Machining Techniques for Additive Manufactured Pistons

Overview
Additive manufacturing (AM) is one method for piston production being considered by Volvo Trucks. Complex features, like enclosed oil galleries, can be fabricated more easily with AM than with traditional casting or forging techniques. Additionally, it can make low-volume prototyping or production faster and more economical. However, AM poses unique challenges: the powders used can present health and safety concerns, and support structures that must be constructed during the build process require machining for removal.

Objectives
- To understand what safety risks are associated with powder-bed additive manufacturing processes and how to appropriately handle these risks
- To evaluate the geometrical accuracy of the powder-bed additive manufacturing process as well as geometry from the post-machining process
- To find an effective way to machine the support structures made by the powder-bed additive manufacturing process without altering the build geometry
- To evaluate and quantify the metallurgical properties of the powder-bed additive manufactured pistons

Approach
- Do a literature review and questionnaire of existing AM shops to find in practice safety regulations and concerns
- Preform a coordinate measuring machine analysis of the pistons to determine the geometrical accuracy of the powder-bed AM process
- Conduct machinability tests and machine and remove the support structure from a piston to Volvo’s specification
- Conduct a material characteristic test where hardness values and thermal stability

Outcomes
- Health regulations were found
- The accuracy of the printing process was validated
- The piston was able to be machined and all support structure was removed
- The material test showed that piston had a high hardness value and cracks in the ring grooves
- All in all, AM is a very promising manufacturing technique for small scale production and rapid prototyping