The ViVitro Pulse Duplicator is the world’s most widely used and cited in-vitro cardiovascular hydrodynamic testing system. It is composed of the ViVitro Model Left Heart, SuperPump, Flow Measuring System and ViViTest Data Acquisition System. The components work together to assess the performance of prosthetic heart valves under simulated cardiac conditions. The ViVitro Pulse Duplicator System is used by the US Food and Drug Administration and is recognised by a number of other regulatory bodies worldwide such as, TÜV, BSI and the Chinese SFDA.
The Pulse Duplicator System simulates the function of the heart by generating pulsatile flow through prosthetic heart valves placed in the Model Left Heart. The Pulse Duplicator simulates physiological or other complex flow variations while allowing the user to vary the peripheral resistance and compliance of the system. Pressure ports and flow measuring locations allow for data to be collected from aortic or mitral sites. Transparent viewpoints allow multiple viewing angles of the valve including inflow and outflow.

When the ViViTest software control system is combined with the ViVitro Labs Pulse Duplicator, physiological flow and pressure can be quickly, easily and reliably collected, and analyzed. The software also allows the user to easily modify and customize the waveforms the pump follows.

Features

- Flow and pressure readings can be collected and analyzed in real-time, meeting ISO 5840 requirements
- Controls pulsatile fluid flows to simulate various cardiac flow conditions including arrhythmia, normal, hypo and hypertensive states at an assortment of cardiac outputs and beat rates
- Transducer sites allow measurement of wall pressures in the atrium, ventricle, and aortic outflow tract
- Flow can be measured directly at the aortic or mitral sites
- Simulates cardiovascular peripheral resistance and compliance
- Thin acrylic windows permit echo imaging, Doppler flow measurements, and PIV for interrogation of flow field regions
Applications

- Transcatheter valves
- Surgical valves (Mechanical and Biological)
- Stentless valves
- Other structural heart and peripheral vascular devices
- Evaluate LVAD or other assist device

Specifications

<table>
<thead>
<tr>
<th>Component</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump &amp; MLH</td>
<td>53 x 92 x 45 cm</td>
</tr>
<tr>
<td>DAS &amp; Flow System</td>
<td>48 x 33 x 32 cm</td>
</tr>
<tr>
<td>Dry weight: Actuator + Model Left Heart + VIA</td>
<td>18 kg</td>
</tr>
<tr>
<td>Dry weight: Flow Measuring System</td>
<td>5.6 kg</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>Ambient to 40°C ± 0.1°C</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>2 - 15 L/min</td>
</tr>
<tr>
<td>Heart rate</td>
<td>30 - 200 BPM</td>
</tr>
</tbody>
</table>
Accessories:

ViVitro Labs offers a wide variety of accessories and complementary equipment to support its products as well as provides customization to suit various requirements.

Viscoelastic Impedance Adapter

The Viscoelastic Impedance Adapter (VIA) produces more physiological ventricular pressures consisting of a fixed resistive element and two adjustable compliance chambers, simulating ventricular viscoelastic behavior. In prosthetic heart valve studies ventricle pressures with physiologic dp/dt values can be achieved using the VIA.

Left Ventricle Outflow Tract

The ViVitro left ventricular outflow tract (LVOT) can be used to mount a compliant aorta and test percutaneous valves in the ViVitro Model Left Heart system. A variety of LVOT sizes can be custom made to accommodate silicone tubes with relaxed tube IDs of 12-24 mm. A tube may be expandable up to about 50mm OD.
ViVitro can provide two methods of deploying devices into the Pulse Duplicator; either Trans Femoral or Trans Apical access. The Percutaneous Device Access is designed to accommodate up to 36 French deployment devices and mounts easily to a ViVitro Model Left Heart.

The ViVitro heat bath has a digital controller that can be used for temperatures from 0 - 100 °C. When coupled with the heat bath, the heat exchanger uses isolated inflow and outflow metal heat conducting channels to transfer the heat to the test solution within +/- 0.5 °C. These two items can work in conjunction or on their own.
ViVitro Labs provides an electromagnetic flow meter and electromagnetic flow transducer probe with each Pulse Duplicator. The system measures the flow channels of either the aortic or mitral sites of the Model Left Heart. This unit provides reliable operations in accurately measuring a wide spectrum of blood flow (2 – 15.4 l/min). A panel meter indicates mean volumetric flow in milliliters per minute and the frequency response is selectable up to 100 Hz. The system works directly with ViVitest Data Acquisition System.

The ViVitro Model Left Heart includes transparent parts to visualize valve function and adjacent flow fields. Ports are available for transducers to measure wall pressures in the left atrium, left ventricle, aortic outflow tract and downstream of the aortic valve.