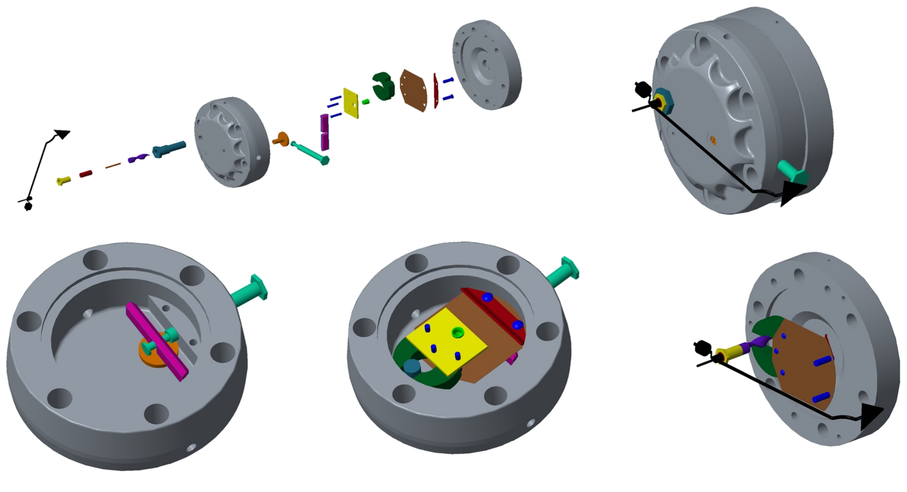
BPMI Senior Design Project 2017



Recently obtained by BPMI, the Yarway Remote Liquid Level indicator is a hydro-mechanical pressure gauge used in fluid tanks. BPMI has very little engineering information, and tasked the GCC senior design team with learning more about the device.

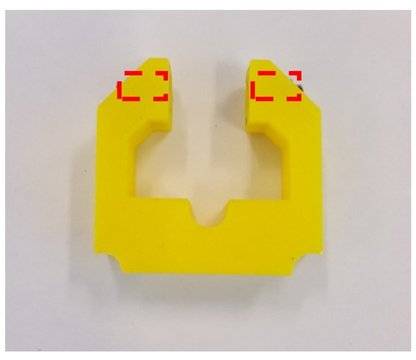
Main Objectives:

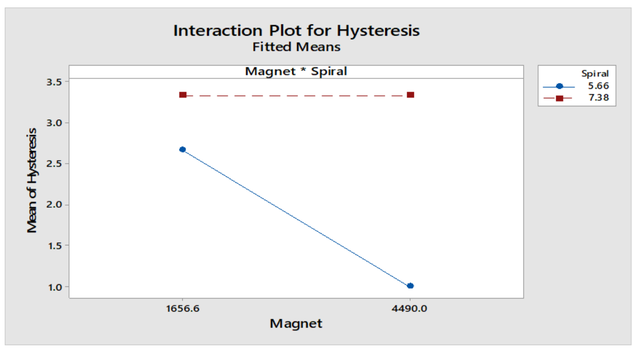
1. Perform testing on Yarway Remote Liquid Level Indicator to determine variables that have impact on hysteresis and linearity of readings.
2. Redesign major components to achieve better hysteresis and linearity.
3. Perform cycle testing on spring plate located in Yarway device.

Magnet Redesign

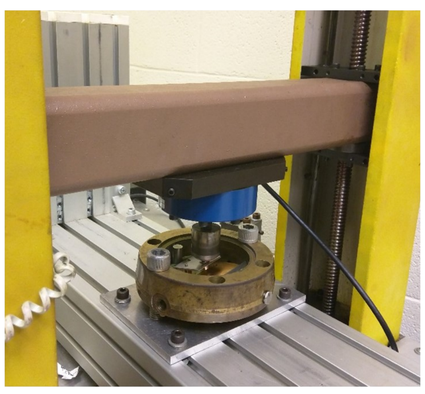
Original magnet could not overcome frictional forces. New design is a 3-d printed plastic casing with slots (red boxes) for neodymium magnets.

New design 3x stronger than original, reducing hysteresis to 1/3 or original. Linearity improved 2x (when paired with better spiral).





Spring Cycle Tests

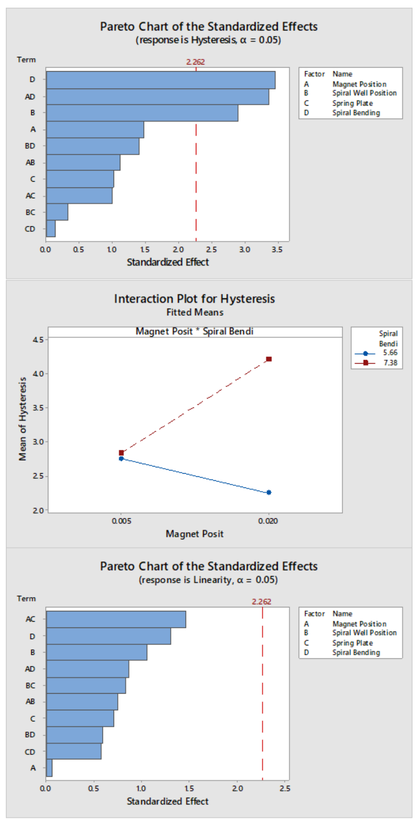


Specifications:
. 182,500 cycles
. .23 in deflection
. 5 cycles per second

Results:

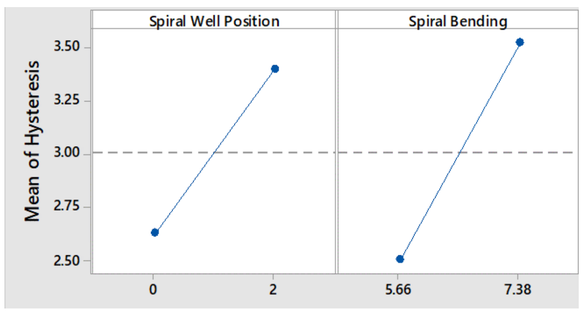
Out of 8 springs, there were no failures and no apparent loss of material strength

Team members (from left to right)
Top row: Wesley Dunkerton, Jacob Zeltman, Zane White
Bottom row: Tyler Lathrop, Eric Schmidt, Joseph Hanson



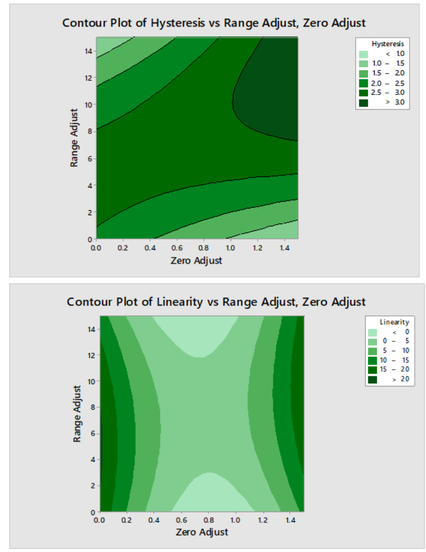
Fractional Factorial Tests:

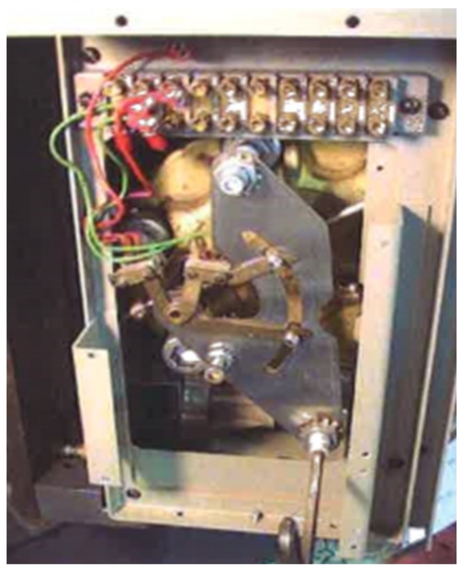
The Pareto Chart to the left describes the factors that have a statistically significant effect on the hysteresis of the system. The graphs below illustrate how both the statistically significant factors and the one variable interaction affect hysteresis.



The Pareto chart for linearity shows that none of the variables in the fractional factorial test have a statistically significant effect on linearity.

A central composite test design was used to map the effect of the range and zero adjust screws which are key to calibration, shown right.





Acroswitch Redesign

The current switch design utilizes a magnetic reed switch which detects a magnet attached to the indicator arm. It was hypothesized that this would have the potential to induce a torque on the indicator arm through the interaction of magnetic forces.

A new inductive switch assembly was designed to detect the position of the indicator arms. This new sensor had no statistically significant effect on hysteresis of the system.