



SKYDANCING

AEROBATIC FLIGHT TECHNIQUES



DAVID ROBSON

SKYDANCING—Aerobatic Flight Techniques
by David P. Robson

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Chapter 1

Terminology

Aerobatic flight has its own terminology which isn't quite universal. Let's introduce a few of the common terms.

General Terms

Departure (From Controlled Flight)

Any situation where the flight path deviates from the direction commanded by the pilot's control input or where the aircraft responds in a manner contrary to the normal, expected response to a particular control input.

Load Factor

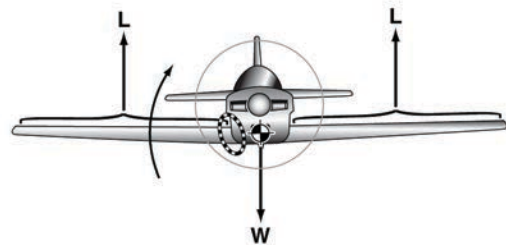
The total load or force on the aircraft caused as a result of both gravity and centrifugal reaction — measured in multiples of the force of gravity, or g . In scientific papers, load factor may be represented by the symbol "Gz."

Rolling g

The non-symmetrical load factor experienced by each wing, when simultaneously rolling and pitching, caused by the aileron deflection, in addition to the applied g .

Wing-Root Bending Moment

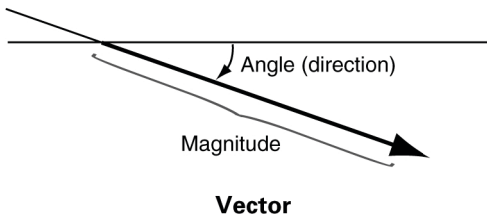
The total bending at the wing-root caused by the total lift force being generated by the particular wing. When pitching, both wing-roots experience the same bending moment. When the aircraft is also rolling, the wing-root bending moment is increased on the wing with the downward deflected aileron as the outboard section of this wing is generating more lift, the center-of-pressure is displaced further out from the wing-root and therefore causes a greater bending moment. This is why it is dangerous to simultaneously roll wings-level when pulling out of a spiral dive.



Wing Root Bending Moment

Vectors

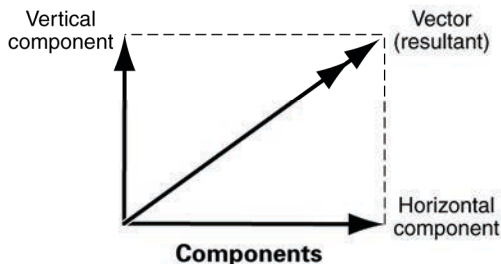
A vector shows the magnitude and direction of a force or path. Thus the flight path vector could be a climb at 100 kt or a 3° approach path at 80 kt. The lift vector is always at right angles to the flight path and the magnitude for our purposes is in multiples of the force gravity (*g*)—which is the same as multiples of weight.



Components

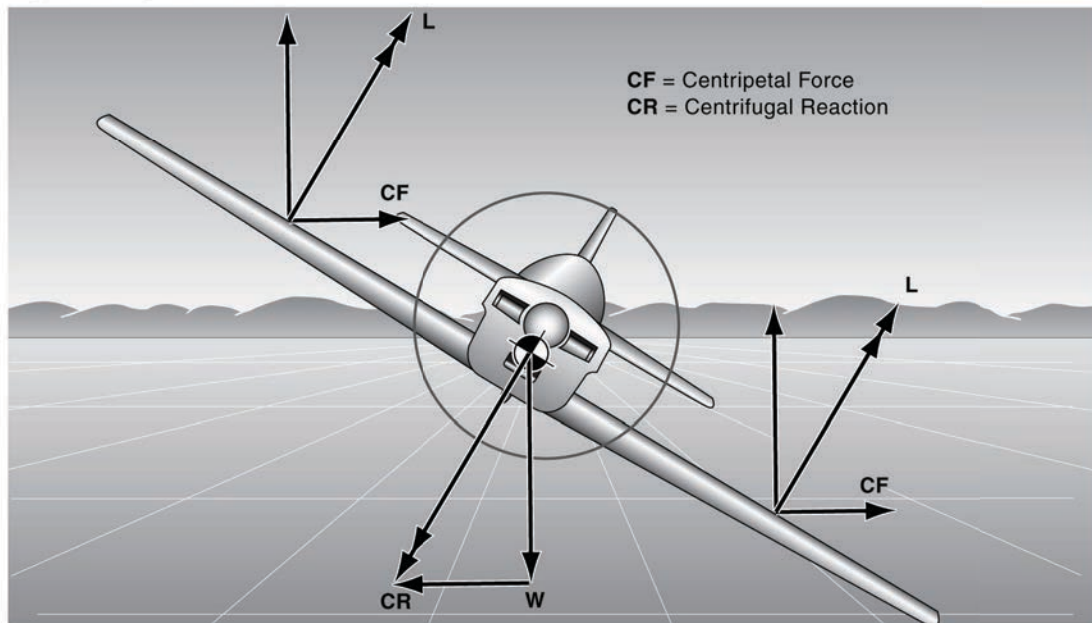
Every force can be resolved into components:

- either a horizontal and vertical component, or
- perhaps a component along the flight path and one at 90° to the flight path.



Resultant

Several forces can be combined into one resultant—thus for a turn, gravity and centrifugal reaction can be combined into a total force which must be overcome by the wings—and in a climb the forces of drag and the component of weight against the direction of the flight path have to be balanced by the thrust to sustain the climb path angle and speed (vector).



Centripetal Force

Centripetal force is the force that changes the flight path. The change is in the direction of the applied force. To turn, a force must be applied, towards the center of the turn. This force, supplied by excess lift from the wings, is called *centripetal* force.

Centrifugal Reaction

To every *action* there is an equal and opposite *reaction*. Thrust is the reaction to the propeller or jet engine pushing air rearward. Centrifugal reaction is the reaction to centripetal force. It causes the pilot to be pushed into the seat.

Airspeeds

- V_A** maneuvering speed—the speed above which full control deflection is to be avoided. This speed is generally a factored margin above stall speed to ensure that full control deflection will result in a stall before exceeding the structural limits of the airframe. Because it is a factor above stall speed and stall speed varies with gross weight then the value of V_A increases with increasing weight. For a normal category aircraft with a limit of +3.8 g then V_A is approximately double V_S. For an aerobatic aircraft V_A may be 2.5 to 3 times V_S.
- V_{NO}** maximum airspeed, normal operations—the maximum speed for normal flight operations. This speed should only be exceeded, with care, in smooth air.
- V_{NE}** maximum speed, never exceed—the maximum speed that is not to be exceeded under any circumstances.
- V_S** the power-off, stalling speed, clean (flaps and landing gear up).

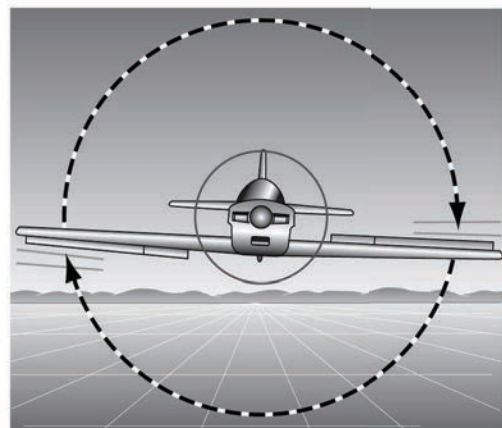
Simple Aerobatic Maneuvers

Rolls

There is no such thing as a simple roll. The following are the common types:

Aileron Roll

A roll nominally about the longitudinal axis of the aircraft, usually a fairly rapid roll and with a straight flight path. It is normal to raise the nose before beginning the roll so there is upward momentum to carry the aircraft through the roll without loss of altitude.



Aileron Roll



SKYDANCING

AEROBATIC FLIGHT TECHNIQUES

The book is designed to tempt you to explore the wonderful world of aerobatic flight. It shows the basic maneuvers in simple diagrams and the techniques for those maneuvers in simple explanations. It also provides an introduction to the effects of the forces of maneuvering flight on the aircraft structure and on the pilot's body.

Aerobatics represent the most satisfying form of visual flight and can be both challenging and rewarding. The scope is unlimited.

The important proviso is that you learn the basics thoroughly and from someone who enjoys and knows aerobatics. Choose the training aircraft and school carefully and try to fly regularly.

Even if you never intend to develop your aerobatic repertoire, the basic aerobatic training will serve you well in all other aspects of your flying – whether for private pleasure or professional career. Someday your basic aerobatic training will come in handy.

Enjoy.

