The airspeed indicator provides some very basic, yet important information on the aircraft's relative velocity through the surrounding air. It helps the pilot establish optimum performance during takeoff and landing; it also shows an impending stall in most aircraft, though the less common angle-of-attack indicator gives a better warning of a stalling condition. Engine and airframe manufacturers use airspeed to establish structural limitations, such as airframe never-exceed speeds, flap and gear operating speeds, and propeller harmonic vibration speeds and RPMs.

Airspeed information is also used for operational calculations such as determining groundspeed and is the controlling factor in optimum climb/descent efficiency for given conditions such as best rate, best angle, minimum controllable airspeed, and glide. In emergency situations, it can be an indicator of airplane attitude when engine power and propeller setting are held constant. In that condition an increasing airspeed indicates descent and a decreasing airspeed indicates a climb. Airspeed is a prime factor in establishing long-range cruise control, including fuel consumption, maximum range, and minimum time enroute.

The construction of the airspeed indicator is simple, as illustrated in Figure 2-1. The otherwise airtight instrument case has a static air pressure vent. A sealed diaphragm is inside the case; the bottom of it is permanently attached to the case while the top is free to move. The diaphragm receives ram-air pressure via the pitot tube and expands or contracts depending on the static pressure and ram pressure differential. The top of the diaphragm is connected by linkage to the indicator needle. The face of the instrument is typically calibrated in knots, though some smaller, older aircraft may display miles per hour, which often is used in advertising to make the airplane speed look better. (One knot means one nautical mile per hour; it is redundant to say "knots per hour." There are 6080.27 feet per nautical mile versus 5280 feet per statute mile; one knot equals 1.151553 statute miles.)

Not much goes wrong with an airspeed indicator, except physical damage to the system and icing. If the pitot tube is blocked by ice, bugs, or trapped water, the airspeed indicator functions like an altimeter. The ram air now trapped within the diaphragm becomes a fixed, static pressure. The static air continues to flow into the instrument case, but its density varies with the aircraft altitude. As the aircraft climbs, density decreases, causing the static air trapped in the pitot tube to expand the diaphragm and cause an indication of increasing airspeed. Similarly, a descent would cause the density of the air blocked in the pitot tube to increase, leading to an indication of an apparent decrease in airspeed.

A blocked pitot tube is a dangerous situation; picture a climbout in instrument conditions. Apparently your airspeed is a little fast, so you instinctively ease the nose up just a bit without watching for the results. You continue climbing and again notice your airspeed is a little bit fast, so you ease the nose up more. This time you get an unexpected stall. It is important to understand that when the pitot tube is blocked, the airspeed indicator no longer measures airspeed.

If the static port is blocked but the pitot tube remains clear, the airspeed indicator becomes an altimeter in reverse, showing an airspeed increase with decreasing altitude. When in areas of potential icing, airspeed corrections should be observed whenever a