Encyclopedia of Technical Aviation

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Abbreviations

AAL	Above aerodrome level
ABC	Auto boost control
AC	Alternating current
ACARS	Aircraft communications and reporting system
ACAS	Airborne collision avoidance system
ADC	Air data computer
ADF	Automatic direction finder
ADI	Attitude director indicator/instrument
ADS-B	Automated dependent surveillance—broadcast
AGC	Automatic gain control
AGL	Above ground level
AH	Artificial horizon; alert height
AIC	Aeronautical information circular
ALT	Altimeter
A(M)SL	Above (mean) sea level
A of A	Angle of attack
AP	Autopilot
APFDS	Autopilot flight director system
APS	Aircraft prepared for service
APU	Auxiliary power unit
ASDA(R)	Accelerate stop distance available (required)
ASI(R)	Airspeed indicator (reading)
AT	Auto thrust/throttle
ATC	Air traffic control
ATM	Aerodynamic turning moment; air traffic management
BDC	Bottom dead center
BEA	British European Airways
BFO	Beat frequency oscillator
BHP	Brake horsepower
C	Celsius
CAA	Civil Aviation Authority
CAS	Calibrated airspeed

CAT	Clear air turbulence
CB	Cumulonimbus cloud; circuit breaker
CDI	Course deviation indicator
CDU	Control display unit
CFIT	Controlled flight into terrain
CI	Cost index
CL	Coefficient of lift
CMD	Command
CN	Compass north
C of A	Certificate of airworthiness
c of g/cg	Center of gravity
c of p/cp	Center of pressure
CP	Critical point
CRT	Cathode-ray tube
CSD(U)	Constant-speed drive (unit)
CSU	Constant-speed unit
CTM	Centrifugal turning moment
CU	Cumulus cloud
CWS	Control wheel steering
DALR	Dry adiabatic lapse rate
DC	Direct current
DH(A)	Decision height (altitude)
DI	Directional indicator
DME	Distance-measuring equipment
EADI	Electronic attitude director indicator/instrument
EAS	Equivalent airspeed
EAT	Expected approach time
ED(R)	Emergency distance (required)
EFIS	Electronic flight instrument system
EGPWS	Electronic ground proximity warning system
EGT	Exhausted gas temperature
EHSI	Electronic horizontal situation indicator/instrument
ELR	Environmental lapse rate
EMDA(R)	Emergency distance available (required)
emf	Electromotive force
EPR	Engine pressure ratio
ETOPS	Extended twin operations
FAA	Federal Aviation Administration
FADEC	Full-authority digital engine control
FAF	Final approach fix
FANS	Future air navigation system
FCC	Flight control computer
FCU	Fuel control unit; flight control unit
FD(S)	Flight director (system)
FIR	Flight information region

FL	Flight level
FMC(S)	Flight management computer (system)
FMS	Flight management system
fpm	Feet per minute
g	Gram
GLONASS	Global orbiting navigation satellite system
GLS	Global landing system
GPS	Global positioning system
GPWS	Ground proximity warning system
GS	Glide slope
HF	High frequency
hPa	Hectopascal
HSI	Horizontal situation indicator/instrument
HUD	Head-up display
HUGS	Head-up guidance system
HWC	Headwind component
IAF	Initial approach fix
IAS	Indicated airspeed
ICAO	International Civil Aviation Organization
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
INS	Inertia navigation system
IRS	Inertia reference system
ISA	International standard atmosphere
ITCZ	Intertropical convergence zone
IVSI	Inertia/instantaneous vertical speed indicator/instrument
L	Light
LDA(R)	Landing distance available (required)
(M)LW	(Maximum) landing weight
LF	Low frequency
LNAV	Lateral navigation
LOC	Localizer
LRC	Long-range cruise
LSS	Local speed of sound
μm	Micron
MABH	Minimum approach break-off height
MAC	Mean aerodynamic chord
MAP	Manifold absolute pressure; missed approach point
mbar	Millibar
MCP	Mode control panel
M_{Crit}	Critical Mach number
MDH(A)	Minimum decision height (altitude)
MEA	Minimum en route altitude
MEL	Minimum equipment list

MLS	Microwave landing system
MM	Mach meter
MN	Mach number; magnetic north
MRC	Maximum range cruise
MSA	Minimum sector altitude
MSL	Mean sea level
MSU	Mode selector unit
NAV	Navigation
NDB	Nondirectional beacon
Notams	Notices to airmen
NTOFP	Net takeoff flight path
OAT	Outside air temperature
OBI	Omni bearing instrument
OCH(T)	Obstacle clearance height (time)
PAPI	Precision-approach path light
PAR	Precision-approach radar
PNR	Point of no return
psi	Pounds per square inch
ρ	Density
RAS	Rectified airspeed
RAT	Ram air turbine
RBI	Relative bearing indicator/instrument
RMI	Radio magnetic indicator/instrument
RNAV	Area navigation
ROC	Rate of climb
ROD	Rate of descent
rpm	Revolutions per minute
RTO	Rejected takeoff
RVR	Runway visual range
RW	Ramp weight
s	Second
S	Span
s/kn	Seconds per knot
SALR	Saturated adiabatic lapse rate
SAT	Static air temperature
SFC	Specific fuel consumption
SG	Symbol generator; specific gravity
SIDs	Standard instrument departures
SL	Sea level
SRA	Secondary radar approach
SSA	Sector safe altitude
SSR	Secondary surveillance radar
STARs	Standard arrivals
SVFR	Special visual flight rules
SWD	Supercooled water droplet

TAF	Terminal aerodrome forecast
TAS	True airspeed
TAT	Total air temperature
TCAS	Traffic collision and avoidance system
TDC	Top dead center
TGT	Total gas temperature
TN	True north
TOD(A/R)	Takeoff distance (available/required)
TOGA	Takeoff go-around
TOR(A/R)	Takeoff run (available/required)
(M)TOW	(Maximum) takeoff weight
TRU	Transformer rectifier unit
TWC	Tailwind component
UHF	Ultrahigh frequency
V	Velocity
V_1	Decision speed
V_2	Takeoff safety speed
V_a	Maneuver speed
V_{app}	Approach speed
VASI/L	Visual approach slope indicator/lights
VAT	Velocity at the threshold
VDF	VHF directional finding
VFR	Visual flight rules
VHF	Very high frequency
VIMD	Minimum drag speed
VIMP	Minimum power speed
VLF	Very low frequency
VMBE	Maximum brake energy speed
VMC	Visual meteorological conditions
VMC(G/A)	Minimum control speed (on the ground/in the air)
V/MDF	Velocity/Mach demonstrated flight diving speed
V/MMO	Velocity/Mach maximum operating speed
V(M)RA	Rough airspeed
VMU	Minimum demonstrated unstick speed
VNAV	Vertical navigation
VNE	Never-exceed speed
VNO	Normal operating speed
VOR	VHF omni range
V_R	Rotation speed
V_{REF}	Reference speed (for approach)
V_S	Stall speed; vertical speed
V_{S0}	Full-flap stall speed
V_{S1}	Clean stall speed
WAT	Weight, altitude, and temperature
WED	Water equivalent depth
(M)ZFW	(Maximum) zero fuel weight

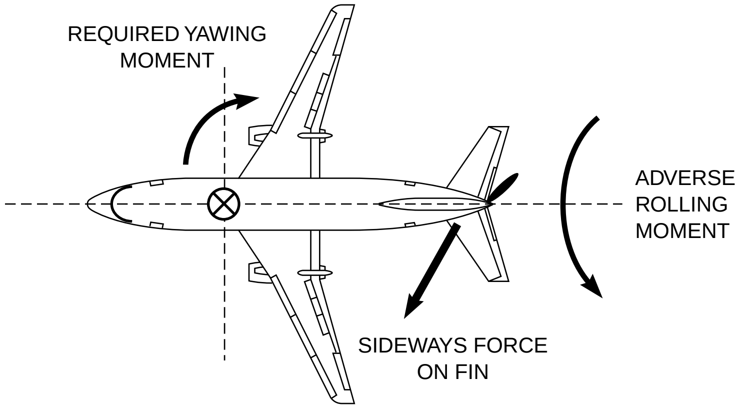

Figure 1 Adverse rolling motion with yaw.

greater than that on the upgoing aileron. This imbalance in drag causes the yawing motion around the normal/vertical axis. As this yaw is *adverse* (i.e., in a banked turn to the right the yaw is to the left), it is opposing the turn, which is detrimental to the aircraft's performance.

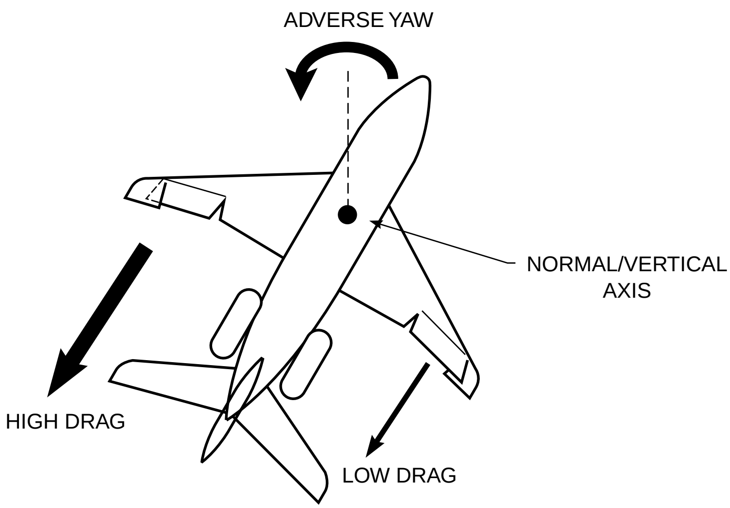

Figure 2 Aileron drag adverse yaw.

Adverse (aileron) yaw is corrected in the design by the use of one of these:

1. *Differential ailerons.* The upgoing differential aileron moves through a greater angle than the downgoing aileron, which balances the aileron drag between both sides. This method is usually found on high-speed aircraft.
2. *Frise ailerons.* The upgoing frise aileron has its "nose" protruding below the underside of the wing, creating a higher value of drag. The downgoing aileron's

drag value remains unchanged; thereby the drag between the two sides is balanced. This method is usually found on older, slower aircraft types. It is not suitable for high-speed aircraft because the protruding nose would cause unacceptable levels of high-speed buffet.

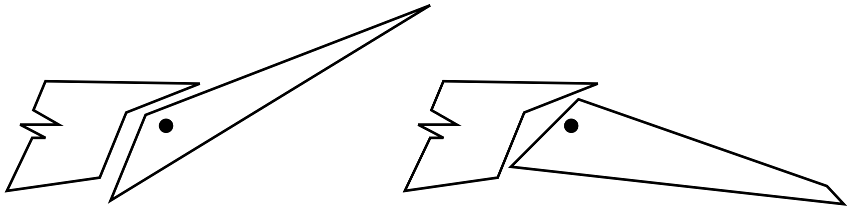

Figure 3 Frise aileron.

Aerodynamic Dampening Natural aerodynamic damping is reduced at high altitudes. The restoring force applied to a body which has been displaced from its neutral position can set an oscillation, e.g., an oscillating yawing aircraft. Here the fin (vertical tailplane), which acts toward the neutral position and is proportional to the displacement from the neutral position, provides the restoring force. The air loads opposing the oscillation motion, which the restoring force caused, provide the aerodynamic damping. Thereby the restoring force, which causes the oscillation, and the damping centering force, which opposes the oscillation once it exists, both come from the aerodynamic forces on the fin. The fin area and how it generates these aerodynamic forces, especially their magnitude, are very important in this equation.

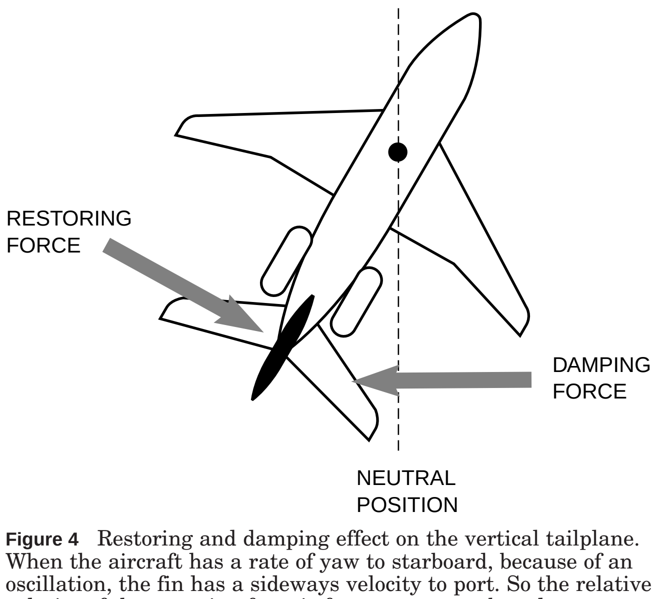

Figure 4 Restoring and damping effect on the vertical tailplane. When the aircraft has a rate of yaw to starboard, because of an oscillation, the fin has a sideways velocity to port. So the relative velocity of the restoring force is from port to starboard.

Now let us examine the effects of altitude. The frequency of the oscillation for a given indicated airspeed (IAS) (and therefore a constant dynamic pressure) is independent of altitude. So for a given amplitude of disturbance the fin will always have the same sideways velocity when passing through the neutral point at both low and high altitudes. However, the sideways velocity is compounded with the aircraft's forward velocity to give the fin its resultant angle of incidence and hence the magnitude of the sideways damping force opposing the direction of the oscillation motion. The higher the altitude, the greater the forward true airspeed (because dynamic pressure is constant); therefore, the smaller the resultant fin angle of incidence, and so the smaller the natural aerodynamic damping effect.

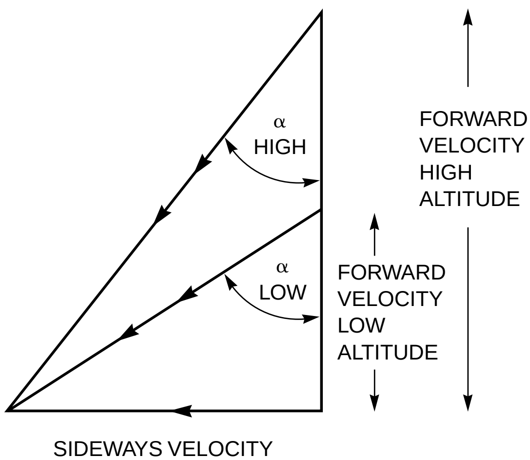

Figure 5 Fin angle of incidence at a constant IAS with altitude.

Aerodynamic Turning Moment (ATM) This is a force that tends to turn the blades to a coarse pitch.

Aerofoil An aerofoil is a body that gives a large lift force compared to its drag when set at a small angle to a moving airstream. Examples include aircraft wings, tailplanes, rudders, and propellers.

Afterburner An afterburner was introduced because it was realized that the compressor was working so efficiently that some compressed air was passing through the engine unburned. Therefore an afterburner was designed to utilize this compressed air as a pure resultant jet thrust.

The afterburner is situated in the exhaust nozzle, after any turbine section, and consists of

1. Igniter(s)
2. Fuel line/jets

Fuel is delivered via the line/jet to mix with the compressed unburned air, and the igniter provides an electric spark to ignite the mixture, thereby producing a jet *afterburn*. This is a pure jet afterburn that gives an instant increase in thrust, albeit rather uncontrolled, except for the on and off choices. An afterburner is usually found on military jets and in only a few airliners, such as the Concorde.

Agonic Line The agonic line is a line joining points of zero variation, i.e., where the true and magnetic headings are the same.

AICs (Aeronautical Information Circulars) Aeronautical information circulars are published monthly and concern administrative matters and advance warnings of operational changes, and they draw attention to and advise on matters of operational importance, such as the availability of aeronautical charts, correction of these charts, and amendments of the chart of airspace restrictions.

- AICs directly associated with air safety are printed on pink paper.
- Administrative AICs are on white paper.
- Operational and air traffic services AICs are on yellow paper.
- Restriction chart AICs are on mauve paper.
- Map/chart AICs are on green paper.

Aileron(s) These are control surfaces located at the trailing edge of the wing that control the aircraft's motion around its longitudinal axis, known as roll. They are controlled by the left and right movement of the control column, which commands the ailerons in the following manner: Moving the control column to the left commands the left aileron to be raised, which reduces the lift on the wing, and the right aileron is lowered, which increases the lift generated by this wing. Thus the aircraft rolls into a banked condition, which causes a horizontal lift force (centripetal force), which turns the aircraft. The ailerons are normally (hydraulically) powered on heavy/fast aircraft because of the heavy operating forces experienced at high speeds.

Aileron Reversal This occurs at high speeds when the air loads/forces are large enough that they cause an increase in lift. But because most of this lift is centered on the downgoing aileron at the rear of the wing, a nose-down twisting moment will be caused. This will cause a decrease in the incidence of the wing to the extent that the loss of lift due to the twisting cancels the lift gained from the aileron. At this point the aileron causes no rolling moment; and if the wing twisting is exaggerated (which a downgoing aileron can do), the rolling motion around the longitudinal axis can be reversed. Hence it is an adverse rolling motion.

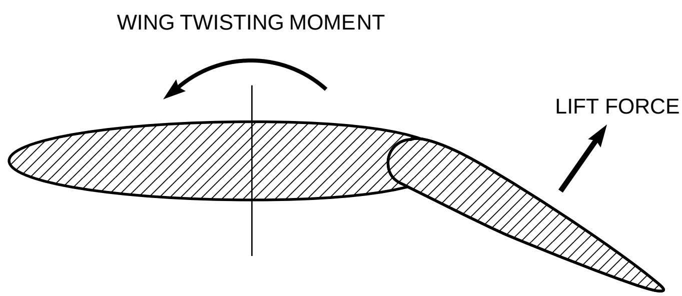

Figure 6 Aileron reversal—wing twisting moment.

Aircraft Weight Categories *See* Weight—Aircraft Categories.

Air Data Computer (ADC) Modern aircraft feed their static and pitot lines into an air data computer which calculates the calibrated airspeed/rectified airspeed (CAS/RAS), true airspeed (TAS), Mach number (MN), total air temperature (TAT), rate of climb (ROC), and rate of descent (ROD) and then passes the relevant information electronically to the servo-driven flight instruments, but not to the standby instruments, which retain their own direct static/pitot feeds.

The advantage of the ADC system is that the data calculated could be fed to the following:

1. Autopilot (AP)
2. Flight director system (FDS)
3. Flight management system (FMS)
4. Ground proximity warning system (GPWS)
5. Navigation aids
6. Instrument comparison systems

Airfields—Beacon Aeronautical light beacons are installed at various civil and military airfields in some countries. Their hours of operation vary, but generally they are on at night and by day in bad visibility whenever the airfield is in operation.

The *identification beacon* flashes a two-letter Morse identifier for the aerodrome.

NB: Usually it is green at civil aerodromes and red at military aerodromes.

They allow a visual identification, as well as a bearing to the aerodrome.

The *aerodrome beacon* flashes an alternating signal as a homing signal to the aerodrome.

NB: Usually it is white/white, or less commonly white/green.

They are not normally provided in addition to an identification beacon.

Air Law When flying over or even landing at a foreign state, you must obey the law of that country. Therefore your aircraft is not to be used for a purpose that is prejudicial to the security, public order, health, or safety of air navigation in relation to that country. However, whenever your own country's (i.e., the country of the aircraft's registration) legislation (on any particular issue) is more limiting, then this should take precedence and should be adhered to.

Air Law—Aerodrome Right-of-Way The right-of-way on the ground is as follows:

1. Regardless of air traffic control (ATC) clearance, it is the duty of the aircraft commander to do all that is possible to avoid a collision with other aircraft or vehicles on the ground.
2. Aircraft on the ground must give way to those taking off or landing, and to any vehicle towing an aircraft.
3. When two aircraft are approaching head-on, each must turn right to avoid the other.
4. When two aircraft are converging, the one that has the other on its right must give way—either by stopping or by turning to pass behind the other. Avoid crossing in front of the other unless passing is clear.
5. An aircraft that is being overtaken by another has the right-of-way, and the overtaking aircraft must keep out of the way by turning left until past and well clear.