Honeywell Bearing Test Fixture

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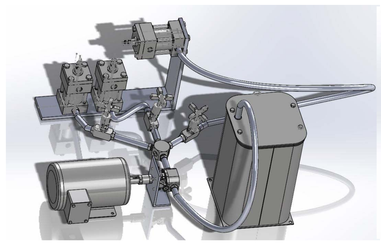
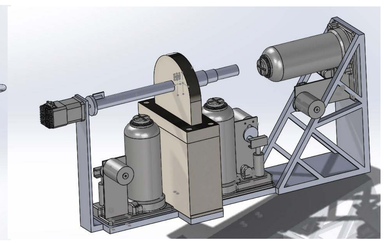
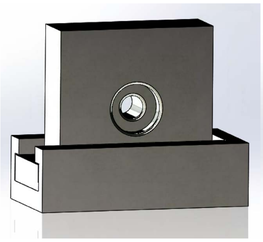
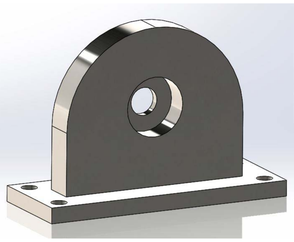
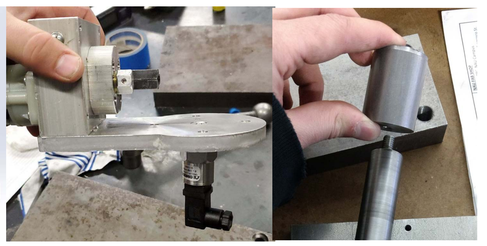
Design Requirements

- Must impart a maximum radial load of 8,000 lbf, and a maximum axial load of 4,000 lbf
- Must be able to test bearings of the following sizes: R14, R12, R8 and 38
- Only power source can be a standard household socket
- Costs $1,500 or less
- Shaft must rotate, and torque must be quantified
- Shaft must turn 90º at a speed of 10º/s or less
- Two people must be capable of moving it
- Must plot friction vs. applied loads in real time

Abstract

Honeywell sells butterfly valves equipped with bearings that experience loads between 2-4 tons depending on where the load is applied, which creates friction that can hurt the performance of the valve. Therefore, a test fixture was designed that replicates those conditions, quantifies the friction these bearings experience, and plots it against the applied loads in real time. Off-the-shelf electric car jacks were chosen to apply the forces for their simplicity and price. To ensure nothing would fail, simulations were created modeling how parts under the maximum loads would react to the forces. To spin the shaft, a stepper motor and crank are used. The pressure within each jack must be found to determine how much force is exerted, thus a pressure measuring device was attached to each one. The user controls the jacks and motor through an Arduino system and a computer program which reads all data from the sensors. The program plots the force and friction data, thus achieving the goal Honeywell set for this system.

Design Approach

Force/torque application

- Fully hydraulic system considered first but scrapped due to high cost, would of provide more control and accuracy
- Car jacks and a stepper motor were chosen instead

Frame/Bearing housing Design

- Housing insert considered first but scrapped due to high weight
- Redesigned to bolt-in to frame
- Bearing rest inside of hole

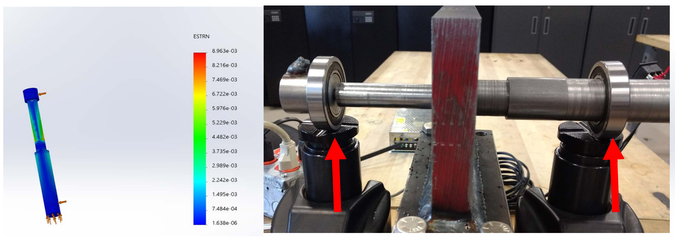
Force Measurement

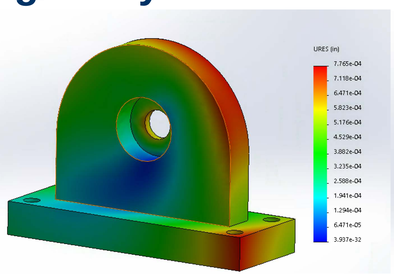
- Load cells rejected
- Pressure transducer shown selected for cost

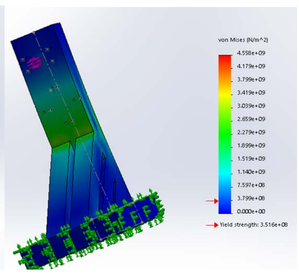
Shaft Design

- All shafts use R14 load bearings. Cap enables removal

Testing/Analysis



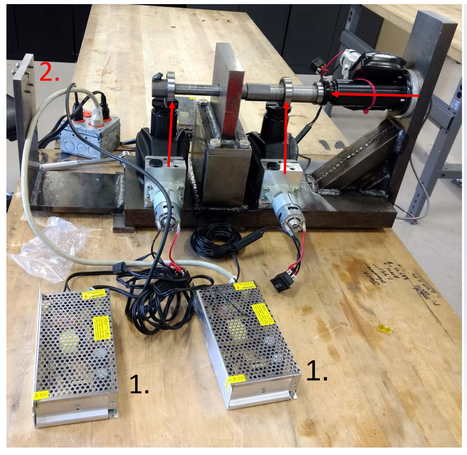


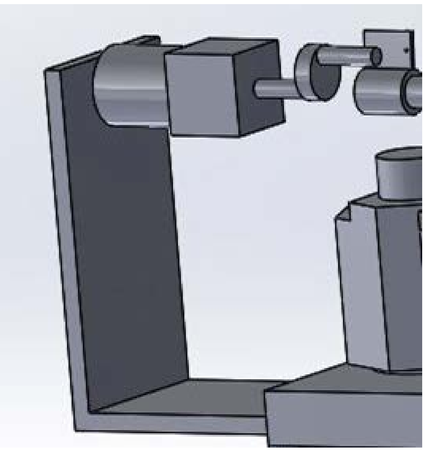


- The shaft shown is designed for the R14 bearing which is subjected to the heaviest load (4 tons)
- The maximum stress equates to 4.35x10^4 psi which does not result in yielding
- Displacement is 0.118 in which was approved by the client
- When tested the shaft deformed elastically

- The maximum stress experienced by the bearing housing is 2.218×10^4 Psi resulting in a factor of safety over 2
- The maximum deflection of the bearing housing is 7.765×10^{-4} in. which was approved by the client
- The the axial load bearing frame is subjected to a stress of 5.51*10^4 psi, and minimal displacement
- When tested nothing deformed

Final Design/Results





- The forces applied are indicated by the red arrows
- The test bearing is inside the bearing housing
- The components shown in position 1 are converters needed to power the jacks
- Position 2 indicates where the stepper motor and crank will be located
- Jacks are controlled through arduino and plots/calculations are handled through a program

Acknowledgements

- Honeywell Project Contact: Haley Flenner
- Honeywell Chief Engineer: Todd Garrod
- NAU Machine Shop managers
- Capstone Advisor: Dr Trevas
- Copperstate Nut and Bolt