INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Oerlikon AM*	**Date Submitted**	*11/18/2022*
Project Title	*Design and Build of a Heat Exchange/Cold Plate Test Rig for Additively Manufactured Components*	**Planned Starting Semester**	*Spring 2023*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	**Number**	**Discipline**	**Number**
Mechanical	3	Electrical	1
Computer	1	Systems	
Other ( )			

Company and Project Overview:

Oerlikon AM is spearheading the revolution that is Additive Manufacturing (AM) and metal 3D printing. We have gathered together a dynamic team with deep industrial knowledge and have built state of the art facilities specifically for AM in multiple countries. We provide AM solutions with a focus in metal alloys for the Aerospace and Defense industries. We support our metal printing capability with our own metal powder production, research and development, component design, application engineering, and finishing capabilities. We are pioneering AM for all scales of manufacture from a single custom part to series production runs lasting decades across all industries.

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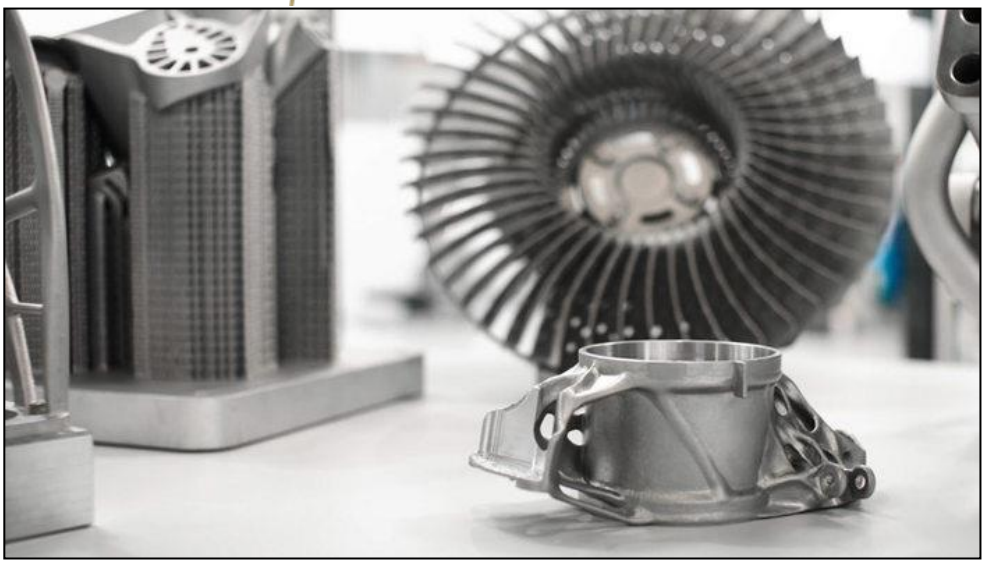

Additive manufacturing allows the creation of new components and designs which cannot be achieved by any traditional manufacturing process. Component weight can be reduced, saving material costs and providing benefits for the service life of the product. Component strength may be increased and several components may be combined into one. Manufacturing costs and time to deliver may be reduced, while product performance and durability can be increased. In addition to these many technical advantages, the AM process consumes much less material to produce a component when compared to traditional processes such as machining, resulting in less waste.

This project seeks to design a heat exchanger/cold plate test rig that will enable Oerlikon AM to perform leak checks, pressure tests, and flow checks on the newest high-performance generation of designs enabled by metal additive manufacturing. This test rig will allow Oerlikon to characterize the thermal performance of AM parts compared to traditionally machined parts. A successful test rig design will utilize a series of sensors to provide relevant information surrounding fluid pressures, fluid flow rates, detection of leaks, and component cleanliness. This test rig will need to be configurable to multiple heat exchanger/cold plate geometries.

Project Requirements:

New, highly complex heat exchangers, cold plates, and other thermal exchange component designs are being enabled by additive manufacturing. While these designs greatly outperform the current generation by a large margin, performance still needs to be evaluated and the component needs to be certified as leak free. Additionally, the nature of the laser powder bed fusion process can make residual powder difficult to remove. A method to verify cleanliness is key.

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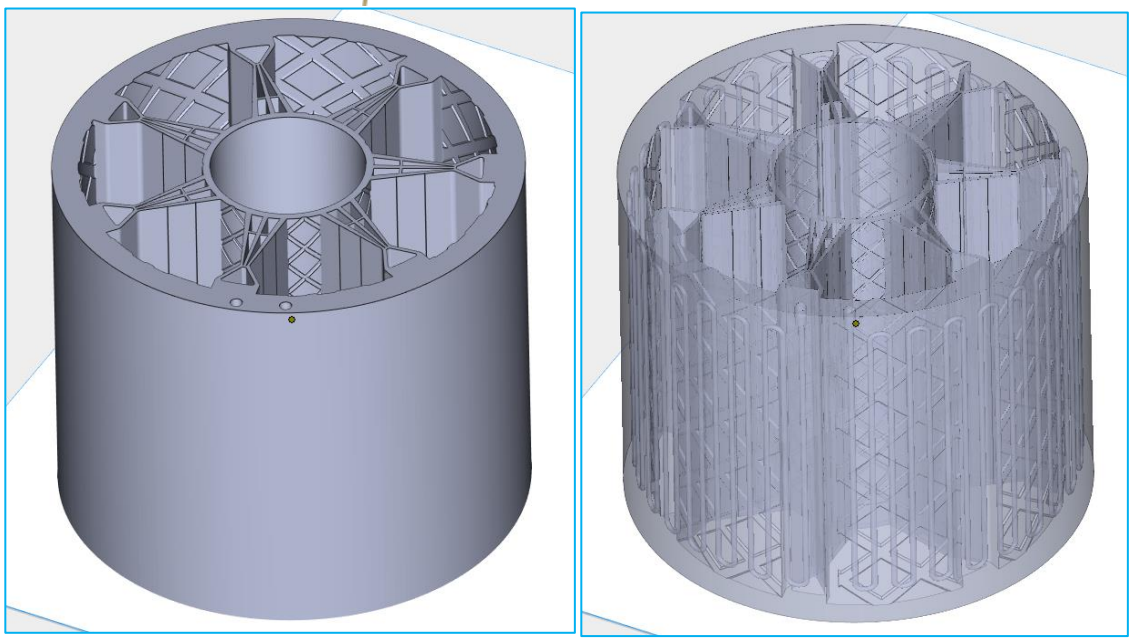

Figure 1: Example of a conformal cooling path not possible using traditional manufacturing methods

The primary objective of this project is to design a HX/cold plate test rig which will ensure the quality of the component in a production setting. This test rig needs to be fully reusable and configurable to the variety of component designs submitted by our customers. The test rig should contain multiple sensors to record the following:

- Leakage up to 130 psi air pressure
- Fluid pressure before and after passing through the component (differential pressure)
- Fluid flow rate
- Fluid Temperature
- Fluid cleanliness/Particle count
- Thermal imaging to show channel blockage

The data collected should be easily shown via display and converted into a report to support the quality control initiatives within the facility. Proof of concept to install and test the rig may be performed on one or more demonstration components with potential use on actual aerospace and defense components.

For the final prototype, the design of the test rig should be such that:

- The system is fully configurable to multiple component designs with standardized fittings
- Safe testing can be performed by the operator following basic training
- Performance of the system is repeatable to allow for use as part of a quality assurance system

The team will have access to the metal 3d printing technology used at Oerlikon AM to help in their design efforts if required. This project can be taken as far as the team decides to take it. Stretch goals for the project include integrating helium leak checking, destructive burst testing, and thermal exchange efficiency.

Expected Deliverables/Results:

- Design a fully configurable HX/cold plate test rig which measures and displays relevant data to the component quality and performance.
- Provide the following for the design solution:
    - Bill of material
    - Engineering drawings
    - Operating instructions
    - Troubleshooting and maintenance procedures

Disposition of Deliverables at the End of the Project:

The prototype design, sensors, and supporting documentation will be delivered to Oerlikon AM at the completion of the project after it is displayed at the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Interest in additive manufacturing/3D printing
- Experience with sensors, data collection systems, and data analysis
- CAD and Design experience
- US Citizenship (required)