



CRITICAL NEED FOR CONTINUING OPERATION OF U.S. NATIONAL WIND TUNNEL FACILITIES

ABSTRACT

The American Institute of Aeronautics and Astronautics (AIAA) – the world’s forum for aerospace leadership – is alarmed at the continuing deterioration of our wind tunnel test infrastructure in the United States. Wind tunnels are used to characterize the aerodynamics, stability and control, and propulsion parameters of vehicles ranging from automobiles, commercial airliners, missiles, and spacecraft for DoD, NASA and private industry. Without adequate, capable wind tunnels, the United States will not be able to effectively field new aerospace or advanced defense systems influenced by aerodynamics. AIAA provides this White Paper to create awareness and serve as a stimulant for Congress to address the funding issues and/or sponsorship of initiatives necessary to sustain this critical technology development infrastructure inside the United States.

ISSUE

DoD, NASA and private industry currently use wind tunnels as required on a project-by-project basis. Fluctuations in Government budgets and industrial consolidations have led to cyclical use of these facilities. The resulting business model for wind tunnels does not compare favorably with other uses of the real estate involved. As a result, many wind tunnels have closed and some capabilities have been permanently lost. The decline in highly capable domestic wind tunnel capabilities decreases our national ability to develop and field complex aeronautics systems, consequently forcing the use of non-U.S. international facilities that may not be available when needed, may not provide adequate capabilities, and may not afford protection from unauthorized access to technologies under test.

BACKGROUND

The remaining wind tunnels in the United States vary in capabilities. Some tunnels operate at very low speeds that are ideal for testing land vehicles, small unmanned vehicles (UAVs), and helicopters. Others operate over a full subsonic regime supporting aircraft testing such as commercial airliners. Supersonic tunnels can be used to test fighter aircraft and some missile configurations. Hypersonic tunnels can be used to ascertain the performance of transatmospheric vehicles, spacecraft, nuclear weapons, or missile defense systems during atmospheric reentry. Trisonic (high subsonic, transonic and supersonic all in one) tunnels can be used for testing missile systems that accelerate through all speed regimes.

Representative models are installed in wind tunnels, instrumented, and tested to characterize the performance of the vehicle. Vehicle designers seek to match the test speed to actual operational speeds and minimize any scaling errors. Vehicle developers must balance the need for the test data obtained in the tunnel against the significant expense associated with testing. The value of wind tunnel testing is in the ability to predict, through physical experiments, the performance of vehicles prior to committing the significant resources needed to field and flight test the design. Computational predictions, while improving significantly and an important augmentation resource, are still a generation away from replacing wind tunnel testing.

1. **Why wind tunnel infrastructure decline is a problem.** Closure of facilities or decline in our national capabilities for wind tunnel testing results in increased technical and financial risk during the development of aerospace systems. As the wind tunnel capabilities decrease and the cost of testing increases, developers are forced to choose between accepting an increased vehicle development risk through limited testing, testing using international facilities (if suitable ones are available), or not

conducting wind tunnel tests at all. If wind tunnel testing is omitted, computational simulation and increased high-risk flight-testing options must be explored. For the foreseeable future, a lack of wind tunnel testing will result in a greater incidence of design problems or flight failures that can be costly and time consuming to rectify.

A specific and immediate example. The North American Trisonic Wind Tunnel (NATWT) located in El Segundo, California is a Trisonic wind tunnel ideal for testing full-scale endoatmospheric tactical missile systems. NATWT has a rich aerospace history rooted in the development of technologically advanced systems such as the XB-70 supersonic bomber, X-15 space plane, Saturn booster, Apollo spacecraft, Space Shuttle and B-1 bomber. The current owner (the University of California at Los Angeles) is terminating the lease with the tunnel operator in mid-2007. The facility owner plans to completely dismantle the wind tunnel and sell the land. Historically, three trisonic facilities have been used in development of DoD tactical missile systems: the NATWT, the Lockheed Martin Missiles and Fire Control High Speed Wind Tunnel, and the Boeing Polysonic Wind Tunnel. The loss of the largest of the three, the NATWT, will force compromises in model scaling and test capacity supporting missiles systems development.

2. **The challenge of maintaining the infrastructure.** Private industry, NASA, and the DoD are all challenged by the required cost and value tradeoffs for this critical capability. The cost of owning and operating these facilities is substantial, particularly when they are not used at full capacity, as is often the case. Their value, at the National level, is our ability to effectively develop and field high technology aeronautics systems, both commercial and military. This value, in our current wind tunnel business model, is not reflected in operating budgets that will sustain our existing capabilities. In aeronautics research and development, wind tunnels are analogous to the U.S. national highway system; they don't generate income directly, but without them we would not have a viable economic system.
3. **A new strategy is needed to maintain and operate wind tunnels deemed essential as a National Capability.** To accomplish this it is necessary to identify and address the status of the wind tunnels that provide essential capabilities for governmental organizations (NASA, US Army, US Navy, and US Air Force) and private industry. A good example of this type of collaboration is that shown by the US Air Force and NASA in their National Partnership for Aeronautical Testing to review laboratory facilities and capabilities in response to the National Aeronautics Research and Development Policy.

RECOMMENDATIONS

As a matter of urgency, Congress should implement a strategy to maintain the essential wind tunnel capability in the United States. This may require provision for new mechanisms to keep the facilities funded and operating. The AIAA recommends that Congress enact legislation directing the National Academies of Engineering to form a commission of recognized experts representing government, industry and academia to perform a complete examination of key US wind tunnel facilities, public and private, assessing the roles and capabilities of those facilities, and fully characterizing the potential facility availability problem scope. The panel should identify essential facility capabilities and recommend strategies for prioritizing, maintaining and fully utilizing these facilities for aerospace research and development. Owners of tunnels with applicable capabilities should be contacted by the panel to determine their intent to continue operating these facilities. Included should be determination of a funding mechanism that would retain and maintain those facilities that are determined to be key to the future of US flight vehicle development. The panel should include responsible personnel from aircraft developers, national, private, and university wind tunnel facilities, and government planning officials who can provide some insight into the future development requirements anticipated for such facilities. AIAA has technical committee members who are voluntarily pursuing a similar recommendation and would be willing participants in this process.

Further, the AIAA recommends that the panel have meaningful deadlines including providing a preliminary report within six months of enactment to include identification of all essential wind tunnel facilities, their critical value to research and development capabilities, the maintenance status of the facilities, and expected consequences of shutting down each facility, as well as a completed report within one year of enactment that would also provide recommended near-term and long-term Congressional and Administration actions to retain critical research capabilities. Prompt action by the Congress to the panel recommendations is essential to successful mitigation of the current wind tunnel crisis.