

Measuring Changes in the Specific Gravity of a Fluid



Authors: Dr. R. Rees Fullmer, James Dean, Bridger Freeman, Ryan Silcock



Strain gages from Micro-Measurements were used in the design of a device that could continuously monitor the specific gravity of a fluid. A strain gage was applied to a cantilever beam that was deflected by a float. The buoyant force the float provided changed depending on the specific gravity of the fluid. A full bridge strain gage was used to make the specific gravity measurements independent of temperature. The precision, reliability, and durability of the product made it ideal for this application.

Company/Institute: Utah State University Department of Mechanical and Aerospace Engineering

Industry/Application Area: Home brewing, food manufacturing

Products Used:

- [J2A-09-S1425-35B Transducer-Class® Strain Gages](#)
- [M-Coat W-1 w protective coating](#)
- [MMF022335 BAK-200 strain gage application kit](#)

The Challenge

The hobby of home brewing has become very popular in the United States in recent years, leading to the emergence of a number of commercial products catering to home brewers. One of the most important devices is the hydrometer, which measures specific gravity. Specific gravity changes



throughout the brewing process until fermentation is finished. Home brewers must sample the specific gravity of their batches to verify when it stops changing, thus telling them when it is finished fermenting. Most traditional methods of measuring specific gravity require manual sampling of the liquid, a process that is inefficient and wasteful. This design project was focused around designing a device that could continuously monitor the changing of specific gravity without manual sampling.

There were a number of challenges associated with this project, the first of which was the harsh brewing environment. The device would be submerged in liquid for a four- to six-week period. The measurement also needed to be independent of temperature. Finally, the strain gage needed to be both precise and accurate to make the device reliable.

The Solution

The concept that was chosen to accomplish the design objective was to apply a strain gage to a cantilever beam. The beam was attached to a float, whose buoyant force would change depending upon the specific gravity of the fluid. This change in buoyant force would result in a different strain in the beam, which was measured by the gage. Measured strain was calibrated to a known specific gravity value. The strain gage was coated in the M Coat W1 wax and food-grade silicone in order to make it waterproof. A full-bridge strain gage was used to negate the effects of temperature change. The accuracy, durability, and reliability of the strain gages and coatings used in the device are what make it an effective product for the home brewer.

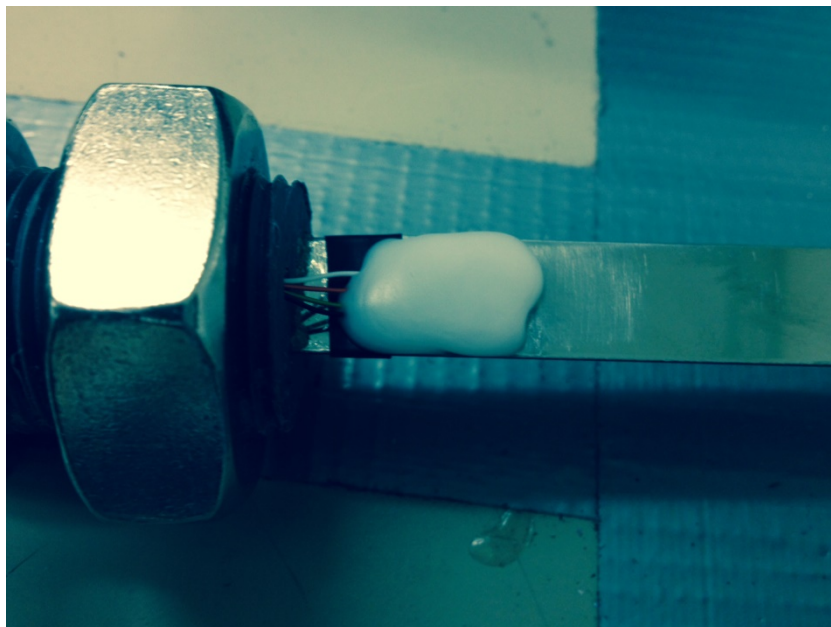


Figure 1: Full-ridge gauge with M Coat W1 wax



Figure 2: Cantilever beam with strain gage attached

“With the quality products from Micro-Measurements, we were able to create a device that can continually monitor the specific gravity of a fluid. The device has proven to be a reliable and accurate tool in the hands of a home brewer. The device also has the potential to be used throughout the food manufacturing industry in various applications.”

Acknowledgement:

The Department of Mechanical and Aerospace Engineering provides each graduate with a foundation of knowledge and experience upon which to build successful careers in mechanical engineering, aerospace engineering, or other fields where a strong engineering background is required or desirable. Undergraduate programs emphasize mechanical engineering fundamentals and computer-based problem solving, while teaching students to learn, synthesize, and communicate engineering information. Graduate programs emphasize research by the faculty with a high level of student involvement, providing enhanced preparation for engineering practice, research, and education. Students, faculty, and staff are committed to excellence in learning, discovery, and engagement in an environment that fosters diversity and mutual respect.

Contact Information

Dr. R. Rees Fullmer
Associate Professor
Utah State University
Logan, Utah
Email: rfullmer@usu.edu
Web: <http://mae.usu.edu/>

Vishay Precision Group, Inc. (VPG)
Micro-Measurements
mm@vpgsensors.com