

Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

A Mechanical System to Reproduce Cardiovascular Flows¹

THOMAS LINDSEY, PIETRO VALSECCHI, ExxonMobil Upstream Research Company, PUMPS AND PIPES INITIATIVE TEAM — Within the framework of the “Pumps&Pipes” collaboration between ExxonMobil Upstream Research Company and The DeBakey Heart and Vascular Center in Houston, a hydraulic control system was developed to accurately simulate general cardiovascular flows. The final goal of the development of the apparatus was the reproduction of the periodic flow of blood through the heart cavity with the capability of varying frequency and amplitude, as well as designing the systolic/diastolic volumetric profile over one period. The system consists of a computer-controlled linear actuator that drives hydraulic fluid in a closed loop to a secondary hydraulic cylinder. The test section of the apparatus is located inside a MRI machine, and the closed loop serves to physically separate all metal moving parts (control system and actuator cylinder) from the MRI-compatible pieces. The secondary cylinder is composed of nonmetallic elements and directly drives the test section circulatory flow loop. The circulatory loop consists of nonmetallic parts and several types of Newtonian and non-Newtonian fluids, which model the behavior of blood. This design allows for a periodic flow of blood-like fluid pushed through a modeled heart cavity capable of replicating any healthy heart condition as well as simulating anomalous conditions. The behavior of the flow inside the heart can thus be visualized by MRI techniques.

¹A collaboration between ExxonMobil URC and Methodist DeBakey Heart & Vascular Center.

Pietro Valsecchi
ExxonMobil Upstream Research Company

Date submitted: 06 Aug 2010

Electronic form version 1.4