dissipating requirements of the brakes. There will be a maximum design landing weight specified for each airplane and this limitation must be respected because of critical landing loads, arresting loads, or brake requirements. Of course, any airplane will have a limiting touchdown rate of descent specified with the maximum landing weight and the principal landing load limitations will be defined by the combination of gross weight and rate of descent at touchdown.

(2) The surface *winds* must be considered because of the large effect of a headwind or tailwind on the landing distance. In the case of the crosswind, the component of wind along the runway will be the effective headwind or tailwind velocity. Also, the crosswind component across the runway will define certain requirements of lateral control power. The airplane which exhibits large dihedral effect at high lift coefficients is quite sensitive to crosswind and a limiting crosswind component will be defined for the configuration.

(3) *Pressure altitude and temperature* will affect the landing distance because of the effect on the true airspeed for landing. Thus, pressure altitude and temperature must be considered to define the density altitude.

(4) The *runway condition* must be considered for its effect on landing distances. Runway slope of ordinary values will ordinarily favor selection of a runway for a favorable headwind at landing. The surface condition of the runway will determine braking effectiveness and ice or water on the runway may produce a considerable increase in the minimum landing distance.

Thus, preparation for the landing must include determination of the landing distance of the airplane and comparison with the runway length available. Use of the angle of attack indicator and the mirror landing system will assist the pilot in effecting touchdown at the desired location with the proper airspeed. Of course, the landing is not completed until the airplane is slowed to turn off the runway. Control of the airplane must be maintained after the touchdown and proper technique must be used to decelerate the airplane.

TYPICAL ERRORS. There are many undesirable consequences when basic principles and specific procedures are not followed during the approach and landing. Some of the typical errors involved in landing accidents are outlined in the following discussion.

The steep, low power approach leads to an *excessive rate of descent* and the possibility of a hard landing. This is particularly the case for the modern, low aspect ratio, swept wing airplane configuration which incurs very large induced drag at low speeds and does not have very conventional flare characteristics. For this type of airplane in a steep, low power approach, an increased angle of attack without a change of power setting may not cause a reduction of rate of descent and may even increase the rate of descent at touchdown. For this reason, a moderate stabilized approach is necessary and the principal changes in rate of descent must be controlled by changes in power setting and principal changes in airspeed must be controlled by changes in angle of attack.

An *excessive angle of attack* during the approach and landing implies that the airplane is being operated at too low an airspeed. Of course, excessive angle of attack may cause the airplane to stall or spin and the low altitude may preclude recovery. Also, the low aspect ratio configuration at an excessively low airspeed will incur very high induced drag and will necessitate a high power setting or otherwise incur an excessive rate of descent. An additional problem is created by an excessive angle of attack for the airplane which exhibits a large dihedral effect at high lift coefficients. In this case, the airplane would be more sensitive to crosswinds and adequate lateral control may not be available to effect a safe landing at a critical value of crosswind.