Engine Test Cell Improvement Project

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AEROTEC ENGINES

Introduction

Aerotec Engines services horizontally opposed aircraft piston engines, rebuilding engines that have suffered damage or have reached Time Between Overhaul (TBO). Each rebuilt engine is tested in-house in Aerotec's current test cell, which will soon become a bottleneck that limits their production. Aerotec identified test cell performance and throughput as a future problem and proposed this project to prepare for the impending issue.

Project Scope

1. Reduce noise pollution to the surrounding environment
2. Improve airflow through the cell
3. Implement an automatic data acquisition system
4. Reduce load in/load out times
5. Minimize effects of temperature change on test cell

Design Process

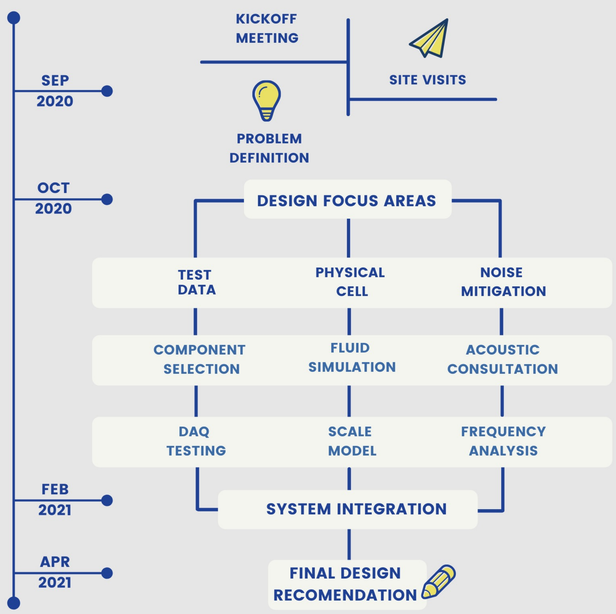

Figure 1: Design process and workflow during the project

Design Information

Physical Cell

The cell design addressed several issues. First, in order to remedy the noise and temperature issues; the cell was moved indoors. To improve the airflow through the cell a recirculating duct was designed to return the engine wake to the front of the cell, which decreases errant pressure zones and allows for cooling of the engine. The duct was sized using flow simulations in SolidWorks. The final design improved operator ease of use by adding:

- Underfloor UV lighting for oil leak detection
- IP cameras for 360° video monitoring
- Ramped entry for ease of loading
- Sloped floor with pan for oil spill collection

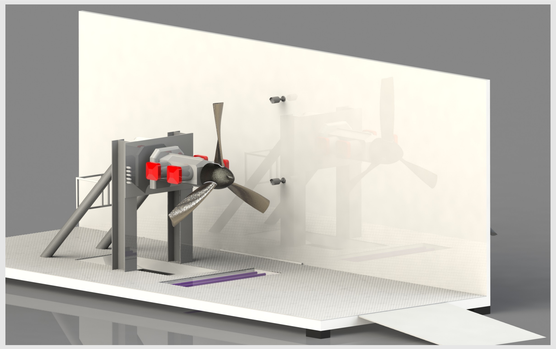

Figure 2: Redesigned test cell and engine mount

Figure 3: Redesigned test cell cockpit including new LabVIEW software

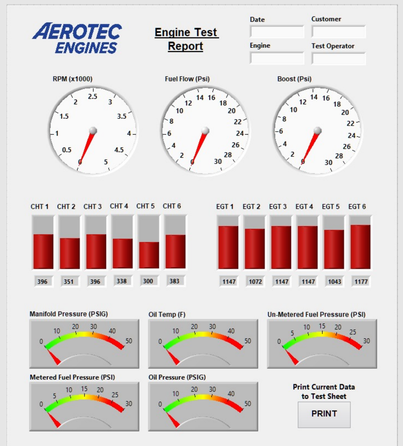

Figure 5: LabVIEW Virtual Interface (VI) for use in the test cell

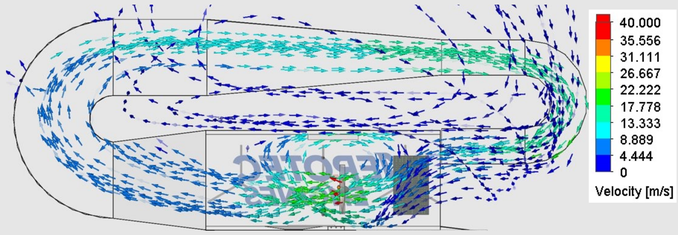

Figure 4: SolidWorks flow simulation of the recirculation design. Results were validated with anemometers within 10% accuracy.

Data Acquisition System (DAQ)

Current test reports are completed by hand after testing. These design objectives will modernize and automate this process.

- Replace manual data entry with digital data collection
- Design a detailed virtual interface that is tailored to Aerotec's testing and data logging needs

Noise Mitigation

To meet the project requirement of measuring less than 85 dBA outside of the test cell room, a multifaceted approach is required.

- Disjoint construction, sound blocking and absorption
- Heavy weight products in the walls, air intake/exhaust mufflers
- Consider sound direction and/or noise cancelling techniques

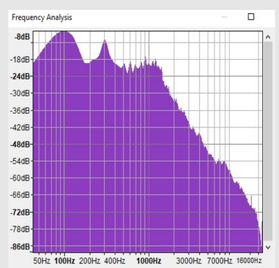

Figure 6: Frequency analysis of a helicopter engine at 3100 RPM

Testing

Data Acquisition equipment was tested in the current test cell, utilizing a thermocouple to measure the Exhaust Gas Temperature (EGT) being produced by an engine cylinder. This test successfully displayed the EGT electronically and showed data logging capabilities.

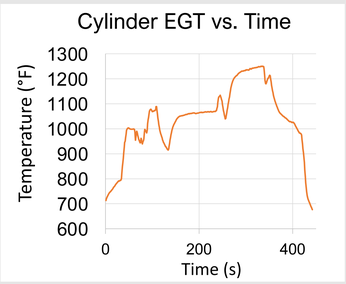

Figure 7: Data log from the DAQ showing EGT vs Time, and a mag drop test showing a temperature spike correlating to a functional magneto

Conclusions

- Air can be recirculated to the front of the cell via external ducting running the length of the cell, fed from the rear
- Digital data collection improves both the accuracy and speed of test cell reporting
- Research into a multifaceted approach to sound mitigation is recommended to satisfy internal and external noise constraints

Acknowledgements

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