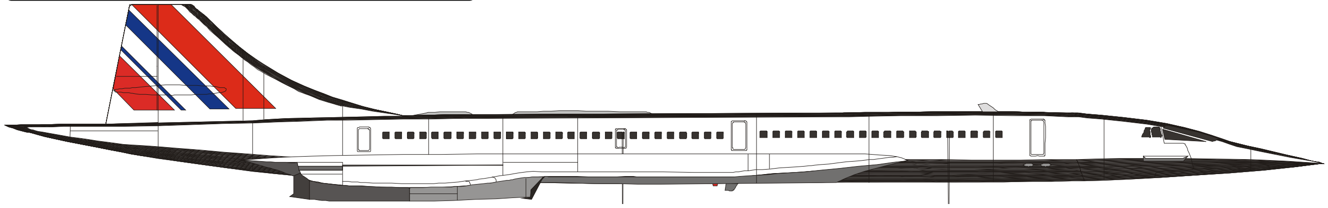


## SPEED LIMITS: (91.117, 97.3, AIM 3-2-4c.5., 3-2-5b.5., 4-2-11, **4-4-12**, **5-3-7**, **5-4-7**, **5-5-9**, AC 90-66A, Controller's Handbook 7110.65, FAA-H-8083-3A, FAA-H-8083-15A, FAA-H-8083-25A, FAA-H-8261-1A)

- Below 10,000 ft........................................................ 250 KIAS
- Class B ..................................................................... 250 KIAS below 10,000 ft (unrestricted at or above 10,000)
- Beneath Class B....................................................... 200 KIAS (or in VFR corridor through a Class B)
- Procedure Turn........................................................ 200 KIAS
- Class C or D (below 2,500 AGL within 4NM of the airport).... 200 (unless a higher speed is ***specifically*** approved by ATC)
- Class E or G Airport Traffic Pattern.......................... 200 KIAS (recommended)

91.117(d) — If the minimum safe airspeed for any particular operation is greater than the maximum speed prescribed in this section, the aircraft may be operated at that minimum speed. NOTE: There is no requirement to advise ATC when exceeding a speed for this reason.

## SPEED RESTRICTION / ADJUSTMENT: (AIM 4-4-12)

1. If a controller issues a **speed restriction** while vectoring you, it **continues to apply with** an **altitude change**.
2. An **approach clearance cancels** any **previously assigned speed** adjustment (however the controller would not anticipate a large speed *INCREASE* when close to the runway). Pilots are expected to make their own speed adjustments to complete the approach unless the adjustments are restated. Speed **adjustments should not be assigned inside** the **final approach fix** on final or a point 5 miles from the runway, whichever is closer to the runway.
3. It is the **pilot's** responsibility and **prerogative**, **to refuse** a **speed adjustment** that he or she considers **excessive** or contrary to the aircraft's operating limitations with a comfortable margin for safety.

## SPEED BELOW 10,000 and/or in CLASS B: (91.117, 91.1, 91.703)

1. **Speed** — **250 KIAS** below **10,000** feet (or 200 KIAS below the floor or in VFR corridor). **250 KNOTS MUST *NOT* be EXCEEDED even if** you are told to **"MAINTAIN BEST FORWARD SPEED."**
2. "Maintain maximum (or best) forward speed" — means — "maximum or best forward ***'LEGAL'*** speed." ATC does not have the authority to lift the 250 below 10,000 speed restriction [91.117(a)]. You cannot be cleared to violate a regulation, and you cannot accept such a clearance.
3. At **10,000 feet and above**, **in Class B** airspace, you can go as **fast as you want unless issued a speed restriction** by ATC.
4. If a controller assigns you 300 kts or greater inbound (10,000 or above), and then later descends you to 8,000, it is ***UNDERSTOOD*** that you must **SLOW** to **250 kts *BEFORE* descending below 10,000**.
5. NOTE: There ***was*** a test program that took place at **HOUSTON** International (IAH) to **delete** the **250 kts below 10,000** for ***DEPARTURES* only**, ***AND*** only **if authorized by ATC**. The phraseology was **"NO SPEED LIMIT"** or **"INCREASE SPEED TO** (number) **KNOTS"** or **"DELETE the 250 kt RESTRICTION"** or **"CLIMB UNRESTRICTED"** or **"HIGH SPEED CLIMB APPROVED"**. This program was cancelled in January of 2004. Currently an air traffic controller does not have the authority to authorize a speed above 250 kts below 10,000 *anywhere* in the United States.
6. The speed restriction: **250 kts below 10,000 does *NOT* apply** to aircraft operating **beyond 12 NM from** the **coastline** of the United States. (91.1, 91.117, 91.703, AIM 4-4-12)

## SPEED in CLASS C, D, E and G Airport Areas: (91.117, AC 90-66A, FAA-H-8083-3A, FAA-H-8083-15A)

1. Unless otherwise authorized or required by ATC, no aircraft may operate at or below **2,500 AGL** within **4 NM** of the primary airport of a **Class C** or **Class D** at an indicated airspeed of more than **200 knots**.
2. "…maintain best forward speed" is *NOT* an authorization to exceed the 200 kts in Class C or D.
3. Any **speed** deviation **above 200 kts** must be ***specifically*** assigned by ATC (e.g. "…maintain 220 kts").
4. It is ***"RECOMMENDED"*** that while operating in the **traffic pattern** at an airport ***WITHOUT*** an **operating control tower** the pilot maintain an airspeed of no more than **200 knots**. In any case, the speed should be adjusted, when practicable, so that it is compatible with the speed of other airplanes in the pattern.

Never let an airplane take you someplace your brain didn't get to five minutes earlier.

# V SPEEDS — V means VELOCITY

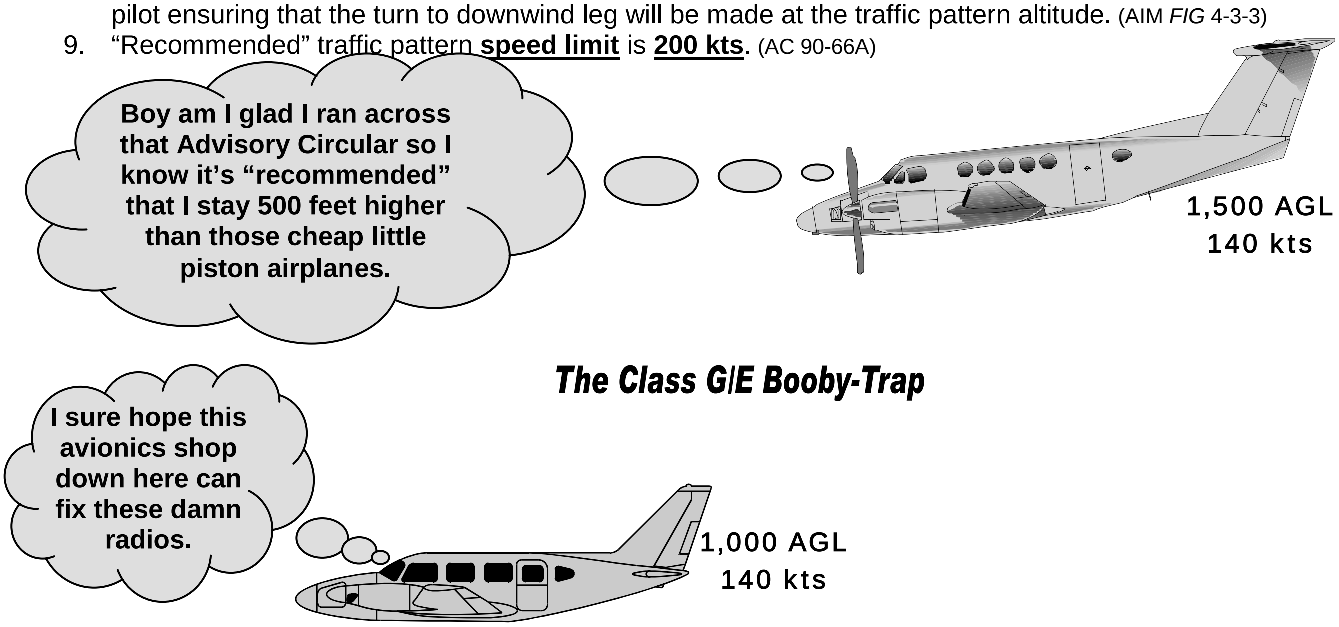
| | |
|---|---|
| $V_1$ | Takeoff **decision speed** for jets, turboprops or Transport category aircraft — Engine failure **BELOW $V_1$** — **takeoff must be aborted** and the aircraft brought to a stop on the runway. Engine failure at or **ABOVE $V_1$** — mandates the pilot **continue the takeoff** — accelerate to **$V_R$** — and after rotation accelerate to **$V_2$**. Does not apply to most light, prop-driven twins because they cannot continue a takeoff roll and accelerate on one engine; there is no choice but to abort. |
| $V_2$ | Takeoff safety speed for jets, turboprops or Transport category aircraft — Best climb gradient speed i.e., best altitude increase per mile with the most critical engine inop — twin engine aircraft with an engine inop are guaranteed a **2.4% climb gradient** (**24 ft UP** per **1,000 ft FORWARD**) — min speed to be maintained to at least 400 ft AGL. |
| $V_{2MIN}$ | Minimum takeoff safety speed. Usually 1.2 times stall speed in takeoff configuration. |
| $V_A$ | Design m**A**neuvering speed — The highest safe airspeed for abrupt control deflection or for operation in turbulence or severe gusts. If only one speed is published it is usually determined at max landing weight. This speed **decreases as weight decreases**. Formula for determining $V_A$ at less than max landing weight: $V_{A2} = V_A \times \sqrt{\text{current weight} \div \text{max lndg weight}}$ |
| $V_{ABE}$ | Maximum speed for **A**ir-**B**rake **E**xtension. |
| $V_{ABO}$ | Maximum speed for **A**ir-**B**rake **O**peration. |
| $V_{AC}$ | Missed **A**pproach **C**limb speed for flap configuration with critical engine inop (2.1% climb gradient). |
| $V_{AP}$ | **AP**proach target speed. **$V_{REF}$** + configuration (flaps/slats setting) & wind factor. Typically — **add** (to $V_{REF}$) **½ the headwind** component + **all the gust** factor (to a **max** of **20 knots**) |
| $V_B$ | Design speed for maximum gust intensity for **Transport-category** aircraft or other aircraft certified under **Part 25**. **Turbulent-air-penetration speed** that protects the structure in **66-fps gusts**. |
| $V_C$ | Design **C**ruising speed. Speed the aircraft was *designed* to cruise at. The completed aircraft may *actually* cruise slower or faster than **$V_C$**. It is the highest speed at which the structure must withstand the FAA's hypothetical "standard **50-fps gust**". |
| $V_D$ | Design **D**iving speed — The aircraft is designed to be capable of diving to this speed (in *very* smooth air) and be free of flutter, control reversal and buffeting. Control surfaces have a natural vibration frequency where they begin to "flutter" like a flag in a stiff breeze. If flutter begins, it can become catastrophic in a matter of seconds. It can worsen until the aircraft is destroyed even if airspeed is reduced as soon as flutter begins. |
| $V_{DEC}$ | Accelerate/Stop **DEC**ision speed for multiengine piston and light multiengine turboprops. |
| $V_{DF}$ / $M_{DF}$ | Demonstrated-**F**light **D**iving speed — $V_{DF}$ is in knots. $M_{DF}$ is in a percentage of Mach number. Some aircraft are incapable of reaching **$V_D$** because of lack of power or excess drag. When this is the case, the test pilot dives to the maximum speed possible — the demonstrated-flight diving speed. |
| $V_{EF}$ | Speed at which the critical engine is assumed to fail during takeoff (used in certification tests). |
| $V_{ENR}$ | **ENR**oute climb speed with critical engine inop—accelerate to **$V_{ENR}$** above 1,500 AGL. |
| $V_F$ | Design **F**lap speed — During the design phase, the flaps are designed to be operated at this maximum speed. If the engineers did a good job, the actual flap speed—**$V_{FE}$**—will be the same. |
| $V_{FC}$ / $M_{FC}$ | Maximum speed for undesirable **F**light **C**haracteristics — must be regarded with the same respect as **$V_{NE}$** — Red line. Instability could develop beyond the pilot's ability to recover. **$V_{FC}$** is expressed in **knots**; **$M_{FC}$** is expressed in a percentage of **Mach** number. |
| $V_{FE}$ | Maximum **F**lap-**E**xtended speed—Top of white arc — Highest speed permissible with wing flaps in a prescribed extended position. Many aircraft allow the use of approach flaps at speeds higher than $V_{FE}$. Positive load for Normal category airplanes is usually reduced from +3.8Gs to +2.0Gs with the flaps down, and negative load is reduced from –1.52Gs to Zero. The purpose of flaps during landing is to enable steeper approaches without increasing the airspeed. |
| $V_{FR}$ | **F**lap **R**etract speed — minimum speed required for flap retraction after takeoff. |
| $V_{FS}$ | **F**inal **S**egment speed (jet takeoff) with critical engine inop. Accelerate to **$V_{FS}$** at 400 feet AGL. |
| $V_{FTO}$ | **F**inal **T**ake**O**ff speed — end of the takeoff path — en route configuration — one engine inoperative. |
| $V_H$ | **Max**imum **speed** in **level flight** with **max**imum continuous **power**. Mainly used for aircraft advertising. Ultralights are limited by Part 103 to a **$V_H$** of 55 knots. |
| $V_{LE}$ | Maximum **L**anding gear **E**xtended speed — **Max**imum **speed** at which an airplane can be safely flown with the landing **gear extended**. In an **EMERGENCY**, **FORGET ABOUT THIS SPEED**, **THROW THE GEAR OUT!** |
| $V_{LLE}$ | Maximum **L**anding **L**ight **E**xtended speed. |
| $V_{LLO}$ | Maximum **L**anding **L**ight **O**perating speed. |
| $V_{LO}$ | Maximum **L**anding gear **O**perating speed — **Max**imum **speed** at which the landing **gear** can be safely **extended or retracted**. Usually limited by air loads on the wheel-well doors. On some aircraft the doors close after extension, allowing acceleration to **$V_{LE}$** — Max gear extended speed. In an **EMERGENCY** — when the ground is getting close and the airspeed is approaching redline — **FORGET ABOUT THIS SPEED**, **THROW THE GEAR OUT!** |

| | |
|---|---|
| VLOF | **L**ift-**OF**f speed. Speed at which the aircraft becomes airborne. Back-pressure is applied at **VR** (rotate)—a somewhat lower speed—so that lift-off actually happens at $V_{LOF}$. |
| VMCA or VMC | More commonly known as VMC (although VMCA is more correct)— **M**inimum **C**ontrol speed with critical engine (usually the left) inoperative out of ground effect in the **A**ir — **"RED line"** — **Most critical engine inop & windmilling**; **5º bank** towards operative engine; **take-off power** on operative engine; **gear up**; **flaps up**; and **most rearward C.G.** In this configuration, if airspeed is allowed below **VMC**, even full rudder cannot prevent a yaw toward the dead engine. At slower speeds, the slower moving wing—the one with the failed engine—will stall first. **VMC** is ***NOT*** a constant, it **can be reduced by** — **feathering** the prop, moving **C.G. forward**, and **reducing power**. |
| VMCG | **M**inimum speed necessary to maintain directional **C**ontrol following an engine failure during the takeoff roll while still on the **G**round — determined using purely aerodynamic controls with no reliance on nosewheel steering — jets, turboprops or transport category aircraft. |
| VMO / MMO | **M**aximum **O**perating limit speed — turboprop or jet — VMO is indicated airspeed measured in **knots** and is mainly a structural limitation that is the effective **speed limit** at **LOWER altitudes**. MMO is a percentage of **Mach** limited by the change to the aircraft's handling characteristics as localized airflow over the aircraft approaches the speed of sound creating shock waves that can alter controllability. As altitude increases, indicated airspeed decreases while Mach remains constant. MMO is the effective **speed limit** (**"barber pole"** on the airspeed indicator) at **HIGHER altitudes**. MMO Is usually much higher for swept winged jets than a straight wing design. |
| VMU | **M**inimum **U**nstick speed. **Slowest speed** at which an **aircraft can become airborne**. Originated as a result of testing for the world's first jet transport, the de Havilland "Comet". During an ill-fated takeoff attempt, the nose was raised so high and prematurely that the resultant drag prevented further acceleration and liftoff. Tests were then established to ensure that future heavy transports could safely takeoff with the tail touching the ground and maintain this attitude until out of ground effect. |
| VNE | **N**ever **E**xceed speed — **"RED line"** — Applies only to piston-powered airplanes. This speed is never any more than 90% of $V_{DF}$. G loads imposed by ***ANY* turbulence** can easily **overstress** an aircraft at this speed. |
| VNO | **NO** go there. Maximum structural cruising speed — Beginning of the yellow arc—or caution range. Theoretically a brand new aircraft can withstand the FAA's 50-fps gust at this speed. Unfortunately the pilot has no way of measuring gust intensity. |
| VR | **R**otation speed. Recommended speed to start applying **back-pressure on the yoke**, rotating the nose so that ideally the aircraft lifts off the ground at $V_{LOF}$. |
| VREF | Calculated **REF**erence speed for final approach—**final approach speed**. Usually **1.3 times VSO** or higher. **SMALL PLANE** — **bottom** of **white arc +30%**. **JETS** — calculated from landing performance charts that consider **weight**, **temperature** and field **elevation**. To this speed jets typically calculate an approach speed (**$V_{AP}$**) by **adding** (to $V_{REF}$) **½** the **headwind** component + **all** the **gust** factor (to a **max** of **20 knots**). |
| VS | **S**tall speed or minimum steady flight speed at which the airplane is controllable. **VS** is a generic term and usually does not correspond to a specific airspeed. |
| VS1 | **S**tall speed or minimum steady flight speed in a **specific configuration**. Normally regarded as the "clean"—gear and flaps up—stall speed. Lower limit of the green arc (remember **S**tuff **I**n). However this is not always the case. It could represent stall speed with flaps in takeoff position or any number of different configurations. So $V_{S1}$ is a clean stall, but the definition of "clean" could vary. |
| VSO | **S**tall speed in **landing configuration** — Lower limit of white arc — Stalling speed or the minimum steady flight speed at which the airplane is controllable in landing configuration: engines at **idle**, props in **low pitch**, usually **full wing flaps**, **cowl flaps closed**, **C.G.** at maximum **forward limit** (i.e. most unfavorable CG), **max gross landing weight**. Maximum allowable $V_{SO}$ for single-engine aircraft and many light twins is 61 knots (remember **S**tuff **O**ut). |
| VSSE | Minimum **S**afe **S**ingle **E**ngine speed (multi) — Provides a reasonable margin against an unintentional stall when making intentional engine cuts during training. |
| VTOSS | Takeoff safety speed for Category A rotorcraft. |
| VWWO | Maximum **W**indshield **W**iper **O**perating speed. |
| VX | Best **angle** of climb speed — Delivers the greatest gain of altitude in the shortest possible horizontal distance. The speed given in the flight manual is good only at sea level, at max gross weight, and flaps in takeoff position. $V_X$ increases with altitude (about ½ knot per 1,000 feet), and usually decreases with a reduction of weight. It will take more time to gain altitude at $V_X$ because of the slower speed, but the goal is to gain the most altitude in the shortest horizontal distance — like **before you hit those *TREES*** that they always seem to put at the end of most every runway! |
| VXSE | Best **S**ingle-**E**ngine **angle** of climb speed (multiengine 12,500 Lbs or less). |
| VY | Best **rate** of climb speed — delivers the greatest gain in altitude in the shortest possible time. Flaps and gear up. Decreases as weight is reduced and also decreases with altitude. Lift-to-drag ratio is usually at its maximum at this speed so it can also be used as a good ball-park figure for **best-glide speed** or **maximum-endurance speed** for holding. |
| VYSE | Best **S**ingle-**E**ngine **rate** of climb speed — **"BLUE line"** (multiengine 12,500 Lbs or less). |

# TRAFFIC PATTERN ALTITUDE at AIRPORTS WITHOUT an OPERATING CONTROL TOWER:

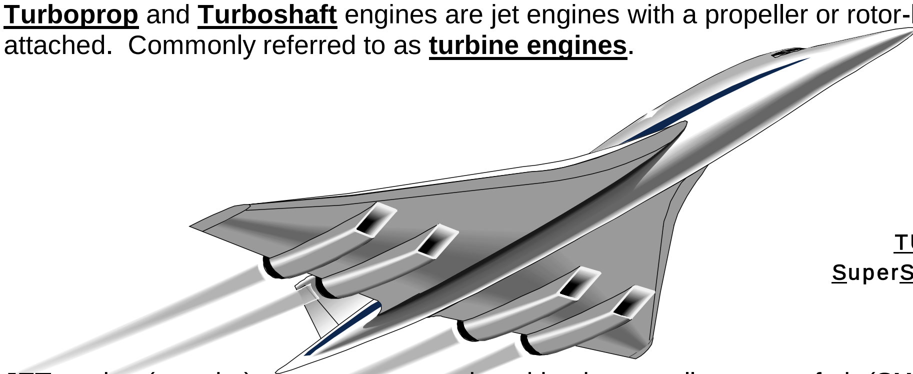
(91.126 thru 91.131, 91.155, AIM 4-1-9, 4-3-3, 4-3-4, 4-3-5, AC 90-66A, FAA H-8083-3A, 8083-15A 8083-25A)

1. At most airports and military air bases, traffic pattern altitudes for **propeller-driven aircraft** generally extend from **600 feet to as high as 1,500 feet AGL**. Also, traffic pattern altitudes for **military turbojet aircraft sometimes extend up to 2,500 feet AGL**. Therefore, pilots of en route aircraft should be constantly on the alert for other aircraft in traffic patterns and avoid these areas whenever possible. Traffic pattern altitudes should be maintained unless otherwise required by the applicable distance from cloud criteria (NOTE: there is different VFR distance from cloud criteria for Class G or Class E airspace).
2. **1,000 feet AGL** is the **recommended pattern altitude unless established otherwise…** (AIM 4-3-4 [1])
3. There is a ***"RECOMMENDATION"*** (in AC 90-66A) that **large and turbine powered** airplanes should enter the traffic pattern at **1,500 AGL** or 500 feet above the established pattern altitude. Apparently someone at the **FAA feels it's OK** for a **large aircraft to descend on top** of a **smaller aircraft** (very possibly moving at a similar speed) **during base to final**. **Wake turbulence** could also be a major concern if a VERY large aircraft is flying around 500 feet above everyone else.
4. Traffic pattern altitudes are occasionally listed in the **Airport/Facility Directory**, in which case the published altitudes would be somewhat regulatory. In some cases these airports actually have different altitudes for small and large or turbine-powered aircraft. In other cases there is only **one altitude** published, and that would be the altitude **for *ALL* aircraft** (unless you accept the recommendation of AC 90-66A and fly your large and **invincible turbine 500 feet above everybody else** — until you turn base to final — **then descend on top of** the other aircraft that was in the pattern below you the whole time flying at just about the same speed!).
5. Other **"unofficially published"** sources of traffic pattern altitude are the **"Flight Guide"** produced by Airguide Publications for VFR pilots; and the two different **"Airport Directories"** produced by Jeppesen and AOPA. These commercial publications list far more pattern altitudes than the A/FD, but very often **disagree as to what these altitudes actually are!**
6. The **majority of Class G or E airports do not have "*officially* published"** (in the A/FD) **pattern altitudes**. In which case you have your choice of the **1,000 AGL (for *ALL* aircraft)** as recommended by the AIM — and/or **1,500 AGL** for **large and turbine powered** as recommended by AC 90-66A — or personally calling the airport manager and asking if he has "established" a "recommended" altitude for "his" airport (an obviously imperfect system).
7. Large and turbojet aircraft are also governed by **91.515** which states those aircraft are required to maintain at least 1,000 feet AGL during the day and the altitudes prescribed in **91.177** at night (IFR). However this rule does not apply during takeoff or landing. There is another reference to minimum safe altitudes in **91.119** that states **"Except when necessary for takeoff or landing… ."** A traffic pattern would certainly be considered a *necessary* part of landing.
8. Aircraft **remaining** in the traffic **pattern** should **not commence** a **turn** to the **crosswind leg** until **beyond** the **departure end** of the **runway** and within **300 feet below traffic pattern altitude**, with the pilot ensuring that the turn to downwind leg will be made at the traffic pattern altitude. (AIM *FIG* 4-3-3)
9. "Recommended" traffic pattern **speed limit** is **200 kts**. (AC 90-66A)



## JET / TURBINE ENGINE — 101:

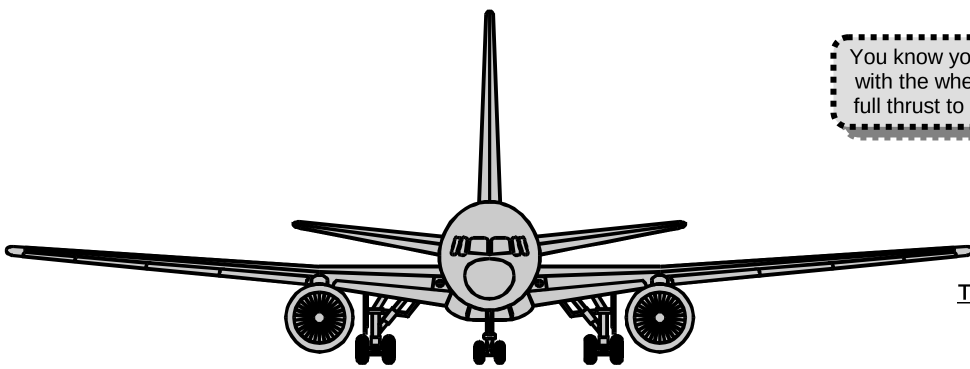
1. All aircraft engines push the airplane forward in the same manner. They take in a volume of air at the front, accelerate it, and then throw it out the back. The result (reaction) is — the airplane moves forward.
2. Propellers, whether attached to a turbine or piston engine, take in a large amount of air, moderately accelerate it, and then throw it out the back — the airplane moves forward moderately fast.
3. Jet engines take in a relatively small amount of air, accelerate it a great deal, and then throw it out the back — the airplane moves forward *very* fast (hopefully).
4. There are **FOUR TYPES** of jet engines, but they all work the same;
   a. **Turbojet** and **Turbofan** engines are more commonly called **jet engines**.
   b. **Turboprop** and **Turboshaft** engines are jet engines with a propeller or rotor-blade (helicopter) attached. Commonly referred to as **turbine engines**.



TURBOJET
SuperSonic Transport

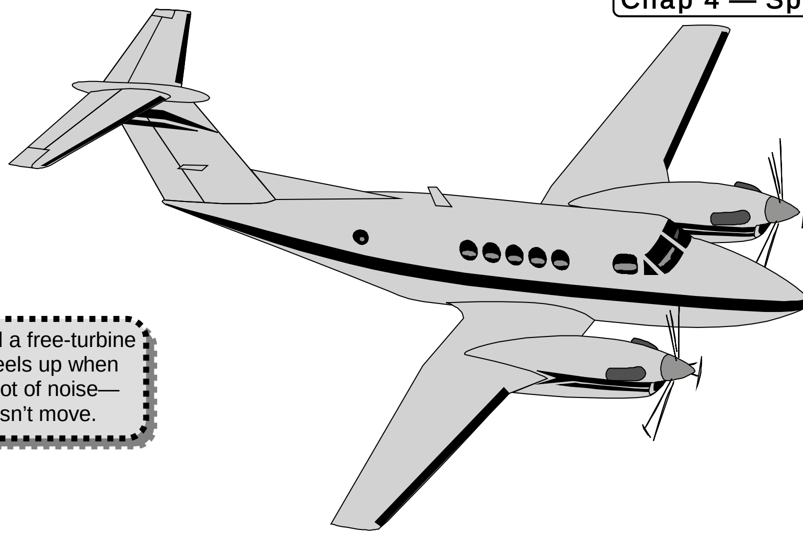
5. **TURBOJET** engine (pure jet) — creates power by taking in a small amount of air (**SUCK**), compressing it a lot (**SQUEEZE**), adding fuel and igniting it (**BANG**). The resultant hot flow of gases turns a turbine wheel, which keeps the front part (compressor section) of the engine turning, before exiting the tailpipe (**BLOW**). Once the **"igniters"** start the fire, **ignition** is normally **self-sustaining**. This type of engine is still used on the **Concorde** and some military aircraft to achieve supersonic flight, but because of its high noise level and relative inefficiency there are virtually no civilian aircraft using it anymore.

You know you've landed a jet with the wheels up if it takes full thrust to taxi to the ramp.



TURBOFAN
B-757

6. **TURBOFAN** engine (combination jet) — merely a turbojet engine with a fixed-pitch propeller, that is, **"ducted fan"** or **"shrouded fan"** at the front of the engine (or sometimes in the rear, although much less efficient in the rear). The fan acts like a propeller to give a moderate acceleration to a relatively **large volume of air**, which then **"bypasses" around** the **turbojet core** of the engine. The turbojet core of this engine creates a large amount of acceleration to a relatively small amount of air. This "combination" retains some of the **low-altitude**, **low-speed efficiency** and takeoff performance of a propeller engine and combines it with **turbojet-like cruise speed** and high altitude ability. A turbofan is also 30% to 40% **more fuel efficient** than a turbojet and **much quieter** because the lower-velocity "bypass" air shrouds and mixes cool bypass air with the hot high-velocity jet core exhaust, which insulates and muffles the sound. The relationship between the amount of air bypassing the jet core to the amount of air passing through the jet core (or, thrust provided by fan to thrust provided by jet core) classifies the turbofan engine as to its **BYPASS RATIO:**
   a. **LOW-BYPASS** — 1:1 ratio — the fan (bypass) and the compressor section (jet core) receive and make use of approximately equal amounts of air. High fuel consumption but capable of very fast, even supersonic speeds.
   b. **HIGH-BYPASS** — In the vicinity of 5:1. The air being bypassed around the jet core by the ducted fan produces 75% to more than 80% of the total thrust. Most popular on the newer airliners for reasons of fuel economy and relatively low noise.

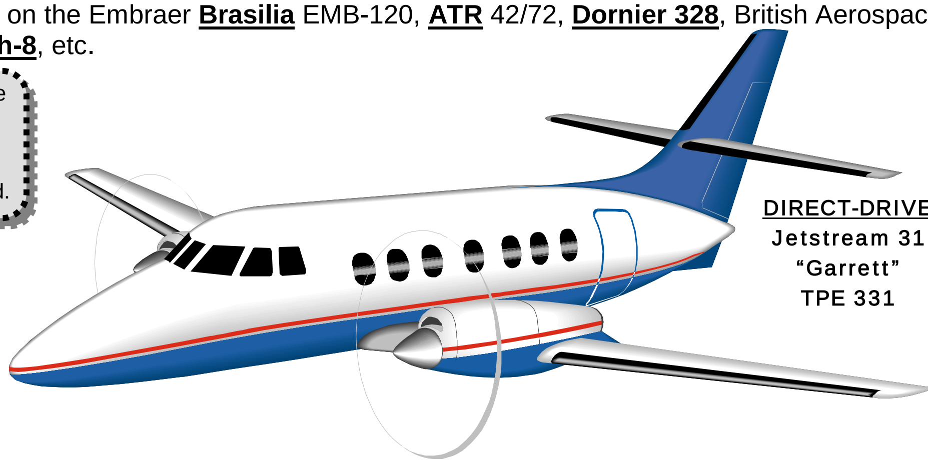


You know you've landed a free-turbine turboprop with the wheels up when —full-power makes a lot of noise— but the airplane doesn't move.

FREE-TURBINE
King Air
P&W "PT-6"

7. **FREE-TURBINE TURBOPROP** — The **propeller** is **not directly connected** to the **jet core shaft**. Exhaust gases from the jet core are used to drive a free spinning **"power turbine"** through a **"gaseous coupling"** (like the automatic transmission in a car but using hot gas instead of transmission fluid), which in turn rotates a shaft that turns a propeller gearbox. The venerable P&W **PT-6** makes the best use of this design by installing the **jet core "backwards"**, that is, intake **air** is **ducted to the rear** of the engine to enter the **rearward-mounted compressor** stage, this arrangement puts the jet core **exhaust at the front** of the engine just where it is needed **to drive** the "gaseous coupling" of the "power turbine" which drives the **propeller gearbox**. After these hot gases spin the "power turbine" they are exhausted rearward. When you turn the propeller of a free-turbine engine by hand you are turning just the "power turbine" not the entire engine. These engines are extremely reliable but somewhat less powerful and fuel-efficient by weight than a direct-drive. A free-turbine is easy to spot on the ramp because the propellers will always be in the **"feathered"** position **when** the engines are **not running** and the **exhaust stacks** are located near the **front of the engine**. The PT-6 is used on most Beechcraft **King Airs**, the **Starship** [now just a footnote in history] and **BE-1900**; **Shorts 360**, De Havilland **Dash-7**, **Piaggio Avanti**, some Cessna **Conquests** and Piper **Cheyennes**. Larger versions of the P&W free-turbine design are used on the Embraer **Brasilia** EMB-120, **ATR** 42/72, **Dornier 328**, British Aerospace **ATP**, De Havilland **Dash-8**, etc.

You know you've landed a direct-drive turboprop with the wheels up 'cause after the scraping sound stops —it gets real quiet— even with the power levers full forward.



DIRECT-DRIVE
Jetstream 31
"Garrett"
TPE 331

8. **DIRECT-DRIVE TURBOPROP** (**TURBOSHAFT**) — The **propeller** is **driven directly** by the engine's **jet core shaft** through a **reduction gearbox**. When you turn the propeller by hand you are turning the entire engine. More immediate power response, more fuel efficient, more power per pound of engine weight but **extremely *LOUD*** on the ground due to the much higher idle RPM of the propeller. The TPE 331 series, made by **GARRETT**, is one of the most popular models. Start locks hold the blades of the propeller at the **0º blade angle after shutdown**. During start the propeller must be turned with the engine, this flat pitch angle serves to lower air resistance making it much easier for the starter to spin the engine jet core to the proper "light-off" speed. A direct-drive (usually Garrett) engine is easy to identify because of the exceptionally ***LOUD* noise** it makes while taxiing, the **flat blade angle** of the propellers after shutdown, and the **exhaust** located at the **rear of the engine**. The Garrett TPE 331 can be found on the Mitsubishi **MU-2**, Fairchild **Merlin**, **Turbo-Commander** series, Fairchild **Metroliner**, British Aerospace **Jetstream** 31 & 41, **Dornier 228**, and some Cessna **Conquests** and Piper **Cheyennes**, etc.