

For NPS use only

# National Register of Historic Places Inventory—Nomination Form

received

date entered

See instructions in *How to Complete National Register Forms*  
Type all entries—complete applicable sections

## 1. Name

historic Eight-Foot High Speed Tunnel

and/or common Eight-Foot Transonic Tunnel

## 2. Location

street & number Langley Research Center \_\_\_\_\_ not for publication

city, town Hampton \_\_\_\_\_ vicinity of \_\_\_\_\_ congressional district \_\_\_\_\_

state Virginia code 51 county Hampton code 650

## 3. Classification

<b>Category</b>	<b>Ownership</b>	<b>Status</b>	<b>Present Use</b>	
<input type="checkbox"/> district	<input checked="" type="checkbox"/> public	<input type="checkbox"/> occupied	<input type="checkbox"/> agriculture	<input type="checkbox"/> museum
<input type="checkbox"/> building(s)	<input type="checkbox"/> private	<input type="checkbox"/> unoccupied	<input type="checkbox"/> commercial	<input type="checkbox"/> park
<input checked="" type="checkbox"/> structure	<input type="checkbox"/> both	<input type="checkbox"/> work in progress	<input type="checkbox"/> educational	<input type="checkbox"/> private residence
<input type="checkbox"/> site	<b>Public Acquisition</b>	<b>Accessible</b>	<input type="checkbox"/> entertainment	<input type="checkbox"/> religious
<input type="checkbox"/> object	<input type="checkbox"/> in process	<input checked="" type="checkbox"/> yes: restricted	<input checked="" type="checkbox"/> government	<input type="checkbox"/> scientific
	<input type="checkbox"/> being considered	<input type="checkbox"/> yes: unrestricted	<input type="checkbox"/> industrial	<input type="checkbox"/> transportation
		<input type="checkbox"/> no	<input type="checkbox"/> military	<input checked="" type="checkbox"/> other: Abandoned

## 4. Owner of Property

name National Aeronautics and Space Administration (NASA)

street & number \_\_\_\_\_

city, town Washington \_\_\_\_\_ vicinity of \_\_\_\_\_ state D.C. 20546

## 5. Location of Legal Description

courthouse, registry of deeds, etc. National Aeronautics and Space Administration (NASA)

street & number \_\_\_\_\_

city, town Washington \_\_\_\_\_ state D.C. 20546

## 6. Representation in Existing Surveys

file None has this property been determined eligible?  yes  no

date \_\_\_\_\_ federal \_\_\_\_\_ state \_\_\_\_\_ county \_\_\_\_\_ local \_\_\_\_\_

depository for survey records \_\_\_\_\_

city, town \_\_\_\_\_

## 7. Description

### Condition

excellent  
 good  
 fair

deteriorated  
 ruins  
 unexposed

### Check one

unaltered  
 altered

### Check one

original site  
 moved date \_\_\_\_\_

### Describe the present and original (if known) physical appearance

The Eight-Foot High Speed Tunnel is a single-return atmospheric pressure tunnel with an 8-foot diameter closed-throat test section. The tunnel became operational in 1936 and at that time had a maximum speed of Mach 0.75 driven by an 8,000-horsepower electric motor/fan.

The design of the Eight Foot High Speed Tunnel was complicated by two problems.<sup>1</sup>

The first problem involved the effect discovered in 1738 by the Swiss mathematician Daniel Bernoulli who observed that as the velocity of flow in a duct is increased by constricting the cross sectional area, the static pressure of the fluid drops. In wind tunnel design, this means that the air pressure in the chamber containing the high-velocity test section will be lower than in the rest of the tunnel. Thus, for the tunnel, the test chamber had to withstand a powerful, inwardly directed pressure.<sup>2</sup>

One method to solve this problem would have been to construct a welded steel pressure vessel around the test section. In an effort to solve the pressing unemployment problem then existing as a result of the Depression, NACA engineers decided to use locally available unskilled labor and build the entire tunnel of reinforced concrete. An igloo-like structure around the test sections was built with walls 1 foot thick. The igloo was essentially a low pressure chamber—just the opposite of the VDT. Operating personnel in the igloo were subjected to pressures that were the equivalent of 10,000 feet altitude and had to wear oxygen masks and enter through airlocks.<sup>3</sup>

The second new problem that was created had to do with the mechanical energy that the 8,000-horsepower fan added to the airstream. NACA engineers calculated that this additional heat would cause the temperature within the tunnel to rise ten degrees per second until it reached the stage at which the amount of heat seeping through the concrete walls would equal the input of heat from the fan. Before this would happen the temperature within the tunnel would reach several thousand degrees.

The task of providing a cooling system was given to Russell G. Robinson who devised a ventilating tower that periodically allowed a small amount of heated air to escape in exchange for fresh cool air. This system proved to be successful and was accomplished with a loss of only one percent of power. This same principle was later applied to many other high speed tunnels.<sup>4</sup>

The Eight-Foot High Speed Tunnel was repowered in 1945 to 16,000-horsepower. By 1950 a slotted throat design was added to the test section that enabled the tunnel to be operated as a transonic tunnel. In 1953 the tunnel was repowered to 25,000-horsepower to yield a speed of Mach 1.2. A schlieren apparatus was also added to the test section of the tunnel to increase the capability for visual flow studies.

# 8. Significance

Period	Areas of Significance—Check and justify below			
<input type="checkbox"/> prehistoric	<input type="checkbox"/> archeology-prehistoric	<input type="checkbox"/> community planning	<input type="checkbox"/> landscape architecture	<input type="checkbox"/> religion
<input type="checkbox"/> 1400-1499	<input type="checkbox"/> archeology-historic	<input type="checkbox"/> conservation	<input type="checkbox"/> law	<input checked="" type="checkbox"/> science
<input type="checkbox"/> 1500-1599	<input type="checkbox"/> agriculture	<input type="checkbox"/> economics	<input type="checkbox"/> literature	<input type="checkbox"/> sculpture
<input type="checkbox"/> 1600-1699	<input type="checkbox"/> architecture	<input type="checkbox"/> education	<input checked="" type="checkbox"/> military	<input type="checkbox"/> social/
<input type="checkbox"/> 1700-1799	<input type="checkbox"/> art	<input checked="" type="checkbox"/> engineering	<input type="checkbox"/> music	humanitarian
<input type="checkbox"/> 1800-1899	<input type="checkbox"/> commerce	<input type="checkbox"/> exploration/settlement	<input type="checkbox"/> philosophy	<input type="checkbox"/> theater
<input checked="" type="checkbox"/> 1900-	<input type="checkbox"/> communications	<input type="checkbox"/> industry	<input type="checkbox"/> politics/government	<input type="checkbox"/> transportation
		<input type="checkbox"/> invention		<input checked="" type="checkbox"/> other (specify) Aeronautical Research

Specific dates 1936-1956 Builder/Architect NACA

## Statement of Significance (in one paragraph)

The Eight-Foot High Speed Tunnel is a landmark in wind tunnel design. At the time of the construction of the High Speed Tunnel, NACA had only two small high speed tunnels (the 11" and 24" tunnels) to test aircraft design in speeds ranging from Mach 0.5 to Mach 0.9. While useful, these small tunnels had two severe limitations. First, the small size of these tunnels meant that only small scale models could be tested. This meant that test results were suspect if high Reynolds numbers could not be obtained. Second, both tunnels were powered by the rapid blowdown of the VDT and were thus restricted to tests lasting less than a minute.

The Eight-Foot High Speed Tunnel solved both of these problems. It was large enough to accommodate sizeable test models and even complete aircraft parts on occasion. It was also a continuous flow tunnel that could operate almost indefinitely thereby giving the engineers sufficient time to run their tests and to check their test results. For the first time NACA engineers had a research tool that could supply high speed test results on a large scale.

Over the years NACA engineers continued to modify and upgrade the Eight-Foot High Speed Tunnel. After the Second World War NACA engineers began to work on improving wind tunnel performance in the transonic range (Mach 0.7 to Mach 1.4). It had long been known that airflow within the test section of a transonic wind tunnel did not represent the actual conditions of free flight. The problem was that the natural pattern of airflow in this range is disturbed and altered by the existence of the walls of the tunnel. This problem became severe in the area of Mach 1 and was known as the tunnel choking effect. Until this problem was solved accurate test results were not possible for transonic tunnels.

Attempts to solve this problem by making smaller models proved unsuccessful when lower Reynolds numbers were obtained. Attempts to eliminate the walls of the tunnel in the area of the test section also proved less than satisfactory. In 1946 Ray Wright at Langley analyzed the potentialities of a partially open or slotted wind tunnel wall. His results suggested that slots occupying about 6 percent of the wall would closely duplicate free-air conditions.<sup>5</sup>

This solution was quickly applied to the Eight-Foot High Speed Tunnel. In February 1950 the tunnel was shut down and slotted walls were added to the test section. The concept worked and NACA now had the first wind tunnel in the world that would give accurate test results in the transonic range. Since all supersonic aircraft would have to fly briefly in the transonic range, knowing what happened to aircraft in this transition zone was critical to the supersonic fighters and bombers being planned in the postwar era. The slotted wall concept was immediately put to work testing the next generation of American aircraft.

United States Department of the Interior  
National Park Service

National Register of Historic Places  
Inventory—Nomination Form



Continuation sheet

Item number 7, 8

Page 3

Footnotes

1. Much of the material in Section 7 and 8 of this report has been adapted from Donald D. Baals and William R. Corliss, Wind Tunnels of NASA (Washington, D.C.: National Aeronautics and Space Administration, 1981), pp. 25-8.
2. Ibid., 25.
3. Ibid., 26.
4. George W. Gray, Frontiers of Flight: The Story of NACA Research (New York: Alfred A. Knopf, 1948). pp. 42-43.
5. Baals, pp. 62-63.

# 9. Major Bibliographical References

See continuation sheets

# 10. Geographical Data

Acres of nominated property Less than 1 acre

Quadrangle name Hampton

Quadrangle scale 1:24,000

UMT References

A	1 1 8	3 8 0 7 1 6 0	4 1 0 4 6 2 0
	Zone	Easting	Northing
C			
E			
G			

B			
	Zone	Easting	Northing
D			
F			
H			

Verbal boundary description and justification

The boundary of the Eight-Foot High Speed Tunnel is defined by the outside perimeter of Building 641 in the East Area of the Langley Research Center.

List all states and counties for properties overlapping state or county boundaries

state	code	county	code

# 11. Form Prepared By

Name/title Harry A. Butowsky

Organization National Park Service

date May 15, 1984

Street & number Division of History

telephone (202) 343-8168

City or town Washington, D.C. 20240

state

# 12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

national     state     local

I, the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-5), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

State Historic Preservation Officer signature

date

For NPS use only

I hereby certify that this property is included in the National Register

date

Keeper of the National Register