

## **A Critical Look at Langley's History: The Arrival of the Pressure Tank of the Variable Density Tunnel at Langley**

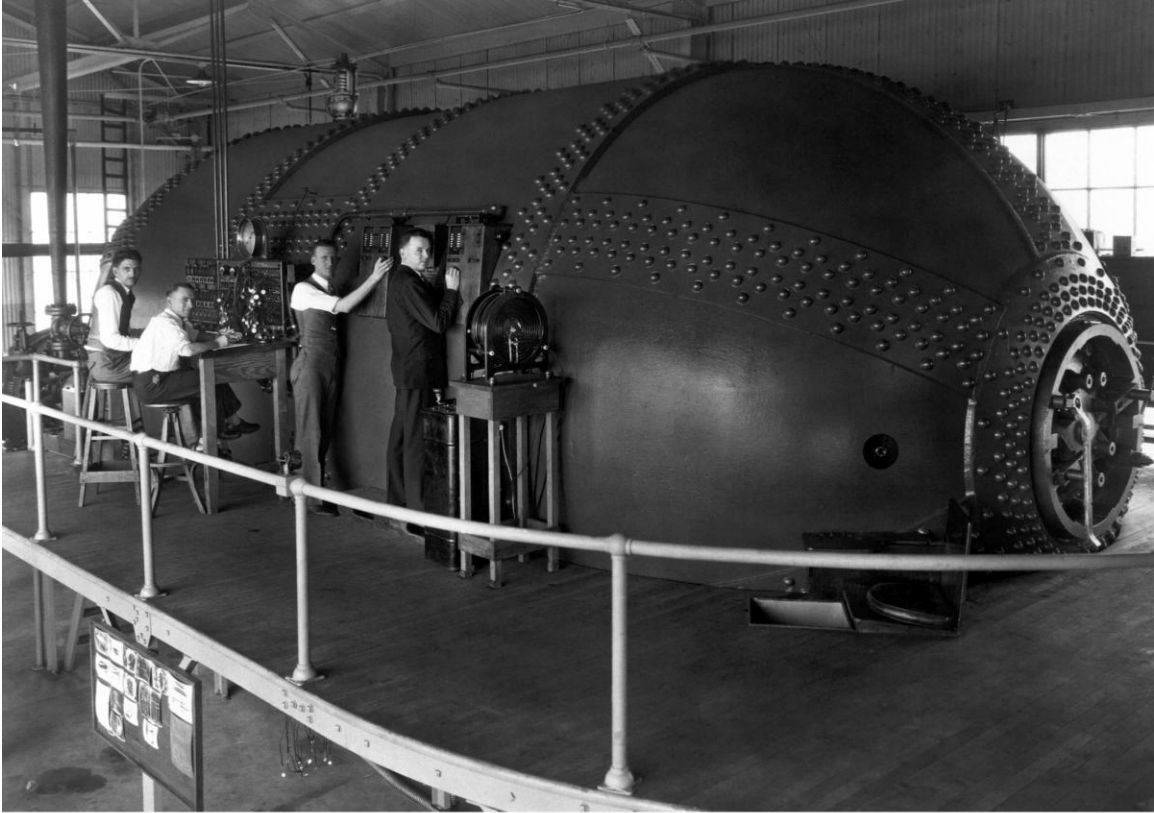
**By  
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The NASA Langley Research Center is currently undergoing a large number of facility changes as wind tunnels, laboratories, and other buildings are being closed and demolished and the New Town concept is being implemented. In the interest of preserving the legacy of Langley, a concerted effort is underway under the leadership of the Center Operations Directorate (COD) to acquire important historic information on demolished and targeted facilities including documentation of the history and research activities conducted within each building during its lifetime. This process includes on-site inspection of files and material left behind within abandoned facilities, electronic scanning of appropriate photographs and documents, digitizing of motion picture film, and video interviews of individuals who worked within the facilities of interest. The ultimate objective of the effort is to post all the information on a web site that is easily accessible by the public, aerospace enthusiasts, historians, and NASA's stakeholders.

The acquisition of relevant historical material has, at times, been very challenging because original photographic negatives have strayed from Langley's archival collection. For example, virtually all of the negatives covering piston-engine research by Langley in the 1920s and 1930s were sent to the NACA Lewis Laboratory in Cleveland during the early 1940s. In many cases the private collections of retirees and obsolete organizations have proven to be invaluable. The task has been made even more complicated because of incomplete, poorly documented, or inaccurate descriptions of historic photographs. Unfortunately, recent data-gathering exercises have revealed erroneous photo captions and conclusions that have become perpetrated in Langley lore for many years.

This situation has occurred relative to one of the most important Langley wind-tunnel facilities, known initially as Wind Tunnel #2 and subsequently as the internationally famous Variable Density Tunnel (VDT). A photograph of the tunnel during research operations in 1929 is shown in Figure 1. The development and technical impact of this remarkable pressurized wind-tunnel facility have been thoroughly documented, and it is widely recognized as the facility that leap-frogged the state of the art in wind-tunnel technology and "put the NACA and Langley on the map" within the international aeronautical community. The unique design concept of the VDT consisted of a wooden 5-ft diameter wind tunnel contained within a 34.5-ft long, 15-ft diameter steel pressure tank capable of being filled with air at pressures up to 20 atmospheres. Today the outer VDT pressure tank is on display as a National Historic Landmark adjacent to the Langley Reid Conference Center.

The fact that the 85-ton pressure shell was fabricated at the Newport News Shipbuilding and Dry Dock Company during 1921 and 1922 is well known; however, the description of how the shell was transported to Langley for installation in what is currently NASA Building 582 (then NACA Building 60A) in the NASA East Area has been erroneously




 Variable Density Tunnel, Being Used by NASA Staff  
NASA Langley Research Center 3/15/1929 Image # EL-1996-00143

Figure 1. The Variable Density Tunnel during a research study in 1929.

reported by NASA for over 30 years. The following information clarifies the actual events and identifies the misleading information that has resulted in wrong conclusions.

### **Fabrication at the Newport News Ship Building and Dry Dock Company**

While the NACA began in-house design and construction efforts on the wooden tunnel insert for the VDT as well as its building site in 1921, the challenging task of fabricating the heavy steel pressure tank was contracted to the Newport News Shipbuilding and Dry Dock Company (now Northrop Grumman Shipbuilding). Early in 1922 the fabrication of the tank had been completed and it was photographed atop a railroad car at the shipyard as shown in Figure 2. This photograph, taken by the shipyard, has been the source of incorrect information on the journey of the tank to its ultimate destination at Langley.

The NASA electronic version of this photograph (EL-2000-00529) contains the following description:

“The Variable Density Tunnel arrives by rail in 1922 from the Newport News Shipbuilding and Dry Dock Company. Photograph published in Winds of Change, 75th



Figure 2. Photograph of the pressure tank of the Variable Density Tunnel at the Newport News Shipbuilding and Dry Dock Company on February 3, 1922. (Photo courtesy of Northrop Grumman Shipbuilding-Newport News).

Anniversary NASA publication (page 72). Also published in *Engineer in Charge: A History of the Langley Aeronautical Laboratory, 1917-1958* by James R. Hansen (page 77). The tank for the Variable-Density Tunnel arrived at Langley by railway from its Manufacturer, the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., on February 3, 1922.” (Author’s note: The photograph also appears on page 36 in *Crafting Flight* by James Shultz as well as numerous NASA multimedia internet sites.).

Several major errors appear in this description. As previously mentioned, the photograph was taken at the shipyard and not upon arrival at Langley. In the early 1920s the NACA at Langley Field had no large buildings of the size shown in the background. As the shipyard marking on the photograph indicates, it was taken on February 3, 1922—but the tank was not shipped to Langley on that day as stated in the caption. In fact, the tank was not delivered until June 1922. More importantly, it was not shipped by railway at all, but via water transportation by a barge from the shipyard, down the James River, around Fort Monroe, and to Langley.

Michael Dillard, the current Photo Library Editor of Northrop Grumman Shipbuilding, recognized the shipyard building in the background and has provided valuable support for this study with several photographs from the files of the shipyard. Figure 3 shows the current machine shop buildings at the yard which have been in existence since 1890. The viewpoint for the picture is looking southward toward the James River. The building in the background of Figure 2 is one of these shops, which included the boiler shop where the tank was fabricated (brick building on the right).



Figure 3. View of the massive 120-year-old machine shop buildings at Northrop Grumman Shipbuilding in Newport News. (Photo courtesy of Northrop Grumman Shipbuilding-Newport News).

Another view of the shop buildings in 1920 is shown in Figure 4 (taken by a U.S. Army Signal Corps photographer based at Langley Field). The shops are located at the middle right of the photograph, adjacent to Dry Dock #1 and the yard's outfitting piers (shipping docks) on the James River. Railways extended through the machine shop buildings and from the buildings to the piers for ship loading.

### **Delivering the Tank to Langley**

During a recent collection of historic documents from the uninhabited VDT building, an unexpected treasure was found in the form of the grainy photograph shown as Figure 5. On the photo cover was the note "Tank on Barge June 1922." The tank is clearly identifiable on a shipping barge in the Back River adjacent to Langley Field with a view



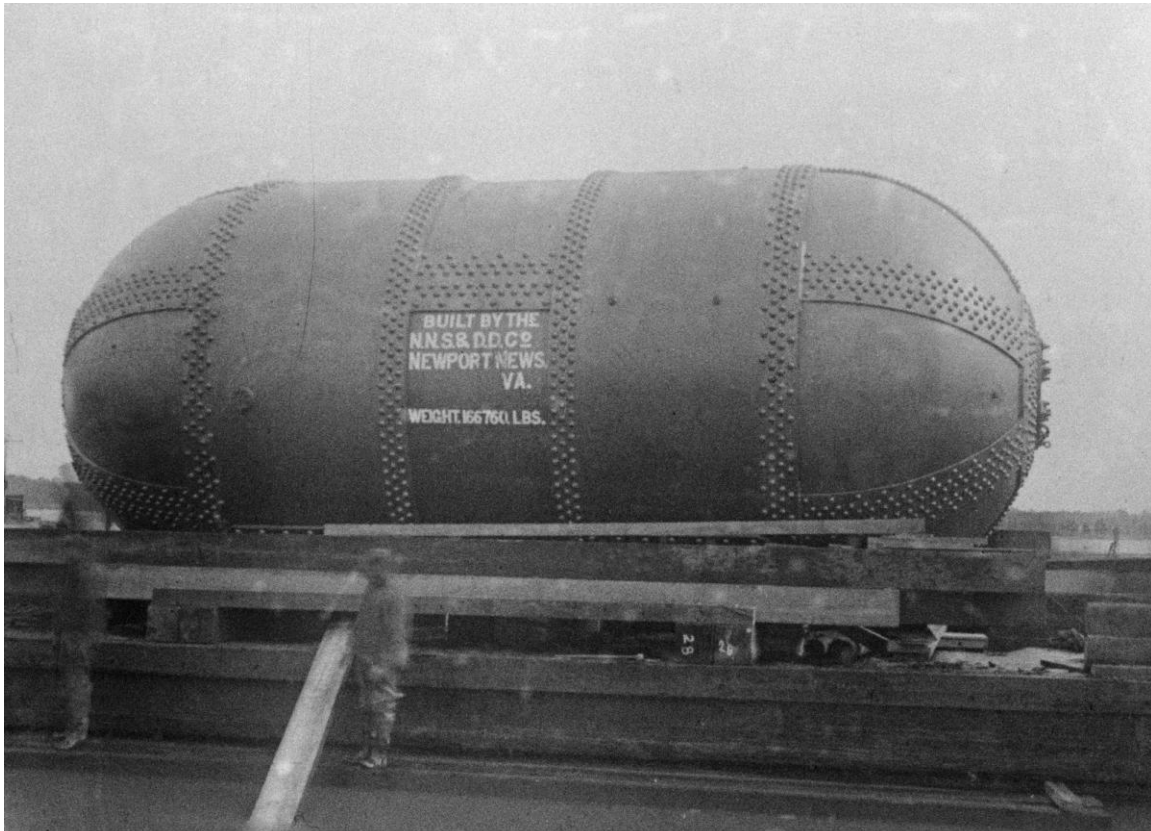


Figure 4. Aerial view of the shipyard taken in March 1920. The machine shops are located at the middle right of the photograph. (Photo courtesy of Northrop Grumman Shipbuilding-Newport News).



Figure 5. Arrival of the pressure tank of the VDT at Langley via barge in June 1922.

toward the southeast. In the background is the shore line of Hampton, Virginia, and the bank of Langley Field is in the foreground. The tank rests on large shipping timbers atop the barge. This photograph is one of the earliest photographs taken at Langley (L-132).



Variable-Density Tunnel  
NASA Langley Research Center

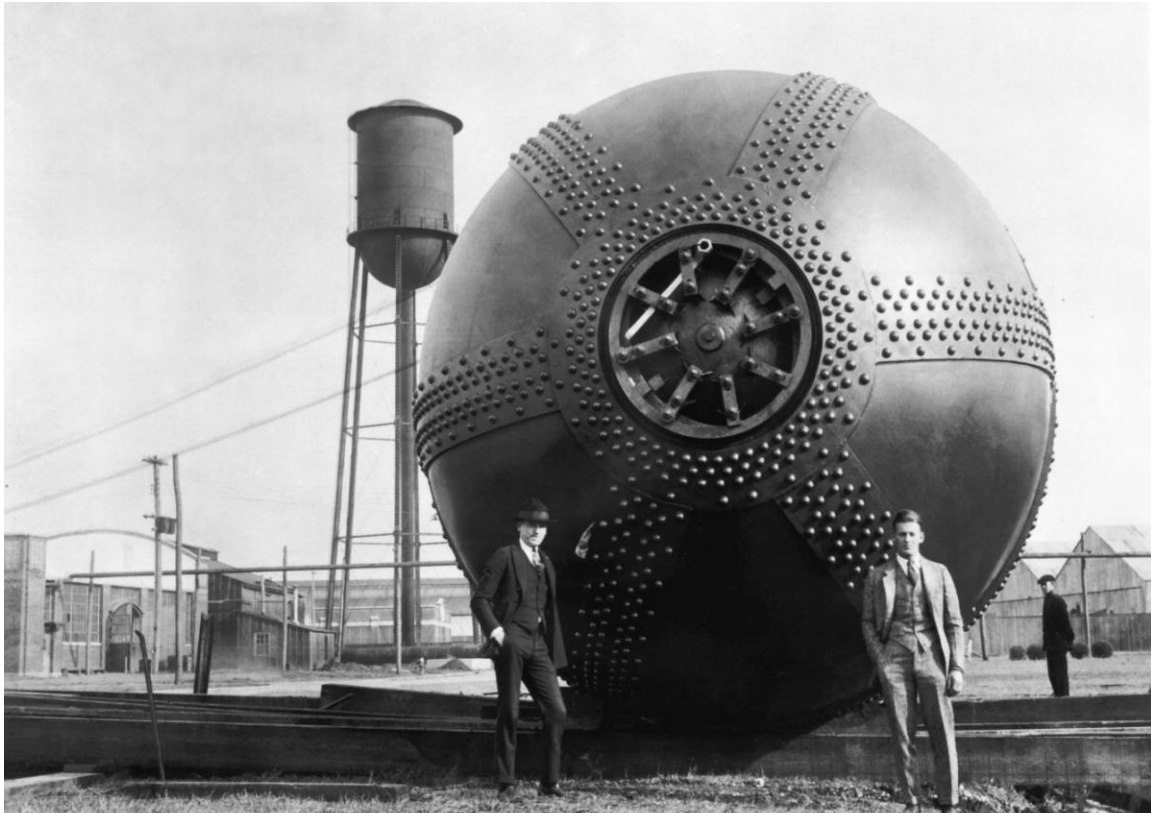
6/22/1921

Image # EL-1999-00256

Figure 6. Tank barge docks at Langley.

Another photograph of the tank on the barge in June 1922 was found in current Langley electronic files (EL-1999-00256) as shown in Figure 6. In this picture the barge has parked at a dock and the tank is in the process of being unloaded. The landing site is believed to be near the original Langley Field Officer's Club (later a boathouse and Yacht Club). Note that caption of the electronic file is in error, giving the date as June 22, 1921—before the tank was completed at the shipyard. A review of the official NACA photographic log book indicated that the picture was taken in June 1922 (no day given).

Later that day, the tank was unloaded and inspected before being moved to Building 582. Figure 7 shows the NACA photograph of that inspection (EL-1997-00136). The man on the left is Harold J. Turner, long-time Safety Engineer of Langley and the man on the




 Variable Density Tunnel Arrives at Langley  
NASA Langley Research Center 6/22/1921 Image # EL-1997-00136

Figure 7. Inspection of the VDT tank after arrival.

right is Art Gardner. Note the location of the tank relative to the old Langley water tower and various buildings. In addition, huge timbers similar to those seen on the barge are being used to support the tank. Once again, the date given in the caption is wrong.

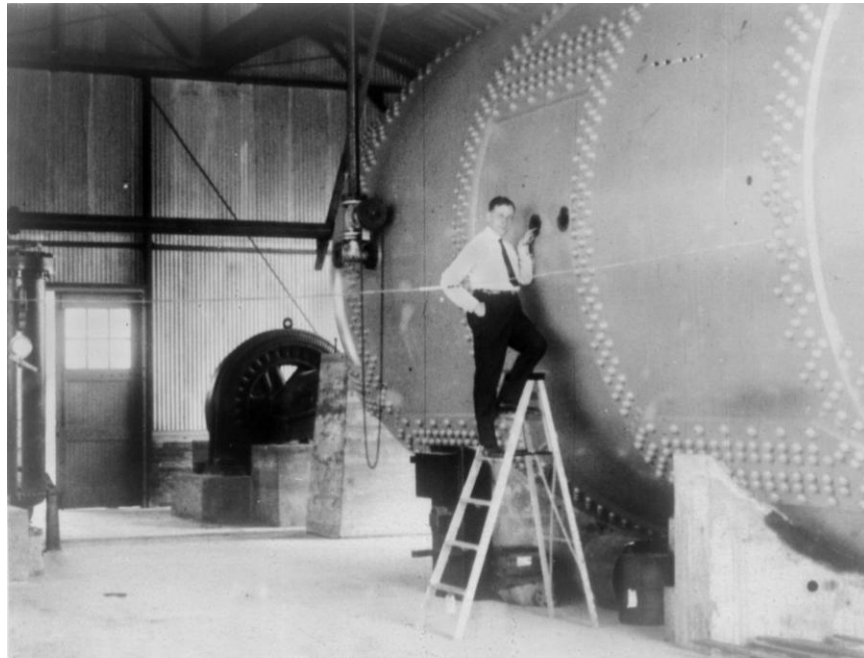
A later aerial view of Langley Field shown in Figure 8 was taken in April 1928 after the VDT was installed and operational in Building 582, but it is helpful to establish the location of several key NACA facilities and the probable site of the previous photograph near the water tower. Shown are (1) the NACA Administration Building, (2) the NACA Service Building, (3) Wind Tunnel #1, (4) the VDT Building 582, (5) NACA aircraft engine research buildings, (6) the Propeller Research Tunnel, and (7) the Langley Officers Club. The “X” denotes the probable site of the previous photograph. How the tank was transported from its arrival site to Building 582 is not known.

Note the clearly visible railroad track between the Services Building (2) and the VDT building (4). Trains crossed a bridge over the Back River several times daily bringing supplies from Hampton to Langley Field; however, the train was not used for the delivery of the VDT tank from the shipyard. The front of the VDT building facing the water had a large opening during its construction in 1922 to permit installation of the tank.





Figure 8. Aerial view of Langley Field in 1928 showing location of major NACA facilities and the probable location of the tank in Figure 7.




 Max M. Munk inspects the Variable Density Tunnel  
NASA Langley Research Center 6/1/1922 Image # EL-1999-00258

Figure 9. Dr. Max Munk inspects the VDT in 1922.



Figure 9 (EL-1999-00258) shows Dr. Max Munk, the famed inventor of the VDT concept, inspecting the tank after it was mounted on concrete pads in Building 582. Dr. Munk has turned toward the front of the building facing the Back River. The photograph was probably taken in the summer of 1922, but the specific date indicated (6/1/1922) is questionable.

Finally, the foregoing explanation of the delivery of the VDT tank to Langley was independently verified in a video-taped interview with P. Kenneth Pierpont, a noted NACA and NASA aerodynamicist who entered duty at Langley in early 1942. Mr. Pierpont was interviewed by Mary Gainer of the COD and the author at the NASA Langley Research Center on April 13, 2010 (video will soon be available online at [http://crgis.ndc.nasa.gov/historic/Variable\\_Density\\_Tunnel](http://crgis.ndc.nasa.gov/historic/Variable_Density_Tunnel)). Pierpont was a friend of Eastman N. Jacobs, the brilliant NACA researcher who led the work in the VDT and appears at the far left in the photograph shown in Figure 1 during a testing session. Jacobs described the delivery of the VDT tank by barge during discussions of the history of the facility with Pierpont.

### **Concluding Remarks**

This brief review of the delivery of the pressure tank of the Langley Variable Density Tunnel has been prepared to correct misleading information presented in current NASA documents, web sites and other works on the history of the facility. The misconceptions arose because of poorly documented photographs, and the lack of documented personal accounts of the activity.

In addition to providing new information on the VDT, this case study hopefully emphasizes the necessity and importance of historical archiving and documentation during the current era of change at Langley.