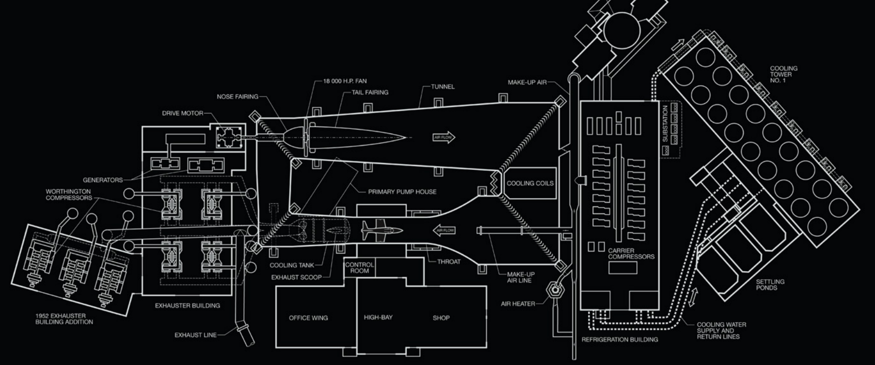
National Aeronautics and Space Administration

NASA Glenn Research Center Altitude Wind Tunnel (AWT)

1944 to 1958

A 31-foot-diameter drive fan in the AWT. This spruce wood fan was rotated up to 410 revolutions per minute by an 18 000-horsepower General Electric induction motor, which was located outside the tunnel in the Exhauster Building.

NACA LEWIS AWT



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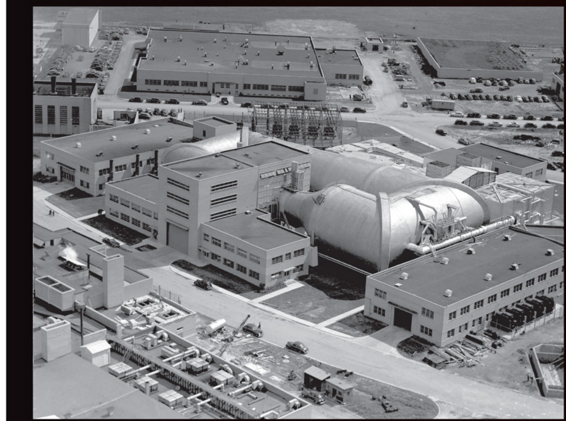
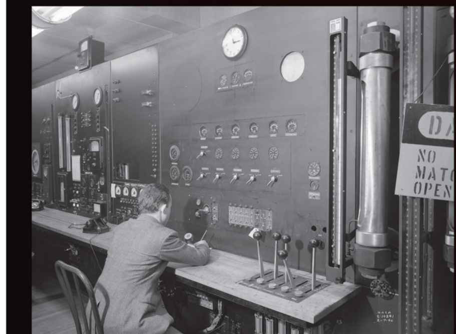
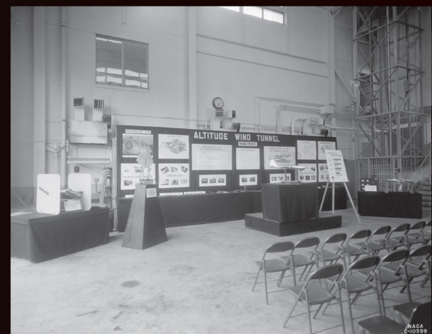


The AWT was the first wind tunnel in the United States capable of operating full-scale aircraft engines in conditions that replicated those actually encountered by aircraft during flight. The tunnel was 263 feet long on the north and south legs and 121 feet long on the east and west sides. The larger west end of the tunnel was 51 feet in diameter, and the east end was 31 feet in diameter at the southeast corner and 27 feet in diameter at the northeast. The 20-foot-diameter test section accommodated full-size engines and in some cases, entire fuselages.

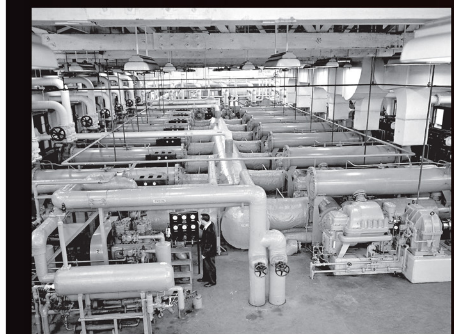
Although initially constructed during World War II to study reciprocating engines, its primary role was the development of the jet engine—from the General Electric I–16 to the powerful Pratt & Whitney J57. The ability to study these early jet engines in controlled altitude conditions gave the researchers the ability to try different modifications to improve performance without redesigning the entire engine. This led to both general improvements that could be used on any jet engine, including restarting the engine at high-altitude, understanding windmilling, and the first applications of the afterburner and specific enhancements for that particular engine model. The AWT was used to study a wide range of engines, such as piston, turbojet, ramjet, turboprop, and early rocket engines. In the late 1950s, the facility shifted its focus to space and was no longer used as a wind tunnel. During its 30 years of operation, the facility continually evolved to meet the nation's ever-changing aeronautics and space needs.



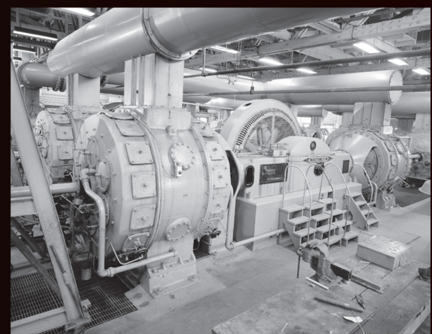
This workstation, located in the soundproof AWT control room, was used to operate the engine being tested in the test section. The running of the tunnel itself was performed at adjacent stations. The tunnel operators were assisted by technicians in the Refrigeration and Exhauster buildings, as well as the Engine Research Building.



This display, set up as part of an Aviation Writer's Association tour of the Aircraft Engine Research Laboratory (AERL), highlights the research conducted in the AWT during the World War II years. The engines tested included the B–29's R–3350, Westinghouse 19B and 19XB, Douglas XTB2, and General Electric's I–16, I–40, and TG–180 engines. The display was set up in the high-bay area of the AWT's Shop and Office Building.

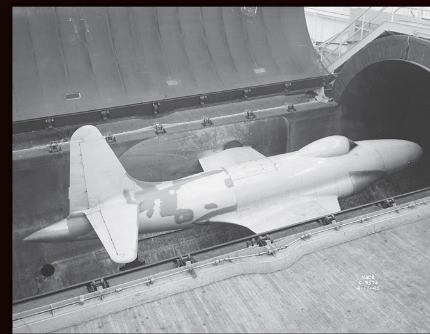


When it was built in the early 1940s, the AWT's refrigeration system was the largest air cooling system in the United States. Willis Carrier, whose Carrier Corporation designed the system, considered it his most significant achievement in a long career of refrigeration innovation. The design of the cooling coils, use of Freon-12, and new compressor models were all unique for the AWT's cooling system. The 14 Carrier compressors and flash cooler were housed in the Refrigeration Building to the west of the the tunnel.

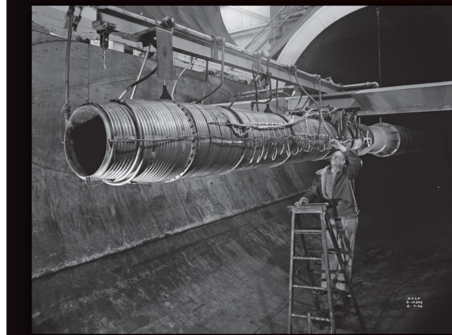


One of four 1750-horsepower Worthington reciprocating exhausters in the Exhauster Building located immediately to the east of the AWT. These blowers were used to remove air and contaminants from the AWT in order to simulate pressures found at high altitudes. The AWT's exhaust system was tied into the Engine Research Building's system and also, later, to that of the Propulsion Systems Laboratory.

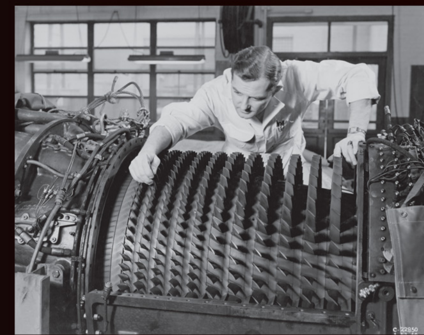
One of the most important World War II aeronautical problems was the overheating of the engines for B–29 bombers. Studies of the B–29's Wright R–3350 engine in the AWT led to a successful redesign of the baffles. Researchers determined that the installation of ducted head baffles and a spray bar prevented overheating, cooled the charge, and prevented prespark explosions.



The Lockheed YP–80A Shooting Star was the first aircraft to incorporate a U.S.-built jet engine. It was also the first Air Force aircraft to exceed 500 miles per hour. The aircraft's General Electric I–40 turbojets were tested in the spring of 1945. The tunnel's 20-foot-diameter test section allowed the entire fuselage to be installed. AERL researchers were successfully able to create a thrust performance curve for the I–40 at all altitudes that permitted future testing at sea-level facilities.

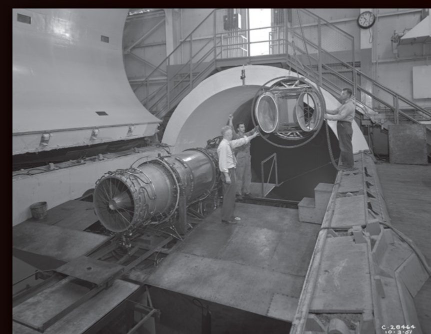


The AWT was used to analyze several early ramjets, including this 20-inch-diameter ramjet for NACA's post-war high-speed flight program. This ramjet was mounted under a wingspan in the AWT's test section, and conditioned air was piped directly to the engine inlet. The tests, which were run at altitudes up to 47 000 feet, studied overall performance and specific issues such as flameholder design and tailpipe configurations for an afterburner.



A technician examines the stator blades on a General Electric TG–190 axial-flow compressor jet engine in the AWT's shop area. The AWT was used to study almost all of the first generation of axial-flow engines in the 1940s, including the first axial-flow jet engine, Westinghouse's 19B and the TG–190's predecessor, the TG–180. The TG–190 was one of the most successful jet engines ever created and was the first jet engine to be approved for commercial use. The engine was tested numerous times in the AWT during the 1948 to 1950 period. These tests analyzed the engine's fuel efficiency, afterburner configurations, inlet designs, and other concerns.

The studies of the British-manufactured Armstrong-Siddeley contra-rotating turboprop was the first time the AWT was used specifically to learn about, not improve, an engine. AWT turboprop investigations in the 1940s were the basis for the successful Advanced Turboprop Program in the 1980s.



A NACA inlet duct being lowered into the 20-foot-diameter AWT test section for installation on a Westinghouse J–40 engine. An overhead rail crane was used to transport test articles from the shop area into the second-story test section. The engines were often installed on wing sections thich were fastened to the balance chamber trunions on the sides of the test section. The large clamshell lid, seen to the left, was lowered into place to seal the test section when the tunnel was operating.

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