



TRANSITION

EQUIPPING THE WARFIGHTER

A SOLUTION PREVIOUSLY THOUGHT TO BE OUT OF REACH

TOPIC NUMBER:

MDA08-018

TOPIC TITLE:

High Temperature Throat Design, Analysis and Fabrication for AEDC Hypervelocity Wind Tunnel 9 at Mach 14/18

CONTRACT NUMBER:

FA9101-14-C-0026

SBIR COMPANY NAME:

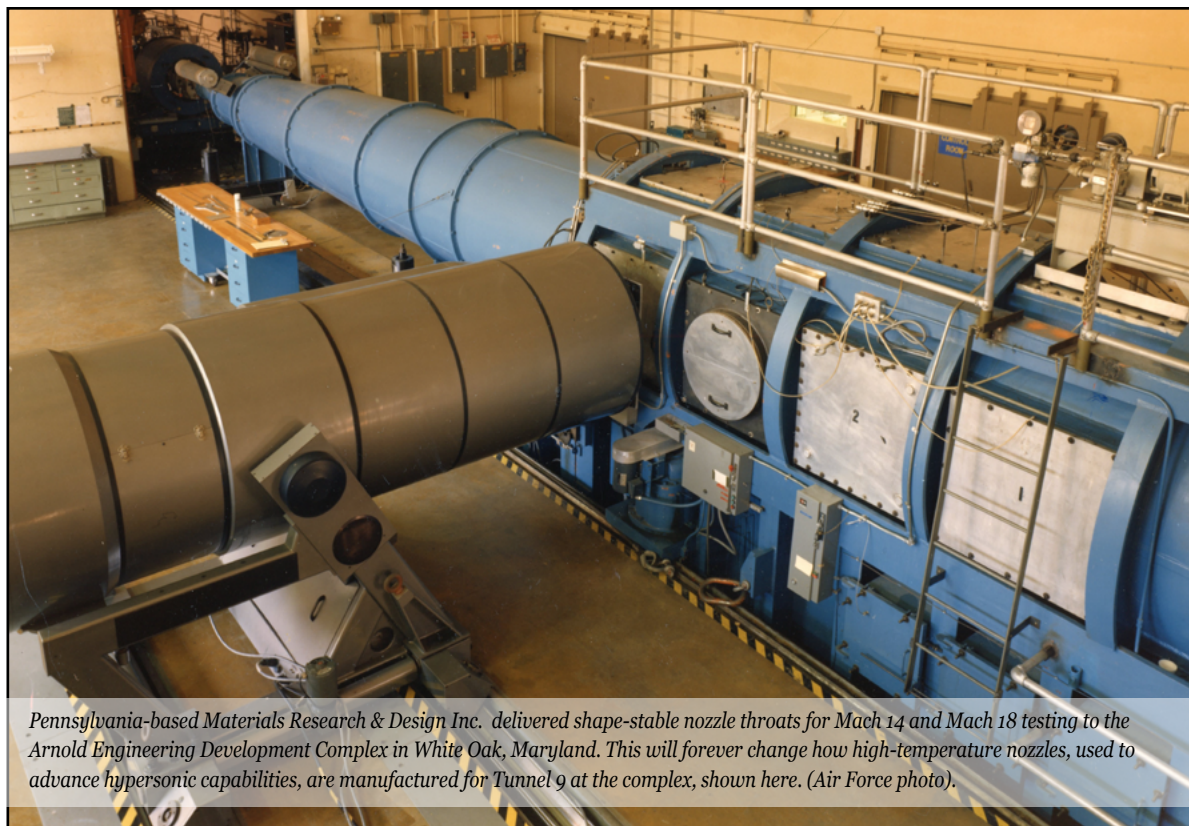
Materials Research & Design Inc. Wayne, PA

TECHNICAL PROJECT OFFICE:

Arnold Engineering Development Complex

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Pennsylvania-based Materials Research & Design Inc. delivered shape-stable nozzle throats for Mach 14 and Mach 18 testing to the Arnold Engineering Development Complex in White Oak, Maryland. This will forever change how high-temperature nozzles, used to advance hypersonic capabilities, are manufactured for Tunnel 9 at the complex, shown here. (Air Force photo).

MATERIALS DEVELOPMENT PROVIDES AIR FORCE WITH CRITICAL TEST ASSETS FOR ADVANCING HYPERSONIC VEHICLES

A small business partner has delivered a critical new tool to assist the Air Force in its race for hypersonic capabilities.

With support from the Air Force Small Business Innovation Research/Small Business Technology Transfer Program, Pennsylvania-based Materials Research & Design Inc. created a material that can survive the extreme pressures and temperatures of a Mach 18 wind tunnel, a solution previously thought to be well out of reach.

As adversaries push for the technology, developing hypersonic capabilities is deemed the 'highest technical priority' by Michael Griffin, the Pentagon's Undersecretary of Defense for Research and Engineering.

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The revolutionary capability Materials Research & Design provided through its material development will prove crucial for many years to come as the Air Force moves from developmental experimentation to rapid prototyping to full scale programs of record, according to Mallory Knight, Director of Engineering and Technical Management for the Air Force Test Center.

Originally managed by another federal agency, the Materials Research & Design project received approximately \$1.5 million in support from the Air Force SBIR/STTR Commercialization Readiness Program. So far, the company has earned more than \$1.1 million in Phase III contracts – funding from outside the Air Force SBIR/STTR Program. Because of its success on this project, Materials Research & Design expects sales to increase \$5 million during the next three years and will need to boost its engineering staff by at least 20 percent.

BOLSTERING SMALL BUSINESS AND CRITICAL TEST ASSETS

The cumulative costs of recovering from even one flight failure, not to mention the number of programs cancelled after two flight failures, is staggering. Each hypersonic flight test typically costs more than \$100 million, so avoiding flight failures through validated test and evaluation would provide a massive benefit to the Air Force.

Completing this project helps highlight the importance of national test assets, such as Tunnel 9 at White Oak, Maryland, which are not always at the forefront. The result of this work directly supported a \$5.5 million investment in the Tunnel 9 Mach 18 capability as a part of the Test Resource Management Center's Central Test and Evaluation Investment Program-funded Hypersonic Test and Evaluation Investment Portfolio.

The nozzle components created for the Air Force also allowed Materials Research & Design to extend its expertise, which should lead to even further improved design techniques and components. Additionally, the working relationships developed during the project will provide the company other opportunities to design similar components through contracts from material suppliers, the Navy, private industry and other Air Force organizations.

BEHIND THE TECHNOLOGY

Flow quality from a nozzle that maintains dimensions when exposed to the extreme pressures and temperature



Gary Tiscia (standing) of Materials Research & Design along with Kent Buesking (center) and Dan Hladio (left) discuss wind tunnel material solutions. (Photo courtesy of Materials Research & Design)

of the Mach 18 tunnel will allow precise measurements of aerodynamic forces and moments. In turn, that will accelerate the development of hypersonic vehicles by providing the highest Mach number to date.

Until this project was completed, a Mach 18 nozzle did not exist and nozzle throats supporting Mach 14 testing had to be changed every 50 to 100 tests.

Materials Research & Design, which specializes in the design and analysis of materials for extreme environments, worked with scientists and engineers at the Arnold Engineering Development Complex to find a solution to the problem.

The work involved simultaneously creating high-strength nozzle materials coupled with detailed thermal and structural design models supported by a measured material property database.

As a result, nozzle throats that are shape-stable for Mach 14 and Mach 18 testing have been delivered to the Arnold Engineering Development Complex Tunnel 9 facility at White Oak. This accomplishment will forever change how high-temperature nozzles are manufactured to support test operations at this hypervelocity wind tunnel.

Primary subcontractors on the effort included Amherst, New Hampshire-based Exothermics Inc.; Huntsville, Alabama-based Plasma Process LLC; Birmingham, Alabama-based Southern Research Institute; and West Nottingham, New Hampshire-based Invenetex Inc.



AIR FORCE SBIR/STTR PROGRAM

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