

WHO

SYSKOM: ONR

Sponsoring Program: ONR Code 35

Transition Target: Hypersonic Vehicles and Weapons

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Other Transition Opportunities: Transition opportunities include: U.S. Navy—Conventional Prompt Strike (CPS); U.S. Army—Long-Range Hypersonic Weapon (LRHW); U.S. Air Force—AGM-183 Air-Launched Rapid Response Weapon (ARRW); DARPA—Tactical Boost Glide (TBG); DARPA—Operational Fires (OpFires); and DARPA—Hypersonic Air-breathing Weapon Concept (HAWC).

Notes: Aerodynamic Technologies has developed a novel approach, ShearCrystal™, that provides a global non-intrusive system for measuring wall shear stress on hypersonic surfaces, for use in large-scale ground test facilities. The technology consists of imaging acquisition system and user-friendly shear stress sensitive film that can be applied onto dedicated test article.

Aerodynamic Technologies was founded in 2020 with strong academic collaboration. In 2021, AT has received its first STTR Phase I contract and Phase II contract in 2022 to present time. Our product development will continue into Phase II Option through 2027.



Air Force image gallery

WHAT

Operational Need and Improvement: This initiative will develop a novel approach for obtaining instantaneous global measurements of shear stress on aerodynamic surfaces. This is critical because shear stress is one of two fundamental forces theoretical and experimental aerodynamicists aim to calculate and measure on all aerodynamic surfaces, the second being static pressure. In order to obtain two-dimensional information using traditional methods, one must use a large number of these point-measurement sensors (i.e. pressure taps) that are individually attached/machined onto the tested surface, a process that can be time consuming and expensive. Ultimately, the number of sensors employed limits the spatial resolution of shear stress data that is obtained from such tests. The approach developed in this project will greatly enhance our ability to measure drag locally, globally and instantaneously, predict its development, study its flow physics, and develop accurate CFD predictive methods for predicting wall shear stress, and use it towards flow control.

- Specifications Required:**
- Provides 2D measurements of the skin-friction distribution (magnitude and direction) on aerodynamic surfaces
 - Non-intrusive technique compatible with standard hypersonic wind tunnel test articles such as a sensing coating that can be applied on the model surfaces
 - Allows measurement on smooth curved surfaces (such as conical geometries)
 - Spatial resolution better than or equal to 5 mm x 5 mm
 - Temporal resolution greater than or equal to 1 kHz
 - Wide dynamic range and sensitivity to allow simultaneous measurements in regions of high shear (shear-stress magnitude ~ 250 Pa) and regions of separated flows (zero shear-stress or low magnitude with reversed direction)
 - Intrinsic insensitivity to spurious inputs such as surface temperature and pressure or accurate correction of spurious inputs via calibration and/or input measurements

Technology Developed: We have demonstrated the ability to provide non-intrusive 2D measurement of the skin-friction distribution up to Mach 5 conditions and surface temperature up to 395K. Optimization of technology to ensure performance at the large ground facility is underway in Phase II.

Warfighter Value: The benefit of our technology is that it will provide a global and non-intrusive method for measuring wall shear stress on hypersonic surfaces. Our technology will help advance critical knowledge of hypersonic flow, thereby allowing for development for high performance hypersonic vehicles and weapons.

WHEN

Contract Number: N68335-22-C-0100 **Ending on:** Mar 22, 2027

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Definable event, verifying system component performance	N/A	Pass small hypersonic tunnel test	4	4th QTR FY25
Verifying system performance at large facility	Low	A significant event defined from Phase II Option	5	1st QTR FY26
Optimization of system component	Low	Defined in Phase II Option	6	3rd QTR FY26
Prototype testing	Medium	Pass prototype test	7	4th QTR FY26
Refine system/prototype testing	Medium	Pass final prototype test	7	2nd QTR FY27

HOW

Projected Business Model: Direct sales to Navy/government and expanding later to licensing with primes.

Company Objectives: Aerodynamic Technologies' mission is to create a non-intrusive method for measuring wall shear stress on aerodynamic surfaces. Transitioning the technology is part of AT's growth plan to provide an innovative solution to the market with Navy/government as the first target market customer. Our goal is to grow with new connections and customers and develop new potential applications in other areas, including continuing development with research funding options.

Potential Commercial Applications: There's a growing interest in commercial supersonic vehicles. Our technologies can be tailored for supersonic vehicles to improve their vehicle design development. Boom Supersonic, Northrop Grumman, Boeing, Lockheed Martin and Hermeus Corporation are major players, which customized engineering solution can be provided for measuring wall shear stress for their application specific test.