

Gas Turbine Industrial Fellowship Program 2008

Flow Modulation Valve Evaluation for Active Combustion Control Applications

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Project Summary

- Helped to configure experimental hardware and prepare data acquisition software for evaluation of electromagnetic (EM) fuel flow modulation valve.
- Designed and performed a series of flow modulation experiments.
- Analyzed data and prepared final report and presentation for distribution to the industrial sponsor and UTSR Peer Review Workshop.

Background

- Active Combustion Control Systems (ACCS) Objectives
 - Combustion Instability Control
 - Active control of “lean” burning combustion instability due to thermo-acoustic driven pressure oscillations.
 - Emission Minimizing Control
 - Active control of the fuel/air mixture ratio.
 - Pattern Factor Control
 - Active control of the turbine inlet fuel flowrate to get rid of hot spots at the turbine inlet.
- Valve technology for modulation of fuel flow in gas turbine engines is a key enabling technology for ACCS.

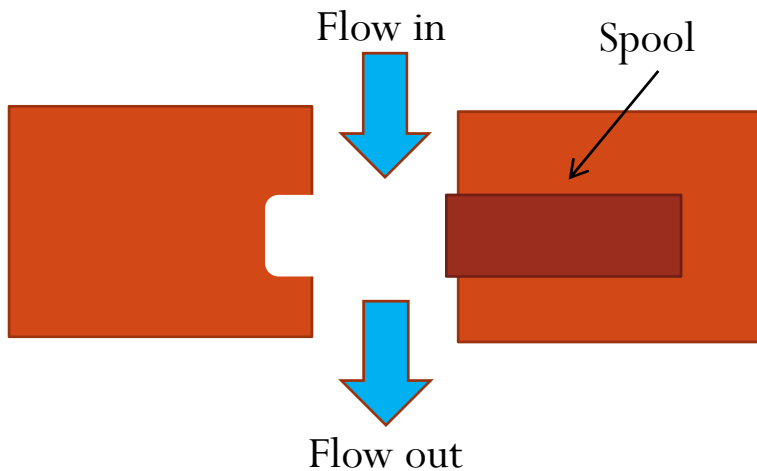
Test Objective

- Construct experimental set up for optimal testing of the flow modulating valve, and come up with DAQ software code that would drive the valve and acquire data.
- Run experiments and analyze the data to help Parker ACCS Team become familiar with how to:
 - operate the valve
 - control its output
 - verify operating envelope
- Modulate fuel flow to demonstrate intended performance.

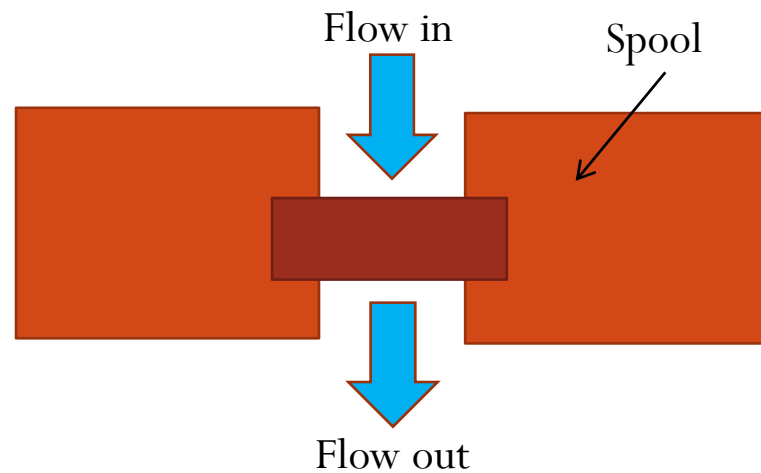
Flow Modulation Valve

- Based on electromagnetic actuation of the spool.
- High frequency movement of the spool controls fuel flow through the valve.

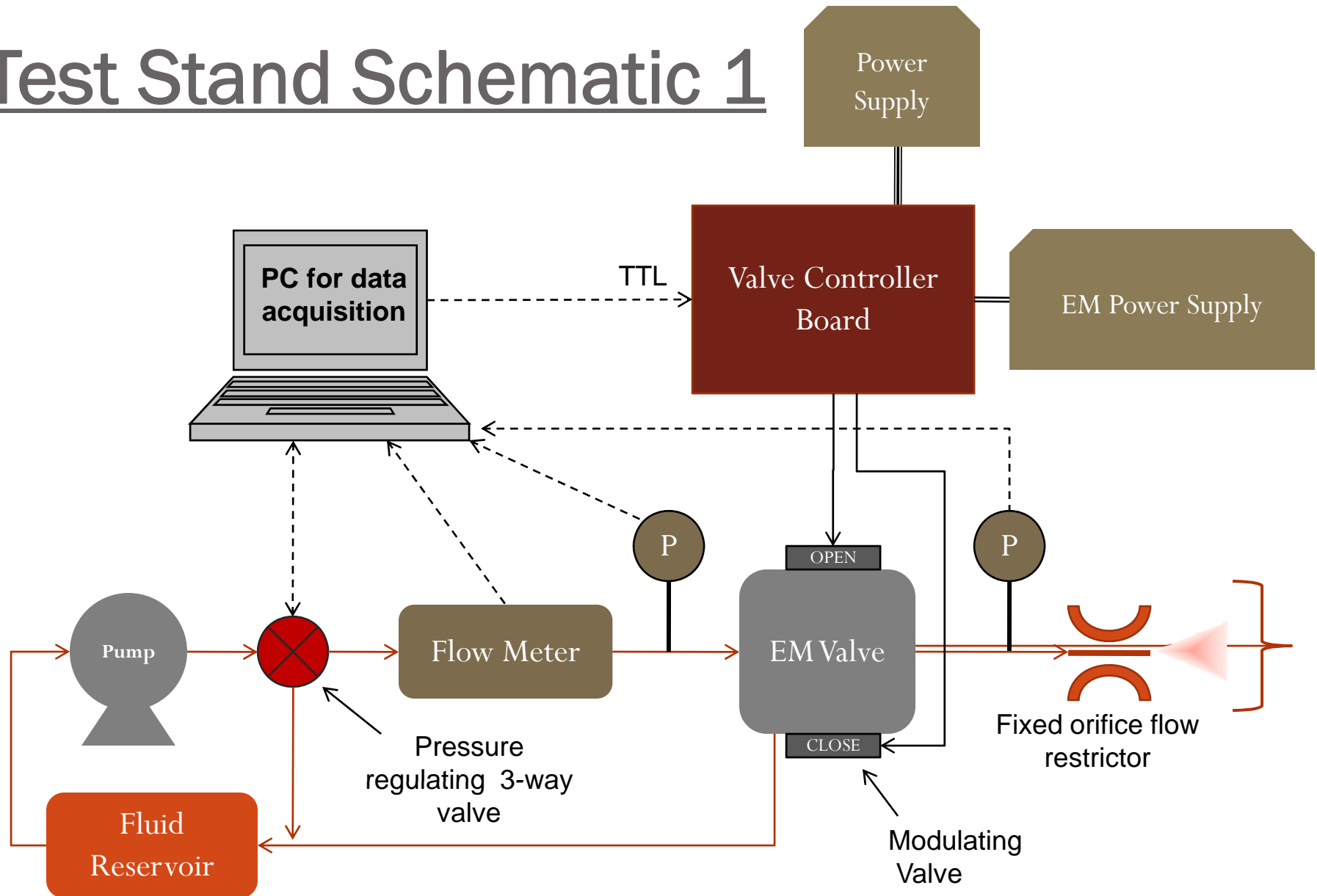
Valve Open



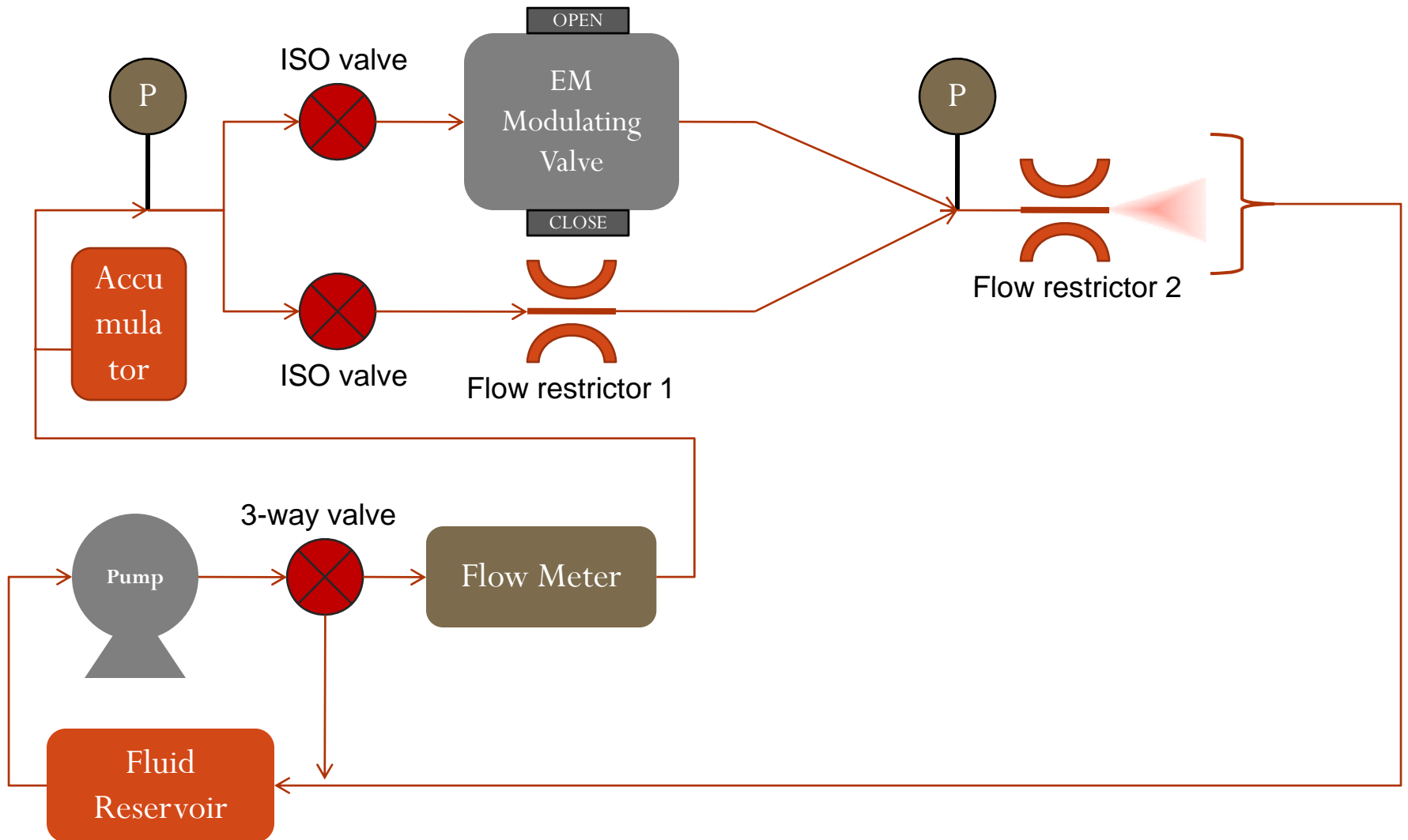
Valve Closed



Test Stand Schematic 1

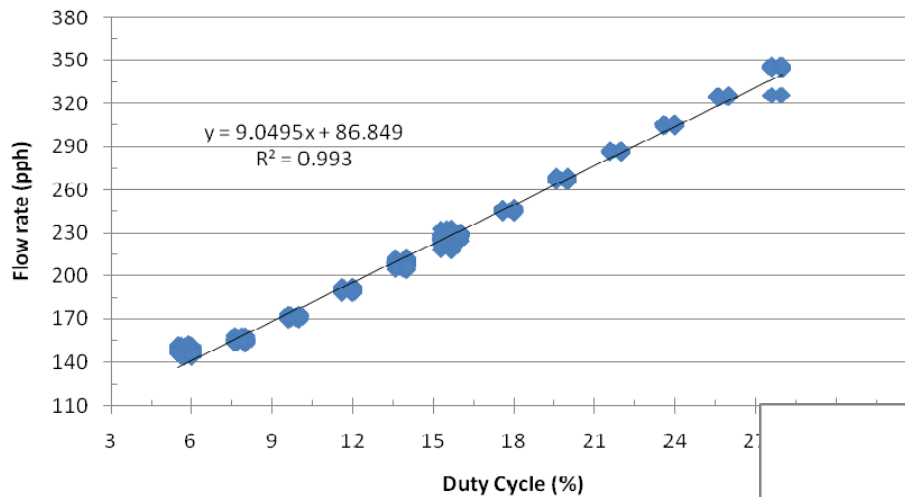


Test Stand Schematic 2



Result Summary

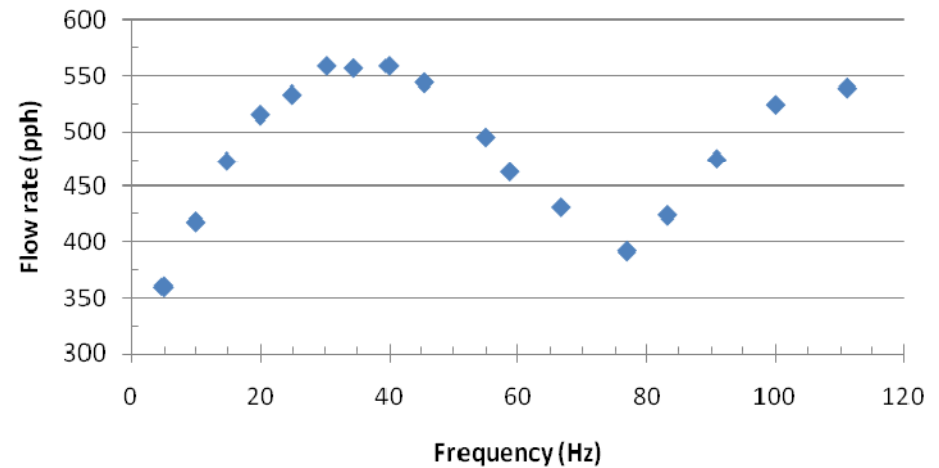
Flow vs Duty Cycle (at 40Hz)



Flow modulation authority shows linear dependence on the actuation duty cycle

Flow modulation authority is shows dependence on an actuation frequency

Flow vs Frequency



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