Twin-Screw Pump Wear Testing CIR_WEAR2

CHARLOTTE

CIRCOR

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Objective

We are to improve this prototype of a testing apparatus designed to measure the wear properties of surface coatings and treatments on metal used in twin screw pumps. The teams goal is to measure tangible data such as: flow rate, fluid temperature and motor torque from the testing of different surface coatings and treatments using LabVIEW. To obtain these metrics, sensors were added to the this prototype, as well as improvements to other aspects the team and industry supporters agreed upon.

Introduction

Performance Specifications:

- PS1: Control surface speeds by variable frequency drive up to 3000 ft/min.
- PS2: The testing device will apply relevant fluid differential pressure drops up to 150 psi.
- PS3: Capable of circulating water or other liquids.
- PS4: Measure & record pressure, torque, fluid slip flow rate, and fluid temperature.
- PS5: All captured data will be viewable and easily transferable utilizing a USB connection to LabVIEW.

Completed Design Improvements and Fabrications:

- Handles for the base of the assembly
- Extension for the base of the assembly
- Pegs for extra grip on gland cap
- Flats on plunger for ease of threading
- Pressure and temperature sensor housing
- Flexible couplings for shaft adaptation and misalignment
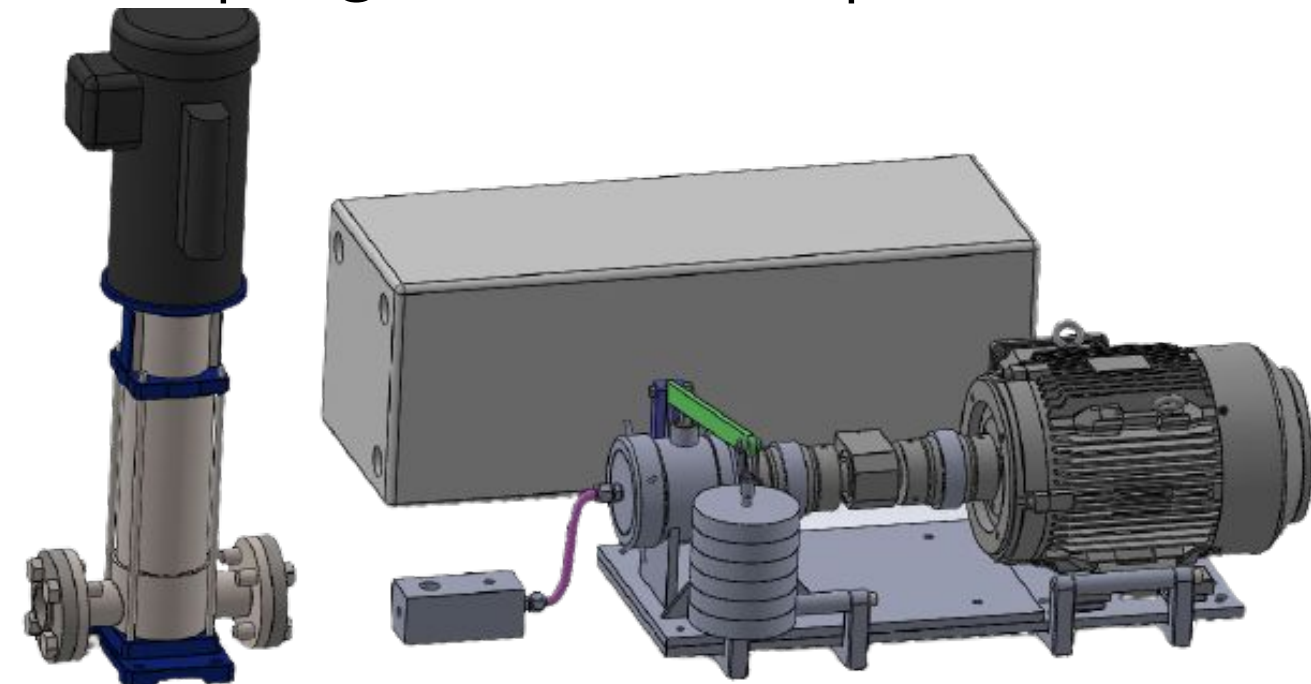
Design of Prototype

Reservoir:

The reservoir we've selected is a 20 gallon fresh water tank for an RV. This tank will provide more than enough fluid and space to absorb any heat soak from the testing.
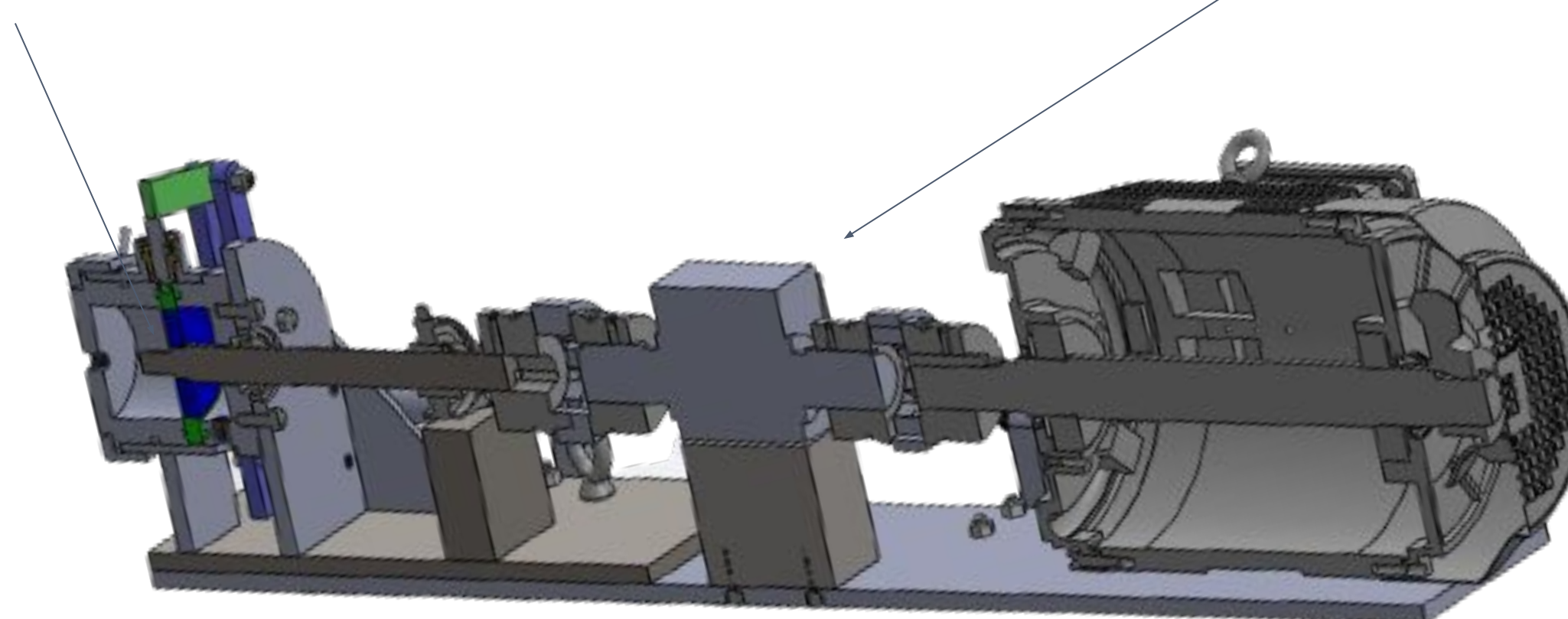
Pump and Hose:

A centrifugal pump capable of pushing 150+psi, in conjunction with an electric motor, moves fluid from the reservoir through the flow meter and sensor housing and into the pressure vessel. A brass garden hose fitting, and a heavy duty hose shuttles the fluid to the inlet and from the outlet of the pump.

Pressure, Temperature and Flow Sensors:

Pressure and temperature sensors are placed at the inlets and outlets to measure relevant pressure drop and temperature delta. A flow meter measures the flow rate of the water before entering the pressure vessel. Each of these sensors interface with a National Instruments data acquisition device.

Temperature Sensor

Pressure Sensor

P & T sensor housing

Inner (blue) and outer (green) coupons
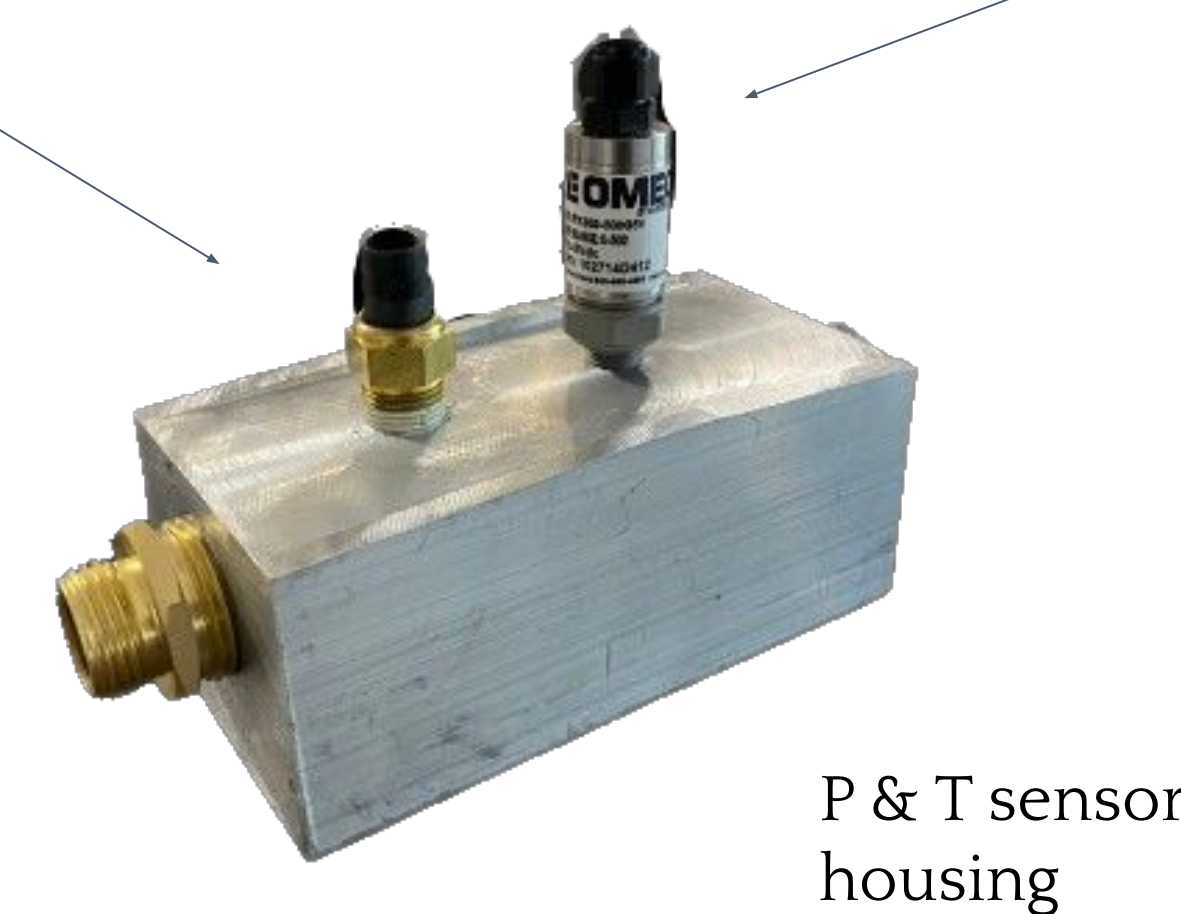
Torque Sensor

### Pressure Vessel, Torque Sensor and Testing Coupons:

The pressure vessel houses two cylindrical discs that make contact on the inner and outer diameters where a surface coating or treatment will be tested. With a load applied, the motor spins the surfaces against one another until a friction failure occurs.

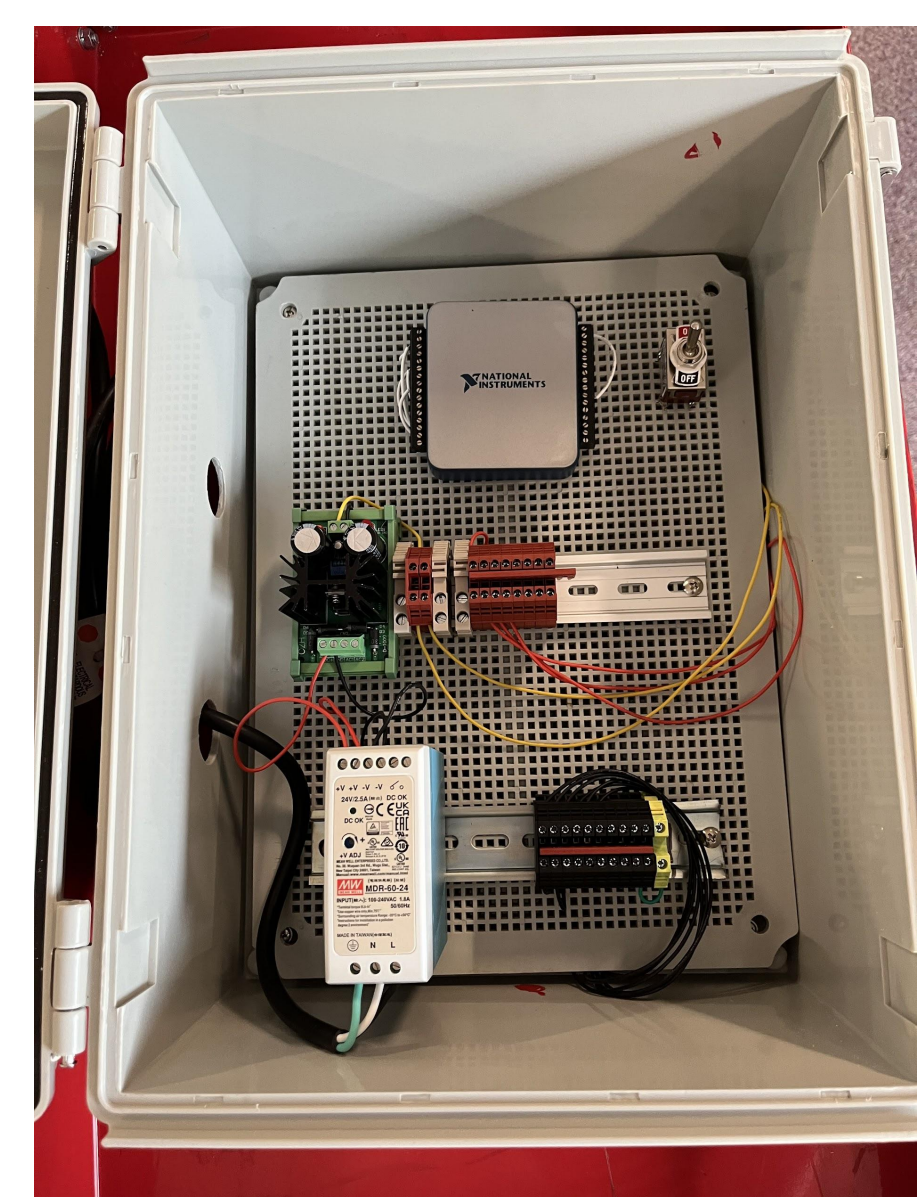### Test Failure (Completion) and liquid recirculation:

The torque sensor will measure the increase in friction between the two surfaces. When the measurement spikes, the surface coating or treatment has reached failure. Once the liquid enters the pressure vessel and flows between the gap in the inner and outer coupon, the liquid exits the vessel and is recirculated back into the reservoir to complete the closed loop system.

Data Acquisition

LabVIEW is the interface the team is using to visualize and collect data from the sensors while the rig is being tested. The program displays real time measurements using torque, temperature, pressure, and flow sensors during testing. In addition, an emergency shut off switch was added to the system so the operator can remove power to the motor when a friction failure occurs.

STOP
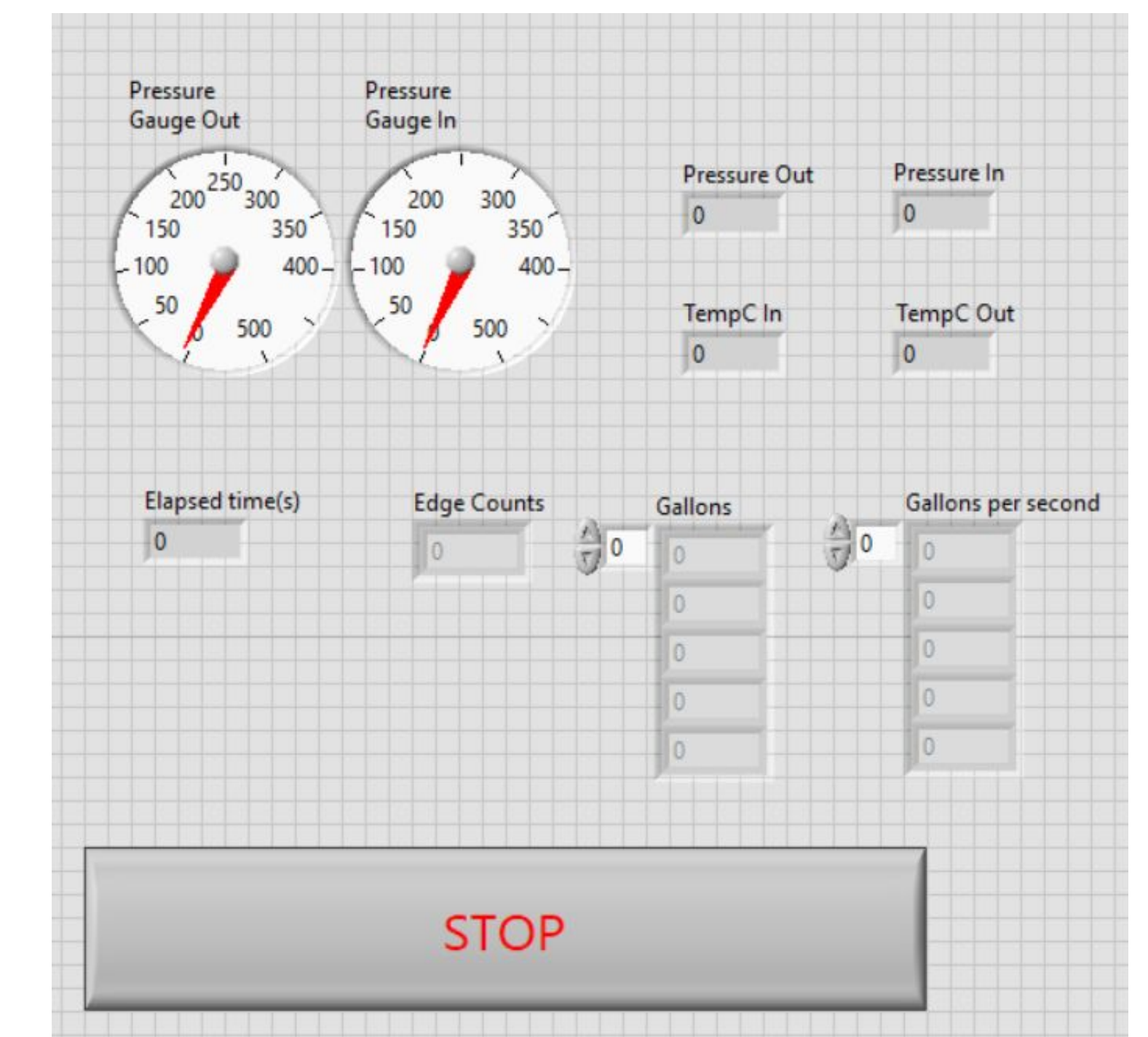
The sensors are connected to a data acquisition device (DAQ) which supports a USB connection for a laptop running LabVIEW. The DAQ is the hub for all of the sensors and provides a digital output for the emergency shutoff. Most sensors will be powered by a 24V DC power supply and there's a voltage step down for the sensor that requires lower voltage.

Acknowledgements