



Company Information

Company Name	Oerlikon AM	Date Submitted	11/18/2024
Project Title	Design of a Modular Mini Build Envelope for 3D Machines (OERLIKON_MINI)	Planned Starting Semester	Spring 2026

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:

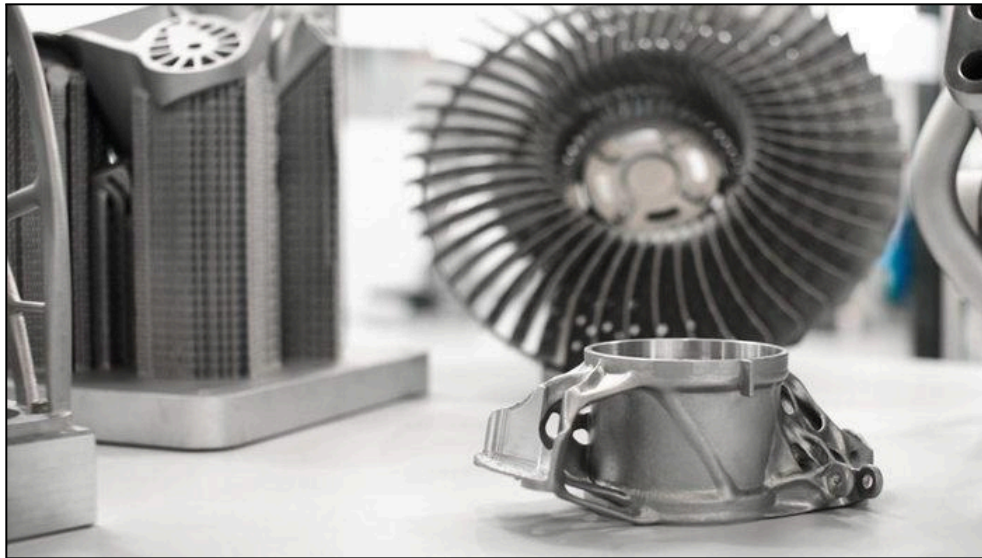
Discipline	Number	Discipline	Number
Mechanical	6	Electrical	
Computer		Systems	
Other ()			

Company and Project Overview:

Oerlikon AM is spearheading the revolution that is Additive Manufacturing (AM) and metal 3d printing. We have gathered 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 on 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 and prototype a modular mini build envelope that can be installed inside Oerlikon's existing metal additive manufacturing systems (M400, M290, CLM2, TP5000, etc.) to enable efficient parameter development and testing. The goal is to create a compact, reusable environment that mimics real build conditions while using minimal powder and machine time. This system will allow engineers to rapidly evaluate and refine laser parameters, scan strategies, and material settings without disrupting production, ultimately accelerating process optimization across multiple AM platforms. Using the mini module, the development engineers will be able to complete their build testing much faster than they could if they had to do this in the normal environment that is much larger.

Project Requirements:

Oerlikon AM is advancing process development across multiple additive manufacturing (AM) systems, including the EOS M400, M290, Concept Laser M2 (CLM2), and TP5000.

Full-scale parameter development consumes significant machine time and material. This project aims to design and prototype a miniature modular build envelope that fits within existing AM machines including future systems via adaptable mounting hardware, enabling faster and more efficient parameter trials without interfering with production.

The system will serve as a controlled, reconfigurable testing environment to develop and verify laser exposure strategies, scanning parameters, and material settings while minimizing powder use and machine downtime.

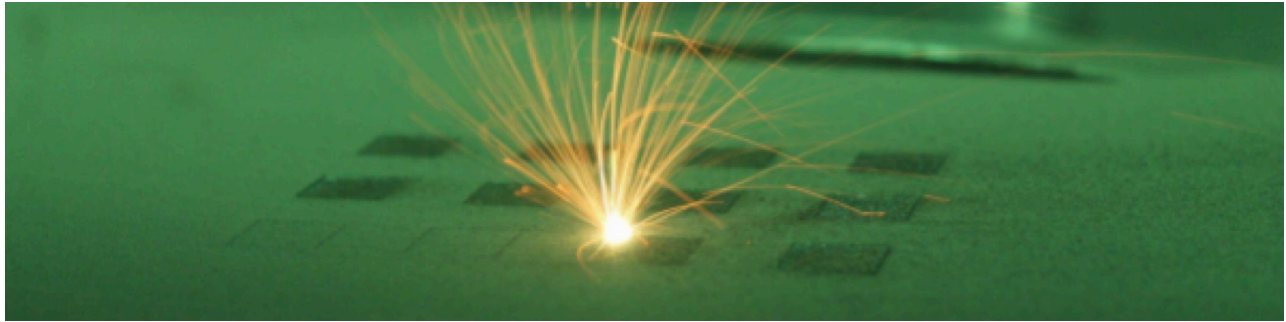


Figure 1: Example of a parameter development job in a Laser Powder Bed Fusion machine

Project Objectives:

1. Design and prototype a Modular Mini Parameter Development Build Envelope that:
2. Fits inside EOS M400, M290, CLM2, and TP5000 additive manufacturing systems.
3. Uses a modular architecture with interchangeable adapter plates to enable compatibility with future machines.
4. Provides a scaled-down build environment for efficient single- or multi-laser parameter trials.
5. Incorporates modular powder containment and gas flow compatibility to simulate real build conditions.
6. Enables rapid setup and removal without requiring full machine requalification.
7. Minimizes powder usage, cleaning time, and machine downtime.
8. Supports full powder recovery and ease of cleaning, especially for high-value materials (e.g., C103).
9. Maintains thermal and optical alignment without affecting laser calibration or recoater motion.
10. Provides optional instrumentation for temperature, oxygen, or plume sensing.
11. Ensures powder leveling accuracy and height control for repeatable results in small builds.
12. Stretch goal – Integrate heater elements to simulate realistic build thermal conditions and improve test fidelity.

Technical Requirements:

- Active build area: target $\leq 50 \text{ mm} \times 50 \text{ mm} \times 50 \text{ mm}$
- Quick-mount system: adaptable between M400, M290, CLM2, TP5000
- Gas flow interface: simulate representative inert gas circulation
- Powder management: sealed mini-hopper or containment to prevent cross-contamination
- Thermal/optical compatibility: must not affect laser calibration or recoater motion
- Instrumentation: optional temperature, oxygen, or plume sensors



- Safety compliance: must meet AM facility standards

Expected Deliverables/Results:

- CAD design and engineering drawings of the modular envelope
- Prototype assembly compatible with at least one target machine
- Bill of Materials (BOM) with sourcing recommendations
- Interface documentation for adapting design to multiple systems
- Operating and maintenance instructions
- Optional: Performance data report comparing mini-build vs. full-scale tests

Disposition of Deliverables at the End of the Project:

The prototype design, hardware, and supporting documentation will be delivered to Oerlikon AM at the completion of the project after it is exhibited 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
- Ability to travel to Oerlikon's Huntersville, NC facility as required. Mileage will be reimbursed IAW ISL's purchasing procedures.
- US Citizenship (required)