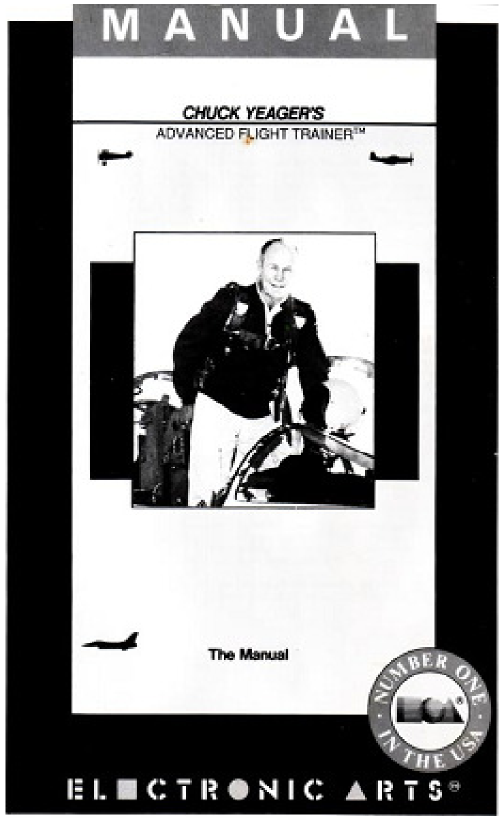

MANUAL
CHUCK YEAGER'S
ADVANCED FLIGHT TRAINER™
The Manual
NUMBER ONE IN THE USA
ELECTRONIC ARTS®

Contents

INTRODUCTION

Things have changed some since the days when I was learning to fly. As I recall, the instructor just slapped your butt in the front seat and demonstrated the airplane, then moved you back, and then you had to learn all this stuff as it happened: how to take off, level off, turn, and everything else associated with flying the damned thing. That was the way you learned to fly because that was the way they taught you. And that was fine by me, because the way I look at it, flying's flying.

General Chuck Yeager
March 1987

What AFT is

"Crash" is not a word pilots ever use. I don't really know why, but the word is avoided in describing what happens when several tons of metal plows intself and its pilot into the ground. Instead, we might say, "He augered in." Or, "He bought the farm."

Advanced Flight Trainer gives you the chance to learn to fly the way General Yeager did, but without the actual danger. AFT and this manual are designed for advanced pilots who already know how to fly a plane and are looking for the thrills and pure enjoyment of flight. But if you're a novice pilot, or just feel that you'd like to do some brush-up flying first, check out "Appendix A - Flight Instruction" at the end of this manual.

After you Get Started and watch the Intro Flight as described in the next two sections, look over the Airplane Specs and pick a plane that interests you. General Yeager attributes much of his success as a pilot to being interested in, and knowing everything there is to know about his ship, so keep this in mind as you look over the Specs. Once you've picked a plane you want to take up, continue on to the Test Flight section and familiarize yourself with the plane's controls and instruments. AFT provides 7 different planes:

Real Aircraft

- **Cessna 172 Skyhawk**
- **F-16 Fighting Falcon**
- **F-18 Hornet**
- **P-51 Mustang**
- **Sopwith Camel**
- **SR-71**
- **Spitfire**

AFT Experimental Aircraft

- **XPG-12 Samurai**

When you feel confident that you know your ship, and you're ready to take her up, go for it. Try any radical manœuvre you like - the worst that can happen is you'll auger in. No big deal. You always walk away from an AFT accident unseathed. Your friends, however, may pretend they don't know you...

Getting Started

Boot AFT according to the instructions on the Command Summary Card. Also study the Command Summary Card to learn how to use AFT's menus and commands.

Note

Because AFT is available on a wide variety of computers with different capabilities, some commands and features described in this manual may be different or unavailable in AFT on your computer system. Please consult the Command Summary Card for a list of any such differences.

When you are confident that you know how to control AFT, continue on the next section for the Introductory flight.

Introductory flight

...after taking my first airplane ride, I'd rather have crawled across country than go back up. I took off for a spin with a maintenance officer flight testing a ship I had serviced, and I threw up all over the back seat, staggering out of that damned thing as miserable as I'd ever been.

1. If you haven't already done so, start AFT as described in the Command Summary Card.
2. Press Return to select the Location Menu.
3. Pull back on the joystick 3 times to select 10,000 ft.
4. Press the button to begin the introductory flight.

Airplane specs

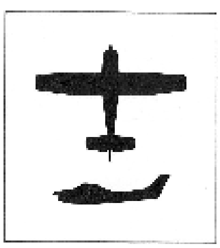
I was always eager to acquire practical knowledge about the things that interested me. That was a big reason for my success as a pilot. I flew more than anybody else and there wasn't a thing about an airplane that didn't fascinate me, down to the smallest bolt.

This section lists all the technical specifications for the 7 airplanes you can fly in AFT. Knowing the capabilities and limitations of your airplane is one of the most important aspects of being an ace pilot. If General Yeager hadn't known his P-51 like the back of his hand in World War II, it's doubtful that he would have the outstanding record and reputation he holds today.

Whether you're planning to push your plane past its limits as a test pilot, or whether your planning to push your plane *to* its limits in formation flying, study the specs for your chosen plane carefully.

Cessna 172 Skyhawk

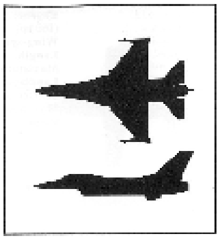
The Skyhawk was introduced in 1955 and its still one of the most widely flown airplanes today. I think that record speaks for itself....



Engine: 4 cyl. horizontally opposed (160 hp)
Wing-span: 36 ft., 6 in.
Length: 26 ft., 11 in.
Maximum Weight: 2,360 lbs.
Landing gear: fixed, tricycle
Service ceiling: 13,340 ft.
Maximum speed: 141 mph
Crew: 4

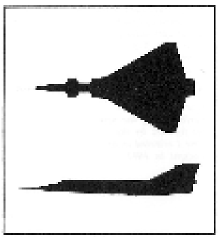
General Dynamics F-16 Fighting Falcon

The F-16 was a real departure for U.S. fighter technology because it was so lightweight, manœuvrable, and dependent upon computers. The F-16 was equipped with analog computers which had no back-up systems. This caused us to lose some planes and pilots in the development stage. But once it was fully developed, the F-16 was a popular fighter. our Air Force used them, and Belgium, Denmark, Netherlands, and Norway used them to replace the old F-104 Starfighter.



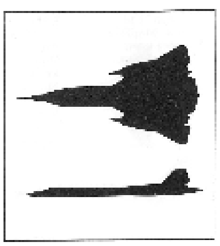
Engine: 1 Pratt Whitney F100-PW-100(3) turbofan (25,000 lbs. static thrust w/afterburning)
Wing-span: 30 ft., 6 in. **Length:** 47 ft., 10 in.
Maximum Weight: 33,200 lbs.
Landing gear: rectractable tricycle
Service ceiling: 50,000 ft.
Maximum speed: Mach 2.3
Crew: 1

Grace Industries XPG-12 Samurai
This one's a test pilot's fantasy. Be prepared for a ride that's fast and furious.



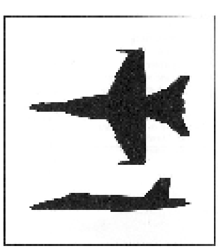
Engine: 2 DKS Inc. "Bonecrusher"turbojets (est. 15,000 lbs. static thrust each)
Wing-span: 25 ft., 6 in.
Length: 45 ft., 8 in.
Maximum Weight: 31,414 lbs.
Landing gear: rectractable tricycle
Service ceiling: Unknown (Engineers estimate 50,000+ ft.)
Maximum speed: Unknown (Engineers estimate Mach 1 possible)
Crew: 2

Lockheed SR-71
The SR-71 is a supersonic reconaissance jet that was developed with funds from the CIA as a replacement for the U-2. The plane was such a success that Lockheed was contracted to design an interceptor version, the YF-12A, and a larger strike bomber version as well.



Engine: 2 Pratt Whitney JT11D-20B turbojets (32,500 lbs. static thrust w/afterburning)
Wing-span: 52 ft., 9 in.
Length: 100 ft., 4 in.
Maximum Weight: 145,000 lbs.
Landing gear: rectractable tricycle
Service ceiling: 81,000+ ft.
Maximum speed: Mach 3+
Crew: 2

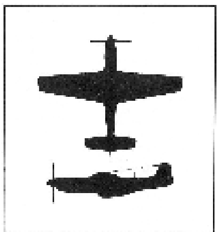
McDonnell Douglas F-18 Hornet
The F-18 was the successor to the F-16 and it's more advanced in all respects. It has two engines that produce 32,000 pounds. It has back-up flight control systems and it has digital computers that are more reliable and finely calibrated than the F-16's. The F-18 also uses a Heads Up Display which projects all the flight data a pilot needs on the windshield: angle of attack, airspeed, altitude, even what weapons are on the airplane.



Engine: 2 General Electric F404-GE-400 low by-pass turbofans (16,000 lbs. static thrust each)
Wing-span: 37 ft., 6 in.
Length: 56 ft.
Maximum Weight: 35,040 lbs.
Landing gear: rectractable tricycle

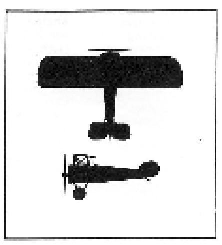
Service ceiling: 50,000+ ft.
Maximum speed: Mach 1.8+
Crew: 1

North American P-51 Mustang
The best American fighter in World War II, equal to anything the Germans put up against her. With her two-thousand-mile range, she turned around the war against Germany by protecting our bombers over the deepest targets. Her Packard-built Rolls-Royce Merlin engine with a two-stage, two-speed supercharger provided terrific speed and manoeuvering performance - she was a dogfighter's dream.



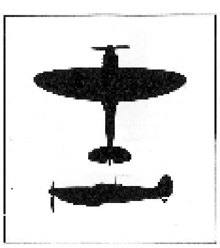
Engine: 1 Packard-built 12 cyl. in-line Rolls Royce Merlin V-1650-7 (1,490 hp)
Wing-span: 37 ft., 6 in.
Length: 32 ft., 3 in.
Maximum Weight: 11,642 lbs.
Landing gear: rectractable wing gear, non-retractable tail wheel
Service ceiling: 41,900 ft.
Maximum speed: 395 mph at 5,000 ft., 437 mph at 25,000 ft.
Crew: 1

Sopwith Camel
Now there's a classic - a little before my time though. The Camel was a British plane that entered into World War I about 1917. It had a bigger engine than any other biplane and it created so much torque tha Camel could turn on a dime. Pilots of the period complained that the airplane was too manœuvrable, and several were killed just trying to master the damned thing.



Engine: 1 Gnome Monosoupape (253 hp)
Wing-span: 28 ft., 7 in.
Length: 18 ft., 9 in.
Maximum Weight: 1,453 lbs.
Landing gear: fixed, conventional (tail skid)
Service ceiling: 19,320 ft.
Maximum speed: 113 mph
Crew: 1

Supermarine Spitfire
This was a great British airplane that was used as a fighter and for photographic reconnaissance in World War II. It was continually redesigned during the war so that it was always a match for what the Germans threw against it



Engine: 1 Rolls Royce Merlin 6I (1,515 hp)
Wing-span: 30 ft., 6 in.
Length: 36 ft., 10 in.
Maximum Weight: 7,570 lbs.
Landing gear: retractable wing wheels, and one fixed tail wheel.
Service ceiling: 45,070 ft.
Maximum speed: 408 mph at 27,500 ft.
Crew: 1

Test Flight

Today you've got computers, and simulators, and wind tunnel data, and so you come up with a lot of data on what your airplane will do. The test pilot's job is to find out how good the theorists were....

When you choose the Test Flight mission, you're completely on your own to fly any plane anywhere any way for as long as you like.

You start in the hangar at the main airport, lined up for take-off on runway 36. You're in the Cessna 172. To taxi or take off, apply power.

Your goal as a test pilot is to take up your chosen plane and test its capabilities to the max. Can you take the Cessna above its 13,000 foot service ceiling? How high can you take the SR-71? And watch out for high speed instabilities - the engineers don't want those any more than you do.

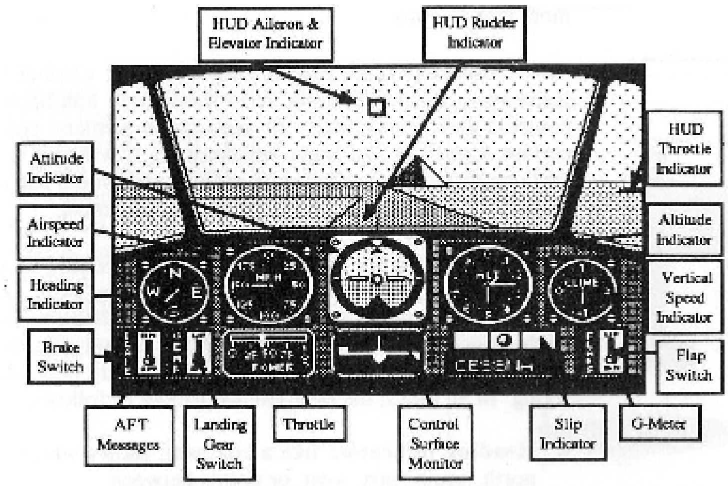
Airplane control systems & simulator controls

Naturally, the first task for any pilot, whether he's testing a rocket plane or learning to fly in a Cessna, is to familiarize him/herself with the airplane and its controls and instruments. In addition to airplane control systems, there are also certain aspects of the flight simulator itself which you can control. The following sections explain the instruments and controls you'll use in the AFT airplanes, and the controls that affect the AFT simulator environment.

AIRPLANE CONTROL SYSTEMS

You can fly an airplane without referring to instruments, but using them enables you to fly more precisely and to get maximum performance from your plane. The AFT instrument panel contains all the instruments you'll need for any of the flight missions. Figure 3 (below) shows a typical instrument panel and glareshield, but what you see on screen may differ slightly depending upon the airplane you're flying. In all cases, the instruments operate as follows:

- **Heading indicator:** like a compass, shows which direction the plane is flying, north, south, east, west, or points between.
- **Airspeed indicator or Mach meter:** registers the speed of the airplane through the air in miles per hour (mph), or registers the ratio of airspeed to the speed of sound (1 Mach is 760 mph at sea level).
- **Attitude indicator:** portrays the airplane's position relative to the horizon. It shows the degree of bank and the amount of pitch.
- **Altimeter:** measures the height in feet of the airplane above sea level. AFT airports and open terrain are at sea level.
- **Vertical speed indicator (VSI):** indicates whether the airplane is climbing descending, or in level flight. The rate of climb is measured in feet per minute (fpm), in rates up to 2,000, 4,000 or 8,000 fpm depending on what plane you're flying.
- **Brake monitor:** registers On while you are applying the brakes.
- **Landing gear monitor:** shows whether the gear is up or down.
- **Power indicator:** tells you how far you have advanced the throttle. It measures power output as a percentage of full engine capacity.
- **Slip indicator (Inclinometer):** helps determine co-ordinate use of the aileron and rudder. In a co-ordinated turn, the ball rests between the two reference marks.
- **Flaps monitor:** shows whether the wing flaps are up or down.



SIMULATOR CONTROLS

AFT simulates not only an airplane and its control systems, but also the airspace it flies through and the ground it flies over. The following sections explain the ways you can control AFT.

Visual reference

Normally when you're flying you'll want to look straight ahead out the windshield, but at times you'll want to look left, right, back, through the belly, and through the roof. You can also view your airplane from points outside the cockpit, including a chase plane, a satellite, the control tower, and the main airport runway.

There are keyboard commands for quickly switching between front, left, right, chase plane, tower, or satellite views. All the keyboard commands are listed on the Command Summary Card. You press a key command once to switch to the new view, and then press the same key a second time a return to the front view.

You can also magnify any view as if you were looking through a telescope. Zoom offers ten magnification factors, from 0 to 9. AFT chooses the most appropriate magnification factor when you change views, but you may choose a different magnification factor any time.

Heads Up Display (HUD)

As explained earlier, you can monitor the airplane controls by watching the instrument panel. That's not possible in any view except front, and it's not always convenient even when you're looking out the windshield. AFT has a secondary control monitoring system called the *heads-up display (HUD)* that appears in every view (Figure 1). Press the HUD key to make the heads-up display visible, and press it a second time to make it invisible.

When the heads-up display is active, a small yellow box in the centre of the screen reports aileron and elevators position; it follows the movement of the joystick. A short vertical black line moves up and down the right edge of the screen to indicate how high or low you have set the throttle.

Pause

Press P at any time to temporarily suspend flying. Press any key to resume. Activate the menu bar by pressing the Commodore key als suspends flying. Pressing Return to choose a menu item returns you to flying, as does the escape sequence listed under "Keyboard Shortcuts" on the Command Summary Card. If you made no new menu selections, your flight resumes where it left off.

Changing planes

In Test Flight, you can fly any of the available planes. The Plane menu lists your choices. Select one of the planes by name and then press Return to fly it. The Cessna 172 described in "Cessna 172 orientation" in Appendix A - Flight Instruction. The Introduction chapter lists specifications for all the planes.

Navigation

The simplest way to navigate is to fly from place to place. The world is 250 kilometres (about 155 miles) square. There are three airports, including the main airport. Because you fly in real time, you can spend hours flying around in a subsonic plane and still have new territory to explore. If you're exploring the AFT world in a supersonic jet, you may be able to circle the world in under a hour, but it will still take you a while to visit and explore all the locations.

OBSTACLE COURSES

...obviously if you're flying through tunnels (which is a kind of stupid thing to do anyway) you know you can't run up the tunnel and go through it. You've got to swing way out and gauge how wide the damn thing is to see if your circle will fit in....

Scattered around the world are seven obstacle courses. As you fly around, see if you can find these:

- Five gates arranged like a "five" playing card
- Three gates in a row, each backed by a large wall
- A street lined on either side by tall buildings
- Six gates arranged in an S-shaped course
- A slalom course consisting of seven cube-shaped pylons with a large pyramid at one end
- An obstacle course consisting of six closely spaced pylons (You're a real pro if you can fly between them!)
- A cube, sphere, and tetrahedron arranged in a line

If you get tires of looking for any of the obstacle courses, you can fly directly to them by using the Location menu.

LOCATION MENU

Once you've found an obstacle course, there's little thrill in spending 15 to 45 minutes flying there from the main airport. The Location menu elimiates that drudgery by instantly transporting your plane to the vicinity of the obstacle course you choose by name. The menu can also transport you to nine other locations, including: the Hangar at the main airport; a two-mile Line Up for landing practice or six-mile Start-Up for final approach; three miles south of the main airport at 3,000 ft. or 10,000 ft.; and 40 miles north, east, south, or west of your present position.

Test pilot procedures

The real hero in the flight test business is a pilot who manages to survive.

The procedures that follow list the manœuvres you should put your ship through the test how good the theorists were. But remember, the only way to obtain accurate results is to fly your plane very carefully, relying heavily on instruments. Attempt to stabilize all the flight parameters: throttle, heading, altitude, attitude, airspeed, vertical climb, and slip. If you are unable to stabilize the aircraft, then it has reached its minimum or maximum limit. After you complete a procedure, write down your results on a copy of the Test Flight Check-list in Appendix B to compare against other aircraft, or against other test pilots' findings.

MINIMUM TAKE-OFF SPEED (FLAPS UP)

This may sound simple, but if the engines don't cut it you can run out of runway...fast.

1. Start in the hangar.
2. Increase throttle to 100%.
3. Pull back on the stick about 75% and hold it there.
4. Watch the altimeter and VSI. When they leave 0, check and record airspeed.

MINIMUM TAKE-OFF SPEED (FLAPS DOWN)

Commercial airliners rely heavily on flaps because they reduce the speed and distances required for take-off.

1. Put flaps down.
2. Start in the hangar.
3. Increase throttle to 100%.
4. Pull back on the stick about 75% and hold it there.
5. Watch the altimeter and VSI. When they leave 0, check and record airspeed.

MAXIMUM LEVEL SPEED (10,000 FT.)

Going faster is one of the things I always found myself doing. I guess it's just one of the things I enjoy the most.

1. Start at 10,000 feet.
2. Increase throttle to 100%.
3. Hold VSI at zero.
4. When airspeed and altitude stabilize, read and record the airspeed.

MAXIMUM LEVEL SPEED (10,000 FT., FLAPS DOWN)

This type of destructive testing isn't something that's pleasant to put an airplane through, but it's crucial information we have to know.

1. Start at 10,000 feet.
2. Put flaps down and increase throttle to 100%.
3. Hold VSI at zero.
4. Watch carefully for the "flaps jammed open" message along the bottom of the screen. **NOTE:** this message occurs *very* quickly on the fast jets, so be alert.
5. When you see the "flaps jammed..." message, read and record the airspeed.

CRUISE SPEED (10,000 FT.)

Knowing your aircraft's cruise speed is useful because it also gives you some insight into the airplane's limitations.

1. Start at 10,000 feet.
2. Set throttle to 75%.
3. Hold VSI at zero.
4. When airspeed and altitude stabilize, read and record the airspeed.

STALL SPEED (GEAR DOWN & FLAPS UP)

Basically, anything that protrudes from the airplane's body is going to affect airspeed and lift - something as "un-aerodynamic" as the landing gear will have a negative effect.

1. Start at 3,000 feet.
2. Increase airspeed to about 125% of clean stall and lower landing gear.
3. Hold VSI at zero.
4. *Slowly* (one notch every 15 seconds or so) reduce the throttle while continuing to keep the VSI as close to zero as possible. When you can no longer keep the VSI at zero, check and record the airspeed.

MAXIMUM SUSTAINED RATE OF CLIMB

This is one of the harder tests and requires the most time and skill. The maximum rate of climb for aircraft like the F-16 and F-18 is found in a ballistic vertical climb. That's because these aircraft often generate thrust greater than their weight. As you approach their ceiling and reduce engine power, they lose their ability to climb this way. At that point they work like other airplanes and you can measure maximum rate of climb. That's why these planes are so easy to fly - there are few problems the go-stick can't correct. Try measuring the Spitfire if you want more of a challenge.

1. This test requires a stop-watch.
2. Start at 3,000 feet with throttle at 100%.
3. At the aircraft's clean stall speed (first try only), pull the nose of the plane into a steady climb, maintaining a constant speed.
4. When airspeed has stabilized, note the altitude and start the stop-watch as you cross a 1,000 foot boundary.
5. After you have climbed an additional 10,000 feet maintaining a constant airspeed, stop the watch. Plot the time at the convergence of the airspeed and seconds on the flight check-list grid. (For aircraft with poor climb performance, try climbing 3,000 feet instead of 10,000.)
6. Repeat steps 3-5, increasing airspeed in increments that match the flight check-list grid. Continue this process until the airspeed matches, and you can maintain, the aircraft's maximum level speed.
7. When you have recorded all the data points on the check-list grid, connect the plots to form a curve. Find the lowest point on the curve and that is your best constant climb rate.

SERVICE CEILING

This is the altitude you can reach without exceeding the normal parameters of the aircraft limits. It sounds easy, but it's another test that requires discipline and skill.

1. Start at 10,000 feet.
2. Climb at the aircraft's maximum sustained rate of climb.
3. Adjust altitude to maintain airspeed.
4. Hold VSI at zero and wait for altitude to stabilize.
5. Record the altitude at which this happens.

MAXIMUM ATTAINABLE SPEED

Be careful when you're pushing the envelope. Experience makes the best test pilots, and in most cases experience and auger jobs don't mix. Some aircraft like the X-3 exhibit a phenomenon known as inertial roll coupling. *This can cause the nose of the plane to pitch away from the flight vector. It can be mild and controllable, or it can be destructive....*

1. Climb almost to the service ceiling.
2. Push the nose down and hold in a steep, steady dive.
3. Watch the altimeter and airspeed indicator.
4. Don't let the altitude get too low to pull out of the dive before the airspeed stabilizes.
5. When the airspeed indicator stabilizes (doesn't continue to climb), record the airspeed.

MAXIMUM ATTAINABLE ALTITUDE

It's simple - take the plane as high as you can. Of cpurse you may encounter problems with speed instabilities, structural damage from G forces, or loss of control in the thin, high altitude atmosphere, but that's all part of being a test pilot.

1. Set the throttle at 100% and climb to 50% of the aircraft's service ceiling.
2. Level off and let airspeed increase to maximum level speed (try not to lose altitude).
3. Push the nose down to obtain maximum speed (recorded earlier).
4. Pull the nose into a climb, thus transferring the built-up airspeed into climb energy. When you are almost vertical (pointed at the star straight up), you should be gaining altitude at a great rate. You are trading airspeed for altitude in a ballistic climb.
5. As airspeed starts to bleed off, reduce your angle of attack to sustain climb.
6. The sky blackens as you enter the edge of space if you exceed 90,000 feet.
7. Expriment. The object is to set the altitude record for the plane. Here's something to shoot for: at the time this manual was written, the SR-71's record AFT altitude was 164,900 feet. Good luck!

Reference

AFT? Basically it's pretty realistic. I'll tell you. It whets the imagination.

Menus

AFT has three menus.

LOCATION MENU

The Location menu lets you instantly relocate your airplane to another part of the AFT world. The various locations include:

- **Hangar** at the main airport, in position for take-off on runway 36
- **Lined Up** on final approach to runway 36 at the main airport, 2 miles out at an altitude of 800 feet
- **3000 ft** up, headed north, and 3 miles south of the main airport
- **10,000 ft** up, headed north and 5 miles south of the main airport
- **N 40 mi** puts your plane 40 miles north of your last position, headed north with your altitude unchanged
- **E 40 mi** puts your plane 40 miles east of your last position, headed north with your altitude unchanged
- **S 40 mi** puts your plane 40 miles south of your last position, headed north with your altitude unchanged
- **W 40 mi** puts your plane 40 miles west of your last position, headed north with your altitude unchanged
- **Logo** puts your plane 57 miles southeast of the main airport at 2000 feet, near a large sphere, cube, and tetrahedon (fly at a heading of 136° from the airport)
- **Street** puts your plane 41 miles south of the main airport, 2000 feet above a street lined on either side by tall buildings (fly a heading of 180° from the main airport)

- **Slalom** puts your plane 11 miles west of the main airport at 2000 feet, approaching 7 square pylons lined up for a slalom (fly a heading of 288° from the main airport)
- **Obstacle** puts your plane 36 miles southwest of the main airport at 2000 feet, approaching 6 closely spaced square pylons lined up on the diagonal (fly heading of 209° from the main airport)
- **Gates** puts your plane 94 miles southwest of the main airport at 1300 feet, approaching a series of rectangular gates, each with a large wall close behind it (fly a heading of 224° from the main airport)
- **S Course** puts your plane 65 miles southwest of the main airport at 1300 feet, approaching a series of 6 gates laid out in an S shape (fly a heading of 218° from the main airport)
- **Square** puts your plane 65 miles northwest of the main airport at 1300 feet, approaching 5 gates arranged in a square with the one in the middle, like the configuration on a "five" playing card (fly a heading of 314° from the main airport)
- **Start Up** puts your plane on approach to runway 36 at the main airport, 6 miles out at an altitude of 3000 feet.

MANEUVRER MENU

The manœuvre menu lists aerobatic manœuvres in which you follow another airplane as it performs a series of aerobatics stunts. ATF graphs and scores your performance against the lead plane's at the conclusion of each stunt. The prerecorded manœuvres are: **Deadman**, where you fly a XPG-12 Samurai and follow another in a slalom around buildings; **Gates**, where you fly a Spad and follow another through gates and over buildings; **Hammer**, where you fly a P-51 and follow another into a hammerhead stall; **Knife**, where you fly a P-51 and follow another into a 90° roll that you must maintain in stable flight (it helps to uncouple the rudder first from the Option menu); **Wax Me**, where you fly a P-51 and attempts to keep your crosshair on General Yeager's plane through a series of easy, medium, and hard manœuvres; **Spad**, where you fly a Spad and follow another through a series of aerobatic stunts.

PLANE MENU

The Plane menu lets you select the airplane you want to fly.

TRAINING MENU

Selecting this menu will load the next flying lesson off the tape for you to either observe or fly as detailed in the "How to take a lesson" section of this manual.

HUD

Deactivates the heads-up display (HUD), or reactivates it if it is inactive. The heads-up display lets you monitor the airplane controls without looking at the instrument panel. A line on the right shows the power setting. A hollow yellow square in the centre of the view indicates the position of the ailerons. A line along the bottom of the glareshield (or the screen in views other than Front) indicates rudder position.

Glossary

Ailerons: The hinged surfaces at the trailing edge of each wing, near the wingtips. Ailerons control the plane's roll; lowering an ailerons increases lift and raises the wing. The ailerons are linked, so that deflecting one down moves the other up.
Angle of attack: The angle at which the wing meets oncoming air. The greater the angle of attack, the more lift occurs, as air striking the bottom of the wing is deflected downward. If the angle of attack is too great, the airplane stalls.
Centre of gravity: The intersection of the aircraft's longitudinal, lateral, and vertical axes.

Crab: To fly at an angle to the track over the ground, in order to compensate for a crosswind.
Drag: The resistance created by air striking the surface of the aircraft as it moves through the air. Some drag also occurs as the wing deflects air downward to produce lift.
Elevators: Hinged surfaces on the trailing edge of the horizontal stabilizer that cause the aircraft to move about its lateral axis, controlling pitch. Pushing the stick forward moves the elevators downward; the resulting airflow pushes the tail upward and the nose downward.
Empennage: The unit consisting of the horizontal and vertical stabilizers; also known as the tail section.
Flaps: Hinged surfaces on the trailing edges of the wings, usually near the fuselage. Flaps can be lowered to increase lift and drag, allowing a slower airspeed and a steeper angle of descent while landing.
Glideslope: The angle of descent.
Heading: The direction in which the aircraft is pointing, as indicated by the heading indicator.
Lateral axis: The axis of the aircraft that extends from wingtip to wingtip.
Lift: The upward force generated by air flowing over the wings. Air moves faster over the curved top of the wing, creating a low pressure that pulls the plane up. At the same time, air striking the bottom of the wing is deflected downward, creating more upward force.
Longitudinal axis: The axis of the aircraft that extends through the fuselage from nose to tail.
Pitch: Rotation about the aircraft's lateral axis, pointing the aircraft's nose up or down.
Roll: Rotation about the aircraft's longitudinal axis. Also an aerobatic manœuvre (see "Barnstorming" in the Sport Flying chapter.)
Rudder: The hinged surface on the vertical stabilizer that controls the plane's yaw. The rudder is controlled by left and right pedals. When the rudder is moved to the right, the resulting air deflection pushes the tail to the left, which in turn yaws the nose to the right (in other words, pressure on a particular rudder pedal turns the plane in that direction on its vertical axis).
Service Ceiling: The altitude above which the engine no longer has enough power to maintain a climb rate of 100 fpm.
Skid: The aircraft's undesirable sideways and upward movement toward the outside of a turn.
Slip: The aircraft's undesirable sideways and downward movement toward the inside of a turn during a sharp bank.
Stall: When the angle of attack is too great, the air no longer flows smoothly across the upper surface of the wing, contributing to lift, but instead results in a turbulent flow of air, rapidly degenerating lift. Most planes stall when the angle of attack reaches around 15° to 20°. To recover from a stall, lower the nose, apply maximum power, and return to level flight when possible.
Vertical axis: The axis of the aircraft that passes vertically through the fuselage, intersecting with the longitudinal and lateral axes at the centre of gravity.
Vertical stabilizer: The vertical section of the tail; also called the fin.
Yaw: Rotation about the aircraft's vertical axis.

Appendix A: Flight Instruction

Never believe anything another pilot tells you about how to fly.

Learning to fly a real airplane requires a good deal of study and practice. AFT greatly speeds learning to fly by eliminating the risk. But you must still learn and practice many manœuvres to become a proficient pilot.

This chapter has a brief ground school section that acquaints you with the airplane, its controls, and its instruments. Three other sections present actual flight lessons in increasing order of difficulty: basic, advanced, and aerobatic. There are also orientation sections that describe each type of airplane that AFT simulates.

Ground school

Before you start flying, you must learn how airplane controls work, what the various instruments measure, and how to control the flying environment. You may also wish to learn what makes an airplane fly and other principles of flight; see one of the reference books listed at the end of this appendix.

AIRPLANES

All airplanes - no matter how new, old, basic, or advanced - have certain basic components (Figure 2). Wings generate lift, tail asssembly provides stability, landing gear furnishes ground manoeuverability, powerplant supplies motive force, and fuselage or body holds everything together and accomodates pilot and passengers.

Flight controls

Movable control surfaces on the wings and tail allow the airplane to manœuvre in three dimensions while airborne. The pilot manipulates the control surfaces by moving pedals and a control wheel or stick in the cockpit.

An airplane has three primary control surfaces. The ailerons and elevators are connected to the control wheel or stick, and the rudder is connected to the rudder pedals. (See the Command Summary Card for control equivalents on your computer.)

In addition to the primary controls, most airplanes also have wheel brakes, wing flaps, and retractable landing gear.

Ailerons

Turn the airplane in flight by banking, or rolling, the wings. To bank the wings, you move the ailerons, located on the outboard trailing edges of the wings (Figure 3). To begin a left turn, move the stick to the left. Bank right by moving the stick to the right.

Figure 2
Parts of an airplane

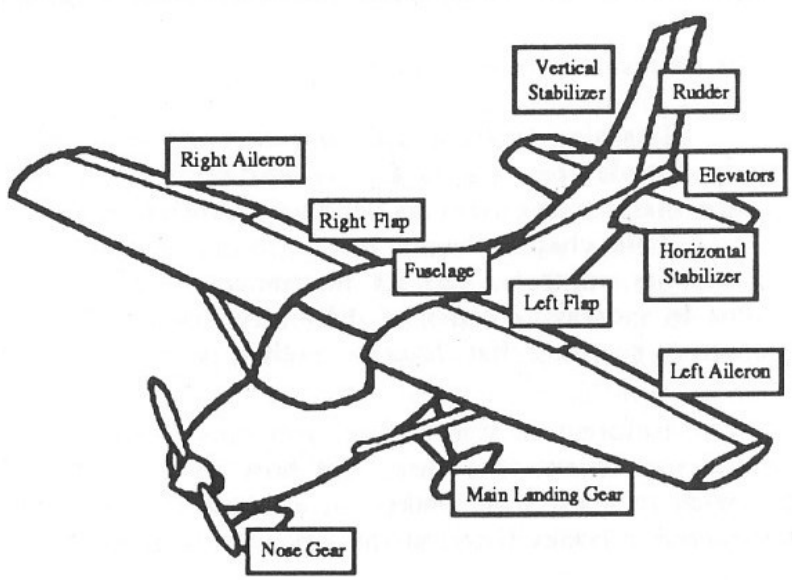
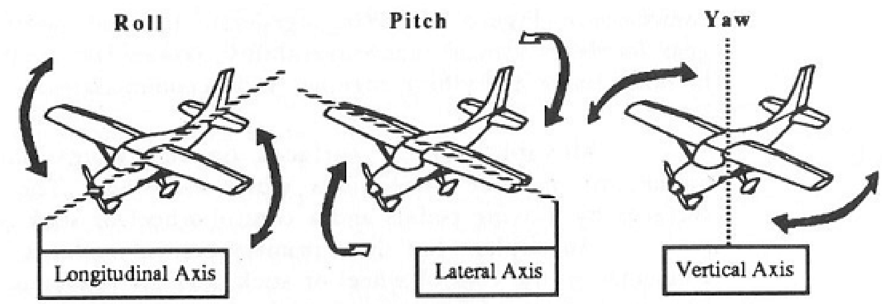


Figure 3
Ailerons roll, elevators patch, and the rudder yaws



Elevators
Elevators are part of the vertical stabilizer, which is part of the empennage (tail assembly). Moving the elevators up or down makes the nose of the airplane pitch the opposite direction (Figure 3). To pull the nose up, pull the stick back. Push the nose down by pushing the stick forward.

Moving the elevators does not cause the plane to gain or lose altitude as you may expect. It only changes the angle at which the wings move forward along the flight path, called the *angle of attack*. For example, holding the stick full back on low powered aircraft eventually results in a stall, whereupon the airplane stops flying and descends rapidly. Use the throttle to control altitude.

Rudder
Moving the rudder, which is located at the trailing edge of the fin, swings the tail right or left (Figure 3). On the ground, the rudder steers the airplane like the rudder of a boat. While airborne, the rudder is used in conjunction with the ailerons to coordinate turns. (In an uncoordinated turn, the tail of the airplane slips to the inside of the turn or skids to the outside of the turn.)

AFT normally couples the rudder to the ailerons in flight so your turns are always coordinated. AFT automatically uncouples it on the ground, when you need it for steering.

Swing the tail left by applying right rudder pedal; swing the tail right with left rudder pedal. You can centre the rudder by pressing both pedals simultaneously.

Wing flaps
Flaps are a movable part of the wing, normally hinged to the inboard trailing edge of each wing (Figure 2). When down, they increase lift and drag. As a result, you can make a steeper approach for landing without increasing airspeed. Lower the flaps by flipping the Flaps switch to DN. Raise them by flipping the switch to UP.

Brakes
Coast to a stop on the ground by chopping the throttle, and use brakes to hasten deceleration. Press and hold the Brake switch ON to apply the brakes. Release the Brake switch so it returns to OFF to release the breakes.

Landing gear
Flip the Gear switch to UP to put the gear up after take-off. Flip the switch to DN to lower the gear for landing. The Gear switch is inoperable on planes without retractable gear, such as the Cessna 172.

Engine control

An airplane needs power to get off the ground and sustain flight. Climbing takes more power. Reducing power is the key to descending and landing.

ATTITUDE FLYING

There are three basic components of airplane control: pitch control using the elevators, bank control using the ailerons, and power control using the throttle. Performing any manœuvre is a matter of coordinating these three components to achieve the desired flight attitude, and if you can smoothly change the attitude, or maintain a constant attitude, as needed.

At first, you consciously note the relationship of specific reference points on the airplane, such as the glareshield above the instrument panel, to the horizon. As you become skilled, you become continuously aware of these relationships without thinking about them. Such outside references are called *visual references (VR).*

You can fly by visual references alone, but you will get better control and become a more proficient pilot if you also confirm your attitude by scanning the instruments. This is called the *instrument reference (IR).*

Basic flight instruction

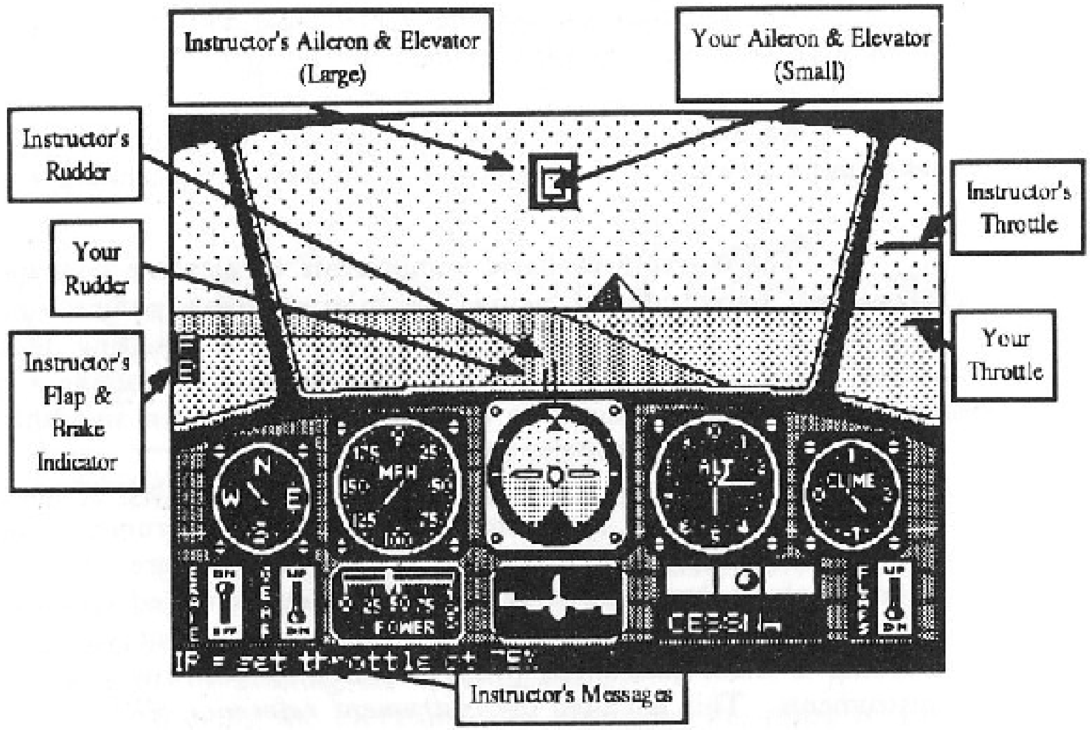
We flew from dawn to dusk, six flights a day, six days a week, dogfighting, buzzing, and practicing gunnery. We crawled exhausted into the sack at ten and straggled to breakfast at 4:30 A.M., taking off on our first flight of the day just as dawn broke. I logged 100 hours of flying that first month. Hog Heaven....

Basic instruction starts with four fundamental flight manœuvres: straight and level, climbs, descents, and turns. All other flight manœuvres, no matter how sophisticated, build on these four fundamentals. Understand them well, and you will make the most efficient use of your airplane in more advanced flight manœuvres. To begin basic instruction:

1. Choose Training from the Main menu.
2. Press play on your cassette recorder.
3. AFT will load in the next lesson from the tape.

Note: The lessons are recorded in the same order as they are detailed in this manual. Straight & Level flight first and Cuban Eight last. If you want to redo a lesson, rewind your tape a littleway (use the tape counter for accurately position the tape.)

Figure 4
The heads-up display during flight instruction



HOW TO TAKE A LESSON

Before taking a lesson, decide whether you want to observe the lesson or fly it. It's usually a good idea to observe each lesson at least once before you try to fly it. The Observe or Fly options are unavailable until you have selected a lesson. When you select your lesson, AFT automatically defaults to Observe mode. Press the CTRL key to toggle between observe and fly.

Whichever option you choose, you'll see a double heads-up display, It shows how the instructor uses the airplane controls and how you use them (Figure 4).

Taking a lesson

1. Study the description of the lesson in this chapter (the descriptions are approximations - the readings you see on your instruments may be slightly different).
2. Watch the heads-up display and try to match your control movements to the recorded movements. Don't forget to watch the throttle!
3. Heed the hints that appear periodically along the bottom of the screen.

You can interrupt any lesson to change the view of zoom. You can also turn off the heads-up display. At the end of the lesson, the menu bar reappears automatically.

Fresh perspective

<u>To see what the airplane looks like during a lesson, use the Chase Plane or Tower view.</u>

If you buy the farm...

Don't worry if you buy the farm while flying AFT. You can start the flight over by selecting the same mission again (see "Keyboard Shortcuts" on the Command Summary Card).

CESSNA 172 ORIENTATION

You can use it as a trainer because it seats two side-by-side, you can use it for cross countries, or you can use it as your personal airplane - but it's not very fast. I suppose you get what you pay for....

No light plane deserves the title "generic airplane" more that the Cessna 172. Its characteristic high-wing, single-engine, tricycle-gear shape is a familiar sight around airports everywhere. The Skyhawk, as it's also known, has introduced thousands to flying since Cessna started making it in 1955. Pilots love it for its roominess, economy, reliability, and safety record, not to mention its stable handling characteristics. The 172 performs modestly when fully loaded with four passengers, but you can expect better performance since you'll be flying it alone. Hop in the left seat and get ready for your first lesson!

PREFLIGHT CHECK

Before starting a flight, take a moment to check the airplane controls, flight instruments, and simulator. Choose Test Flight from the Main menu. The plane is standing still in the hangar, lined up with runway 36. Run down this check-list:

- **Instruments -** check (heading indicator, airspeed indicator, attitude indicator, altimeter, vertical speed indicator, slip indicator).
- **Ailerons, elevators, and rudder -** correct response to control movement.
- **Flaps -** test.
- **Views -** check left, right, and satellite.
- **Brakes -** hold ON.
- **Engine -** check. Advance throttle, then retard throttle.
- **Brakes -** off.

As you test the ailerons, elevators, rudder, flaps, brakes, and power, be sure to check both the instrument panel and the heads-up display. For information on the controls and understanding the instruments, see the "Airplane & Simulator Controls" section of the Test Flight chapter. When you feel comfortable with the airplane instruments and controls, return to the Main menu, then back to Flight Instruction.

STRAIGHT AND LEVEL FLIGHT (LEVEL)

Straight and level flight, as the name implies, is a matter of maintaining a constant heading and altitude. You monitor visual references (VR) and instrument references (IR) to maintain straight and level flight.

You achieve level flight by adjusting pitch with the elevators and power with the throttle until the distance between the glareshield and horizon stays the same. For straight flight, use the ailerons to keep the wings level, so that the glareshield remains parallel to the horizon. The glareshield and horizon are your inside and outside visual reference point.

Confirm straight and level flight by scanning the instruments. The miniature airplane on the attitude indicator splits the artificial horizon, the altimeter is constant, the vertical speed indicator hovers around 0 fpm, and the heading indicator is steady.

Level flight is possible at a variety of power and picth stettings. The airspeed is different for each combination, but remains steady if you are flying level. As you apply more power, you lower the nose to maintain level flight, and the airspeed increases. The reverse is also true. Straight and level cruise speed at 100 mph requires 75% power and about one-third up-elevators.

You begin at 3000 feet, headed north over the airport.

STRAIGHT CLIMB (CLIMB)

In a straight climb, the pitch attitude and power settings result in a gain of altitude while the bank attitude remains level for straight-ahead flight. Adding power while holding the pitch attitude required for straight and level flight result in a climb. Best climb performance occurs with 100% power and with the nose higher than for straight and level flight. Holding the stick back about half-way raises the nose and reduces airspeed to about 75 mph.

The visual references for a climb resemble the visual references for straight and level flight. The glareshield remains parallel to and a constant distance from the horizon. However, the nose is higher when climbing so distance from glareshield to horizon changes. In a steep climb, the glareshield may even be above the horizon.

You can also scan the instrument panel to confirm what you see outside the airplane. When climbing, you should see the miniature airplane in the attitude indicator above the horizon. The altimeter should be moving in a clockwise direction and the vertical speed indicator should be above the 0 point. Provided you keep the wings level, the heading indicator will remain constant.

You start at 3000 feet, 1 mile north of the airport heading north. You climb at 75 mph for about two minutes, gaining 800 feet at 500 fpm.

STRAIGHT DECENT (DECENT)

Descents are pretty much the opposite of climbs. That being the case, you would expect that because you add power to climb, you would reduce power to descend, and you do. In the descent, or glide, you reduce power from cruise (75%) to cruise descent (50%) and adjust the pitch attitude so that gravity pulls the airplane forward and down along an inclined path. Reducing power to 50% and holding the stick about 1/8 forward lowers the nose and results in an 500 fpm descent at about 100 mph.

The visual references for a descent look so much like those for straight and level flight, it's hard to tell them apart. In both cases the glareshield remains parallel to and a constant distance from the horizon, but the glareshield is slightly lower on the horizon during a descent.

You can clearly spot a descent on the flight instruments. The miniature airplane in the attitude indicator is below the horizon, the altimeter moves counter-clockwise, and the vertical speed indicator registers close to -1. The heading remains constant as long as you keep the wings level.

You start at 3000 feet, 5 miles south of the airport heading north. You descend 1000 feet at 500 fpm while traveling at 100 mph on a 50% power setting.

LEVEL LEFT TURN, 30° BANK ANGLE (LEFTTURN)

A turn involves close coordination of all three flight controls - ailerons, rudder, and elevators. You turn the airplane by banking the wings - left bank for a left turn, right bank or a right turn. The banked wings no longer lift the plane straight up; now they lift both up and sideways. It is this sideways lift of the wings that turns the plane. The total amount of lift is the same, so there is necessarily less upward lift. You must compensate by raising the nose or the plane will descend. For example, with power set at 75% and the stick held slightly less than half-way left or right, you must hold the stick back almost half-way to maintain constant altitude.

The visual reference in a turn is again the relationship between the glareshield and the outside horizon, but this time the glareshield is at an angle to the horizon instead of parallel. If you hold the pitch attitude constant a level turn occurs.

The turn can clearly be seen on the attitude indicator, where the minature airplane is at an angle to the artificial horizon. If you hold the pitch attitude constant during the turn, then the altimeter will be constant, and the vertical speed indicator will be steady on 0 fpm. On the instrument panel, only the heading indicator moves, confirming the turn.

You circle at 3000 feet, 3 miles south of the airport, in a 30° bank.

LEVEL RIGHT TURN, 30° BANK ANGLE (RIGHTTRN)

The only difference between a right turn and a left turn is the direction of bank. You circle at 3000 feet, 3 miles south of the airport, in a 30° bank.

NORMAL TAKE-OFF (TAKEFF)

To tak eoff, the airplane must accelerate from a standstill to an airspeed that moves enough air over its wings to create the lifting force needed to overcome gravity. The take-off also includes the initial climb away from the take-off area to a safe manoeuvering altitude. The entire procedure involves a high degree of control on the ground as well as in the air.

You begin by lining the airplane up with the runway and applying 100% power. Maintain directional control while on the ground with the rudder. Use the runway markings as a visual reference. When you reach take-off speed, 75 mph in the Cessna, you rotate the airplane to the climb attitude by pulling back on the stick to raise the nose. After lift-off, you may need to lower the nose slightly until airspeed builds up to normal climb speed, 75 mph. At that point, you can establish the airplane in the familiar climb attitude that you have already practiced.

As you take off, notice how the balls on the ground grow smaller, helping you judge your altitude by eye. Because of your nose-high pitch angle, you quickly lose sight of them unless you change to an alternate view.

You begin in the hangar, lined up for take-off on runway 36.

BEGINNER LANDING (LANDING)

Landing the airplane requires very careful control of power and pitch attitude to achieve a descent at the proper approach speed. You must also maintain directional control if you want to land on the runway.

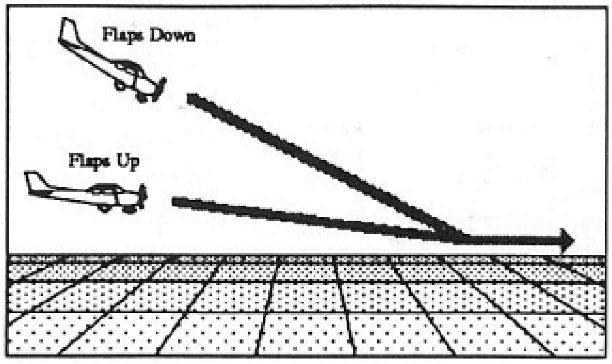
Note

Both landing lessons are recorded at the secondary airport, which 40 miles south of the main airport.

Plan your approach to the airport so that you are lined up withthe runway at an altitude of about 500 feet when you are about 2 or 3 miles out. Prior to reaching that point, move the elevators about one-third up and set power at 50% for a descent rate of about 500 fpm and an approach speed of 75 mph. You are now on final approach.

As you line up on final, lower the flaps and adjust the pitch attitude to maintain your descent rate. With the flaps down, the pitch attitude is lower for the same descent rate, giving you a better view of the runway. The airplane can also fly at a slower speed with the flaps extended, so there's less danger of stalling.

Figure 5
Flaps steepen the descent angle



One short final, about one-half mile out, locate a touch-down spot on the runway. This touch-down spot should remain at a constant distance above your glareshield when approaching the runway. If the touch-down point appears to rise in your windshield it means your angle of descent is too steep. In that case, add power as necessary to make the descent angle shallower. If you were to continue the approach without adding power you would surely land short of your touch-down point, if not short of the entire runway.

Conversely if you see the touch-down point descent in your windshield, then your angle of descent is too shallow and you are going to overshoot your desired touch-down point or the entire runway. To avoid this, you must decrease power, thereby increasing the descent angle.

Watch for the balls on the ground as you descent, and use their size to gauge your height above the ground. At 200 feet, you are low enough to see the balls through the windshield. Looking out a side window, you can see them below about 1000 feet.

Controlling the descent
You control the glideslope, or angle of descent, with power, not with pitch attitude. Think of the throttle as your altitude control.

While on final approach you must watch your airspeed closely. As mentioned earlier, your target airspeed for a smooth and safe landing in the Cessna 172 is 75 mph. If you need to adjust your airspeed while on the final approach, adjust the pitch attitude. For example, if you notice the airspeed has crept up to 80 mph, raise the nose slightly to slow down. If you have inadvertently slowed to 70 mph, lower the nose slightly to speed up.

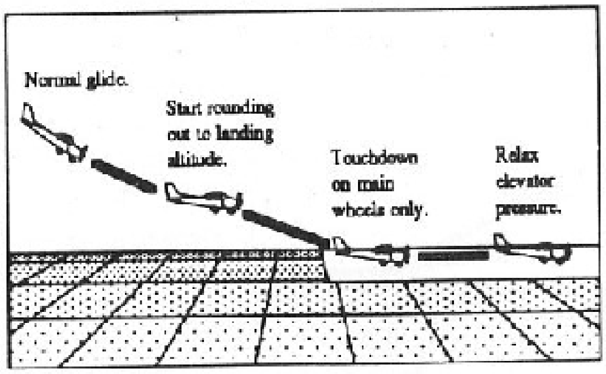
Controlling the airspeed
You control the airspeed with pitch attitude, not power. Think of the elevators as your speed control.

You'll learn the touch-down procedure in the next lesson. You are on a one-mile final for runway 36 at an altitude of 500 feet.

NORMAL LANDING (FLARE)

The landing flare is a slow, smooth transition from a normal approach attitude to a landing attitude. When the airplane is 10 to 20 feet above the runway, you gradually apply back pressure on the stick, raising the elevators to slowly increase the pitch attitude. At the same time, you reduce power to idle so as to land on the main gear first with the nose gear still up in the air (Figure 6).

Figure 6
Landing flare



Increasing the pitch attitude increases lift, thereby decreasing the downward velocity of the airplane, so you gently settle onto the runway. This increase in lift also increases drag which helps to slow the aircraft before touch-down. After touch-down, brake to taxi speed, raise the flaps, and taxi off the runway.

You are lined up on final for runway 36 at an altitude of 300 feet.

SOLO

After nine basic flying lessons, you're ready to solo. To do that, go back to the Main menu and choose Test Flight. You start lined up for take-off at the approach end of runway 36 on the main airport. Apply power to taxi or take off.

At first, you'll probably want to stick pretty close to the airport, practicing take-offs, landings, and the other manœuvres you learned in your basic lessons. Later, you can head out on cross-country trips. For more information on navigation, finding the airport and other landmarks, changing planes, and flying with wind, see the Test Flight chapter.

Advanced flight instruction

The advanced instruction section covers transitions from one fundamental manœuvre to another, steep turns, and stall recoveries. All advanced lessons are given in the Cessna 172, which is described in "Cessna 172 orientation" earlier in this chapter. If you need instructions on taking AFT flight lessons, see "How to take a lesson" earlier in this chapter.

STRAIGHT AND LEVEL TO CLIMB (LVL_CLMB)

The goal here is to make the transition from straight and level cruise flight into a straight climb. Earlier lessons showed you what cruise and climb flight attitudes looked like visually and on the instruments. You also learned that the cruise power setting is 75%, and the climb setting is 100%.

With this in mind you can begin the transition to a climb. First, you raise the pitch attitude from straight and level attitude to the climb attitude. Do this by bringing the elevators back until the visual reference looks like what you expect for a straight climb.

Increase the power from cruise (75%) to climb power (100%). The transition is complete when the airspeed is constant, about 75 mph for a Cessna 172.

A check of the instruments shows the miniature airplane on the attitude indicator above the horizon in the climb position, the altimeter moving clockwise, the vertical speed indicator above the 0 point and the airpseed indicator moving counter-clockwise.

You start at 3000 feet, 2 miles south of the airport heading north at about 90 mph. During the transition, you climb 250 feet.

CLIMB TO STRAIGHT AND LEVEL (CLMB_LVL)

The transitions from climb to straight and level is pretty much the opposite of the last transition. After climbing to the desired altitude, you lower the pitch attitude from climb to straight and level flight. Continue operating at full power to let the airspeed increase to the approximate cruise airspeed. Then decrease the power to 75%. If you reduce power early, the acceleration to cruise speed will take longer.

The transition is complete when the pitch attitude is appropriate for straight and level flight, the power is set at 75% and the airspeed indicator is approximately 100 mph.

You start at 3250 feet, 9 miles south of the airport, climb 300 feet, and level off.

STRAIGHT AND LEVEL TO DESCENT (LVL_DSNT)

In this lesson you make the transition from straight and level cruise configuration to the descent configuration, which you learned in one of the basic lessons. All you do is reduce power gradually to about 50%. This correlates to your pre-landing instruction that said "power controls altitude."

The more you reduce power, the greater the descent angle and rate of descent. In a real airplane, your descent rate should not exceed 1000 fpm to avoid ear discomfort.

This transition is complete when the power is reduced to 50%, the pitch attitude is set at the normal descent attitude. Then the airspeed is constant, the altimeter is moving counter-clockwise, and the vertical speed indicator is below the 0 point.

You start at 2000 feet, over the airport heading north at about 100 mph. During the transition, you descend 800 feet.

DESCENT TO STRAIGHT AND LEVEL (DSNT_LVL)

The transition from descent to straight and level flight is the opposite of the last lesson. If a reduction in power causes the aircraft to descend, then an increase should cause the aircraft to level off or climb.

As you increase power, you see the glareshield move up closer to the horizon. Increasing power to 75% should bring the airplane to a straight and level attitude.

You start at 3000 feet, 2 miles south of the airport, descending at 100 mph.

STEEP LEFT TURN (STEEPLFT)

The key to performing steep turns (45° to 60°) is understanding what happens to lift in a turn. You may remember from an early lesson that banking for a turn creates sideways lift at the expense of upward lift. In a steep turn, the amount of vertical lift lost to the horizontal is substantial and the result will be a serious loss of altitude unless the pilot does something to prevent it.

To maintain level flight while executing a steep turn, you must increase the pitch attitude and set to power to 100%. The increased power and pitch attitude will increase the upward lift to offset the loss due to sideways lift.

Start the manœuvre by setting the power to 100%. Then roll the airplane to about 60° of bank. When passing 30° of bank, increase the pitch attitude slightly.

If you start to lose altitude during the turn, make the bank shallower to increase the vertical lift. Upon reaching the desired altitude again, you may resume the steep bank but with more back pressure on the stick.

You must roll out of a steep turn before reaching the desired heading. As a rule of thumb, start to roll out about half the bank angle ahead of the desired heading. If, for example, the bank angle is 60°, start the roll out 30° early.

As you roll the airplane to level flight, reduce the pitch attitude to that of straight and level flight. Reduce power to cruise (75%) and the manœuvre is complete.

You circle at 3000 feet 1 miles north of the airport.

STEEP RIGHT URN (STEEPRGT)

The only difference between a steep left turn and the steep left turn you learned in the last lesson is the direction of bank. You cicrle at 3500 feet 2 miles south of the airport.

POWER OFF STALL AND RECOVERY (STALL1)

A stall occurs when the smooth airflow over the airplane's wing is disrupted, and the lift degenerates rapidly. Without lift, the airplane cannot fly. A stall occurs because you have over controlled the pitch attitude of the airplane. Specifically, if you apply too much back pressure too fast, the wing stops flying. This condition must be changed quickly if the airplane is to remain in the air where it belongs.

Stall recovery is very simple: release back pressure on the stick. Since back pressure caused the stall, releasing that back pressure restores the smooth airflow over the wing and the airplane flies again.

The power-off stall generally occurs when an airplane is approaching an airport for a landing. The pilot's attention is divided between controlling the airplane, recognizing the airport layout, spotting other traffic in the area, communicating with controllers, and so on. The stage is now set. If the pilot lets the airspeed get too low or pitch attitude too high, a stall may occur. Recovery must be swift because of the proximity to the ground. Any delay in the recovery would most certainly result in a bought farm.

The first indication of an approaching stall may be the stall warning horn. If the stall progresses unchecked, you will see visually and on the instruments a descending pitch attitude. You should then release the back pressure on the control stick and add full power (100%) to begin a climb to a safe altitude.

Practice stalls at a safe altitude - at least 3000 feet above ground level. The manœuvre is complete when you have reestablished the airplane in straight and level flight.

You start at 3000 feet 3 miles northwest of the airport.

POWER ON STALL AND RECOVERY (STALL2)

The power-on stall generally occurs shortly after take-off. If the pitch attitude of the airplane is increased beyond that of the normal climb attitude, a stall may occur.

Power-on stall parctice starts in cruise flight. You increase power to 100% and increase back pressure on the stick until the stall occurs.

The recovery is quite simple: release the back pressure on the elevators to restore smooth airflow over the wings. Once the airplane is flying, you resume your normal climb attitude.

You begin at 3000 feet, directly over the airport heading north at about 100 mph.

Aerobatic instruction

No sooner was the airplane invented than the earliest fliers were trying to see just what their new machines could do. Many of these stunt, now referred to as aerobatic manœuvres, were invented or discovered purely by accident. When some stunt did not go exactly to plan the result was often a newly discovered manœuvre. Others were invented as evasive manœuvres for the dogfighting pilot and many are still used today by the modern fighter pilot.

Considering the technology of yester-year, those pilots were true dare-devils. They never knew for sure what limiting aerodynamic forces and stresses they and their early airplanes could withstand.

SPITFIRE ORIENTATION

It's tough trimming airplanes like the P-51. It's a lot harder to fly than an F-16 - or any jet. Jets are easy to fly compared to prop-driven fighters. You don't have torque and prop-wash turbulence to worry about.

Before beginning aerobatic lessons, you must be thoroughly proficient at flying the Spitfire in the basic and advanced manœuvres taught in "Basic flight instruction" and "Advanced flight instruction." If you have been flying a Cessna, you must switch to the Spitfire.

Be careful taxiing. Don't apply too much power or you'll get going to fast and may lose control.

Apply full power for take-off. You'll reach rotation speed - 100 mph - remarkably fast. Once airborne, retract the gear. As you climb, don't let yourself become mesmerized by the spinning altimeter hands. Watch your airspeed; 170 mph is the best climb speed.

After leveling off, you'll find that like the real airplane, you can't fly the ATF spitfire hands-off for more than a few seconds. Let your attention wander, and a wing will drop or the nose will leave the horizon. In a real Spitfire, leaning forward to adjust an instrument is enough to drop the nose.

Practice ascending and descending to and from straight and level. Remember, your rate of climb or descent, at a given airspeed and power setting, is determined by the pitch attitude. When flying at high speeds, a very slight change of pitch attitude immediately results in a high rate of climb or descent and a rapid gain or loss of altitude. Therefore, you must exercise extreme caution when manoeuvering at low altitude and high airspeed.

Steeply banked turns required extra caution too. Control pressure on the elevators changes rapidly during the entry into a steeply banked turn, and it's very easy at this time to make inadvertent changes in your pitch attitude. The resulting altitude variations can be critically dangerous if you're close to the ground.

Having fun? Don't forget you've got to get this thing back on the ground some day. As you near the airport, slow the plane to 160 mph, the approach to landing speed, and adjust power and pitch to establish a suitable rate of descent. Lower the flaps and the gear and add a little power to keep the nose up as the plane slows to 150, 140, 130. If you find yourself settling too fast, add a little power. Careful with the power, or you'll find yourself going around for another landing! Mustang pilots often learn the hard way that a full burst of power at landing speeds will flip the ship on its back. Cut the gun on short final, then ease back the stick and touch down. Hit the brakes, and raise the flaps as you roll to a stop.

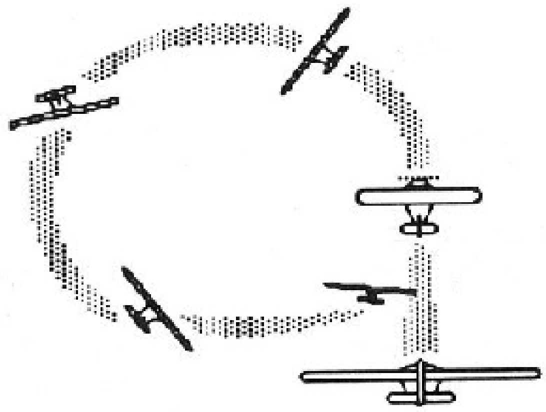
Inverted Flight

The Spitfire fuel system cannot maintain fuel pressure during extended inverted flight. For this reason, you must limit inverted flight to 30 seconds - plenty of time for any normal manœuvre - or the engine will quit. (The engine restarts when you right the plane.)

AILERON ROLL (AIL_ROLL)

The aileron roll was one of the early stunts invented by barnstorming pilots (Figure 7). Today there are many variations of this manœuvre - slow, fast, four-point, eight-point, barrel, and so on.

Figure 7
The aileron roll



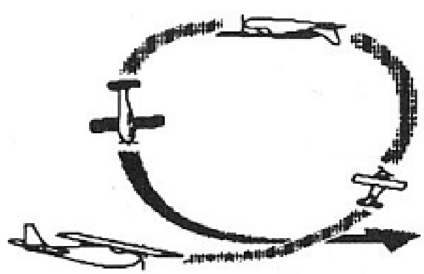
Begin the aileron roll by increasing the power to 100% and increasing the pitch attitude to approximately 20° above straight and level attitude. Next, initiate a coordinated roll - right aileron, right rudder - while maintaining slight back pressure on the elevators. The slight back pressure maintains a constant positive G-force throughout the roll.

When the upright horizon appears, centre the ailerons and rudder to initiate the rollout and resume straight and level flight. The maneuver is now complete.

LOOP (LOOP)

Lincoln Beachey, an early dare-devil barnstroming pilot, is credited with inventing the loop, or "loop-the-loop" as it was originally known (Figure 8). It was used extensively by WOrld War I pilots as an evasive action manœuvre while dogfighting in the skies over Europe.

Figure 8
The loop



The first step in learning to execute the loop is to fly at an altitude that gives you plenty of room for error. The next step is to set up the manœuvre over a road or straight line reference point such as a runway. Then increase power to 100% and start to increase the back pressure on the elevators. Constantly increase the back pressure until the inverted horizon comes into view.

You might need to select a left view or right view in order to keep the wings of the airplane parallel to the horizon. If the wings are not parallel to the horizon use aileron control to level them.

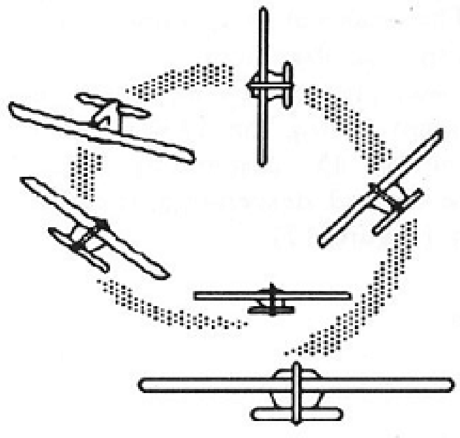
As the inverted horizon comes into view, you must relax some of the back pressure in order to make the circle symmetrical. You may also need to reduce power on the back side of the loop to keep the airspeed from becoming excessive and to keep the loop symmetrical.

As the upright horizon comes into view, set the pitch attitude for straight and level flight attitude. If you haven't already reduced the power to cruise then now is the time. You should start and finish the loop on the same heading. The manœuvre is now complete.

SLOW ROLL (SLOWROLL)

The slow roll is essentially the same as the aileron roll, in that the movement is around the longitudinal axis of the airplane (Figure 9). The major difference is that the pitch attitude (nose of the aircraft) is held on the horizon throughout the roll.

Figure 9
The slow roll



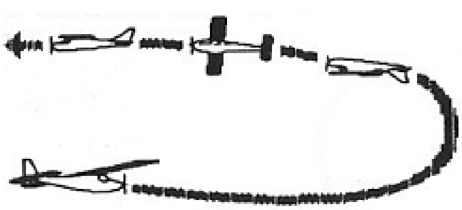
Begin the slow roll by increasing power to 100%. Then initiate a coordinated roll, left or right, with ailerons and rudder. As the bank angle passes 90°, you will have to hold the stick forward to keep the nose of the aircraft on the horizon.

As you complete 270° of roll, neutralize the elevators. When the upright horizon returns to view, increase the back pressure to maintain straight and level attitude and reduce power to cruise (75%). The manœuvre is now complete. The final heading should be the same as the entry heading.

IMMELMAN (IMMELMAN)

The Immelmann was invented by Lt. Max Immelmann of the German air force in World War I as a manœuvre to reverse direction whike gaining altitude. It is a half loop followed by a half roll (Figure 10). Lt. Max Immelmann was credited with 17 kills as a German fighter pilot, but his career was brief. He entered combat August 1915 and died June 1916 when his aircraft broke up in flight due to structural failure.

Figure 10
The Immelmann



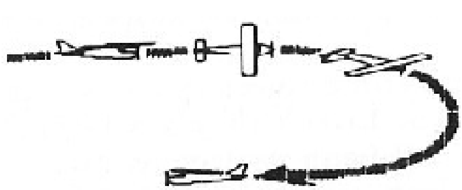
To begin an Immelmann, increase power to 100% and increase back elevators as if you were performing a loop. But when the inverted horizon comes into view, initiate forward elevators. Hold this attitude until the airplane is stabilized in inverted flight.

The heading of the airplane should be 180° opposite that of the entry. Next, half roll the airplane left or right to the upright straight and level flight attitude. Finally, reduce the power to cruise (75%) and the manœuvre is now complete.

SPLIT S (SPLITS)

The Split S is nothing more than half a roll and the last half of a loop (Figure 11). A reference line on the ground helps when executing this manœuvre.

Figure 11
The Split S



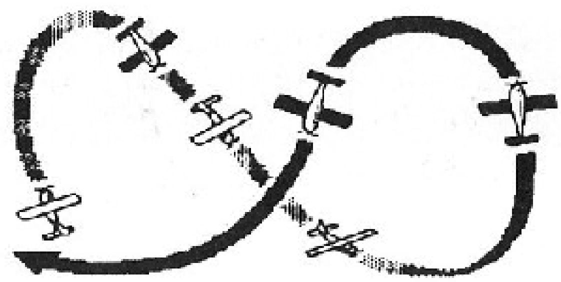
You begin the Split S by reducing power to approximately 50%, causing the airspeed to decrease if the altitude is maintained. This is important because the second part of the manœuvre generates excessive airspeed.

Next you execute a roll, stopping in the inverted position. As the airplane reaches inverted flight, apply back pressure on elevators. Steadily increase back pressure until the upright horizon comes into view. When you reach the straight and level attitude, increase power to normal cruise. The heading should be 180° opposite the entry heading. The manœuvre is now complete.

CUBAN EIGHT (CUBAN8)

The Cuban 8 was invented by an American Pilot named Len Povey, who flew for the Cuban Government during the 1930's. Briefly, the Cuban 8 consists of a 3/4 loop with a half roll on the 45° descending angle followed by anoither 3/4 loop and another half roll on the second decending angle at which time the figure 8 has been scribed through the sky (Figure 12).

Figure 12
The Cuban 8



You start the Cuban 8 by increasing power to 100% and reducing the pitch attitude to increase the airspeed. Then apply continuous back pressure just as in a loop. You must neutralize the elevators as the glareshield of the aircraft reaches a point of 45° below the inverted horizon. At this time the aircraft is half rolled to the upright still in a 45° descent attitude.

You increase back pressure again, just as in a loop. And again when the glareshield of the aircraft reaches a point 45° below the inverted horizon, you release back pressure. The airplane is now upright in a 45° descent attitude. Apply more back pressure to regain a staright and level flight attitude, and reduce power to normal cruise. The exit heading should be the same as the entry. The manœuvre is now complete.

To learn more about flying

There are lots of books about flying and about the airplanes in AFT. Here are a few:

- U.S. Department of Transportation. Federal Aviation Administration. *Pilot's Handbook of Aeronautical Knowledge.* AC 61-23B. Washington, D.C.: GPO.
- U.S. Department of Transportation. Flight Standards Service. *Flight Training Handbook.* AC 61-21A. Washington, D.C.: GPO.
- Medore, Arthur S. *Primary Aerobatic Flight Training With Military Techniques.* Glendale, CA: Aviation Book Company, 1972.
- Cessna Aircraft Company. *1986 Skyhawk Information Manual.* Witchita, KS: 1985.
- Cole, Duane. *Roll Around a Point.* Milwaukee, WI.: Ken Cook Company, 1976.
- *P-51D Mustang Handbook.* Dallas, TX: Flying Enterprise Publications.
- Morgan, Len. *The P-51 Mustang.* Blue Ridge Summit, PA.: Aero/Tab Books, Inc., 1979.
- Yeager, General Chuck and Janos, Leo. *YEAGER.* New York, NY: Bantam Books, Inc., 1985
- Miller, Jay. *The X-Planes, X-1 to X-29.* Marine on St. Croix, MN: Specialty Press Publishers and Wholesalers, Inc., 1983

Appendix B-Test Flight Check-list

Aircraft ___________________________ **Test Pilot** ________________________________

Minimum Take-off Speed ___________ Mach
Minimum Take-off Speed (Flaps Down) ___________ Mach
Maximum Level Speed (100% Throttle) ___________ Mach
Maximum Speed with Flaps Down ___________ Mach
Cruise Speed (75% Throttle) ___________ Mach
Stall Speed (Clean) ___________ Mach
Stall Speed (Flaps Down) ___________ Mach
Stall Speed (Gear Down, Flaps Up) ___________ Mach
Stall Speed (Gear & Flaps Down) ___________ Mach
Speed for Maximum Sustained Rate of Climb ___________ Mach

Speed (Mach)										
.2	+	+	+	+	+	+	+	+	+	+
.3	+	+	+	+	+	+	+	+	+	+
.4	+	+	+	+	+	+	+	+	+	+
.5	+	+	+	+	+	+	+	+	+	+
.6	+	+	+	+	+	+	+	+	+	+
.7	+	+	+	+	+	+	+	+	+	+
.8	+	+	+	+	+	+	+	+	+	+
.9	+	+	+	+	+	+	+	+	+	+
1.0	+	+	+	+	+	+	+	+	+	+
1.1	+	+	+	+	+	+	+	+	+	+
1.2	+	+	+	+	+	+	+	+	+	+
1.3	+	+	+	+	+	+	+	+	+	+
1.4	+	+	+	+	+	+	+	+	+	+
1.5	+	+	+	+	+	+	+	+	+	+
1.6	+	+	+	+	+	+	+	+	+	+
1.7	+	+	+	+	+	+	+	+	+	+
1.8	+	+	+	+	+	+	+	+	+	+
1.9	+	+	+	+	+	+	+	+	+	+
2.0	+	+	+	+	+	+	+	+	+	+
	5	10	15	20	25	30	35	40	45	50

Time to 10,000 feet (or 3,000 feet for lower performance aircraft)

Service Ceiling (Using Maximum Sustained Rate of Climb) ___________ Feet
Maximum Attainable Speed (in Dive) ___________ Mach
Maximum Attainable Altitude ___________ Feet

NOTICE

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