Aluminum/Silicon Carbide Matrix Material for Targeting System

Project Number #NP06008102
Contract #W31P4Q-05-D-R003

Final Report

Lockheed Martin Missiles & Fire Control
Orlando, FL

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14. ABSTRACT

Lockheed Martin Missiles & Fire Control (LMMFC) of Orlando, FL, is currently in the process of producing components using Metal Matrix Composite (MMC) materials. This material is most desirable in high performance applications due to their improved material properties over monolithic metals. The most common MMC is cast aluminum reinforced with various amounts of silicon carbide. LMMFC is currently machining very high precision components for targeting systems from cast aluminum/silicon carbide (AlSiC) matrix material (with a very high SiC content) and are experiencing difficulty achieving the accuracy they require due to excessive tool wear and failure, from the properties of this material. LMMFC demands are increasing for the manufacture of targeting systems from AlSiC matrix material. Therefore, LMMFC called upon the National Center for Defense Manufacturing and Machining (NCDMM) to research and provide a more efficient solution to produce these components to specifications required by LMAC.

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Lockheed Martin Missiles & Fire Control (LMMFC)

Aluminum/Silicon Carbide Matrix Material for Targeting System

Prepared by: Joe Slusarcyk

Executive Summary

Lockheed Martin Missiles & Fire Control (LMMFC) of Orlando, FL, is currently in the process of producing components using Metal Matrix Composite (MMC) materials. This material is most desirable in high performance applications due to their improved material properties over monolithic metals. The most common MMC is cast aluminum reinforced with various amounts of silicon carbide. LMMFC is currently machining very high precision components for targeting systems from cast aluminum/silicon carbide (AlSiC) matrix material (with a very high SiC content) and are experiencing difficulty achieving the accuracy they require due to excessive tool wear and failure, from the properties of this material.

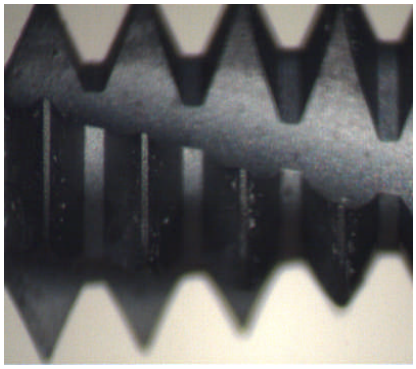
LMMFC demands are increasing for the manufacture of targeting systems from AlSiC matrix material. Therefore, LMMFC called upon the National Center for Defense Manufacturing and Machining (NCDMM) to research and provide a more efficient solution to produce these components to specifications required by LMAC.

Project Details

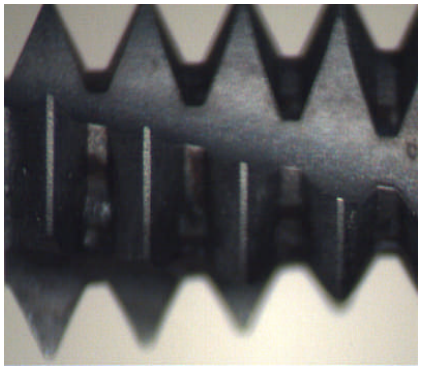
LMMFC supplied the AlSiC matrix material to the NCDMM for a threadmilling test. Testing began by researching various tool geometries and coatings associated with them. This became a difficult process, due the special tooling needed to machine these unique components as well as the little data available on machining this type of material. A main obstacle was

searching to find the proper tool supplier to fabricate a cutting tool along with a protective coating to help resist excessive tool wear and failure associated when machining this material.

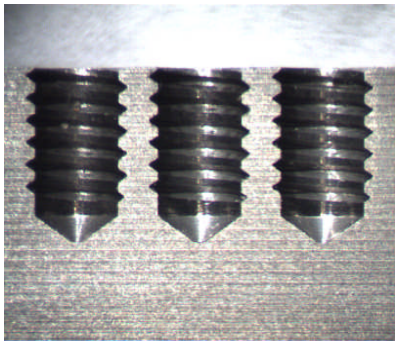
A tool supplier that provided a diamond coating was selected and tested. This tool could not produce one good thread because the coating would flake off of the cutting edge. The test was repeated to ensure that first cutting tool was not defective. This lead to believe that more research was needed to be done on the tool coatings. Again, the NCDMM researched tool coating to find a usable coating. A coating was selected along with the proper tool vendor's carbide that would adhere to this diamond coating. Testing began with great results, Twenty-five- (25) #6-32 & twenty-five- (25) #8-32 threaded holes were completed for a total of fifty(50) threaded holes. Photos of the tools were taken, while the tool wear was measured and all the data recorded. Wear measurements showed very little wear



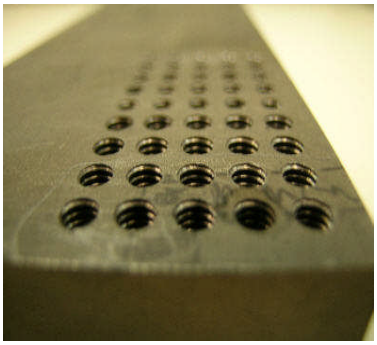
New Diamond Coated Threadmill



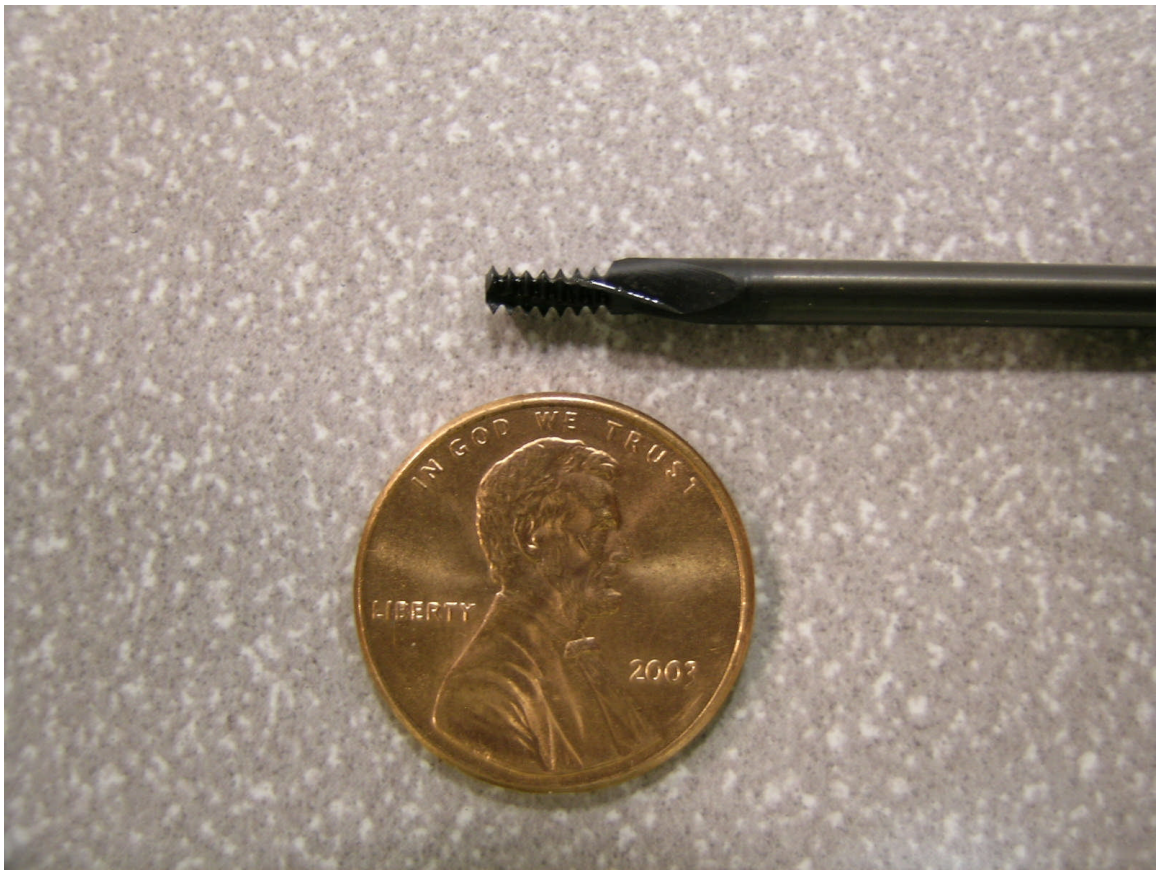
After 25 Threadmilled Holes



Cut away view of threads



Threaded Material



Diamond Coated #6-32 Threadmill

Conclusion

Based on the test results from the test evaluation the best performing tool was a threadmill supplied by ThreadmillsUSA, with Diamond Tool Coatings Dia Tiger applied to them to protect the cutting edge.

Machining parameters were as fallow:

- 0.0015” radial width of depth of cut (RWOC)
- 16 passes per orbit
- .0003 inches per tooth (IPT)
- 50 surface feet per minute (SFM)

The NCDMM recommends that a full review be used, at to help optimize the current tooling, machine parameters, and machining techniques that are currently used to machine these very high precision components for targeting systems.