

# Cavitation Peening of Aerospace Bearings, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



## ABSTRACT

High-value bearings are a critical part of the safety, reliability, cost and performance of modern aircraft. A typical passenger jet will have 100 to 175 high-valve bearings costing from \$2,500 to \$50,000 each for a total aircraft cost of \$300,000 to \$600,000. All gas turbine engine bearings are inspected at overhaul and typically 30-40% of there are rejected. For each engine overhaul, bearing replacement costs on average \$100,000. Any process that increases bearing performance and reliability will have a commensurate effect on aircraft safety, reliability, performance and operating cost. In Phase I, Ormond demonstrated a novel surface enhancement process, cavitation peening, imparting deep, high magnitude residual stresses that are predicted to significantly enhance bearing life, reliability and performance. Preliminary fatigue results generated in Phase I look promising and analytical results indicate a fatigue life improvement of over 100% may be possible. Cavitation peening uses ultra-high pressure water jets to generate intense clouds of cavitation bubbles that collapse on the work piece generating shock waves that cold work the material. No particles are use, the process produces no waste and adds no weight to the part and is very inexpensive. The new technology is currently being evaluated by Boeing, Sikorsky, Bell and Rolls-Royce for aerospace applications and is proving particularly effective for gears. The company is also working with major bearing manufacturers Timken and SKF to investigate the value of the technology for bearing applications. The proposed Phase II work would refine the process, address readiness level issues and generate the fatigue data that is critical to wide spread acceptance of the cavitation peening technology.

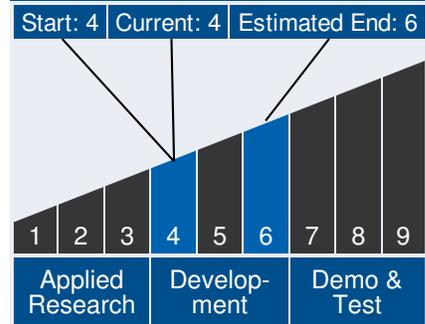


Cavitation Peening of Aerospace Bearings

### Table of Contents

Abstract . . . . .	1
Anticipated Benefits . . . . .	1
Technology Maturity . . . . .	1
Management Team . . . . .	1
Technology Areas . . . . .	2
U.S. Work Locations and Key Partners . . . . .	3
Details for Technology 1 . . . . .	4

### Technology Maturity



### Management Team

**Program Executives:**

- Joseph Grant
- Laguduva Kubendran

*Continued on following page.*

## ANTICIPATED BENEFITS

**To NASA funded missions:**

Potential NASA Commercial Applications: The target application for NASA programs is primarily aircraft gas turbines, particularly

# Cavitation Peening of Aerospace Bearings, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



high performance engines where the added bearing rating could be utilized to increase engine output, reduce fuel consumption and maintenance costs and increase safety and reliability. Other NASA applications could be any rotating components where weight or power consumption is an issue, such as motors, rotors, pumps and wheels. The process would also be applicable to new bearing materials and non-bearing applications such as airframe structures, gears, drivetrain components and any component where fatigue and flaw tolerance are issues of concern.

### To the commercial space industry:

Potential Non-NASA Commercial Applications: Bearings are a fundamental mechanical component used throughout transportation, energy generation and manufacturing. Improving bearing load ratings in a cost effective manner could have a significant impact on automobile fuel economy, wind turbine power generation, aircraft engine efficiency and reliability, manufacturing machinery reliability, and just about any other rotating component. With all these applications, the global bearing market is a worth \$42B/year, with more than 75 bearing manufacturers. The cavitation peening technology is also widely applicable to other materials and components, such aluminum airframes, carburized gears, titanium rotors and disks, steel structures and just about any place where fatigue is a concern.

### Management Team (cont.)

**Program Manager:**

- Carlos Torrez

**Principal Investigator:**

- Tom Butler

### Technology Areas

**Secondary Technology Area:**

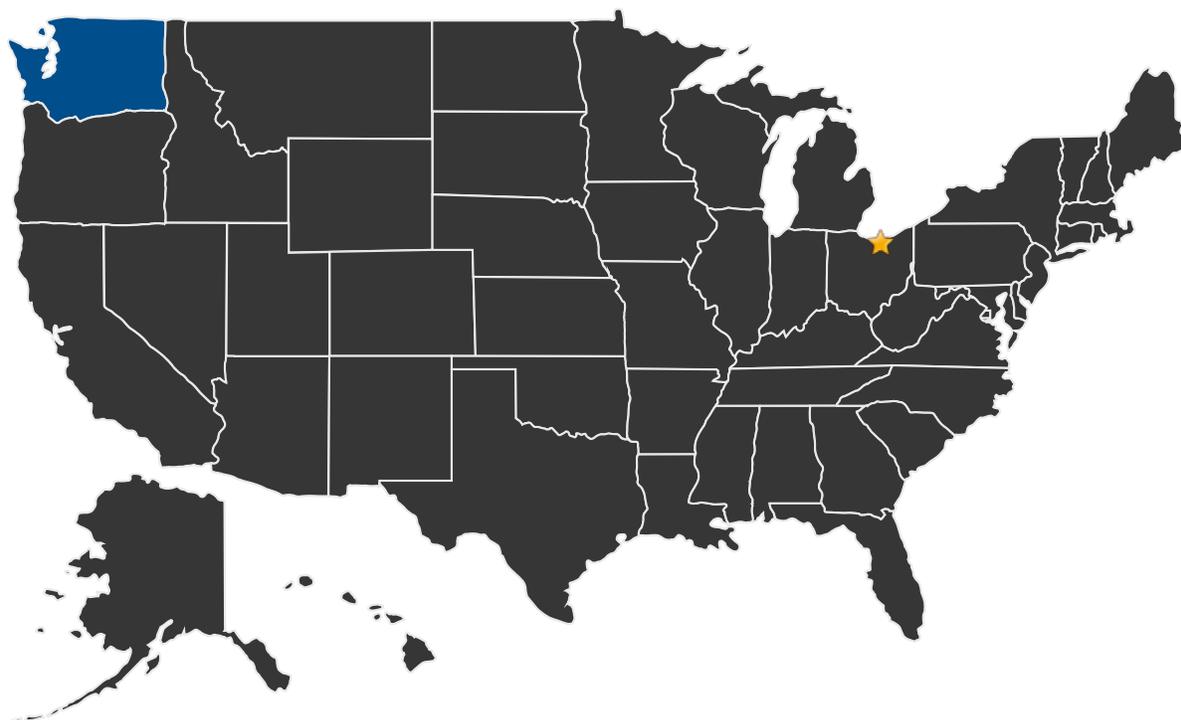
Human Health, Life Support, and Habitation Systems (TA 6)

- └ Environmental Control and Life Support Systems and Habitation Systems (TA 6.1)
  - └ Waste Management (TA 6.1.3)



## U.S. WORK LOCATIONS AND KEY PARTNERS

---



- U.S. States With Work      ★ **Lead Center:**  
Glenn Research Center

### Other Organizations Performing Work:

- ORMOND, LLC (Auburn, WA)

## PROJECT LIBRARY

---

### Presentations

- Briefing Chart
  - (<http://techport.nasa.gov:80/file/18008>)



## DETAILS FOR TECHNOLOGY 1

---

### Technology Title

Cavitation Peening of Aerospace Bearings