HISTORIC AMERICAN ENGINEERING RECORD

7 x 10-FOOT HIGH SPEED WIND TUNNEL
BUILDING 1212B

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA

Submitted to:
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER

Submitted by:
JAMES RIVER INSTITUTE FOR ARCHAEOLOGY, INC.

Date: September 2006

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HISTORIC AMERICAN ENGINEERING RECORD

NASA LANGLEY RESEARCH CENTER
7 x 10-FOOT HIGH SPEED TUNNEL

HAER No. VA-118-F

Location: 11 West Taylor Street
National Aeronautical and Space Administration's (NASA) Langley Research Center (LaRC), Hampton, Virginia

UTM Coordinates for facility center point: E376855, N4105734

The 7 x 10-Foot High-Speed Tunnel (HST), Facility No. 1212B, has on its south side and east end an office, shop and laboratory building (Facility No. 1212) which it shares with the 7 x 10 Foot Low-Speed Tunnel (Facility No. 1212C). Its north side faces two parking areas that separate it from Victory Street. Opposite its west end is an open space bounded by a wooded natural area. The HST has a relatively compact size when compared with other major LaRC wind tunnels. With a substantial set back from Victory Street and partially concealed behind Facility No. 1212, it does not have a strong visual presence. The site is on the edge of the core of the developed area at LaRC, which is characterized by a mixed collection of one and two story brick office/research facilities and test facilities of various designs and sizes, including other wind tunnels.

Date(s) of Construction: 1943-1945

Engineer: Thomas A. Harrison and Charles J. Donlan

Present Owner(s): United States Government

Present Use: Vacant

Significance: When it was completed, the 7 x 10-Foot HST did not incorporate any new or unique design features. However, the installation of a "transonic bump" in 1946 allowed Langley engineers an early opportunity to experiment with transonic testing. Subsequently converted to a slotted throat design, the tunnel facilitated transonic testing on a wide variety of military aircraft until the late 1980s. Langley engineers continued to use the facility for aerodynamic research experiments until it was closed in 1994. The 7 x 10-Foot HST has national significance as an early testing facility capable of reaching transonic speeds and for its contributions to aircraft testing and design.

Project Information: This documentation was prepared in February 2006, for NASA Langley Research Center under contract with Science Applications International Corporation which assists NASA in addressing environmental compliance requirements.

Historical Background:

Early Wind Tunnel Research

Early experimenters in the field of human flight, including Leonardo da Vinci and Sir Isaac Newton, recognized the necessity of testing the aerodynamic characteristics of aircraft models, whether by propelling them through the air or by placing them in a moving airstream. As early as the eighteenth century, Benjamin Robins had developed the first mechanical "whirling arm" device to spin a test model through the air, a concept that was elaborated on by Sir George Caley in the early nineteenth century. However, it was clear that these whirling arm devices created excessive turbulence that interfered with accurate testing. The result was the development of the wind tunnel, a device in which air could be moved past a stationary model under relatively controlled conditions.

A wind tunnel has five essential characteristics: it is comprised of an enclosed passage through which air is driven by a fan or other *drive system*. The heart of the wind tunnel is the *test section*, in which an aircraft *model* is supported in a carefully *controlled airstream*, which produces a flow of air around the model, duplicating that of a full-scale aircraft. The aerodynamic characteristics of the model and its flow field are then measured by appropriate balances and *test instrumentation*.

Francis H. Wenham, a Council Member of the Aeronautical Society of Great Britain, is widely credited with designing and operating the first wind tunnel in 1871, using a steam-powered fan to propel air through a tube. Most famously, Orville and Wilbur Wright used a wind tunnel of their own design to develop the glider prototype of the famous 1903 Wright Flyer, with which they performed the first powered aircraft flight at Kitty Hawk, North Carolina. Despite the success of the Wright brothers, however, it was European researchers who dominated the field of wind tunnel research in the years prior to World War I.[1]

The Establishment of NACA and the Langley Memorial Aeronautical Laboratory

Recognizing that the U.S. was lagging considerably behind the Europeans in wind tunnel research, members of the American Aeronautical Society proposed at their inaugural meeting in 1911 that a national aeronautics laboratory be established. After several years of bureaucratic in-fighting, Congress finally created the National Advisory Committee for Aeronautics (NACA) in 1915, which was directed to "supervise and direct scientific study of problems of flight, with a view to their practical solution." In 1917, an aeronautical research facility and laboratory was established near Hampton, Virginia. Named for aviation pioneer Samuel P. Langley, the new Langley Memorial Aeronautical Laboratory (LMAL) began operation with relatively little experience in wind tunnel design or operation. In fact, its first operational tunnel, Wind Tunnel No. 1, was a direct copy of a British model which was already obsolete by the time it was completed in 1920.

[1] Donald D. Baals and William R. Corliss, *Wind Tunnels of NASA* (Washington, D.C.: National Aeronautics and Space Administration, 1981), 1-12.

By 1922, however, NACA made a tremendous leap forward in the field of aeronautical research with the completion of the Variable Density Tunnel (VDT), the first tunnel in the world to use the principle of variable density in pressure to accurately predict flow characteristics of scale model aircraft. When using small-scale models, engineers had to contend with "scale effects," as the flight characteristics of scaled-down versions could not be applied to full-sized aircraft without applying a correction factor. Scale effects could be addressed by proportionally varying air pressure in the tunnel, however, and the VDT was successfully used to test aircraft components. For example, research on airfoil sections conducted in the tunnel was used in the design of a number of famous aircraft, including the DC-3, B-17, and P-38.[2]

Despite its research value, the VDT could not evaluate the aerodynamic characteristics of a complete airplane, such as how rotating propellers affected aircraft control, nor could it adequately quantify the interference effects—or "drag penalties"—of various aircraft components such as external struts, wheels, and engine-cooling installations. In addition, aircraft test models had to withstand large forces and the strength of available materials limited their size. It was always possible to test actual aircraft in flight, but variations in atmospheric conditions required numerous flight checks to average the results. Given the current state of testing technology, the only alternative was to build a wind tunnel large enough to accommodate full-sized aircraft.

The first tunnel at Langley to accommodate full-scale aircraft components was the Propeller Research Tunnel (PRT), which became operational in 1927. Measuring 20 feet in diameter, the tunnel was large enough to test actual fuselages, engines, and propellers. Based on research conducted with the PRT, NACA engineers redesigned engine cowlings that dramatically reduced drag. Bolstered by the success of the PRT, NACA authorized the construction of the Full Scale Tunnel (FST) at Langley in February 1929. With the benefit of relatively low labor and material costs and a large pool of unemployed engineers, this Depression era project was completed in May 1931 at a cost of $900,000. The largest wind tunnel in the world at that time, the enormous exterior structure measured 434 feet long, 222 feet wide, and 90 feet high. The test section measured 30 feet high by 60 feet wide and allowed the installation of aircraft with wingspans up to 40 feet. Early testing in the FST indicated unexpectedly high wind resistance caused by external aircraft components, prompting the government to send a steady stream of military aircraft to Langley for "drag cleanup tests."[3]

Origins of the 7 x 10-Foot High Speed Tunnel

In December 1938, the Special Committee on Future Research Facilities chaired by Rear Admiral Arthur Cook, chief of the Navy Department's Bureau of Aeronautics, recommended the construction of several new facilities at Langley geared toward

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[2] Baals and Corliss, 12-19.

[3] HAER, *NASA Langley Research Center, Full-Scale Wind Tunnel, VA-118-A* (Washington. D.C., U.S. Department of the Interior, 1995), 9-15.

investigating the special characteristics of military aircraft. One of these proposed facilities was a wind tunnel with a 7 x 10-foot diameter test section that could evaluate general aerodynamic effects at high speed, especially stability control problems. The onset of World War II delayed plans for a new facility, but by 1943 the significant backlog of aircraft to be tested in Langley's existing wind tunnels prompted the National Advisory Committee for Aeronautics (NACA) to authorize the tunnel construction in the new West Area granted by the War Department in 1939. The tunnel was designed by Langley engineers Thomas A. Harris and Charles J. Donlan, and became operational in November 1945.[4]

Early Testing

Completed at an initial cost of $2,052,000, and located adjacent to a low-speed tunnel of the same dimensions (7 x 10-Foot 300 mph Tunnel), the 7 x 10-Foot High-Speed Tunnel (HST) had an atmospheric, single-return circuit with closed-throat test section. The 18-blade fixed-pitch wooden fan was powered by a 14,000 hp variable-speed AC electrical-drive system, and the tunnel could develop a maximum speed of approximately 675 mph. Shop and office space and other auxiliary facilities were shared with the neighboring Low Speed Wind Tunnel (Building 1212-C).

Although the 7 x 10-Foot HST did not incorporate any new or unique design features when first built, a number of subsequent modifications greatly enhanced its value in aerodynamic research. In 1946, a carefully designed "transonic bump" was installed. Air flowing over the bump was accelerated to the transonic range (up to and beyond the speed of sound, Mach 1, approximately 761 mph at sea level) even though the main airflow remained subsonic. Admittedly a crude modification, the bump nonetheless allowed engineers an early opportunity to experiment with transonic testing.[5]

Conversion to the New Slotted Throat Design

In the early 1950s, the tunnel was upgraded once again in response to a design breakthrough spearheaded by Langley engineer Ray H. Wright. Aeronautical engineers had long recognized a significant flaw inherent in solid-walled test chambers, observing that the walls tended to suppress flow streamlines and produced deceptive aerodynamic effects. Reducing the size of aircraft models allowed for greater distance from the walls and raised the choking speed. However, this exacerbated the problem of "scale effects," as the flight characteristics of a model could not be applied to a full-sized aircraft without applying a correction factor. The use of smaller models hampered the engineers' ability to evaluate the aerodynamic characteristics of a complete airplane, such as the interference effects—or "drag penalties"—of various components such as external struts, wheels, and engine-cooling installations. Aircraft test models had to withstand large

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[4] Hansen, *Engineer in Charge: A History of the Langley Aeronautical Laboratory, 1917-1958* (Washington, D.C., National Aeronautics and Space Administration, 1987), 192, 469-70.

[5] Hansen, 469-70; Baals and Corliss, 37; NACA, *Characteristics of Nine Research Wind Tunnels of the Langley Aeronautical Laboratory* (Washington, D.C., NACA, 1957), 49-64.

forces, and the strength of available materials also limited the extent to which they could be reduced in size.

Researchers already had theorized that this interference problem might be counteracted by placing slots in the test section throat which would reduce the blockage effect caused by the tunnel walls, and some experimental configurations had been tested. However, Wright was the first to engineer a practical application for this concept, which came to be known as "slotted throat" or "slotted wall tunnel" design. John Stack, Wright's division chief, took up the cause of slotted-throat testing, and—despite considerable skepticism—succeeded in persuading NACA to allocate funding and personnel to the problem. After considerable experimentation, Wright and his fellow engineers successfully converted two existing tunnels (the 8-Foot and 16-Foot High Speed Tunnels) to the new configuration in late 1950. Their success prompted the construction in 1953 of the 8-Foot Transonic Pressure Tunnel, the first to be built with the slotted-throat design from its inception. That same year, the 7 x 10-Foot HST was retrofitted with slotted walls, increasing its top speed to Mach 1; then, in the mid-1950s, it was connected to the 35,000 hp compressor of the 16-Foot HST for boundary layer extraction, boosting its speed even further to Mach 1.2.[6]

The Cold War Era and Beyond

Throughout the Cold War era, the 7 x 10-Foot HST facilitated important research on a number of U.S. military aircraft and missiles. The Bell X-5, the world's first airplane to vary the sweepback of its wings in flight, was tested here in the early 1950s. During the Vietnam War era, extensive testing was conducted on designs submitted by Grumman, Northrop, McDonnell, General Dynamics, and Fairchild Republic for the Air Force's new Attack Experimental (A-X) Program. More intensive testing of Fairchild Republic's design in the early 1970s led to the refinement and eventual production of the A-10 Thunderbolt II close support and attack aircraft. Other craft tested in the 7 x 10-Foot HST included Grumman's A-6E Intruder and EA-6B Prowler, the General Dynamics F-111 Aardvark and F-18 Hornet, as well as the proposed Advanced Manned Launch System, a two-stage, fully reusable launch system consisting of an unmanned glide-back booster and a manned orbiter.

By the 1980s, the 7 x 10-Foot HST was no longer required for transonic testing, and the slots in the test section were sealed to facilitate new research experiments. As a result, the tunnel was no longer capable of Mach 1 airspeeds. A fiber-optic-based laser vapor screen (LVS) flow visualization system was installed in 1990. In this system, fiber optics were used to deliver a laser beam through the plenum shell that surrounded the test section of the tunnel and to the light-sheet generating optics positioned in the ceiling window of the test section. Water was injected into the wind tunnel diffuser section to increase the relative humidity and promote condensation of the water vapor in the flow field around the model. The condensed water vapor was then illuminated with an intense

[6] Hanson, 320-24, 469-70.

sheet of laser light to reveal features of the flow field, while being observed and documented with a video system. Experiments using this technology in the 7 x 10-Foot HST were conducted on a number of prototypes, including a generic reusable earth-to-orbit transport circular body vehicle (CBV). After determining that it was underutilized, NASA shut the tunnel in 1994. A subsequent 1996 survey of NASA facilities nationwide confirmed that at least 12 other wind tunnels had similar or superior research capabilities, and the 7 x 10-Foot HST has remained closed since that time.[7]

[7] Joseph R. Chambers, *Partners in Freedom: Contributions of the Langley Research Center to U.S. Military Aircraft of the 1990s* (Washington, D.C., NASA, 2000); Delwin R. Croom and Jarrett K. Huffman, *Investigation of Deflectors as Dust Alleviators on a 0.09-Scale Model of the Bell X-5 Airplane with Various Wing Sweep Angles From 20 Degrees to 60 Degrees at Mach Numbers from 0.40 to 0.90* (Washington, D.C., NACA, 1957); Gary E. Erickson and Andrew S. Inenaga, *Fiber-Optic-Based Laser Vapor Screen Flow Visualization System for Aerodynamic Research in Larger Scale Subsonic and Transonic Wind Tunnels* (Washington, D.C., NASA, 1994); Roger A. Lepsch et al., *Subsonic Aerodynamic Characteristics of a Circular Body Earth-to-Orbit Vehicle* (Washington, D.C., NASA, 1996); George M. Ware, *Subsonic Aerodynamic Characteristics of a Proposed Advanced Manned Launch System Orbiter Configuration* (Washington, D.C., NASA, 1993).

Chronology:

1938	The Special Committee on Future Research Facilities recommends construction of a wind tunnel at Langley with a 7 x 10-Foot diameter test section.
1943	The National Advisory Committee for Aeronautics (NACA) authorizes construction of the 7 x 10-Foot tunnel and construction is undertaken.
1945	The 7 x 10-Foot High-Speed Tunnel (HST) is completed and becomes operational in November.
1946	A "transonic bump" is installed, allowing early transonic testing.
1953	The tunnel is retrofitted with slotted walls, increasing its speed to Mach 1.
1958	The National Aeronautics and Space Administration (NASA) assumes control of the tunnel when the agency is established.
1990	A state-of-the-art fiber-optic-based laser vapor screen (LVS) flow visualization system is installed.
1994	NASA closes the facility.

Sources Consulted:

Baals, Donald D. and William R. Corliss. *Wind Tunnels of NASA*. Washington, D.C.: National Aeronautics and Space Administration, 1981.

Chambers, Joseph R. *Partners in Freedom: Contributions of the Langley Research Center to U.S. Military Aircraft of the 1990s.* Washington, D.C: National Aeronautics and Space Administration, NASA History Division, 2000.

Croom, Delwin R., and Jarrett K. Huffman. *Investigation of Deflectors as Gust Alleviators on a 0.09-Scale Model of the Bell X-5 Airplane with Various Wing Sweep Angles From 20 Degrees to 60 Degrees at Mach Numbers from 0.40 to 0.90.* Washington, D.C.: National Advisory Committee for Aeronautics, TN 4175, 1957.

Erickson, Gary E., and Andrew S. Inenaga. *Fiber-Optic-Based Laser Vapor Screen Flow Visualization System for Aerodynamic Research in Larger Scale Subsonic and Transonic Wind Tunnels.* Washington, D.C.: National Aeronautics and Space Administration, TM-4514, 1994.

Hansen, James R. *Engineer in Charge: A History of the Langley Aeronautical Laboratory, 1917-1958.* Washington, D.C.: National Aeronautics and Space Administration, 1987.

Historic American Engineering Record (HAER). *NASA Langley Research Center, Full-Scale Wind Tunnel, VA-118-A*. Washington, D.C.: National Park Service, U.S. Department of the Interior, 1995.

Lepsch, Roger A., Jr., George M. Ware and Ian O. MacConochie. *Subsonic Aerodynamic Characteristics of a Circular Body Earth-to-Orbit Vehicle.* Washington, D.C.: National Aeronautics and Space Administration, TM-4726, 1996.

National Advisory Committee for Aeronautics (NACA). *Characteristics of Nine Research Wind Tunnels of the Langley Aeronautical Laboratory.* Washington, D.C.: NACA, 1957.

Ware, George M. *Subsonic Aerodynamic Characteristics of a Proposed Advanced Manned Launch System Orbiter Configuration.* Washington, D.C.: National Aeronautics and Space Administration, TM-4439, 1993.

Physical Description:

The purpose of the HST is defined in the NASA Real Property Record of 1965 for the facility as: "To provide static and dynamic studies of aerodynamic characteristics of aircraft." Construction commenced in December 1943 and was completed in November 1945. Key design team members were Thomas A. Harris and Charles J. Dolan. The Pittsburgh - Des Moines Steel Company was the contractor. The facility was closed in 1994 after 51 years of use.

The HST originally had a single-return, atmospheric circuit with at 7-foot by 10-foot closed-throat adjustable test section. In 1953 it was upgraded with a slotted-throat test section that was removed after the facility was closed in 1994. The test section was located on the south side of the tunnel in a test cell house. A door on the south side of the test cell house provided access for models. The test cell was 70 inches long by 115 inches wide and had useable lengths of 60 inches for subsonic operation and 120 inches for transonic operation. Transonic operation was obtained by use of a boundary layer air removal system. The air removal system connected the test cell plenum to a 35,000-horsepower air compressor located at the 16 Foot Transonic Tunnel (Facility No. 1146) via a large tubular steel duct.

The HST tunnel circuit forms an elongated rectangle with four 90-degree corners. The airflow is clockwise. The circuit's overall plan dimensions are approximately 242 feet (east-west) by 75 feet (north-south). The skin of the exposed sections of the tunnel circuit is ¼-inch-thick steel plate reinforced by 10-inch longitudinal steel channels that are in turn ringed by 2 ½" x 2" x ¼" steel angles. The rings of steel angles form "truss stiffeners" along with webbing of ½" diameter steel rods welded between the angle rings and the tunnel skin. The tunnel is supported by bents composed of 12-or 16-inch wide-flange I-beams.

Adjacent and south of the test cell house the tunnel circuit passes through the air intake house. The air intake house has an exposed welded steel frame with a low slope gabled roof. The gables are on the east and west ends. Corrugated asbestos cement (transite) panels are applied to the inside face of the steel frame. They also serve as the roofing material. Louvers surround the top 20 feet of the 54-foot-tall air intake structure. The test cell entrance cone is located between the east end of the test cell and the east leg of the tunnel circuit. The exterior construction of the east leg enclosure of the tunnel circuit is similar to that of the air intake house with corrugated asbestos cement panels attached to the inside face of the exposed steel structure. This enclosure has a low slope gabled roof; the gables are on the north and south ends. Recent installation of a large rolling steel overhead door has modified the north wall of the enclosure. The air exhaust house straddles the north leg of the tunnel circuit, immediately adjacent to the east leg enclosure. Like the east leg enclosure, its construction is similar to that of the air intake house. In plan the air exhaust house is 25 feet 6 inches (north-south) by 80 feet (east-west) and it is approximately 60 feet tall. Continuous horizontal louvers occupy most of its upper wall surfaces. Because of their height, the air intake and air exhaust houses are visual focal points in an otherwise horizontal structure. Vertical expansion joints are in the north and west legs of the tunnel. A freestanding concrete compressor house (Facility No. 1212D) is on the south side of the tunnel at its southwest corner. An 18-blade fixed-pitch fan is located at approximately the mid point of the north leg of the circuit and is flanked by upstream and downstream acoustic baffles. A 14,000-hp, 3-phase, AC powered, variable speed motor drove the fan. Power for the motor was drawn from a transformer rated at 300-KVA (kilo-volt-amperes). Each of the four 90-degree corners is fitted with turning vanes, and there is a turbulence screen at the upstream end of the entrance cone.

Major modifications of the HST improved its performance. In 1946 a "transonic bump" was installed that allowed air passing over to accelerate to the transonic range. In 1953 the introduction of a slotted test section increased maximum speed to Mach 1 and in the mid-1950s the connection of the facility to the 35,000-horsepower air compressor in the 16-Foot High Speed Tunnel allowed speeds to increase to Mach 1.2. Operations ceased in the HST in 1994. Even after major improvements and removal of interior equipment this facility retains its design integrity.

HISTORIC AMERICAN ENGINEERING RECORD

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NASA LANGLEY RESEARCH CENTER
7 X 10-FOOT HIGH-SPEED TUNNEL
Hampton
Virginia

HAER No. VA-118-F

Chris Cunningham, photographer, March 2006

VA-118-F-1	VIEW OF 7 X 10-FOOT HIGH-SPEED TUNNEL LOOKING SOUTHWEST.
VA-118-F-2	VIEW OF 7 X 10-FOOT HIGH-SPEED TUNNEL AIR EXHAUST HOUSE LOOKING SOUTHWEST.
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VA-118-F-8	Photocopy of photograph (original in Langley Research Center Archives, Hampton, VA [LaRC] (EL-2002-00246) INTERIOR VIEW OF 7 X 10-FOOT HIGH-SPEED TUNNEL LOOKING WEST (DOWNSTREAM) AT LIGHTED TEST CELL IN EXTREME BACKGROUND, AS SEEN FROM EASTERN END OF ENTRANCE CONE.

VA-118-F-9	Photocopy of photograph (original in Langley Research Center Archives, Hampton, VA [LaRC] (EL-2002-00226) INTERIOR VIEW OF 7 X 10-FOOT HIGH-SPEED TUNNEL WITH F-84 TEST MODEL AND SCALE.

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7- x10-FOOT HIGH SPEED WIND TUNNEL

Building 1212B

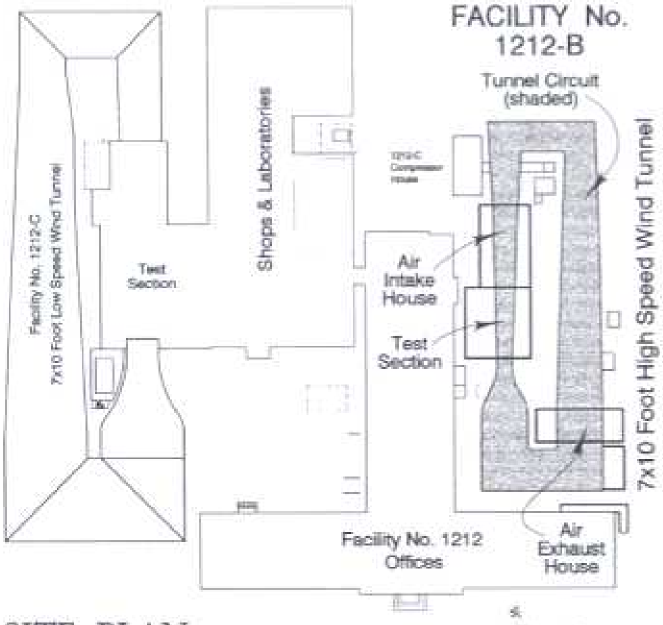
National Aeronautics and Space Administration - Langley Research Center
Hampton, Virginia

The 7- x 10-foot High Speed Tunnel (HST) was proposed in 1938 by Special Committee on Future Research Facilities for the purpose of evaluating high speed aerodynamic effects and stability control problems. Impelled by a backlog of wartime aircraft tests, the National Advisory Committee for Aeronautics authorized the proposed facility, and Langley engineers Thomas A. Harris and Charles J. Donlan designed the new tunnel as a single-return, atmospheric circuit with a closed-throat test section powered by an 18-blade fixed pitch wooden fan and a 14,000 hp variable-speed motor which could drive tunnel speed up to 675 mph. The shop and office facilities were shared with the neighboring 7- x 10-foot Low Speed Tunnel. The new tunnel began operation in November 1945, and in 1946 a "transonic bump" was installed to accelerate air flow to transonic speeds. In 1953 the test cell in the 7- x 10-foot HST was upgraded with a "slotted throat" design capable of Mach 1.1 based on achievements at the 8-foot and 16-foot High Speed Tunnels. The tunnel was connected to the 35,000 hp plenum blower at the 16-foot HST in the mid 1950s, permitting the 7- x 10-foot HST to achieve Mach 1.2.

During the Cold War, the 7- x 10-foot HST facility contributed to research on numerous U.S. military aircraft, including missiles. The world's first variable-sweep wing aircraft, the Bell X-5, was tested here, as were various designs for the Air Force Attack Experimental Program. Aircraft such as the A-10 Thunderbolt II, A-6E Intruder, EA-6B Prowler, F-111 Aardvark and F-18 Hornet were tested here, along with a reusable launch system with a manned orbiter. In 1990 a laser vapor screen flow visualization system was installed which illuminated water vapor condensing around a model's surfaces with laser light to reveal airflow characteristics. Air flow features were recorded via a video system.

After nearly 50 years' service and numerous alterations, NASA decided to close the 7- x 10-foot HST in 1994.

These drawings were completed by Richard K. Anderson, Jr. of Cultural Resource Documentation Services, Sumter, SC for inclusion in the Historic American Engineering Record (HAER) of the National Park Service, U.S. Department of the Interior. The HAER program documents significant engineering and industrial sites throughout the United States. Project records are maintained in the Prints and Photographs Division of the Library of Congress. Mr. Anderson prepared these drawings under contract to the James River Institute of Archaeology (JRIA) of Williamsburg, VA (Matthew Laird, Senior Historian) with the assistance of Carol Tyrer. JRIA conducted the HAER documentation project for NASA Langley Research Center under contract to Science Applications International Corporation (SAIC), Hampton VA, which assists NASA in addressing environmental compliance requirements. Caroline Diehl of SAIC and Carol Herbert of Tessada & Associates assisted in identifying and copying numerous references and engineering drawings in support of this project. Matthew Laird composed the HAER data pages with input from David Dutton and Michael Newbill; Chris Cunningham of Richmond, VA prepared the large format photographs.



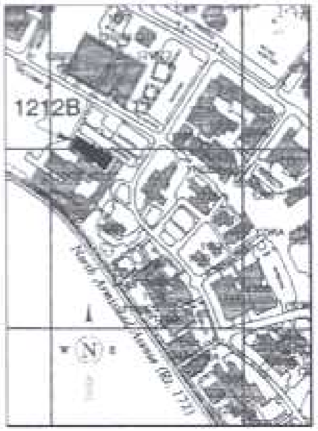
SITE PLAN

Scale: 1" = 40'-0" (1:480)

0 50 100 150 200 250 300 350 400 Feet

0 10 20 30 40 50 60 70 80 90 100 110 120 Meters

Based on entry for Building 1212B in NASA Langley Research Center "Real Estate Management Office, January 1995, Facility Brochure."



LOCATION MAP

Scale: 1" = 300' (1:3600)

0 500 1000 1500 Feet

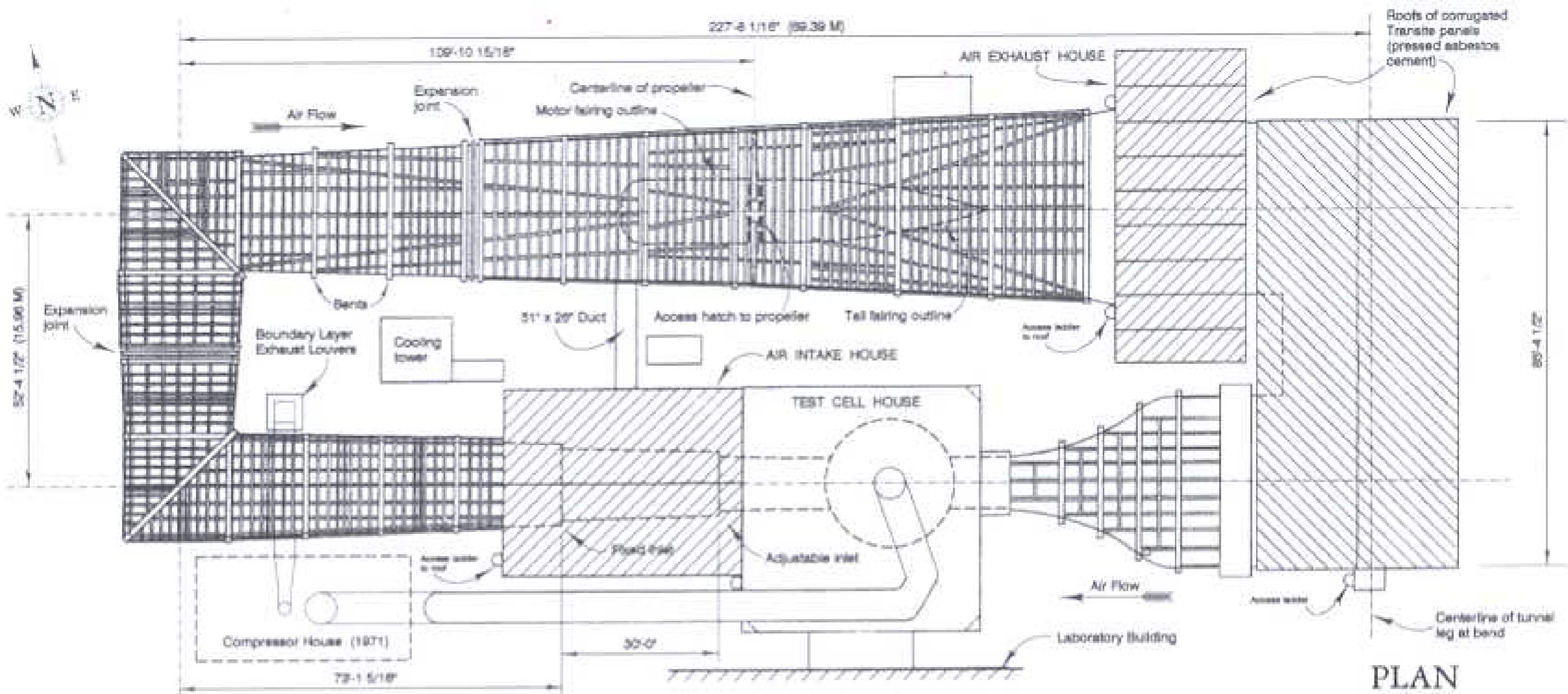
0 100 200 300 400 Meters

Based on NASA Langley Geographic Information System map, October 2001.

UTM Coordinates: 18.378860.4105730

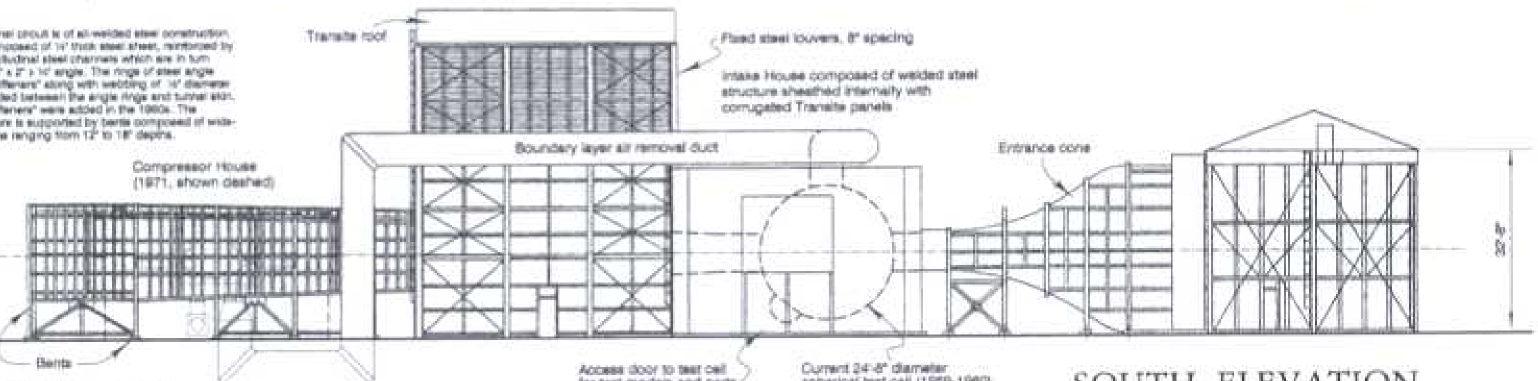
Richard K. Anderson, Jr., 2006.

NASA LANGLEY RESEARCH CENTER RECORDING PROJECT	7- BY 10-FOOT HIGH SPEED WIND TUNNEL (1945) — HAMPTON	SHEET 1	VA-118-F



PLAN

The wind tunnel circuit is of all-welded steel construction. Its skin is composed of ½" thick steel sheet, reinforced by 10" wide longitudinal steel channels which are in turn ringed by 2½" x 2" x ¼" angle. The rings of steel angle form "truss stiffeners" along with webbing of ¾" diameter steel rod welded between the angle rings and tunnel skin. The "truss stiffeners" were added in the 1960s. The tunnel structure is supported by bents composed of wide-flange I-beams ranging from 12" to 18" depths.



SOUTH ELEVATION

Scale: 3/32" = 1'-0" (1:128)

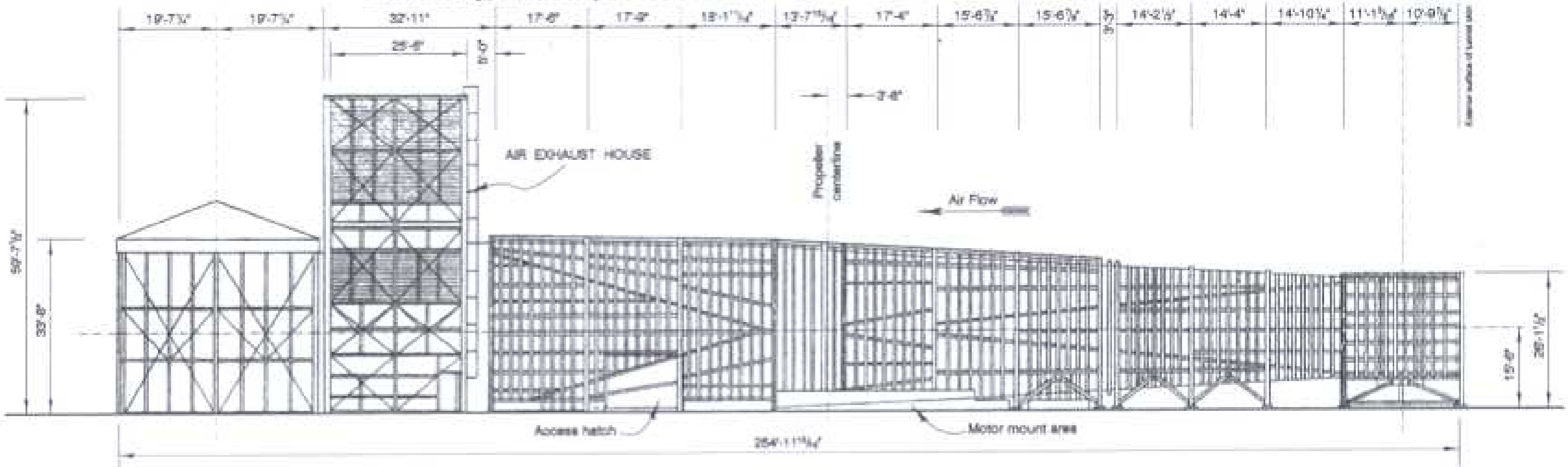
0 10 20 30 40 50 60 70 80 90 100 Feet

0 5 10 15 20 25 30 Meters

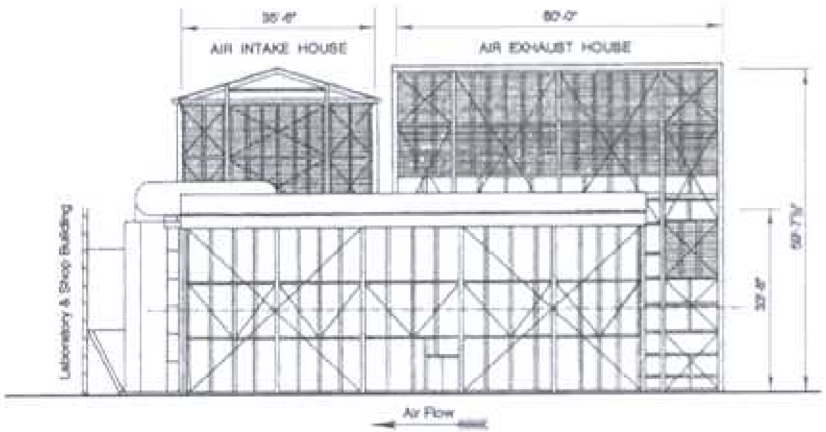
Plan based on NASA Langley Research Center drawing LD-791148, south elevation on drawing LD-791150, both by Seama, Inc. Hampton, Virginia, June 1984. Information for boundary layer compressor house and ducting based on LD-255794 "Boundary Layer Removal System Bldg. 1212B: Enclosure Plans & Elevations" and on LD-255796 "Boundary Layer Removal System Bldg. 1212B: Enclosure Sections & Details." Spherical test cell outline based on LD-523400 "7' x 10' Transonic Test Section: Sphere Assembly" by Horne Bros., Inc. Newport News, Va., 1959.

Richard K. Anderson, Jr., 2006.

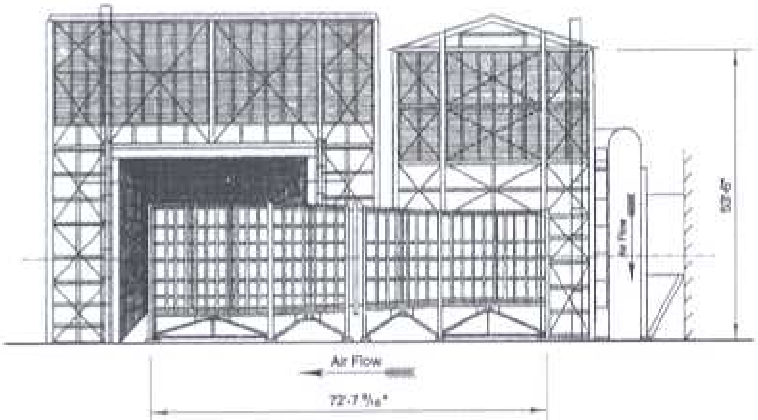
7- BY 10-FOOT HIGH SPEED WIND TUNNEL (1945)



SOUTH ELEVATION



EAST ELEVATION



WEST ELEVATION

Scale: 3/32" = 1'-0" (1:128)

Plan based on NASA Langley Research Center drawing LD-791148, south elevation on drawing LD-791150, both by Seema, Inc. Hampton, Virginia, June 1984.

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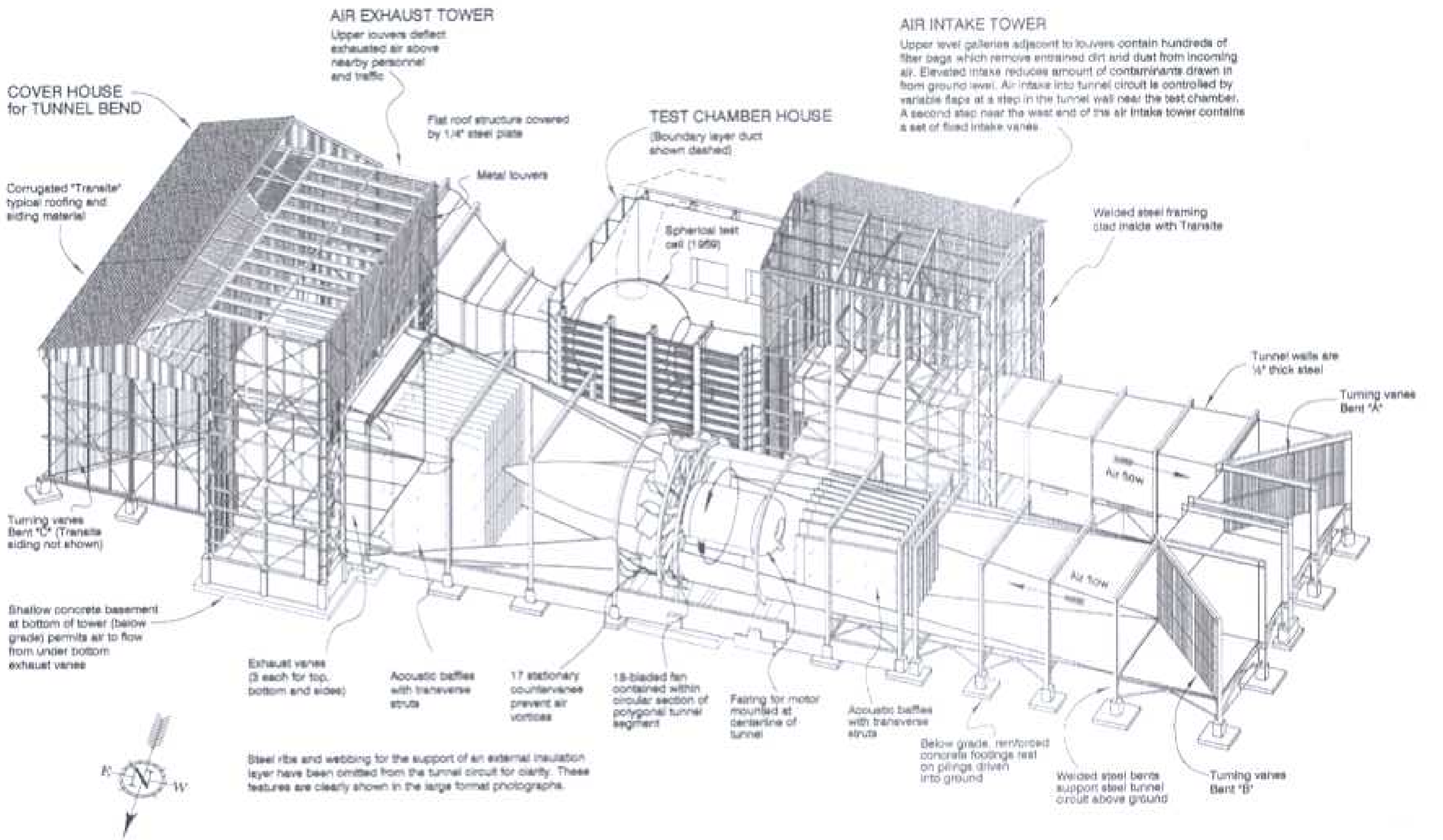
7- BY 10-FOOT HIGH SPEED WIND TUNNEL (1945)

CUTAWAY VIEW of TUNNEL COMPONENTS



No scale.
Cutaway view exported from a 3-dimensional model generated in computer-aided design (CAD) software. Model based on several dozen NASA Langley Research Center drawings and photographs. Principal drawings relied on were LD-1001019, LD-258408, LD-258454, LD-19603, LD-258458 thru LD-258460, LD-258474, LD-1011614 thru LD-1011618, LD-1011575, LD-1011536 thru LD-1011538, LD-1011540 thru LD-1011544, LD-1011530, LD-19043, LD-19044, LD-258481, LD-F44771, LD-525980, LD-525485, LD-705960, LD-258-462, LD-258463 thru LD-258467, LD-1011546 thru LD-1011587, LD-19062-F1, LX-19063-F2 LD, LD-258472, LD-523400, LD-258455, LD-258456, LD-1011569, LD-1011570, LD-258481 thru LD-258497. Some components such as roofs, louvers, siding, structural members, longitudinal tunnel bracing and lateral ring braces have been omitted for clarity. Please refer to HAER photographs for detailed exterior appearance.

7- BY 10-FOOT HIGH SPEED WIND TUNNEL (1945)

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