Preparation of the Multistage Compressor Facility

Student Researcher: Ashlie B. Flegel

Advisor: Hal Weaver

The University of Toledo
Mechanical Engineering Department

Abstract

Research and developments of new aerospace technologies is one of NASA Glenn Research Center’s specialties. One facility that deals with the research of aerospace technologies is the High-speed Multistage Compressor Facility. This facility will be testing the performance and efficiency of an Ultra Efficient Engine Technology two-stage compressor.

There is a lot of preparation involved with testing something of this caliber. Before the test article can be installed into the test rig, the facility must be fully operational and ready to run. Meaning all the necessary instrumentation must be calibrated and installed in the facility. The test rig should also be in safe operating condition, so the proper safety permits can be obtained. In preparation for the test, the Multistage Compressor Facility went through a few changes. For instance, the facility will now be utilizing slip rings, the gearbox went through some maintenance, new lubrications systems replaced the old ones, and special instrumentation needs to be fine tuned to achieve the maximum amount of accurate data.

The objective of my internship was to help in the finalizations of the test facility by designing and installing components such as a coolant reservoir and inching drive guard to ensure safety of the facility; a calibration isothermal block to ensure accuracy of the temperature devices; and update schematics of the facility layout.

Objectives and Results

Slips rings help gather information off of a rotating device—in this case from a shaft-onto stationary contacts. The contacts (or brushes) need to be cooled to reduce the amount of frictional heat produced between the slip ring and brushes. The coolant running through the slip ring is AK-225, a material hazardous to the ozone. To abide by the safety regulations the coolant must be run through a closed chiller system. A new chiller system was purchased but the coolant reservoir was ventilated which doesn’t make the system truly closed and sealed. My task was to design and have a new reservoir built for the chiller system that complies with the safety guidelines.

The gearbox had some safety issues also. Located in the back of the gearbox an inching drive was set up. When the inching drive is in use the gears and chain are bare which posed as a safety issue because someone can easily get caught up in it. The safety board required the inching drive guard to fully cover the whole sprocket gear and chain. So to prevent anyone from getting hurt in the gears I designed a chain guard.

Some of the facility’s systems were modified such as the lubrication system. This system is used to lubricate both the gearbox and compressor bearings, but now the system has been split into two independent systems. Since the lube system has been changed, the facility drawings became incorrect so it was my task to look over each system and update the drawings.

When it comes time to test the compressor it is vital to get accurate data, one of the important pieces of data is to find out the compressor efficiency. Through calculations the efficiency can be found by getting the compressor discharge temperature. The facility uses thermocouples for temperature readings; they are very useful but not very accurate and have many uncertainties. A method has been found to improve the accuracy of these thermocouples by putting them through extreme and controlled temperature changes.
The thermocouples will have to be heated up and cooled at a uniform temperature; there are four thermistors, which are another form of temperature devices that are highly accurate, inserted in the block with the thermocouples. Once the uniform temperature is achieved the temperatures between the thermocouples and the thermistors are compared and will establish the error in the thermocouples. The best way to achieve this is to put the thermocouples in an isothermal calibration block. I was given a 10” diameter by 12” copper block and my assignment was to design the isothermal block for the thermocouple rakes to be tested later on.

**Acknowledgments**
The author would like to thank NASA Glenn Research Center for the opportunity to have an internship experience during the summer. The author would also like to thank Hal Weaver and Brent Nowlin for their guidance and expertise. Additionally, she would also like to thank Ken Ulicny with the help and knowledge of fabricating and machining.