



AEROBATICS consist of maneuvers requiring either abrupt attitude changes or attitudes exceeding more than 60 degrees of bank or 30 degrees of pitch. Such maneuvers can place heavy strain on a pilot or an aircraft, but these are not required to obtain a pilot certificate (license). Aerobatic maneuvers are performed only by those interested in developing these specialized skills.

Many aerobatic maneuvers are mild, such as the lazy eight. However, it is not easy to perform them well. Smooth coordination of constantly changing flight-control movements is required. Maneuvers such as the outside loop can tax aircraft and pilots to their structural and physiological limits. In extreme cases, pilots can encounter red-out (in which their eyes literally see red). This apparently is due to the lower eyelid acting as a red curtain over the eye, and it occurs when centrifugal forces cause excess blood to flow from the lower to the upper extremities.

A blackout can occur during a rapid pull-up from a steep, high-speed dive. The pilot is forced hard against the seat by a combination of gravity and centrifugal force, causing blood to leave the pilot's head. This can temporarily result in a partial (gray-out) or complete (blackout) loss of vision.



OTHER MANEUVERS—such as spins, loops, and rolls—are safe, fun, and pose no hardship to pilots and aircraft qualified to perform them. Sustained inverted flight is possible only in aircraft modified to provide fuel and oil to the engine when the aircraft is upside down. If an unmodified airplane is flown inverted for more than several seconds, fuel and oil starvation can cause engine failure.

