be produced without the fuel detonating. Larger, high-compression engines require fuel with a greater amount of potential power production without detonation than smaller low-compression engines.

Volatility

One of the most important characteristics of an aircraft fuel is its volatility. Volatility is a term used to describe how readily a substance changes from liquid into a vapor. For reciprocating engines, highly volatile fuel is desired. Liquid gasoline delivered to the engine induction system carburetor must vaporize in the carburetor to burn in the engine. Fuel with low volatility vaporizes slowly. This can cause hard engine starting, slow warm-up, and poor acceleration. It can also cause uneven fuel distribution to the cylinders and excessive dilution of the oil in the crankcase in engines equipped with oil dilution systems. However, fuel can also be too volatile, causing detonation and vapor lock.

AVGAS is a blend of numerous hydrocarbon compounds, each with different boiling points and volatility. A straight chain of volatile compounds creates a fuel that vaporizes easily for starting, but also delivers power through the acceleration and power ranges of the engine.

Vapor Lock

Vapor lock is a condition in which AVGAS vaporizes in the fuel line or other components between the fuel tank and the carburetor. This typically occurs on warm days on aircraft with engine-driven fuel pumps that suck fuel from the tank(s). Vapor lock can be caused by excessively hot fuel, low pressure, or excessive turbulence of the fuel traveling through the fuel system. In each case, liquid fuel vaporizes prematurely and blocks the flow of liquid fuel to the carburetor.

Aircraft gasoline is refined to have a vapor pressure be between 5.5 pounds per square inch (psi) and 7.0 psi at 100 °F. At this pressure, an aircraft fuel system is designed to deliver liquid fuel to the carburetor when drawn out of the tank by an engine-driven fuel pump. But temperatures in the fuel system can exceed 100 °F under the engine cowl on a hot day. Fuel may vaporize before it reaches the carburetor, especially if it is drawn up a line under a low pressure, or if it swirls while navigating a sharp bend in the tubing. To make matters worse, when an aircraft climbs rapidly, the pressure on the fuel in the tank decreases while the fuel is still warm. This causes an increase in fuel vaporization that can also lead to vapor lock.

Various steps can be taken to prevent vapor lock. The use of boost pumps located in the fuel tank that force pressurized liquid fuel to the engine is most common.

Carburetor Icing

As fuel vaporizes, it draws energy from its surroundings to change state from a liquid to a vapor. This can be a problem if water is present. When fuel vaporizes in the carburetor, water in the fuel-air mixture can freeze and deposit inside the carburetor and fuel induction system. The fuel discharge nozzle, throttle valve, venturi, or simply the walls of the induction system all can develop ice. As the ice builds, it restricts the fuel-air flow and causes loss of engine power. In severe cases, the engine stops running. *[Figure 14-5]*

Carburetor icing is most common at ambient temperatures of 30–40 °F but can occur at much higher temperatures, especially in humid conditions. Most aircraft are equipped with carburetor heating to help eliminate this threat caused by the high volatility of the fuel and the presence of moisture. *[Figure 14-6]*

Aromatic Fuels

The aviation gasoline market is a relatively small part of the overall gasoline market. AVGAS producers are few. In years past, when this was less the case, considerable quantities of aromatic hydrocarbons were sometimes added to increase the rich mixture performance of AVGAS. It was used mainly in high horsepower reciprocating engines, such as military

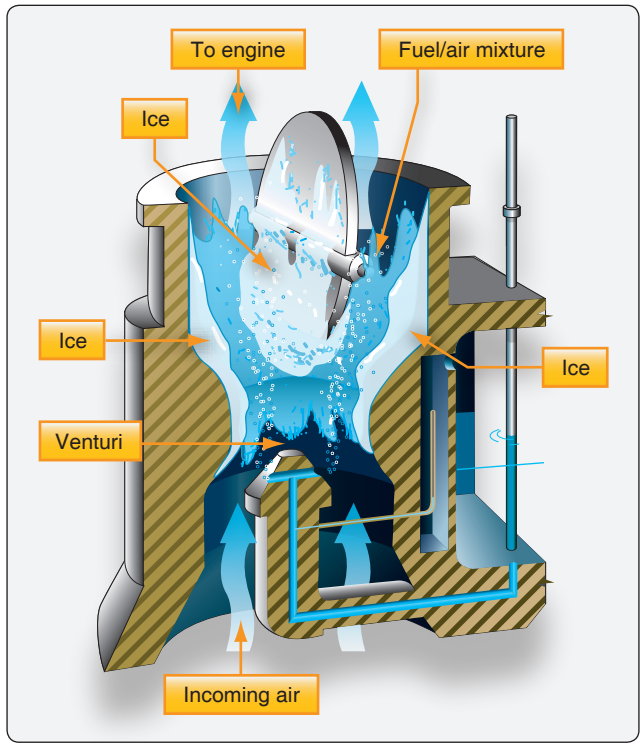

Figure 14-5. *An example of common areas where ice can form on a carburetor. The evaporation of volatile fuel takes energy from its surroundings to change state. As it does, water in the fuel-air mixture condenses and freezes.*