Abstract
Pacific Design Technologies (PDT) designs liquid cooling systems that include components such as pumps, filters, accumulators and heat exchangers; all of which need to be tested to meet military and aerospace standards. Currently, PDT must disassemble and assemble custom test stands for each product. To facilitate increased efficiency in completing these tests, a multipurpose standardized fluid test stand was designed. A design package, which includes a hydraulic schematic, assembly drawing, and bill of materials (BOM), was provided to PDT. A scaled proof of concept model was assembled to verify different products could be removed and installed quickly with the use of Quick Disconnects (QDs) and flow rate, pressure and temperature of the unit under test (UUT) could be measured accurately.

Design Development
In developing this design a hydraulic schematic was created to visualize the layout of components necessary for the test stand. Several schematics were developed. The finalized hydraulic schematic is shown below. This schematic includes all the major components necessary to test a variety of PDT devices.

Modeling
The hydraulic schematic was used to translate the design into a 3D model of the test stand. With the use of this model, a BOM was created. The test stand is considerably large, with dimensions of 34″H x 84″W x 42″D. The BOM is composed of 70 items totaling 368 parts. Using the 3D model and BOM an assembly drawing package was created and provided to PDT.

Analysis
The design is composed of 1-½" stainless steel piping and fittings. Pressure is expected to drop throughout the system. Each UUT, passive or active, must be tested at a certain flow rate and pressure. The equation below was used to calculate the power needed to pump the fluid through the system for each UUT (10). The plots below provide a comparison of the power provided by the bypass pump or active UUT to the power the system needs.

Testing
Testing was conducted on the proof-of-concept model (Figure 1). This was done to verify specific project completion requirements. These requirements include quickness and ease of switching out the UUT and accuracy of the measuring devices and data acquisition system. The table below lists each requirement and test results.

Table 1: Proof of Concept Test Results

Data Acquisition System
A LabVIEW program was written to display and record flow rate, pressure and temperature measured during testing. Turbine flow meters, pressure transducers, and thermocouples are used to measure each parameter. These measurement devices are connected to FieldPoint Modules for analog to digital conversion. The figure below provides an illustration of the graphical user interface in the LabVIEW program and the FieldPoint Modules.

Conclusion
The Proof of Concept Model of the Multipurpose Standardized Fluid Test Stand demonstrates the ability to quickly change out UUTs. With the added LabVIEW data acquisition system, testing and data collection can be completed efficiently and accurately. The design package and LabVIEW program supplied to PDT provides the basis for building the final test stand.

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