Increased Range / Mini-Cruise Missile

NCDMM Project No. 05-0071-09

Technical Report

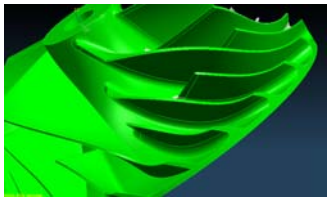
PROBLEM / OBJECTIVE

Technical Directions Inc. (TDI), Ortonville, Michigan was asked by the U.S. Army and the U.S. Air Force to improve the efficiency of their J-45 missile engine for the NLOS-LS LAM Loitering Attack Missile. The ultimate goal is to improve the overall engine efficiency by 8%, thereby reducing fuel consumption for the propulsion system, allowing for both increased vehicle payload and/or increased vehicle range.

The current compressor wheel in the J-45 missile engine is an investment casting and purchased fully machined at $23 per part. The new redesigned high efficiency compressor wheel will be lighter, stronger and more efficient, but will add machining costs to the overall J-45 missile engine system. The targeted cost for this new compressor wheel was established by TDI at $100 per part.

The newly designed compressor wheel requires very thin blades and a higher blade complement for optimum flow guidance with minimal flow losses. These requirements eliminate the investment casting of the compressor wheel, replacing it with the fully machined compressor wheel. The complex passages within the wheel require tolerances within .001", and blade thicknesses in the .010" range.

Realizing this challenge, TDI requested the help of the National Center for Defense Manufacturing and Machining (NCDMM) to meet these heightened manufacturing goals.



High efficiency compressor wheel design

ACCOMPLISHMENTS / PAYOFF

Process Improvement

The NCDMM reviewed the drawings along with solid model files and determined that due to the time constraint and part complexity, specialized programming software would be needed to produce machine code for machining the compressor wheel. The NCDMM contacted Moore Tool Co., to assist with this project.

Moore Tool recommended that the firm, Concepts NREC, program the finish machining paths of the compressor wheel. CNC Software/MasterCam was utilized to program the rough machining paths.

Due to price and availability of the requested material, TDI and NCDMM decided to manufacture the test wheels from two types of aluminum material. The results would then be used to determine justification of cost.

Moore Tool machined the compressor wheels using their FSP-300X 5-axis machine utilizing high-speed 5-axis machining technology. Six (6) complete compressor wheels were sent to TDI for performance evaluations.

New Compressor Wheel Results

- All geometric part features were within the specified tolerances
- Machining cycle time was under 60 minutes
- The target compressor wheel cost of $100 was achieved
- Initial overall engine efficiency improvement was measured as high as 5%

Expected Benefits

The cooperative effort between TDI and NCDMM resulted in an increase of up to 5% in vehicle efficiency with additional efficiency gains expected with further development. The NCDMM manufacturing effort has maintained the total cost goal of $100. This effort has brought TDI, the U.S. Army, and the U.S. Air Force closer to their overall efficiency goal and will assist TDI in future efficiency upgrade proposals.

The TDI/J-45 project has brought advanced mini-cruise missiles like the U.S. Army Loitering Attack Missile and the U.S. Air Force Low Cost Autonomous Attack System one step closer to supporting our nation's warfighters.

TIMELINE / MILESTONE

Start Date ..... August 05
Recommendations Made ..... March 06

PROJECT FUNDING

NCDMM funding $60K

PARTICIPANTS

NCDMM Technical Directions Inc.

For additional information concerning this project, contact the NCDMM at www.ncdmm.org