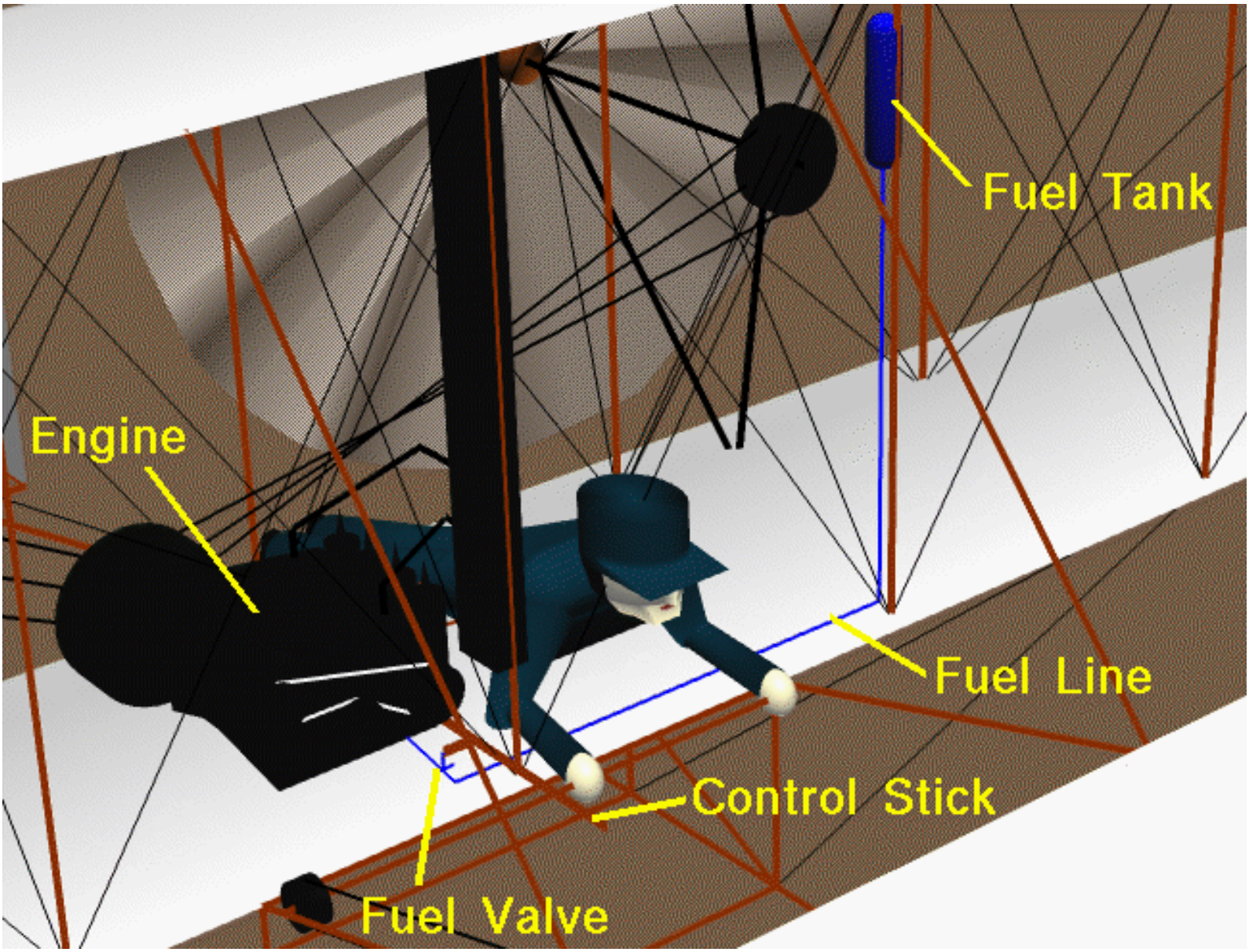
Engine Fuel System

Glenn Research Center



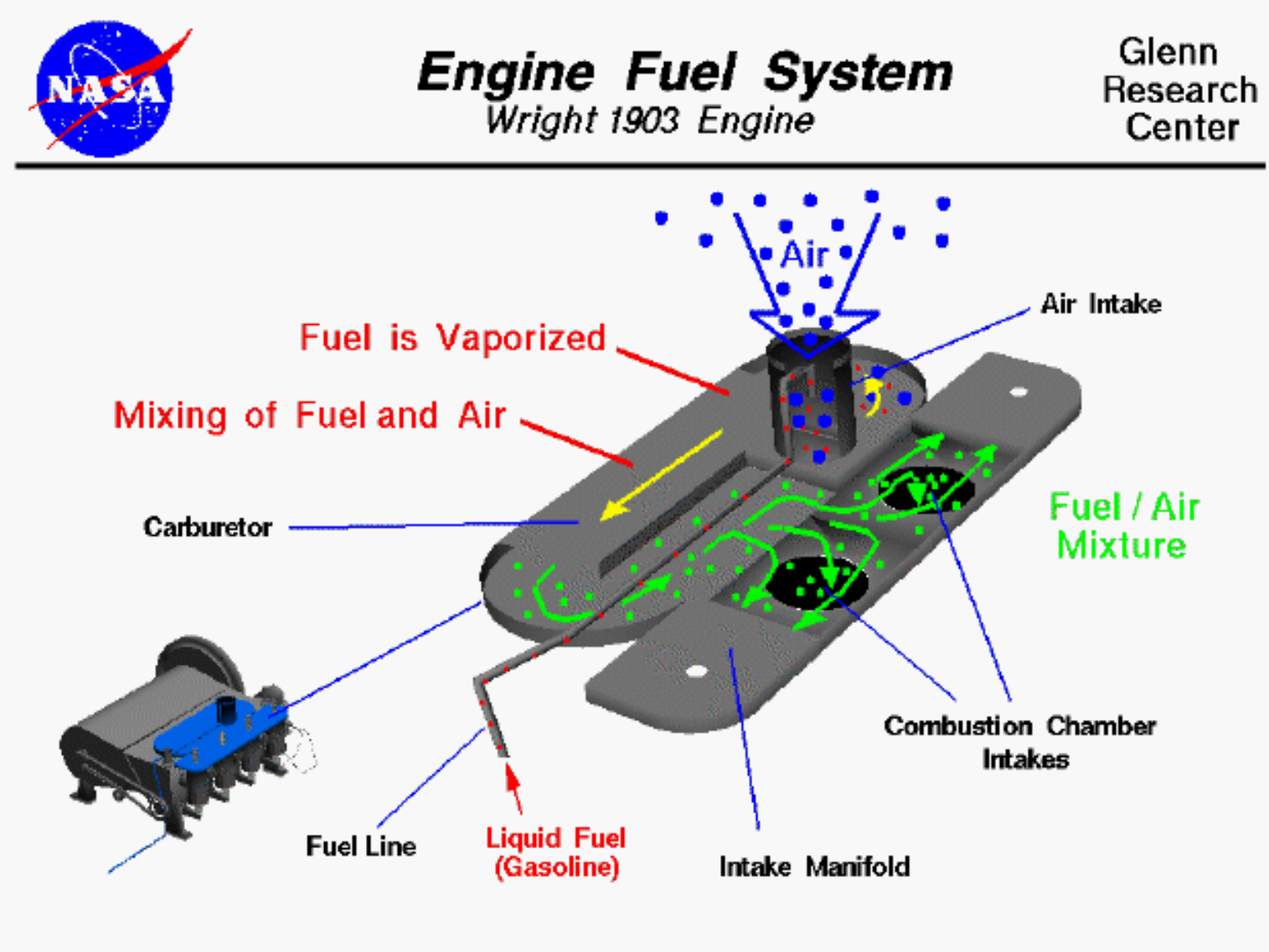
This is a computer drawing of the **fuel system** of the Wright brothers' 1903 aircraft engine. This engine powered the first, heavier than air, self-propelled, maneuverable, piloted aircraft; the Wright 1903 Flyer at Kitty Hawk, North Carolina, in December, 1903. To generate thrust for their aircraft, the brothers used twin, counter-rotating propellers at the rear of the aircraft. To turn the propellers, the brothers designed and built a water-cooled, gasoline powered, four-stroke, four cylinder, internal combustion engine.

In any internal combustion engine, fuel and oxygen are combined in a combustion process to produce the power to turn the crankshaft of the engine. The job of the **fuel system** is to mix the fuel and air (oxygen) in just the right proportions for combustion and to distribute the fuel/air mixture to the combustion chambers. The fuel system of the Wright brothers is composed of three main components; a fuel tank and line mounted on the airframe, a

carburetor in which the fuel and air are mixed, and an intake manifold which distributes the fuel/air mixture to the combustion chambers.

In the figure, the fuel tank and line are colored blue. The tank is mounted high because the brothers used gravity to feed the fuel into the engine. Fuel flows through a small metal **fuel line** from the tank to the engine. The flow of fuel to the engine is controlled by a **fuel valve** located on the fuel line. On the Wright 1903 aircraft, the fuel flow to the engine was adjusted while the aircraft was sitting on the launch rail. When the engine was running as fast and smooth as possible the aircraft was ready for launch. The pilot had a **control stick** which was connected to a cut-off valve to stop the engine at the end of the flight. But the brothers had no throttle or engine control during the 1903 flights.

Historical note *- Your modern automobile uses a fuel pump to move the fuel from the gas tank to the motor. The brothers' 1903 engine had no fuel pump but they added a fuel pump to later engines.*



The fuel line continues past the valve, along the top of the engine, and into the the side of the **air intake** as shown on this figure. The liquid fuel drips into the **carburetor**, which is a flat, enclosed pan that sits on the top of the engine. The floor of the carburetor is hot because it sits over the engine cylinders. Air is drawn into the carburetor, through the air intake, because of the action of the pistons far downstream. During the intake stroke of the engine,

the piston is pulled into the cylinder, increasing the volume in the combustion chamber. Fuel and air are pulled through the carburetor and intake manifold to fill the increased volume. The combination of air being drawn over the fuel and the heat of the floor of the carburetor cause the liquid fuel (gasoline) to evaporate. The gasoline mixes with the air as the gases move through the carburetor, as indicated by the yellow arrow on the graphic. Near the exit of the carburetor, there is uniform gas mixture of fuel and air, which is indicated by the green "molecules" and arrows on the figure.

Historical note *- The carburetor used by the Wrights is merely a pan in which to mix fuel and air. Modern automobiles use computer-controlled fuel injectors to accomplish the same function. Before fuel injectors were used, automobiles (and aircraft engines) used much more sophisticated carburetors to spray the fuel, mix it with the air, and vary the fuel/air ratio for optimized performance over a range of operating conditions. Modern carburetors have many, small, moving parts; the Wright carburetor has no moving parts. With modern carburetors and fuel injection systems you can throttle the engine to make it run at different speeds. Without the moving parts, brothers engine ran at just one speed throughout the flights of 1903.*

The fuel/air mixture leaves the carburetor and enters the **intake manifold**. The job of the manifold is to distribute the fuel/air mixture to the four cylinders. On the graphic, we have peeled open the manifold across the two center cylinders; similar openings are found to the outer two cylinders. The flow of the fuel/air mixture out of the manifold is controlled by the intake valve of the combustion chamber of each cylinder.

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by Tom Benson
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