Wind Tunnels. Part (2)

5. Another method of obtaining high velocities is **to fire models out of the barrel** gun inside a supersonic wind tunnel. The speed of the model is combined with the speed of the moving air to produce high velocity. The models are photographed as they streak by. Because the air itself does not move at hypersonic velocities, this does not create the problems associated with liquefaction of the air. But the models are destroyed during testing.

What is the disadvantage of firing models inside the supersonic wind tunnel ?

6. Another major development was **the slotted wall wind tunnel**. A problem with wind tunnels is that the air flowing off a model can hit the tunnel wall and flow back toward the model and interfere with the test measurements. Ray Wright, a researcher at Langley, proposed slots in the walls of a wind tunnel. So the air could move more freely around the model. Another group of aerodynamicists, led by John Stack, applied this technique to the transonic wind tunnel. And many issues encountering as air speeds approached Mach 1 were solved. And in 1951 Stack and his group were awarded the Collier Trophy, which honors the most important advances in aeronautics.

What is the idea of the slotted wall wind tunnel ?

7. Besides the design of new planes, wind tunnels are also used to solve the problems that affect the aircraft in flight at low temperatures. Ice is concentrated on propellers, aircraft surfaces and wings and seriously affects aircraft performance. Ice on the wings can destroy lift and may cause lack of altitude and even crash. It can block control surfaces. Icing tunnels were developed 1940s to study this problem. They are similar to conventional subsonic wind tunnels but are equipped with refrigeration systems that can cool the air to well below freezing. Water droplets are then sprayed into the airflow so that they can freeze on aircraft surfaces. Engineers monitor the buildup of ice on the aircraft. Anti-icing devices such as electric heaters or pipes containing a heated liquid such as alcohol are installed in the aircraft parts that generate ice.

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8. There are many other different kinds of wind tunnels. There are **"spin tunnels"** that test how aircraft behave when they fly out of control and start spinning, a situation that is commonly referred to by pilots as "departure from controlled flight." These tunnels test whether the pilot can recover in this situation or needs to parachute out of the airplane. There are **"free flight" tunnels** where models are actually "flown" by remote control by a pilot sitting in a control booth and sending signals to the model through a wire tether. There are also **blast-furnace-type tunnels** for testing how spacecraft and missiles act in high temperature airflows such as during reentering the Earth's atmosphere. And there are **magnetic tunnels**, where the model is held stable inside the tunnel by powerful magnetic fields so that more accurate measurements can be taken.

What types of wind tunnels have been developed?

9. For years wind tunnels represented a less expensive way of testing an airplane than building the full-size vehicle. But wind tunnel research was and still is expensive. Testing a new airplane design in a wind tunnel costs millions of dollars. As a result, aircraft designers have increasingly shifted to computers and a method called **computational fluid dynamics** (air is a fluid, like water), which simulates airflow entirely within a computer. Computing power is relatively cheap, and computer models can be changed much more easily than physical models made of plastic, metal, and wood. The giant wind tunnels are now used only to serve as backups to the computer simulations, to prove that their predictions are sound.

What are the advantages of a computer aided design (computational fluid dynamics) ?

http://www.centennialofflight.net/essay/Evolution_of_Technology/advanced_wind_tunnels/Tech36.htm

10. The wind tunnels operated in the United States were run by the NACA. But the universities play a greater role in operating wind tunnels. This led to the National Unitary Wind Tunnel Plan Act of 1949. The Act established new supersonic wind tunnels at the three major NACA facilities, but also pushed for the creation of supersonic wind tunnels at universities. The development of a university wind-tunnel base was important for NACA research and new aeronautical engineers. The NACA tunnels were also directed to perform more industry research, symbolizing a decreased emphasis on government-sponsored wind tunnel research.