



## Product Description

The CardioFlow 5000 MR flow pump system is designed to generate realistic, accurate and repeatable physiological volume flow waveforms, including pre-programmed; carotid, femoral, sine, square and constant flow waveforms. The system includes an embedded industrial grade motherboard and proprietary *SimuFlow III Waveform Editing Software* for creating user-defined physiological flow waveforms. Users have the option of inputting their own waveform data points, reshaping the supplied pre-programmed waveforms (click and drag) or downloading waveforms onto the system.

The CardioFlow 5000 MR is accurate to within  $\pm 3.0\%$  over a flow range of 50 to 300 ml/s. Each system is calibrated and accompanied by a *certificate of calibration* specifying the calibration results at relevant flow rates, as well as being provided with a calibration constant to verify the pump systems accuracy.

The CardioFlow 5000 MR is three-unit design, a Control Unit, a Pump Unit and an external Reservoir. For MRI environments the Control Unit is positioned outside the MRI suite, the Pump Unit can be positioned in the scanning room. Shielded cables are supplied to connect the computerized motor control unit to the pump unit via the penetration panel or waveguide.

Combine the CardioFlow 5000 MR with an appropriate vascular, heart or heart valve phantom and blood mimicking fluid, and the closed flow loop ensures easy, accurate and reliable evaluation and validation of diagnostic imaging systems and endovascular techniques. The system is ideal for MRA, iMRI, DSA, CTA, Doppler ultrasound, and endovascular simulation applications.

## Applications

Research and new technology developments requiring accurate and repeatable pulsatile and constant flow waveforms (i.e. flow quantification, MRA, iMRI, DSA, CTA Doppler ultrasound, and endovascular techniques).

Ability to control waveform shape.

Gated flow studies.

Calibration of clinical imaging systems.

## Product Features

**REALISTIC** PHYSIOLOGICAL FLOW WAVEFORMS  
**PULSATILE** AND CONSTANT FLOW WAVEFORMS  
**ACCURATE** VOLUME FLOW WAVEFORMS  
**REPRODUCIBLE** WAVEFORMS  
**PROGRAMMABLE** USER DEFINED WAVEFORMS  
**CALIBRATION** CERTIFICATE  
**MULTIMODALITY** IDEAL FOR COMPARING IMAGING MODALITIES

**Pump unit can be in close proximity to a magnetic bore**, resulting in clinical acquisition of realistic and accurate ( $\pm 3.0\%$ ) physiological waveforms.

**Pre-programmed waveforms include;** carotid, femoral, sine, rectangular and constant flow waveforms.

**Embedded industrial grade motherboard and SimuFlow III waveform editing software** allows for the design of user-defined pulsatile and constant flow waveforms. Users can control the shape of the waveform.

**Robust gear pump** ensures uninterrupted volume flow waveforms.

**Accurate and reproducible physiological flow waveforms** including those with reverse flow components such as the femoral waveform.

**Control** with user supplied keyboard, mouse and monitor to communicate with the embedded computer.

**Calibration certificate** is provided with each system verifying the systems accuracy. The system can be calibrated and certified traceably to a national standard for regulatory requirements. A re-calibration service is available.





### Fluid Flow Specifications

Volume range 1.0 – 300 ml/s  
 Accuracy of  $\pm 3\%$  for 50 to 300 ml/s  
 Sine waves up to 12 Hz  
 Physiological flow waveforms including reverse flow components  
 Capable of pumping non-viscous fluids

### Mechanical Specifications

High-torque servo-motor  
 Gear pump  
 Adjustable over-pressure shut-off (7 to 50 psi)  
 Self-sealing 5/8 inch inner diameter plastic connectors

### Computer Control

On-board dedicated motor controller  
 Easily upgraded high level control software  
 Windows XP Embedded Operating System

### Interface

User supplied monitor, keyboard and mouse

### Physical

Control Unit dimensions: 14" (L) x 11" (W) x 9" (H)  
 Control Unit Weight: 11.2 lbs. (5.1 kg)  
 Pump Unit dimensions: 17" (L) x 17 3/4" (W) x 10 1/2" (H)  
 Pump Unit Weight: 44 lbs. (20 kg)  
 Reservoir capacity: 20 litres  
 Circulating Fluid Volume: 9 litres minimum

### File Format

Waveform data is stored on embedded harddrive  
 Files can contain up to 1,000 flow-rate values describing a waveform  
 User specified time-base ranging from 2 to 50 ms per point  
 Waveforms can be looped continuously  
 Variable frequency waveforms can be generated

### Electrical

110/220 VAC 50/60 Hz, 4.0 amps @ 120V  
 EMI shielding  
 1 RS-232 serial communication port  
 1 ECG TTL trigger output (BNC)  
 Monitor port  
 Keyboard port  
 Mouse port  
 Two shielded cables between the Control Unit and a penetration panel (10 foot lengths).  
 Two shielded cables between the Pump Unit and a penetration panel (20 foot lengths).

### Calibration Options

Standard calibration  
 Traceable calibration to a National Standard

### Accessory Products

MR Finger for ECG gated flow studies  
 Multi+ Variable Waveform Software Option to mimic arrhythmia  
 Anatomically correct hearts, heart valves and vascular models  
 Blood mimicking fluids



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#### Sales Office

157 Ashley Crescent, London, Ontario N6E 3P9 Canada  
 Phone: 1 (519) 690-0874 Fax: 1 (519) 690-0875  
 Email: bob.gravett@simutec.com Web: www.simutec.com

#### Service Centre

41 Coldwater Road, Toronto, Ontario M3B 1Y8 Canada  
 Phone: 1 (416) 447-6471 Fax: 1 (416) 447-9313  
 Email: service@simutec.com

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