

## PHASE IIE PROJECT SUMMARY

**Firm:** Creare LLC

**Contract Number:** NNX11CB90C

**Project Title:** Compact Vacuum Pump for Titan Lander Missions

---

### **Identification and Significance of Innovation:**

A compact vacuum pump is highly sought after by the science community, since it provides a hard vacuum in a compact, low-power package that can be used directly in both planetary and Earth atmospheres. Creare has developed highly miniaturized vacuum pumps that are capable of generating the necessary high vacuum and directly exhaust to the Martian atmosphere. The purpose of the research conducted under this SBIR project is to design, build, and test a vacuum system that can be compactly integrated with a Creare hybrid turbomolecular/molecular drag pump (TMP/MDP) design to exhaust directly to Earth and Titan atmospheres. The Creare TMP comes in two versions: (1) a heritage unit developed under prior NASA programs, and (2) an enhanced high-flow version developed under this Enhancement project.

### **Technical Objectives and Work Plan:**

The overall goal of the Phase IIE project was to develop and test an enhanced high-flow version of our standard TMP/MDP. As a result, our high-vacuum system would be able to support higher flow rates, which are often desired for portable analytical instruments. To achieve this goal, we will build on our Phase II hardware, and improve performance of the existing TMP design.

### **Technical Accomplishments:**

During the Phase IIE project, we designed an enhanced-flow TMP by increasing the blade height to increase the flow capacity, increasing the number of blade rows to increase compression ratio, and welding the stator segments to reduce bypass leakage. We performed the necessary fabrication trials, and we built a functional prototype for testing. We conducted limited functional testing to verify the pumping performance and power draw. The testing showed that the pump draws very little power and provides at least a compression ratio of  $10^8$ .

### **NASA Application(s):**

Planetary atmospheric and solid sample analysis using mass spectrometers and electron microscopes include planned missions to Mars, Jupiter's moons, and the major moons of Saturn (notably Titan) and will require vacuum pump capabilities exceeding current technology. Terrestrial applications within NASA include atmospheric sampling instruments in support of several spaced-based remote atmospheric sensing systems.

### **Non-NASA Commercial Application(s):**

The key markets we will pursue are portable, handheld leak detectors and mass spectrometers. The former are expected to find wide application in the process industries, especially for the manufacture of semiconductors. The latter are mainly used for environmental monitoring and forensic applications, although there is a growing interest in using gas chromatograph/mass spectrometers for chemical and biological defense.

### **Name and Address of Principal Investigator: Name and Address of Offeror:**

Paul H. Sorensen  
Creare LLC  
16 Great Hollow Road  
Hanover, NH 03755

Creare LLC  
16 Great Hollow Road  
Hanover, NH 03755