specific medical gas mixtures and pressure regulators for calibration and testing

PC & Peripherals
- Proven PCs & peripherals fully compatible w/ COSMED equipment, factory-installed to avoid any possible compatibility issue

Explicative colour printout reports in different formats deliver clear information to user including: graphical test display, numerical data compared to predicted values and automatic interpretation of test results.
## Technical Specification

### Tests

<table>
<thead>
<tr>
<th>Category</th>
<th>Subtests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>Forced/Slow Vital Capacity (SVF-VFC)</td>
</tr>
<tr>
<td>Lung Volumes</td>
<td>Maximum Voluntary Ventilation (MIV)</td>
</tr>
<tr>
<td>Respiratory Mechanics</td>
<td>Bronchial Challenge Test</td>
</tr>
<tr>
<td></td>
<td>Integrated Dosimeter</td>
</tr>
<tr>
<td></td>
<td>Multi-Breath Nitrogen Wash-out</td>
</tr>
<tr>
<td></td>
<td>Single-Breath 100% O₂ (Closing Volume)</td>
</tr>
<tr>
<td></td>
<td>Lung Volumes by DLCO Single Breath dilution</td>
</tr>
<tr>
<td></td>
<td>Thoracic Gas Volume (TGV)</td>
</tr>
<tr>
<td></td>
<td>Airway Resistance (Racc/Rint)</td>
</tr>
<tr>
<td></td>
<td>DLCO Single Breath (w/ Breath Hold &amp; Intra/breath)</td>
</tr>
<tr>
<td></td>
<td>DLCO 3eq (3 equations method)</td>
</tr>
<tr>
<td></td>
<td>Membrane Diffusing Capacity</td>
</tr>
<tr>
<td></td>
<td>MIP/MEP</td>
</tr>
<tr>
<td></td>
<td>Respiratory Drive (PO.1)</td>
</tr>
<tr>
<td></td>
<td>Airway Resistance (Racc/Rint)</td>
</tr>
<tr>
<td></td>
<td>Forced Oscillation Technique (FOT)</td>
</tr>
<tr>
<td></td>
<td>Indirect Calorimetry w/ Mask</td>
</tr>
<tr>
<td></td>
<td>Indirect Calorimetry w/ Canopy Hood</td>
</tr>
<tr>
<td></td>
<td>Indirect Calorimetry w/ Ventilator</td>
</tr>
<tr>
<td></td>
<td>VO₂ max, Anaerobic Threshold</td>
</tr>
<tr>
<td></td>
<td>Integrated Pulse Diameter (SpO₂)</td>
</tr>
<tr>
<td></td>
<td>Integrated 12-lead ECG (Gas/ECG)</td>
</tr>
<tr>
<td></td>
<td>HR Interface w/ external ECG (TTI)</td>
</tr>
</tbody>
</table>

### Analyzers

<table>
<thead>
<tr>
<th>Type</th>
<th>O₂</th>
<th>CO₂</th>
<th>CO</th>
<th>CH₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0-100 %</td>
<td>0-10%</td>
<td>0-0.35 %</td>
<td>0-0.35 %</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.1 %</td>
<td>± 0.1 %</td>
<td>± 0.003 %</td>
<td>± 0.003 %</td>
</tr>
<tr>
<td>Response time</td>
<td>120 ms</td>
<td>100 ms</td>
<td>200 ms</td>
<td>200 ms</td>
</tr>
<tr>
<td>Warm-up time</td>
<td>5 min</td>
<td>10 min</td>
<td>15 min</td>
<td>15 min</td>
</tr>
</tbody>
</table>

### Flowmeter

<table>
<thead>
<tr>
<th>Type</th>
<th>Digital turbine (Ø 18mm)</th>
<th>Digital turbine (Ø 28 mm)</th>
<th>Flowsafe PNT</th>
<th>PNT X9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow range</td>
<td>Bi-directional</td>
<td>Bi-directional</td>
<td>Lilly Pneumotach</td>
<td>Lilly Pneumotach</td>
</tr>
<tr>
<td>Ventilation range</td>
<td>0-50 l/min</td>
<td>0-100 l/min</td>
<td>0-14 l/min</td>
<td>0-14 l/min</td>
</tr>
<tr>
<td>Accuracy (flow)</td>
<td>±2% or 20 ml/s</td>
<td>±2% or 20 ml/s</td>
<td>±2% or 20 ml/s</td>
<td>±2% or 20 ml/s</td>
</tr>
<tr>
<td>Accuracy (ventil.)</td>
<td>±2% or 100 ml/min</td>
<td>±2% or 200 ml/min</td>
<td>±2% or 140 ml/min</td>
<td>±2% or 140 ml/min</td>
</tr>
<tr>
<td>Resistance</td>
<td>&lt;0.7 cmH₂O/O₂·l/s·30l/s</td>
<td>&lt;0.8 cmH₂O/O₂·l/s·140l/s</td>
<td>&lt;1 cmH₂O/O₂·l/s·140l/s</td>
<td>&lt;1 cmH₂O/O₂·l/s·140l/s</td>
</tr>
</tbody>
</table>

### Hardware

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>0-50°C (32 - 122°F)</td>
</tr>
<tr>
<td>Barometer</td>
<td>400-800 mmHg</td>
</tr>
<tr>
<td>Humidity</td>
<td>0-100%</td>
</tr>
<tr>
<td>Dimensions (Main unit)</td>
<td>33 cm x 41 cm h 16 cm (12.9 x 16 in h 6.2 in)</td>
</tr>
<tr>
<td>Weight (Main unit)</td>
<td>11 kg (24.2 lb)</td>
</tr>
</tbody>
</table>

### Available languages

- Italian
- English
- German
- Spanish
- French
- Portuguese

### Electrical requirements

- Power supply: 100-240V ± 10% 50/60 Hz
- Power consumption: 100 VA
- Class: I type BF (EN60601-1)

### PC configuration required

- Pentium or faster, Windows XP, VISTA (32 bit), Windows 7 (32 bit), 128 MB RAM or more, USB or RS 232, CD-ROM reader, 80 Mb on HD space available

### Safety & Quality Standards

- Equipment complies with MDD (93/42 EEC) and FDA 510(k) cleared, EN 60601-1 (safety) and EN 60601-1-2 (EMC)
- COSMED is an organisation whose quality management system is certified by CERMET according to UNI EN ISO 9001:2008 and UNI EN ISO 13484:2004