

Rolls-Royce Senior Design 2015



Rolls-Royce

Design Objective

To induce, detect, and diagnose three distinct degraded conditions on the final control elements of a pneumatic control valve.

Hardware

- OMB-DAQ-2416
- 2 J-Type Thermocouples
- OMEGA PX309-500G5V
- OMEGA LD620-25



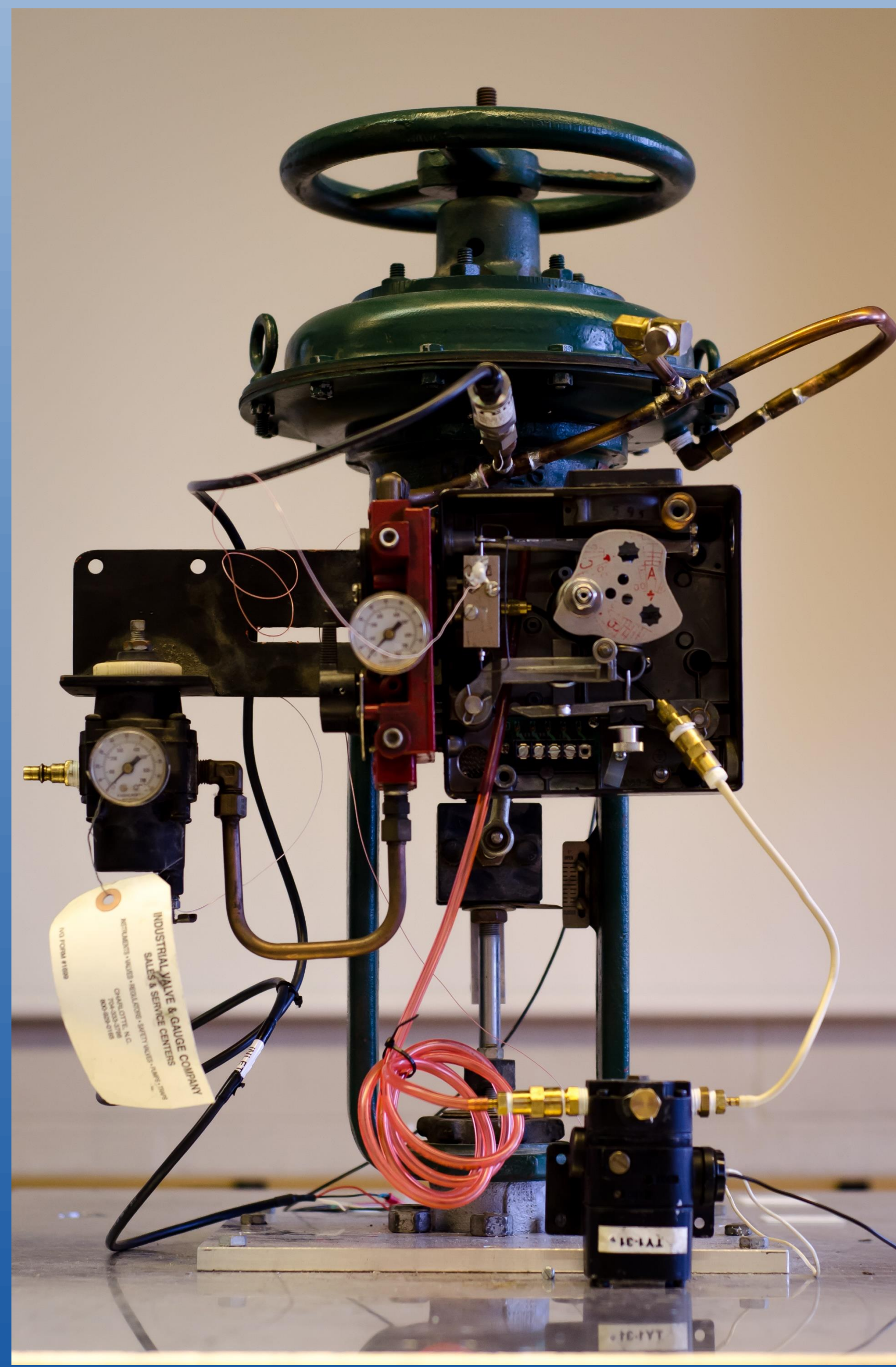
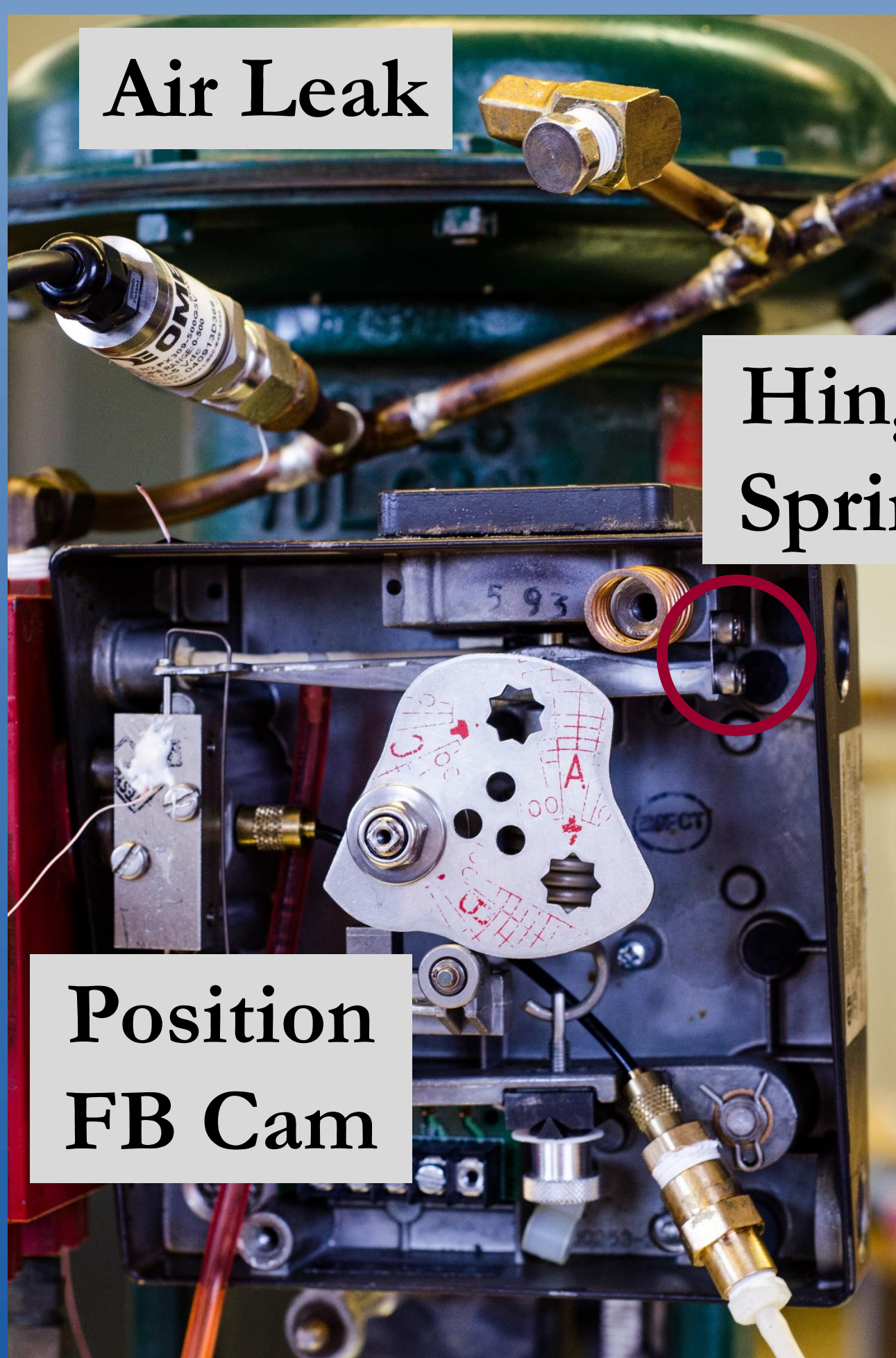
Methods

Degraded conditions were artificially induced in three locations known to fail on a pneumatic control valve: an air leak on the pressure line connecting the positioner to the actuator, wear on the gain hinge spring, and worn edges on the position feedback cam.

Tests were run using constant, sine wave, and square wave current inputs in order to simulate working conditions in a nuclear power plant.

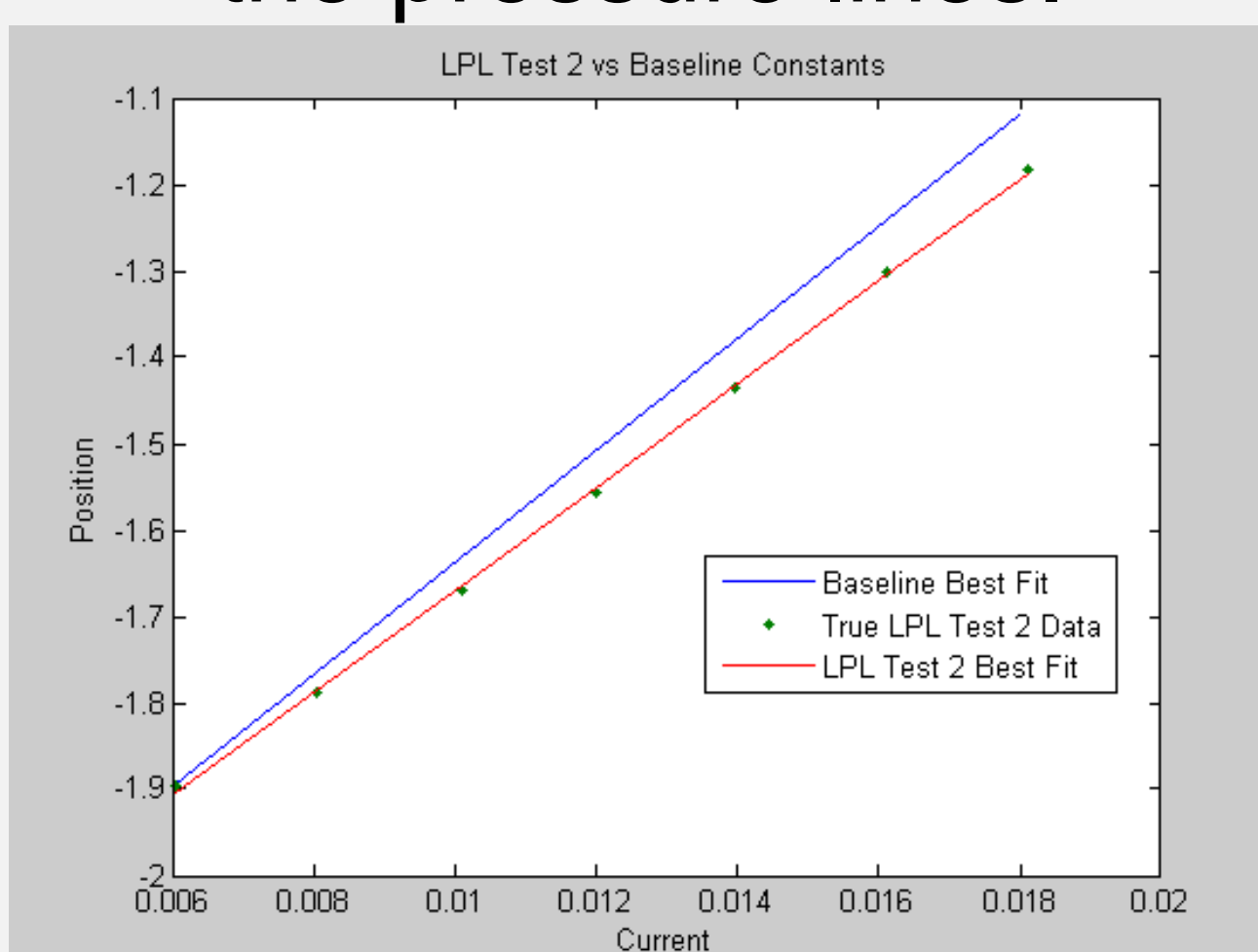
Response data was collected using several thermocouples, a position sensor, a pressure sensor, and analyzed using several MATLAB codes.

Degraded Conditions



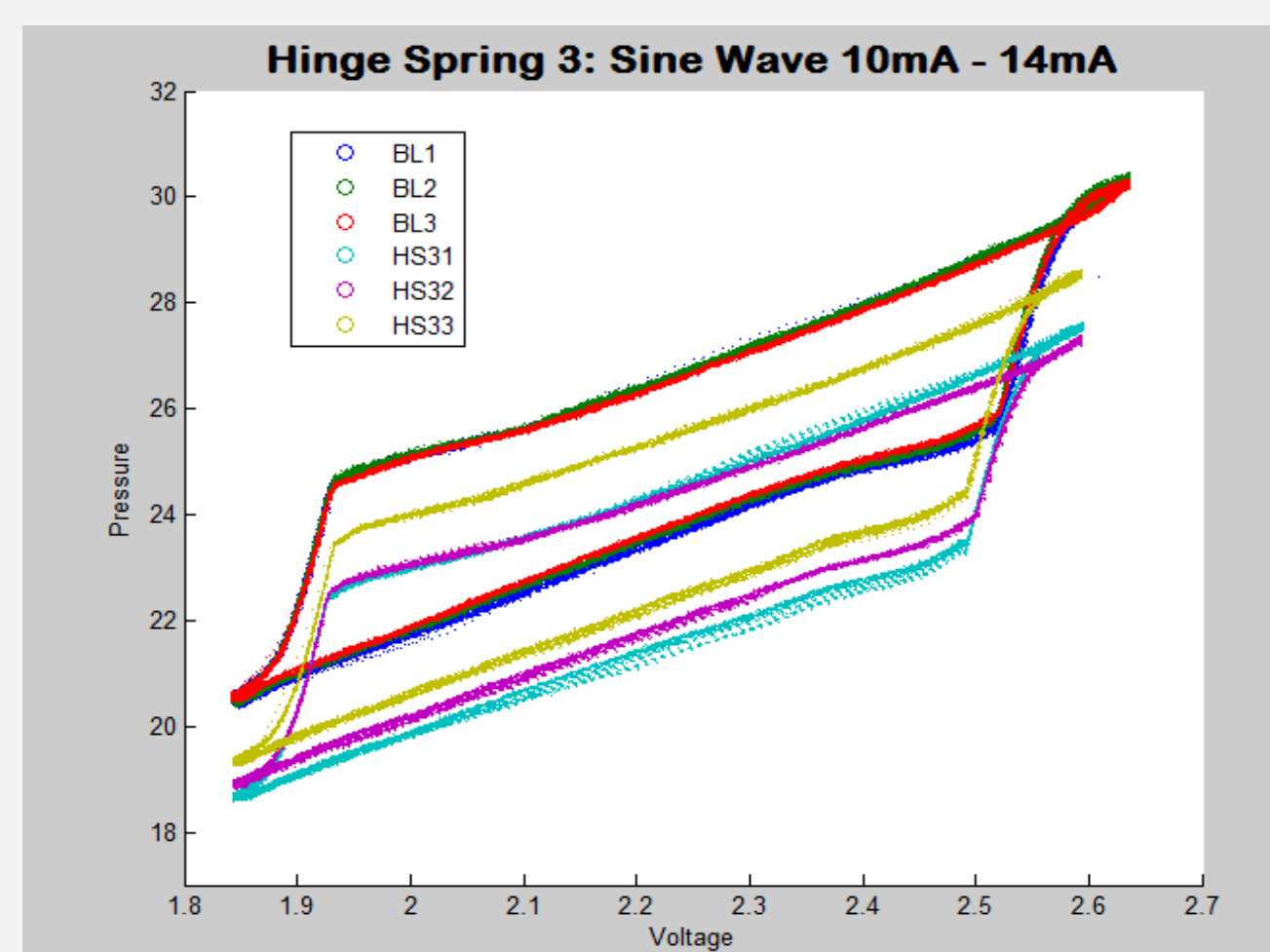
Air Leak Results

Failure was best detected by linearly modeling slopes the slopes of position and / or pressure vs. voltage. Smaller slopes correlate to larger leaks in the pressure lines.



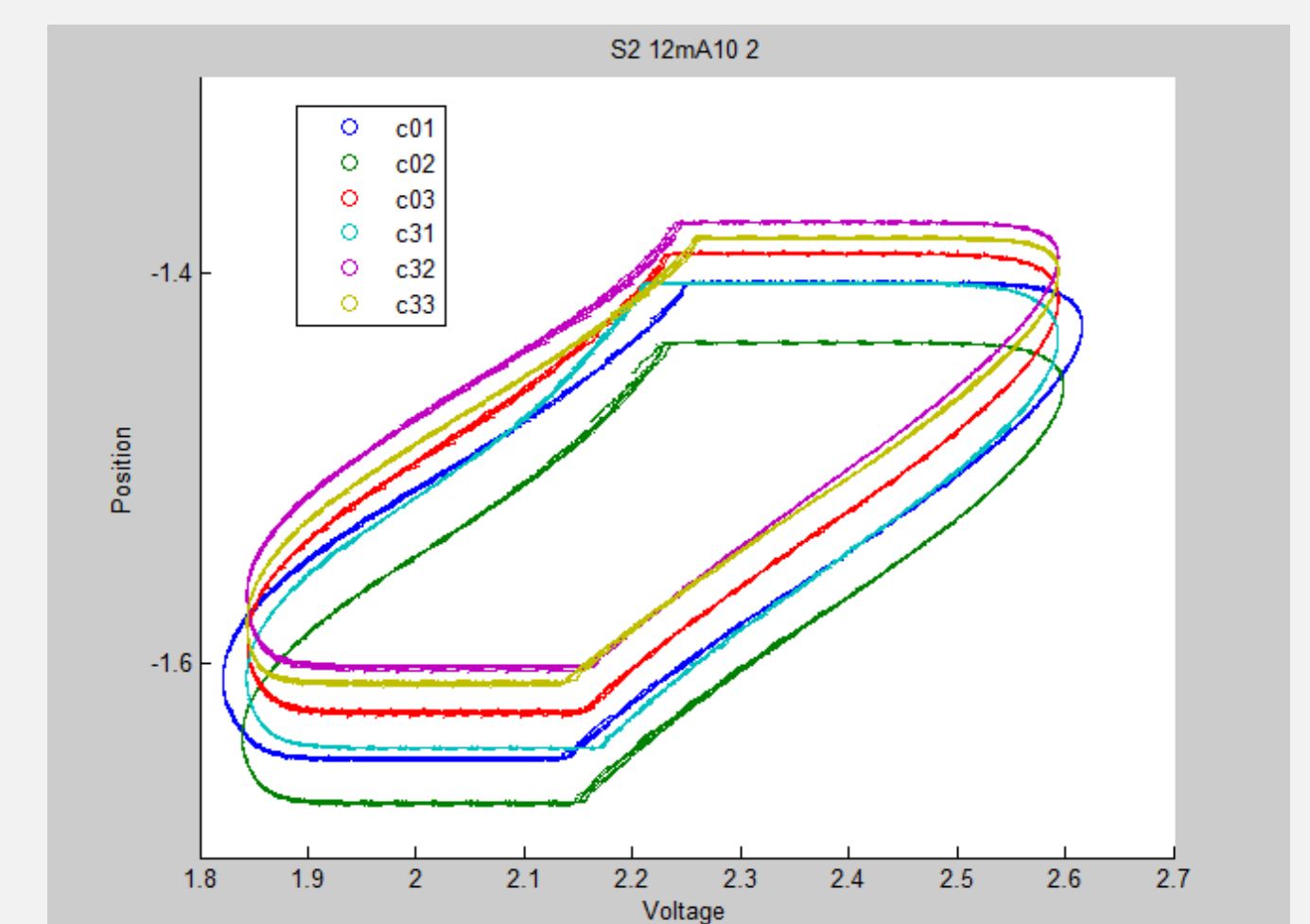
Hinge Spring Results

Failure in the hinge spring was detected when analyzing position vs. voltage and pressure vs. voltage. In this case the pressure and position were shifted down.



Cam Wear Results

Tests regarding cam wear were determined to be inconclusive.



Conclusions

The team was able to successfully detect failure in two of the three degraded conditions. Using our results, Rolls-Royce will be able to begin forming models to detect failure in the nuclear power plants they service.



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