



Flexible Solutions for all of your  
Cardiopulmonary Bypass  
Procedures



## Quantum Perfusion Systems for the O.R.

Spectrum Medical proudly presents a modular range of Quantum Perfusion Modules and Patient Safety Systems for a wide range of ECLS procedures used in Cardiopulmonary Bypass.



The New York HLM Frame

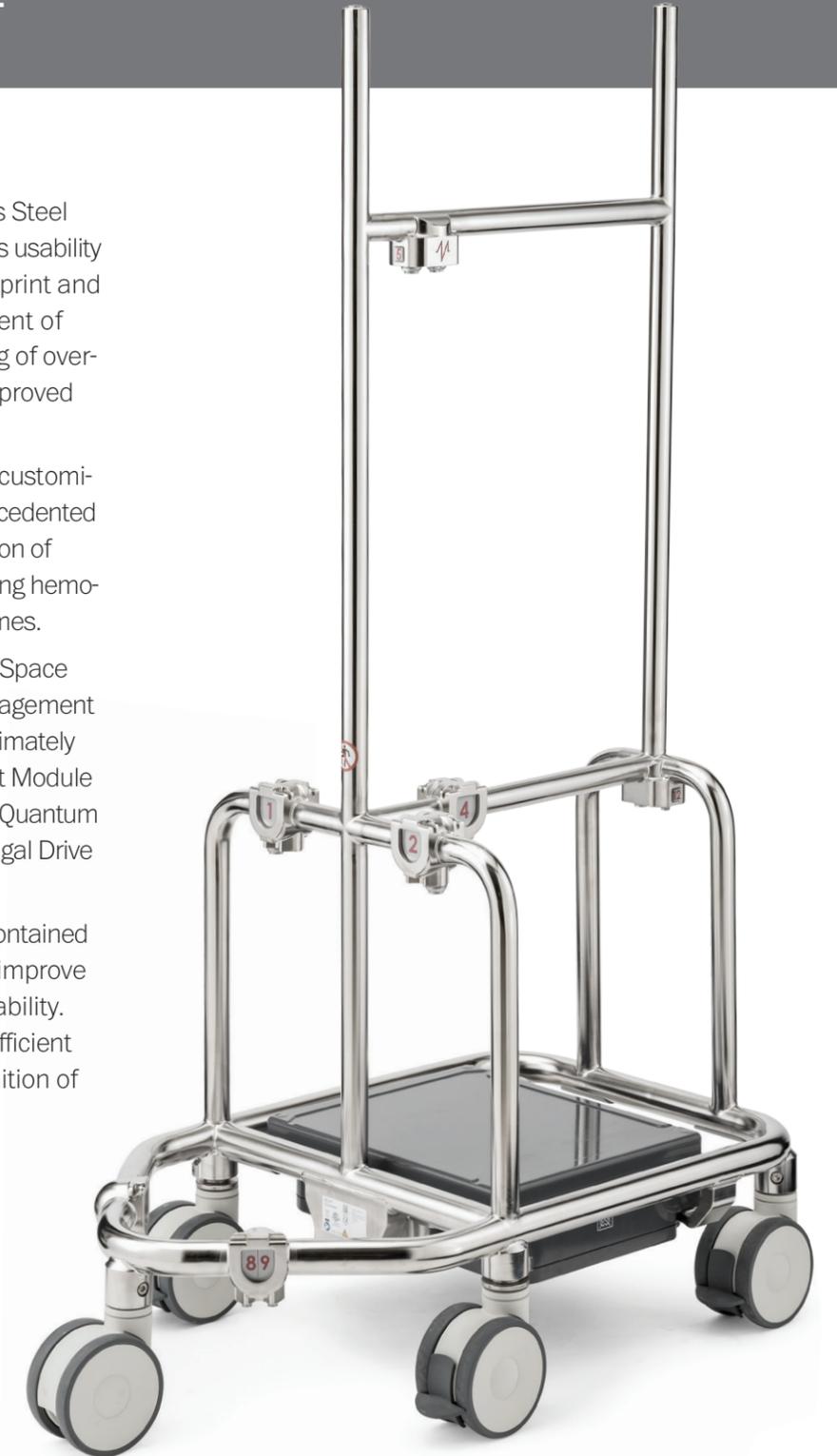


The Cheltenham HLM Frame

## Quantum Space Frame Technology

Committed to Clinical Ergonomics and patient centric solutions.

- The robust and compact Stainless Steel Space Frame construction improves usability by significantly reducing both footprint and weight. The independent placement of system modules allows fine-tuning of overall ergonomics, which leads to improved patient focus and safety.
- The compact modular design and customization opportunities offer an unprecedented degree of flexibility in the optimization of perfusion circuits focused on lowering hemodilution for improved patient outcomes.
- Integrated into the Stainless Steel Space Frame is the Quantum Power Management Module with a battery life of approximately four hours. The Power Management Module can support a maximum of thirteen Quantum Modules and two 3rd Party Centrifugal Drive motors.
- All power management cabling is contained within the stainless steel frame to improve both ergonomics and system durability. Integrated software provides for efficient power regulation and auto-recognition of correct Quantum Modules.



The Cheltenham HLM Frame

# The Principles of Quantum Directed Perfusion (QDP)

Quantum Directed Perfusion (QDP) provides the next generation capabilities beyond basic Goal Directed Perfusion (GDP) techniques and the simplistic approach of measuring  $DO_2$ .

This multifaceted approach to QDP provides the clinical team with the methodologies to improve the quality of bypass management that can lead to the reduction of AKI, and the higher costs associated with extended I.C.U. Time. <sup>1,2,3,4</sup>

## Real-Time Diagnostics:

The starting point for QDP is the use of Spectrum Medical's non-invasive diagnostic technology for the measurement of Oxygen Delivery ( $DO_2$ ), Oxygen Consumption ( $VO_2$ ),  $CO_2$  Production ( $VCO_2$ ), and multiple other calculations and indices. The monitoring of real-time total Oxygen Deficit is a completely new and critically important concept to the world of Perfusion. The Quantum technology displays the real-time reporting of total time and percentage of case time when actual  $DO_2$  is below target  $DO_2$ .



## Visualising Real-Time Information:

Spectrum Medical's Critical Care Scoring technology supports a proactive clinical risk assessment using recognized AKI markers such as age, gender, Pre-op Hct /Hb, EF, DM, and existing renal issues, and the subsequent deployment of an individual patient care strategy. Using Quantum Informatics and its LIVE VUE technology patient care is improved with the seamless integration of "multiple information feeds" into a real-time display system.



## Oxygen Deficit:

It is accepted that the potential of AKI is significantly increased with large  $DO_2$  deficits.<sup>4</sup> Calculating the Oxygen Deficit and then equating it to actual patient outcomes is a relatively straight forward process when using Spectrum Medical's Quantum Informatics technology.

The Quantum Directed Perfusion calculation of Oxygen Deficit is expressed as total "Area Under the Curve", and is a product of the accumulation of an actual deficit value (target  $DO_2$  minus actual  $DO_2$ ) multiplied by a unit of time.



## Metabolic Compensation:

To further increase the precision of patient  $DO_2$  requirements Spectrum Medical includes the capability to apply a percentage reduction per degree C to reflect decreasing metabolic activity as patients are cooled during Cardiac Bypass Surgery. The reduction per degree C is fully programmable and dependent on hospital based protocols. For example, if a  $DO_2$  of 270mL/kg/m<sup>2</sup> at 37°C is the standard target and hospital protocols indicate a 7% / degree C as the change in Oxygen demand, the target  $DO_2$  would be 251mL/kg/m<sup>2</sup> when the patient is at 36° C.

### References

1. Alshaiikh, et al. Financial Impact of Acute Kidney Injury After Cardiac Operations in the United States. *Ann Thoracic Surg.* 2018 Feb;105(2):469-475.
2. de Somer, et al.  $O_2$  Delivery and  $CO_2$  Production During Cardiopulmonary Bypass as Determinants of Acute Kidney Injury: Time for a Goal-Directed Perfusion Management? *Critical Care* 2011; 15:R192.

### References

3. Dasta JF, Kane-Gill SL, Durtschi AJ, et al. Costs and Outcomes of Acute Kidney Injury (AKI) Following Cardiac Surgery. *Nephrol Dial Transplant.* 2008;23:1970-1974.
4. Ranucci M, Romitti F, Isgro G, et al. Oxygen Delivery During Cardiopulmonary Bypass and Acute Renal Failure After Coronary Operations. *Ann Thorac Surg.* 2005;80:2213-20.

# The Family of Quantum Workstations

Your gateway into the management of the World's most advanced Perfusion Patient Safety System. Highly configurable, integrated software applications (Apps) and advanced Quantum Modules extend perfusion management and functionality well beyond today's conventional technologies.

## The 15" Quantum Workstation

The 15" Quantum Workstation has been designed to support complex perfusion procedures utilized during Cardiac Surgery. Using its high-resolution touch screen technology the 15" Quantum Workstation supports the centralization of critical patient data, optional EMR generation and advanced perfusion management functions with single-level user navigation.

The 15" Quantum Workstation is supplied with Spectrum Medical's proven non-invasive measurement of O<sub>2</sub> Saturations and Hb/Hct and supports connectivity to a wide range of Quantum modules including the Ventilation and Sensor modules.

Systems interoperability and patient safety are fundamental to Spectrum Medical and its commitment to partnering with customers to improve patient outcomes. The new 15" Quantum Workstation has an integrated 3<sup>rd</sup> party device connectivity solution that enables the central display and transfer of critical real-time continuous clinical information.



Quantum Pump Control Module

## The Quantum Pump Control Module

The Quantum Pump Control Module provides complete manual support of your Quantum Perfusion System with functionality that includes alarm management, pump management and the delivery of cardioplegia.

The system also includes a range of safety and best practice systems. Compliance is supported by the Best Practice App and patient safety through our Checklist and Complications Apps. Spectrum Medical's Live Vue technology and Critical Care Scoring systems functionality is available when the Quantum Workstation is network connected to a Quantum Informatics server installation.



15" Quantum Workstation with optional Pump Control Module

# The Quantum Ventilation System

Finally, a fully integrated “single solution” Ventilator technology designed to provide the safe delivery of patient ventilation and the management of vacuum during Cardiopulmonary Bypass.



## The Quantum Ventilation System

The second-generation Quantum Ventilation System is a world first solution designed to manage extracorporeal patient ventilation, including the blending of gases, the management of vacuum, integrated patient safety systems, perfusion diagnostics and delivered anaesthesia gas concentration and a calculated MAC value.

The ultra-compact Quantum Ventilation System employs the very latest gas blending technologies to provide the user with an Atmospheric or Hypobaric patient ventilation capability.

In Atmospheric mode the Quantum Ventilation System delivers precision regulated  $\text{FiO}_2$ ,  $\text{CO}_2$  with a sweep flow range from 0.025 to 10 L/m when flowing a single gas e.g.  $\text{O}_2$  and up to a maximum flow rate of 20 L/m when modulating the delivery of two gases. e.g. 60%  $\text{FiO}_2$ .

In Hypobaric mode the Quantum Ventilation System regulates the delivery of two channels of  $\text{O}_2$  to Spectrum Medical's new Ventilator technology with a sweep flow range of 0.025 to 10L/m per channel.

To ensure system performance and safety the ventilation system has a fully integrated secondary monitoring system that continuously compares actual measured values with user defined set-points and activates an alarm when the discrepancy between the two systems is greater than 10%.

In 'Patient Ventilation Mode' the Quantum Ventilation System, combined with its patented  $\text{PaO}_2$  and  $\text{PaCO}_2$  measurement technologies, provides a

decision support capability and an auto regulation function for the modulation of gas flows and gas concentrations when setting  $\text{PaO}_2$  and  $\text{PaCO}_2$  target values. The Quantum Ventilation System provides precision modulation and monitoring of W.A.G and V.A.V.D.

To further improve patient safety the Quantum Ventilation System provides real-time monitoring of the following gas-ventilation parameters:

- Incoming Supply Pressures of Air,  $\text{O}_2$ ,  $\text{CO}_2$ , & Vacuum Channels
- $\text{O}_2$  and  $\text{CO}_2$  Gas Concentrations & Pressures to the Oxygenator
- Overall Gas Flow to the oxygenator (SWEEP)
- $\text{CO}_2$  concentrations measured from the W.A.G. line

Integrated within the Quantum Ventilation System is Spectrum Medical's full range of Non-Invasive Diagnostic and Calculated Physiologic Measurements. To further improve usability the system includes the measurement of Flow (including bubble detection), Pressure, Temperature and Reservoir Level Management.

The second-generation Ventilation System has been further modified to allow the hospital to connect to two independent vacuum sources for both WAG and VAVD. Furthermore, and to reduce routine servicing requirements, the System now includes a new “long-life”  $\text{O}_2$  measuring technology.

# The Quantum Centrifugal Pump CP37

The world's latest and most advanced Centrifugal Pump technology setting new standards for patient safety, hydraulic performance and hemolysis.

Spectrum Medical's next generation Quantum Centrifugal Pumps provide exceptional levels of performance along with significantly reduced prime volumes. The integration of a single sapphire bearing and patented hydro-dynamic balancing technology ensures levitation at low RPMs leading to significantly reduced heat generation and haemolysis.

The CP37 is integrated directly with the Quantum Perfusion System and can be connected to any port location within the Quantum Console to optimize the design of cardiopulmonary bypass circuits.



Quantum CP37 Hand Crank



Quantum CP37 Motor Drive



CP37 (Order Code: CP37V-V0)

To support the introduction of the Quantum Heater-Cooler Technology and to minimise circuit complexity Spectrum Medical has integrated its' stainless-steel PureFlow Venous heat exchanger and the CP37 Centrifugal Pump into a single disposable assembly.

Mounted directly to CP37 motor drive system, the CP37 with its integrated Venous heat exchanger is used exclusively with the Quantum Heater-Cooler technology and its Glycol heat transfer fluid.

The CP37 is Spectrum Medical's most powerful Centrifugal Pump and designed to support applications in the O.R.

With its 3/8 port and a prime volume of only 37cc, the CP37 is rated to 8 liters/min at 800 mmhg.

PC1036 Bio-Compatibility coating and the availability of a hand crank further improves patient safety.



CP37 with Integrated Heat Exchanger  
(Order Code: PH77V-V0)

## Perfusion Roller Pump

A Quantum leap in usability and perfusion systems' functionality.



The compact range of Quantum direct drive peristaltic roller pumps are provided with 4", 6" and 8" raceway diameters which maximizes both flexibility and compactness when optimizing HLM design. In particular, the introduction of the mid-range 6" option eliminates the current compromise that compels users to use 8" pumps in medium flow applications.

The Quantum Universal Clamping System supports the mounting of pumps into multiple locations and pump change times of less than 60 seconds. Importantly, Quantum's pump detection software eliminates user intervention when adding or exchanging pumps.

Smart LEDs enable visual identification of pump function and color coordination with both the Quantum Workstation and the Quantum Pump Control Module. Spectrum Medical's universal tube clamping system is designed to eliminate the frustration of using current tube clamping solutions and colour coded plastic inserts. A single 'bobbin' solution allows for the clamping of all tubing diameters associated within the selected size of race-way.

## Intelligent Tube Occlusion

Enhancing patient safety with precision solutions for complex phases of care during cardiopulmonary bypass.



The Quantum Smart Occluder is a revolutionary new approach to the management of perfusion-tube occlusion during bypass surgery. The Quantum Smart Occluder replaces the guesswork associated with conventional technologies by utilizing precise user inputs for the setting of flow—a critical requirement during certain phases of care.

The introduction of closed loop flow control ensures flow control within +/- 2% of the requested set point. System wide communication allows the user to combine the Smart Occluder with other Quantum

Modules to deliver levels of functionality new to the world of Perfusion, such as automated initiation, weaning and R.A.P.

Continuing the Quantum philosophy of seeking to improve system ergonomics, wherever possible, the Smart Occluder module includes two channels of flow measurement and bubble detection, two channels of pressure measurement and a two channel reservoir level detection system.

An interlocking lid, Color-coded LEDs and a mechanical override system maximizes system safety.

## The Quantum Sensor Module

Proven non-invasive measurement technologies provide flexible cost-effective management of Cardiopulmonary Bypass.



### The Quantum Sensor Module

The Quantum Sensor Module is designed to provide the complete range of perfusion circuit parameters required for the safe management of Cardiopulmonary Bypass and the measurement of DO<sub>2</sub>.

The sensor module includes:

- Three temperature measurements
- Three pressure measurements

- Three flow measurements (including emboli and bubble detection)
  - A two-position reservoir level detection system
- Offering complete flexibility, the Quantum Sensor Module can be connected directly to the Quantum Workstation and to multiple locations on the Quantum Perfusion Console.

## The Quantum Syringe Pump

A precision fluid delivery system flow-interlocked to maximise patient safety.



Exciting new technology  
for the end of 2020!

# Total Customer Support

With an absolute dedication to customer support and a total solutions approach to a long-term partnership Spectrum Medical is proud to present Sentinel Total Care.

## Sentinel Total Care:

**Extended Warranty:** Full warranty on your Quantum Perfusion System including Associated Accessories (sensors, cable assemblies) for its 10-year life at no cost to the customer. Quantum products beyond economic repair will be replaced with latest 'new build' technologies.

**Annual Servicing:** Includes all required servicing visits performed by dedicated Spectrum Medical's service personnel and the cost of all servicing items.

**Accidental Damage:** Accidental damage including accessories (sensor, cable assemblies) for the 10-year life of your Quantum Product at no cost to the customer. (Available with Vigilance in US Markets).

**Quantum eLearning:** Includes access to Spectrum Medical web-based electronic Learning Management System (or LMS) to streamline product training and to complement your current training practice and recertification.

**Remote On-Line Support:** Integrated within the VISION Server System and with VPN access, the Sentinel maintenance application provides a capability to support the remote monitoring and fault diagnosis of all Quantum systems network connected to the local VISION server.

**Emergency Loan Equipment** For all products that cannot be repaired within 24 hours of being returned to Spectrum Medical Service Center.

**Software Updates:** During the service visit Quantum Software will be maintained to latest standards, including changes to user functionality, updates to enhance maintainability, reliability and protocol changes to 3<sup>rd</sup> party device driver software at no cost to the customer. Software deployment is subject to prior customer approval and training via webinar or in-house at Spectrum Medical is included free of charge.

**Comprehensive 24/7 Support:** Spectrum Medical's innovative 24-hour live messaging support platform enables users to have immediate access to an extensive knowledge-based product library, frequently asked questions and troubleshooting tips. Additionally the 24 hour support platform supports immediate communication with Spectrum Medical's global support team which comprise, service technicians, clinical consultants and system application experts via a dedicated phone number, email address or Spectrum Medical 24-hour live messaging service.



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