Honeywell Endurance Valve test

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Introduction

Who is our client?

Honeywell - What do they want?

- Test that by replacing the internals of a pneumatic control valve with gemlike material it will expand the lifetime, thus broadening the application of the valve

Project Goals -

- Design and manufacture a two way valve that can test gemlike materials and cycle at 8-10 cycles per second (Hz)
- Plot leakage vs cycles
- Lifetime goal: 10 Million Cycles

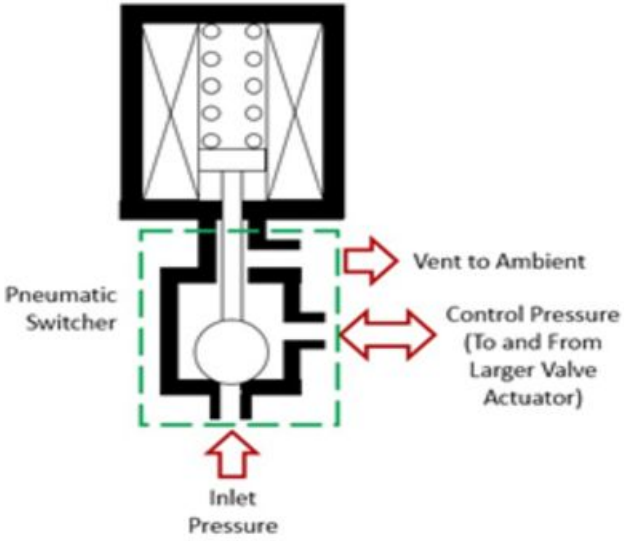


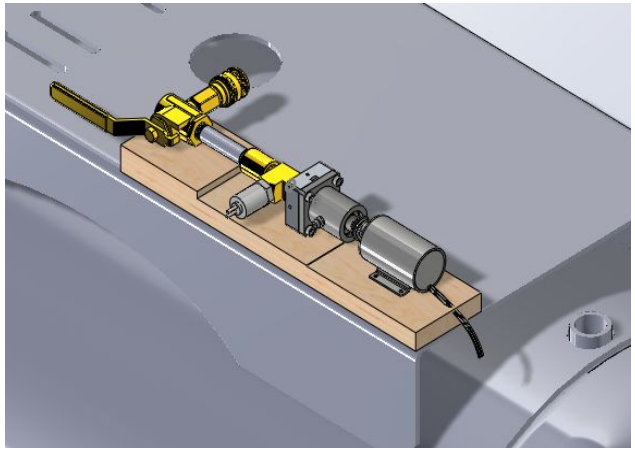
Figure 1: Pneumatic 3-Way Switcher Valve

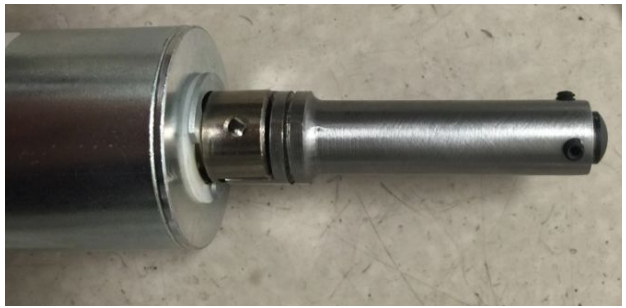
Customer requirements

- Research a gemlike material for the hemispherical poppet/ seats
- Create a seal between the seats and poppet that doesn't leak pressure over time
- Build a testing apparatus that will cycle through 10 million cycles at 10 Hz
- The apparatus must be durable
- The experiment must be repeatable
- Maintain constant inlet pressure

Design Solution

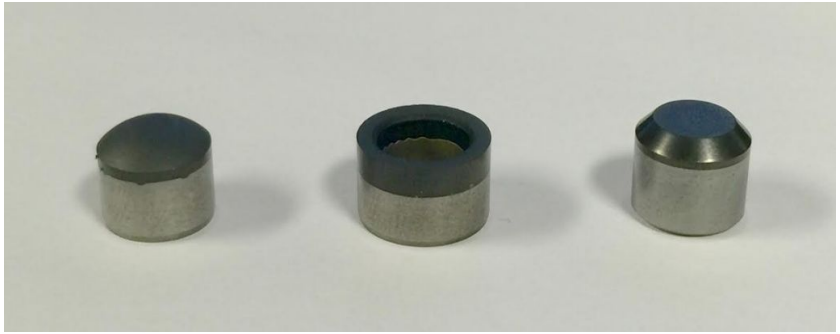
- Endurance- Polycrystalline Diamond (PCD)
- Proper sealing - Rounded seal to match the radius of the poppet
- Constant Pressure - Air compressor
- Measurement of Leakage and Pressure - Pressure transducer
- Repeatability and Cycling - Pulse Width modulation (PWM) controlled solenoid

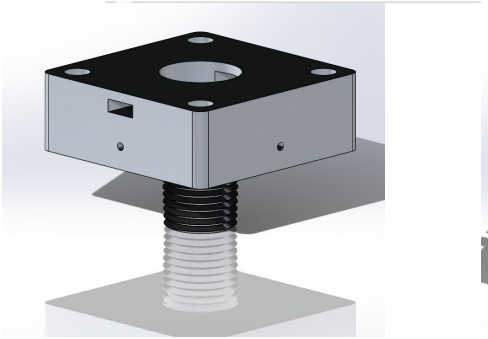


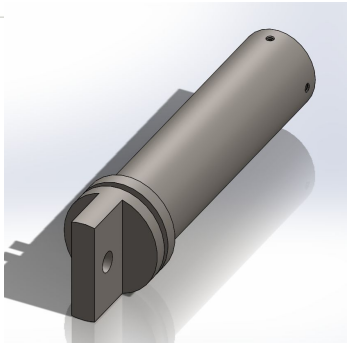


Manufacturing

- US Synthetic - PCD poppets and seats
  - Hemispherical and Chamfered
- Proto Labs - Housing and armature
  - Refinement through NAU Machine Shop
- Additional Components - standard over the counter products including parts like the solenoid, hoses, and springs
  - Spring Rate - 25 lbs/in
    - Generates 5 lbs of Force with a displacement of 0.2 in





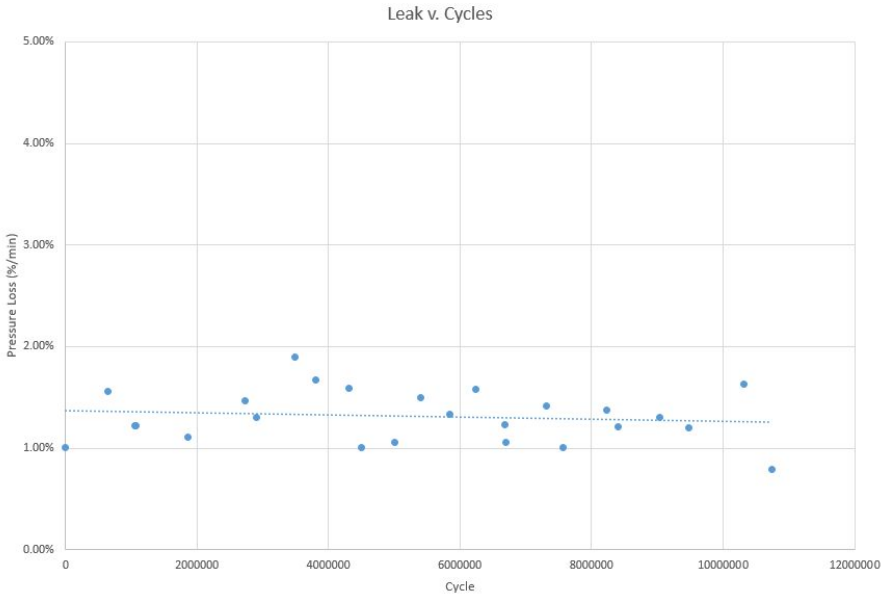


Testing Procedures

- To ensure no leakage within the assembly, Teflon-tape is wrapped around the threads and hose clamps secure the tubing
- 60-gallon tank is filled to 10 psi
- Inlet hose is connected to valve through quick-connect attachment
- Pressure is released from tank, pressure transducers record pressure leakage over 3 minutes.
- After leakage is recorded, inlet air is connected to the valve and solenoid returns to cycling

Results

- Diamond seats withstood the required ten-million cycles, with no signs of increased leakage
- The variation in pressure readings stemmed from alignment issues
- Time permitting, the team would have liked to also test the chamfered poppet design to compare results
- Project outlook moving forward



Questions

References

[1] Honeywell, " Honeywell Aerospace: Ruby Ball and Sapphire Seat Endurance Test Project," Flagstaff, AZ, 2016.