

MP3 Pulse Duplicator



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The MP3 is a pulse duplicator designed to generate physiological flows and pressures for testing heart valves while giving full visibility of the device.

Versatility

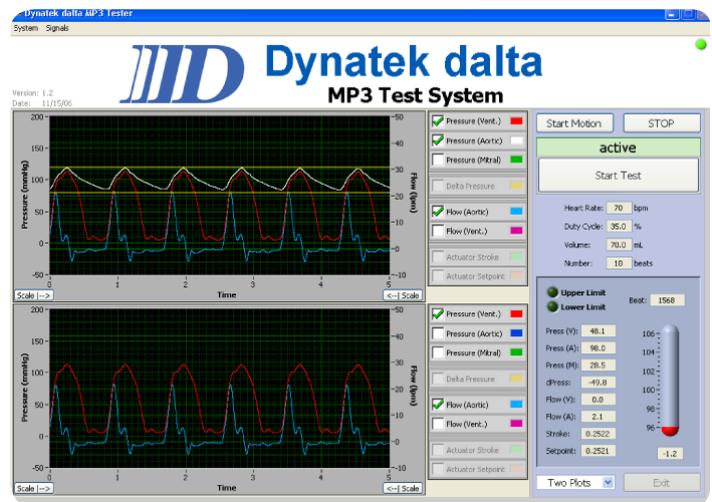
Optical transparency of the MP3 system provides viewing when visual, photographic, ultrasound or laser Doppler studies of the valves are of interest. The ventricle chamber and valve holders are machined with ports and adapters to accept aortic flow, aortic pressure, mitral flow, mitral pressure and ventricular pressure transducers. Properties are not subject to change due to age or usage of the acrylic components.

Aortic and Peripheral Flow Loops

Combining adjustable vascular clamps with compliant vascular vessels, one can independently adjust systolic and diastolic pressure as well as vascular resistance. When coupled with the programmable pumping system, the MP3 gives a high degree of control over all flow and pressure parameters.

MP3 Flow Loop

The MP3 Flow Loop represents several breakthroughs in the technology of designing and operating a cardiovascular simulator. First, LabVIEW®-based computer control and acquisition software gives the user a single programming source to both control the pumping system as well as monitor the important parameters. Custom systems can be designed to automatically adjust to vary performance (i.e. ventricular pressure, flow, etc.) to give true computer control to the system. Analyses can include laser, ultrasound or photographic recording capabilities. The MP3 also utilizes a ventricular design that can be adapted to include varying ventricular compliances if necessary.



Main display screen on the MP3, showing ventricle pressure (red) and aortic pressure (blue)



Left Ventricle Chamber

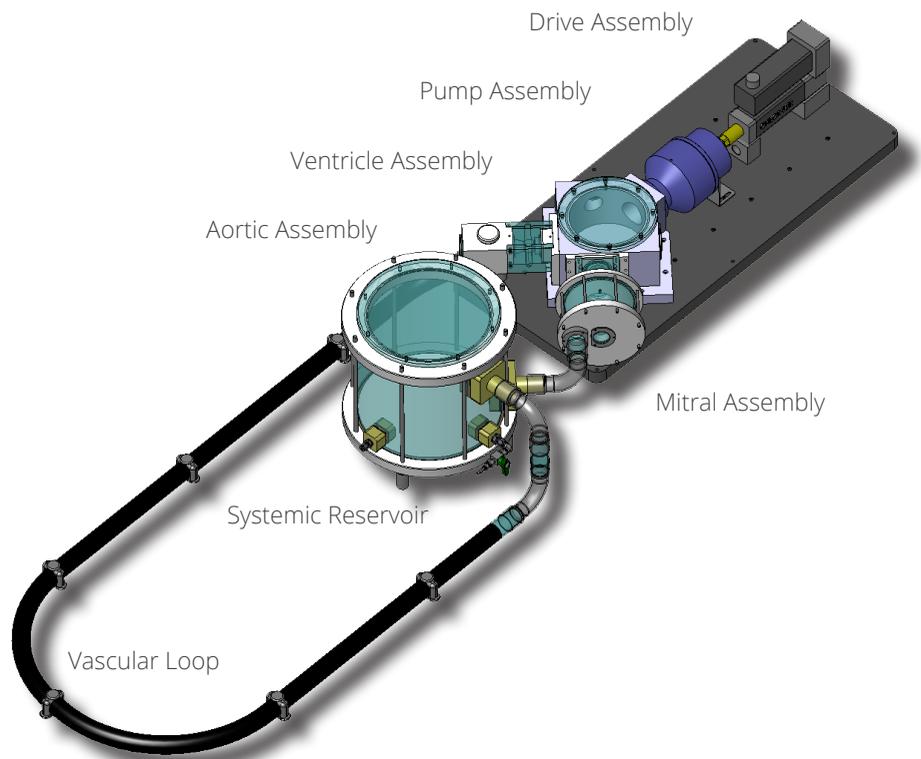
The design of the left ventricle allows for an optically transparent and unobstructed view of the inlet and outlet sides of both the mitral and aortic valves simultaneously. Adapters allow mitral valves of all sizes to be tested. Aortic valve chambers fit into the MP3 to allow for the testing of all sizes of aortic valves. The simple insertion design does not require total emptying of the MP3 to change valves. Customized valve holders optimize the flow dynamics of the ventricle to simulate in vivo flow conditions.

The Motion Control System

The drive system combines the versatility of a programmable stepper or servomotor with a piston. Each cycle can be broken up into as many as 121,600 steps, although most applications use between 1,000 and 2,000 steps. The waveform generated by the motor can be defined with as many as 500 control statements. This versatility allows the user to contour flow and pressure traces with an accuracy not previously attainable with a pulse duplicator. This system provides absolute control of dP/dt which is essential to the elimination of mechanical valve cavitation problems.

Designed to Ensure Regulatory Compliance with ISO and US FDA Regulations

ISO 5840 and the US FDA have clear regulations for the hemodynamic evaluation of prosthetic heart valves. The MP3 is compliant with ISO and FDA regulations and provides you with real-time data to assess the device's performance. The MP3 can be used to evaluate the hemodynamic performance of transcatheter and surgically-implanted aortic and mitral heart valves and LVADs. Pulsatile fluid flow is measured ultrasonically and prosthetic heart valves can be swapped out easily without completely draining the system. System pressure can be measured at multiple points with high natural-frequency transducers.



MP3 Pulse Duplicator System Components

Description

Cardiac output
Mean aortic pressure
Backflow pressure
Systolic duration
Pressure transducer accuracy
Pressure transducer natural frequency
Flow accuracy
Regurgitation volume accuracy

Specification

1 – 10L/min
> 13.3 kPa (100mm Hg)
5.2 – 20.8 kPa (40 – 156mm Hg)
25% - 50% of cycle
 ± 0.2 kPa (1.5mm Hg)
> 50kHz
 $\pm 4\%$ FSO
 ± 2 ml

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