

In a simple, unbalanced, flap-type hinged aileron, the center of mass will be downward. This will result in the wing momentarily generating more lift, which will increase its upward bending moment and its velocity relative to the fuselage. The inertia of the wing will carry it upwards beyond its equilibrium position to a point where more energy is stored in the deformed structure than can be opposed by the aerodynamic forces acting on it.

The wing "bounces back" and starts to move downward but, as before, the aileron lags behind and is deflected upwards this time. This adds to the aerodynamic down force on the wing, once more driving it beyond its equilibrium position and the cycle repeats.

At low airspeeds, structural and aerodynamic damping quickly suppresses the motion but, as the airspeed increases, so do the aerodynamic driving forces generated by the aileron. When they are large enough to cancel the damping, the motion becomes continuous. Further small increases in airspeed will produce a divergent, or increasing, oscillation, which can quickly exceed the structural limits of the airframe. Even when flutter is on the verge of becoming catastrophic, it can still be very hard to detect. What makes this so is the high frequency of the oscillation which is typically between 5 and 35 HZ (cycles per second). It will take only a very small increase in speed to remove what little damping remains and the motion will become divergent rapidly.

Flutter testing of factory prototypes has resulted in establishing a true and indicated NEVER EXCEED SPEED (Vne) of 210 statute mph for the RV-3,4 and RV-6/6A, 230 statute mph for the RV-7/7A/8/8A, and 210 statute mph for the RV-9A. This speed was determined through flutter testing at a speed of 20 mph above Vne. (FAA certification criteria require flutter testing up to Vne plus 10% or about 20 mph) The flutter testing performed consisted of exciting the controls by sharply slapping the control stick at various speed increments up to this level. Under all conditions, the controls immediately returned to equilibrium with no indication of divergent oscillations indicative of flutter. This testing was performed on factory prototype aircraft, and the flutter free flight operation of subsequent amateur built RVs has substantiated published Vne.

The "slap-the-stick" method of exciting the controls for flutter testing is potentially dangerous and requires a very skilled pilot trained to recognize the subtle control responses which indicate the onset of flutter. For this reason, it is suggested that amateur builders do not perform flutter testing of their RVs. Rather, the airplane should be constructed in strict conformity to the plans with particular attention paid to the control system—trailing edge radii, skin stiffness, control linkage free-play, and static balance in particular. Maintaining conformity with the prototype (plans) will provide an adequate level of assurance against control surface flutter. Any design changes to the control surfaces, control system, or primary structure could invalidate the testing which has been done, and require that testing be re-accomplished.