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ADDITIVE MANUFACTURING AND ITS APPLICABILITY ON ROCKETS ENGINES

Abstract

Rocket engines manufacturing has some unique requirements in that often few are made every year, performance in terms of the temperature and pressure domain are rather extreme, the low weight not to mention the short time it is used and the need of the highest reliability. The engines performance and recurring cost goals are therefore always a delicate balance as is the manufacturing lead time especially during the development phase. Additive Manufacturing has the potential to revolutionize how we in the near future design and make rocket engine parts which will lead to customer benefits in terms of reduced lead time and recurring costs.

At GKN “Additive Manufacturing” (AM) is the phrase that covers different typed of manufacturing methods where we build the part by melting wire or powder through the use of laser or Electron Beam. Our first rocket engine part where we used AM (then called Laser Metal Deposition, LMD) was in 2001 where we attached manifolds on the RL-60 rocket engine nozzle. In 2009 on the Vulcain 2 SWEA nozzle demonstrator over 50 kg of LMD was used for the reinforcement jacket in essence replacing over 50 parts on the operational Vulcain 2 nozzle. LMD was also used on several other places on the Nozzle. Today we are in development of the new Vulcain 2.1 nozzle using also AM.

In 2006 we made our first turbine parts using Powder Bed AM by using an ARCAM machine. Today we are working with our agencies and customers to enable AM powder bed to be used for serial production on Vinci. Similarly we today use AM-LMD in serial production of commercial jet engines parts.

GKN is in a unique position to take advantage of Additive Manufacturing as one of the world’s largest tier 1 supplier to aerospace engines and as GKN Powder Metallurgy is the world’s leader in the development and production of atomized metal powders. We are committed to the whole value chain of AM; powder-design-process-application and has five AM centers of excellence in Europe and in the US.

This paper expands on these rocket engine examples of where AM is used as well as the different types of AM investigated by GKN; - large scale deposition by laser wire , - fine scale deposition by laser wire and powder and - Laser and EB powder bed. The paper will also high light the challenges in front of us.