



AIRCRAFT HANDBOOK

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INTRODUCTION

Welcome to your Flight Simulator 2002 Aircraft Handbook. Inside, you'll find detailed histories, specifications, and flight notes for all of your Flight Simulator 2002 aircraft.

There are 12 player-flyable aircraft available in the Standard Edition of Flight Simulator 2002, and 16 aircraft in the Professional Edition. In addition to the player-flyable aircraft, you'll find three other aircraft sharing the Flight Simulator skies: the Dash 8-100, the MD-83, and the Piper Cherokee 180. Keep an eye out for them as you take to the skies.

For more information about any of your aircraft, see the **kneeboard**, or the manufacturer Web sites of your favorite plane, helicopter, or sailplane.

BEECHCRAFT

History of Beechcraft

The story of Beech is a love story; one that encompasses the union of two of aviation's legendary characters and their determination to build superior aircraft. Walter Beech met Olive Ann Mellor when he was president and she was office manager of the Travel Air Company. They married in 1930, and in 1932, formed the Beech Aircraft Company. They were the perfect team—Walter provided the entrepreneurial spirit, and Olive Ann supplied the financial wizardry. After Walter's death in 1950, Olive Ann led the company until her retirement decades later, earning her universal respect in the industry and the sobriquet of "First Lady of Aviation." In 1980, she was the first woman to receive the coveted Wright Brothers Memorial Trophy for her contributions to aviation. Both Beeches were eventually inducted into the Aviation Hall of Fame.

From the beginning, Beechcraft airplanes have been distinguished by their attention to quality and aesthetics. The D17 Staggerwing was the first model off the line and is still considered to be one of aviation's most elegant designs. Though the final models were built in the 1940s, some of the nearly 800 Staggerwings built are still flying and turning heads at airshows today.

Unlike many of its competitors, Beech has always been a profitable company. World War II brought large contracts for training aircraft and other defense-related material. After the war, Beech capitalized on the corporate and private airplane markets, where they have been an enduring presence. They have continued to develop and supply aircraft for U.S. military services, and even designed cryogenic life-support systems for NASA.

BEECH

The most famous Beech in the light-plane category is the Beechcraft Bonanza. This classic, single-engine, V-tail helped establish Beech singles as the Cadillacs of their class. In all its variants, over 3,000 Bonanzas have taken to the skies in the past 52 years. In the light-twin market, the Beech Baron has been popular for both business and leisure use.

Now a division of Raytheon Aircraft Company, Beech still has a solid position in the corporate aircraft market. Speed, comfort, and luxury appointments characterize the typical Beechcraft business plane. One of the more spectacular

designs was the beautiful Beech Starship 2000A (ultimately unsuccessful in sales volume). From the Staggerwing and the D-18 twin through the extremely successful King Air line and the Beechjet, corporations have been using Beech airplanes to conduct the business of business for almost 70 years. With more than 50,000 aircraft delivered, the company created by Walter and Olive Ann Beech has been one of the greatest success stories in aviation and industry. It is likely to remain so for decades to come.



Beech Baron 58 (Professional Edition Only)

With the wonderful control harmony that is the hallmark of the Bonanza line, the Beech Baron 58 is considered a classic light twin. The Baron 58 is a spiffed-up version of a time-tested favorite made modern by its new Continental Special engines. The Baron combines the attractiveness of Beechcraft design with the reliability of twin engines, resulting in a gorgeous workhorse of an aircraft.

Specifications	U.S.	Metric
Cruise Speed	200 kts	370 km/hr
Engine	Teledyne Continental Motors IO-550-C 300 hp	
Propeller	Three McCauley constant-speed, variable pitch	
Maximum Range	1,569 nm	2,906 km
Service Ceiling	20,688 ft	6,306 m
Fuel Capacity	142 gal	514 L
Maximum Gross Weight	5,524 lbs	2,509 kg
Length	29 ft, 10 in	9.09 m
Wingspan	37 ft, 10 in	11.53 m
Height	9 ft, 9 in	2.97 m
Seating	Up to 6	
Useful Load	1,634 lb	741 kg

When the first light twin appeared in the 1950s, aviation enthusiasts quickly recognized it as the height of personal air transportation. More than 50 years later, the Baron 58 serves as an excellent example of why that's still true. The Baron 58 was beautifully designed with both comfort and safety in mind. But it's not just another pretty plane—with full fuel, a Baron 58 can carry up to 931 pounds of people or cargo for 1,340 nautical miles with 45 minutes reserve. Twin 300-hp TCM IO-550-C, six-cylinder, fuel-injected engines provide enough power to take off with a scant 1,400 feet ground run and climb at over 1,700 feet per minute, even fully loaded. The Baron carries payload further and faster than any other piston twin currently manufactured.

Flight Notes

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight on a day with International Standard Atmosphere (ISA) conditions.

Important

These instructions are intended for use with Flight Simulator only and are no substitute for using the actual aircraft manual for real-world flight.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Note

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you select "Display Indicated Airspeed" in the Realism Settings dialog box. Speeds listed in the specifications table are shown as true airspeeds.

Required Runway Length

2,200 feet with ISA conditions. 3,800 feet with a 50-foot obstacle.

Engine Startup

The engine will be running automatically every time you begin a flight. If you shut

BEECH

the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**. If you want to do the startup procedures manually, use the checklist on the Kneeboard.

Taxiing

Set prop and mixture to full forward, and taxi at a brisk walking pace.

Takeoff

Run through the Before Takeoff checklist found in the Kneeboard (press **F10**).

Align the aircraft with the white runway centerline, and advance the throttle to takeoff power.

Climb

Climb at approximately 105 kts.

Cruise

Cruise altitude would normally be determined by winds, weather, and other factors. You might want to use these

factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

However, as an example: At 11,500 feet, set your airspeed for 196 KTAS (true airspeed). Keep full power, around 2500 rpm.

Descent and Approach

Reduce airspeed to 170 kts when below 13,000 feet.

Landing

Reduce airspeed and adjust flaps as you descend. At 152 kts, apply 15 degrees of flaps. Extend full flaps at 122 kts.

Upon touchdown, bring the power back to idle and lightly apply the brakes by pressing the **PERIOD** key.



Beech King Air 350 (Professional Edition Only)

With more than 5,000 delivered, there is no other turbine-powered business aircraft that can match the success of the Beech King Air. At times, nearly 90 percent of the cabin-class turboprops in the world have been King Airs. Designed as a turbine-powered alternative to the Queen Air, the King Air eventually supplanted the Queen Air as the number one choice in executive turboprops.

Specifications	U.S.		Metric
Cruise Speed	315 kts	363 mph	583 kph
Engines	Pratt & Whitney PT6A-60A	1,050 shp	
Maximum Range	1,894 nm	2,180 mi	3,508 km
Service Ceiling	35,000 ft		10,668 m
Fuel Capacity	539 U.S. gal		2,040 L
Maximum Takeoff Weight	15,000 lbs		6818 kg
Length	46.7 ft		14.23 m
Wingspan	57.9 ft		17.65 m
Height	14.3 ft		4.36 m
Seating	Up to 11		
Useful Load	5,810 lb		2,635 kg

BEECH

The King Air in all its variants is a beautiful airplane with classic styling and graceful lines. Many of the improvements over the years have provided better aerodynamic efficiency, increased muscle under the cowlings, greater speed, upgraded avionics and electrical systems, and increased cabin luxury. In addition to duties as a corporate shuttle, the plane is also available in cargo configurations.

A significant design change that would set the tone for future models in the line was the Model 200 Super King Air. A swept T-tail design was adopted, allowing the stabilizer and elevator to operate in relatively smooth, undisturbed air, out of the wing's downwash. It also gave the King Air a rakish new look. The length, wingspan, and power were increased, resulting in a greater useful load. The plane carried eight passengers in a pressurized cabin altitude of 6,740 feet at 25,000 feet.

Along with other improvements, Beech experimented with putting turbofan engines on the King Air. A test bed was flown with this modification, but the idea was never put into production.

The latest derivative of the King Air is the Model 350. With the most powerful engines on a King Air to date (1,050 shaft horsepower) and a fuselage 34 inches longer than the Model 300, the 350 sits at the pinnacle of a great lineage. It can seat up to 11 passengers in double-club chair arrangements that are standard in this plush airplane. A small galley and an in-flight entertainment system provide a level of comfort King Air customers have come to expect. Distinctive winglets are the most obvious external feature that make the 350 easy to distinguish from its King Air siblings on the airport ramp.

The entire King Air line is characterized by a great basic design that has only improved over the decades. It is a legend that continues to be a top pick for corporate flight operations. The King Air is a plane that richly deserves its regal moniker.

Flight Notes

The elegant King Air is a high-performance, pressurized-cabin, twin-engine, turboprop airplane. Most often employed as a corporate transport, it usually seats from 9 to 11 (although it's certified for up to 17 people). The structure is distinguished by its efficient wing and NASA-designed winglets. The T-tail on the Super King Airs was designed to provide improved aerodynamics, lighter control forces, and a wider center-of-gravity range.

Many a young pilot has stepped up from more lowly positions to corporate flying in the right seat of a King Air. Piloting the beautiful Beech is a good transition toward the more complex world of turbine engines and larger aircraft.

Required Runway Length

- Takeoff: 4,193 ft, flaps up
- Landing: 3,300 ft, approach flaps extended

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

- Weight: 15,000 lb (6,804 kg)
- Altitude: sea level
- Wind: no headwind
- Temperature: 15° C
- Runway: hard surface

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Engine Startup

The engines are running by default when you begin a flight. If you shut the engines down, it is possible to initiate an auto-startup sequence by pressing **CTRL+E** on your keyboard. If you want to do the startup procedures manually, follow the checklist procedures on the Kneeboard.

The propellers on the King Air 350 will automatically feather on engine shutdown and unfeather when the engines are started.

- The power levers on the King Air control engine power, from idle to takeoff power, by controlling N_1 . Increasing N_1 increases engine power. The power levers have three regions: **Forward Thrust**, **Ground Fine**, and **Reverse**. When moved into the Reverse region, the levers control both engine power and propeller blade angle.
- The propeller levers are operated forward and aft for setting the required RPMs for various phases of flight. The normal range is from 1450 to 1700 RPM. To feather a propeller manually, move the prop lever (press **CTRL+F2**, or drag the prop levers) back into the red-and-white striped section of the quadrant (autofeather is on by default and will take care of feathering in the event of an engine failure).

- The condition levers have three positions: **Fuel Cutoff**, **Low Idle**, and **Hi Idle**. At Low Idle, the N_1 range is from a minimum of 62 percent to a maximum of 104 percent. At Hi Idle, the range is from 70 percent to 104 percent. Low Idle is the condition setting for 99 percent of the King Air's operating range.

Taxiing

The normal power setting for taxiing is the Ground Fine setting (press **F2** on the keyboard, or drag the power levers). For normal operation on the ground when the props are not in feather, the RPM should be maintained above 1050. The prop levers should be set to maintain RPM above 1050 or below 400 while on the ground to avoid propeller resonance. Sustained operation in feather at engine idle should be avoided. Monitor interstage turbine temperature (ITT) to avoid exceeding ground-operations temperature limits of 750° C.

Flaps

Unless the runway is short, a no-flaps takeoff is standard for the King Air. On the King Air 350, available flap settings

are **Up**, **Approach**, or **Down**. The flaps cannot be stopped at an intermediate point between these positions. See the Kneeboard for the flap operating speeds.

Takeoff

Run through the Before Takeoff checklist. With the aircraft aligned with the runway centerline, check that the propeller levers are full forward and that the condition levers are in Low Idle (press **CTRL+SHIFT+F2**, or drag the levers).

Advance the power levers to 100 percent N_1 , and monitor the ITT during the takeoff roll (it should remain at or below 750° C).

Directional control is maintained by use of the rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

- V_1 , approximately 105 knots indicated airspeed (KIAS), is decision speed. Above this speed, it may not be possible to stop the aircraft on the runway in case of a rejected takeoff (RTO).

- At V_r , approximately 110 KIAS, smoothly pull the stick back (use the joystick or yoke, or press the **DOWN ARROW**) to raise the nose to 10 degrees above the horizon.
- At V_2 , approximately 117 KIAS, the aircraft has reached its takeoff safety speed. This is the minimum safe flying speed should an engine fail. Hold this speed until you get a positive rate of climb.

As soon as the aircraft is showing a positive rate of climb on liftoff (both vertical speed and altitude are increasing), retract the landing gear (press **G**, or drag the landing gear lever).

Climb

Set climb power to approximately 90 percent N_1 (press **F2**, use the throttle control on your joystick, or drag the thrust levers). Set the prop RPM to 1600. Turn the synchrophaser on (click the **Prop Synch** button). Maintain 6- or 7-degrees nose-up pitch attitude to climb to your cruising altitude. Your indicated airspeed will vary in a climb as you hold a constant power setting and pitch attitude. Expect it to read approximately:

Sea level to 10,000	170 KIAS
10,000 to 15,000	160 KIAS
15,000 to 20,000	150 KIAS
20,000 to 25,000	140 KIAS
25,000 to 30,000	130 KIAS
35,000 to 40,000	120 KIAS

Cruise

Cruise altitude would normally be determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section

Let's say you've filed a flight plan for FL 300. Approaching your cruising altitude, begin leveling off at about 50 ft (15 m) below your target altitude.

You'll find it's much easier to operate the King Air in cruise if you use the autopilot. The autopilot can hold your specified altitude, speed, heading, VOR course, and more. For more information on using the autopilot, see **Using the Autopilot** in **Help**.

BEECH

A typical power setting in the King Air for the parameters chosen here is 66 percent on the torque (percent) gauge. That will give you a fuel flow of around 575 pounds per hour (PPH) and an indicated airspeed of 185 kts. The propeller levers should be set to maintain 1500 RPM.

Remember that your true airspeed is actually much higher in the thin, cold air. Experiment with power settings to find the one that maintains the cruise speed and fuel consumption you want at the altitude you choose.

Descent

A good descent profile includes knowing when to start down from cruise altitude and planning ahead for the approach. Normal descent is done using idle thrust and clean configuration (no speed brakes). A good rule for determining when to start your descent is the 3-to-1 rule (three miles distance per thousand feet in altitude.) Take your altitude in feet, drop the last three zeros, and multiply by 3.

For example, to descend from a cruise altitude of 30,000 ft (9,144 m) to sea level:

30,000 minus the last three zeros is 30. $30 \times 3 = 90$

This means you should begin your descent 90 nautical miles from your destination, maintaining a speed of 250 KIAS (it won't indicate this high until you descend into denser air), and a descent rate of 1,500 ft per minute. Add two extra miles for every 10 kts of tailwind, if applicable.

In the King Air, adjust thrust during descent to maintain 250 KIAS or VMO, whichever is less (use the joystick throttle, or press **F2** to decrease thrust and **F3** to increase thrust). The propeller levers should remain at 1500 RPM.

The King Air performance manual says that this descent profile will take 20 minutes, 103 miles, and 245 lb of fuel.

Approach

As you near the approach phase of flight, begin to bring the power back to around 55 percent torque or less, so that you're below 180 KIAS by your initial approach fix (use the joystick throttle, or press **F2**).

BEECH

At the final approach fix, bring the power back to 30 percent torque, and your speed will start slowing towards 140 KIAS. Verify that the autofeather is armed (click the **Autofeather** switch into the ARM position).

When you intercept the glideslope or enter the downwind, set the flaps to Approach (press **F6**, or click the flap lever) and put the landing gear down (press **G**, or click the landing gear lever).

Bring the power back to 25 percent torque. Adjust power as you near the threshold to reduce speed to a target landing speed of 109 KIAS.

At around 300 ft (91 m) AGL, continue reducing power. If you've broken out on an ILS or the landing is assured on a visual approach, set flaps to Full.

Landing

As you cross the threshold at around 50 ft (15 m) AGL, the power should be at 10 percent torque. (You can actually come back to idle power at this point, but the King Air will settle rather quickly. The best technique is to hold 10 percent torque until the main gear are on the pavement.)

Raise the nose slightly to flare and slow the descent rate. Once the King Air mains are down, bring the power back to idle and hold some back pressure on the controls (hold the joystick aft, or press the **DOWN ARROW**.) The nose on the King Air tends to start down right away on touchdown, so you'll want to hold some back pressure to bring it down gently.

The King Air decelerates rapidly on landing. Once the nose gear is on the runway, move the propeller levers into the bottom of the Ground Fine range (press **CTRL+F2**, or drag the levers).

There's no need to use the full reverse propeller setting on landing unless the runway is short. If you're performing a short-field landing, move the propeller levers into Reverse once the nose gear is on the ground.

Apply the brakes (press the **PERIOD** key). Move the propeller levers to Ground Fine, exit the runway, and taxi to parking.

History of Bell

It is fitting that the permanent collection of the Museum of Modern Art in New York City contains a Bell-47 helicopter, an object whose beauty is inseparable from its efficiency. The genius of Leonardo Da Vinci produced the idea of vertical flight; centuries later, it would take another brilliant innovator, philosopher, and artist to bring the concept to commercial reality. His name was Arthur Young.

Young came to Larry Bell's attention in 1941 after Young had been working on helicopter design for over a decade. Bell was an entrepreneur and a successful manufacturer of military aircraft like the Airacobra P-39. A demonstration of Young's working model convinced Bell of the design's importance. He set Young's research group up in their own facility in Gardenville, New York, and let them go to work. Thirteen days later, Pearl Harbor was attacked, initiating United States' official involvement in World War II.

During the war, Young's small team worked hard on developing the helicopter while the rest of the company constructed war machines. Two dramatic, unplanned mercy flights in 1945 presaged the helicopter's future role as a medical evacuation ("medevac") vehicle. On March 8, 1946, the Bell Model 47 was awarded the world's first commercial helicopter license, and the U.S. Army took delivery of production models the same year. Model 47s saw medevac service in the Korean conflict. The Bell-47 had a long production life, and hundreds are still in service around the world.

Textron Corporation acquired Bell in 1960, and by 1976, it was Textron's largest division. Among its most successful developments was the UH-1 "Huey," the workhorse of the Vietnam War. Variants of the Huey were used as troop transports, gun ships, and air ambulances. They also see service today as

BELL

corporate shuttles and medical transports. The AH-1 Cobra attack helicopter, H-40 Iroquois, OH-58D Kiowa Warrior, TH-67 Creek trainer, and CH-146 Griffon also join the ranks that make Bell the largest supplier of helicopters to the U.S. armed forces. Bell also teamed with Boeing to produce the V-22 Osprey tilt-rotor aircraft for the United States Marine Corps.

Perhaps the most recognizable Bell is the 206B JetRanger. The highly regarded 206 is employed around the world in military service, as a corporate transport, as a rescue service/medevac vehicle, as a police unit, and in television reporting.

With more than 35,000 aircraft delivered in more than 120 countries, Bell notes that their helicopters around the world accumulate fleet flight time at more than 10 hours per minute. That gives a whole new meaning to the old adage, "Helicopters don't fly; they beat the air into submission."



Bell 206B JetRanger III

The Bell 206 series has accumulated an astounding array of impressive statistics. More than 6,000 JetRangers are flying worldwide in roles as diverse as corporate transportation, police surveillance, and United States Army aviation training. The series has flown over 26 million flight hours, and a few JetRangers are flying with more than 30,000 hours on their airframes.

Specifications	U.S.		Metric
Cruise Speed	115 kts	132 mph	213 kph
Engine	Allison 250-C20J	420 shp	
Maximum Range	435 nm	500 m	805 km
Service Ceiling	20,000 ft		6,096 m
Hovering Ceiling	19,600 ft		5,974 m
Fuel Capacity	91 U.S. gal		344 L
Empty Weight	1,640 lbs		744 kg
Maximum Gross Weight	3,200 lbs		1,451 kg
Maximum Gross Weight (External Loading)	3,350 lbs		1,519 kg
Length	31.2 ft		9.51 m
Rotor Span	33.3 ft		10.15 m
Height	11.7 ft		3.51 m
Seating	Up to 5		
Useful Load	1,498 lbs		679 kg

BELL

The JetRanger design was derived from a Light Observation Helicopter (LOH) proposal Bell submitted to the United States Army in the 1960s. Though it lost out to a Hughes Aircraft Company design, Bell decided to develop the model as the 206 for the civilian market.

Despite Bell's best efforts, the original LOH design was found unsuitable for conversion to civilian use, primarily because of its limited carrying capacity. Engineers started over with an entirely new fuselage, resulting in an elegant teardrop-shaped aircraft that would seat five and carry their baggage, too.

Due to rising costs of the Hughes helicopter, the LOH competition was reopened in 1967, and Bell's 206 won this round. The 206 was purchased by the Army and put to work under the designation OH-58A. JetRangers are still serving in the armed forces. The newest model in uniform is the TH-67 Creek primary trainer. The United States Army credits a rise in student grades and a drop in course failures to the use of the Creek in training programs.

It's as a civilian aircraft, however, that the JetRanger has seen its biggest success. The original 206 has evolved into the JetRanger II and the JetRanger III, both incorporating major upgrades to more powerful engines.

Although helicopters are inherently unstable and difficult to fly, testimony to the JetRanger's ease of handling is the fact that it can be certified for single-pilot IFR operation. In 1994, Texas businessman Ron Bower flew a Bell 206B JetRanger III solo around the world. Bower navigated across 21 countries and 24 time zones in 24 days. By the end of the journey, he'd flown over 23,000 miles and had broken the previous around-the-world helicopter speed record by nearly five days.

The JetRanger III costs less to operate and maintain than any other craft in its class and has the highest resale value of any light helicopter. A winning formula for safety and value has made the JetRanger the world's most popular helicopter series.

Flight Notes

If you've seen a helicopter in the role of police chopper, rescue helicopter, or news reporter—either in movies or in real life—chances are you've seen a Bell JetRanger. It's one of the most popular and successful helicopters ever built, and they're flying all over the world.

Flying rotary-wing aircraft is quite different from flying fixed-wing aircraft. Mastering helicopter flight will not only challenge you but will present some of the best flying experiences Flight Simulator has to offer. There's nothing like threading your way through the skyscrapers of downtown Chicago or New York, and with practice, you'll be able to make rooftop landings. For more information about the fundamentals of rotary-wing flight, see **Basic Helicopter Flying** in **Help**.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

Controlling the Helicopter using a Joystick

You can use a joystick to operate the basic flight and power controls for the Bell 206B JetRanger III helicopter.

The stick part of the joystick controls the cyclic, which controls the helicopter's pitch attitude in flight and movement over the ground while in a hover.

If you have a joystick like the Microsoft® SideWinder 3-D Pro, you can twist the stick to apply left or right anti-torque pedal inputs. Anti-torque pedals are used to yaw the nose of a helicopter side to side by adjusting the pitch of the blades on the tail rotor. Push the left pedal, and the helicopter's nose will rotate to the left. Pushing the right pedal has the opposite effect.

The lever, or wheel, on the joystick, which you use as a throttle in airplanes, is the collective when flying a helicopter. This controls pitch in the main rotor blades collectively. Its primary function is to control altitude.

In recent years, sophisticated turbine-engine helicopters have all but eliminated the throttle from the collective lever.

Computerized mechanisms control the power necessary to maintain rotor RPM appropriate to the collective setting chosen by the pilot. This is essentially how the collective works in Flight Simulator. The fuel control unit automatically adjusts the throttle (engine speed) as you move the collective.

To control the throttle manually, press **CTRL+F2** to decrease power and **CTRL+F3** to increase power. (This procedure is not recommended unless you're familiar with helicopter operation.) Monitor the power turbine gauge to set engine power as a percentage of power turbine RPM.

Required Runway Length

Practically speaking, the required runway length for the JetRanger is the length of its skids (the long bars that contact the ground to support the fuselage). You can land this aircraft on buildings, boats, or anywhere except on water (in real life, JetRangers can be equipped with floats in order to land on water).

Engine Startup

The engines are running by default when you begin a flight. If you shut the engines down by clicking the Fuel Valve Switch, you can return to engine ON by clicking the Fuel Valve Switch again or by pressing **CTRL+SHIFT+F4**.

Hovering and Taxiing

Taxiing in a helicopter is often called hover taxiing. This means that you will hover just a few feet off the ground with a forward motion. Generally, you would use this technique when taxiing from one area to another on the airport or if you needed to move the helicopter a short distance.

Under typical weather conditions and operating weights, you'll need 70 to 75 percent torque to hover or hover taxi. If you lift the skids more than about 3 ft (1 m) above the ground, the helicopter effectively flies out of ground effect, and you'll need about 10 percent more power to maintain a hover.

Keep in mind that under certain conditions, such as in tall grass, over steep or rough terrain, or at high altitudes, the helicopter may not be able to hover out of ground effect.

Remember that the cyclic controls the direction in which the helicopter moves.

Use small, smooth adjustments of the collective to maintain the proper altitude.

To keep the nose straight, apply pressure to the left or right anti-torque pedal.

Flaps

Helicopters don't have flaps.

Takeoff

Note the wind direction and speed. If possible, plan to take off directly into the wind to minimize sideways drift and to increase the helicopter's performance during takeoff and climb.

Wind blowing through the main rotor disk has the same effect as forward airspeed. For example, if the helicopter is facing into a 10- to 15-knot wind, the rotor experiences effective translational lift (ETL) even when the aircraft is on the surface.

When you're ready to make a vertical takeoff, use scenery objects as a guide. Note a point in the distance (such as a building, tower, or gas pump). Use that

point and the outside horizon as references to help you maintain the helicopter's alignment and attitude as you lift off.

Set the cyclic (joystick handle) in an approximately neutral position. Set the collective in the full down position (use the joystick throttle, or press **F2**).

Smoothly and slowly raise the collective (press **F3**, or push forward on the joystick throttle). The helicopter should become light on the skids as you reach 40 to 60 percent torque. Ease into this range smoothly and slowly.

As the helicopter's weight comes off the skids, it will start to drift and turn to the right. Hold the collective steady at this point, and use slight left cyclic pressure to hold the helicopter in position.

Apply left pedal pressure (twist the joystick to the left, press the left rudder pedal, or press **O** on the numeric keypad) to compensate for the torque from the main rotor.

Keep your attention outside the helicopter, and focus on the horizon and other visual clues. To continue the liftoff, smoothly increase the collective.

Anticipate the need to add left pedal as you lift off and make small, smooth corrections with the cyclic (move the joystick, or press the **UP ARROW** or **DOWN ARROW**) and pedals (twist the joystick, or press **O** [left] or **ENTER** [right] on the numeric keypad) to maintain heading and position.

Hold the helicopter skids about 3 ft (1 m) above the ground. You want to stay low in case the engine fails and to keep the helicopter in ground effect. You'll probably need 70 to 75 percent torque to maintain the hover.

Raise or lower the collective to maintain altitude. Maintain the correct attitude using light, small cyclic pressures, and use the anti-torque pedals to keep the helicopter's nose from rotating.

Anticipate corrections to compensate for wind. You'll need slight forward cyclic pressure if you take off into a headwind, left pressure with a left crosswind, and so forth.

When you're ready to continue the takeoff, gently apply a small amount of forward cyclic (push the joystick forward,

or press the **UP ARROW**) to lower the nose and begin moving forward along the departure path. The helicopter may tend to settle as you start forward. Compensate by adding slight up collective (increase the joystick throttle setting, or press **F3**).

As airspeed reaches 10 to 15 kts, the helicopter enters effective translational lift. The nose tends to yaw left and pitch up slightly. Apply some forward cyclic to prevent the nose from rising.

Add some left lateral cyclic (push the joystick left, or press the **LEFT ARROW**) to prevent the helicopter from drifting right, and apply right pedal pressure (twist the joystick to the right, use the right rudder pedal, or press **ENTER** on the numeric keypad) to maintain heading. The helicopter will continue climbing and accelerating.

If you feel like you're juggling a lot at this point, you are. Helicopter flying is not easy, and it's been described as an activity similar to trying to balance one ball on top of another.

Continue the takeoff by flying a modified traffic pattern. Climb straight ahead at 60 kts to 300 ft (90 m). The helicopter should be in a nearly nose-level attitude.

Turn 90 degrees left (standard traffic pattern) or right to the crosswind leg. Maintain 60 kts indicated airspeed (KIAS) and continue the climb to 500 ft (150 m).

To accelerate and maintain rate of climb, increase collective and add slight forward cyclic. On the crosswind leg, depart the traffic pattern or return for another landing by turning 90 degrees again to join the downwind leg.

Climb

The Bell 206B JetRanger III can achieve a maximum rate of climb of about 1,300 feet per minute at sea level under standard weather conditions. The aircraft's best rate-of-climb airspeed is 52 kts. However, 60 kts is a good climb speed because it's also the speed to use for autorotation if the engine fails.

For a normal climb, adjust the collective (use the joystick throttle, or press **F3**) for a torque setting about 10 percent

above that required to maintain a hover in ground effect.

Under standard conditions and at typical operating weights, you'll need 80 to 85 percent torque for a normal climb. Use the cyclic (the joystick or the ARROW keys) to set a pitch attitude that maintains an airspeed of about 60 kts.

Note that as you climb, the engine produces less power. As a rule of thumb, expect torque to drop 3 percent per 1,000 ft (305 m) of altitude gained. Monitor the engine instruments and smoothly add collective to maintain climb power as your altitude increases.

Keep the following considerations in mind as you climb:

- Use the collective to control power and the rate of the climb.
- Monitor engine instruments closely to ensure that you stay within operating limits.
- Maintain attitude (thus airspeed) by looking out to the horizon. Focusing on a point too close to the nose makes it difficult to maintain the proper aircraft attitude.

- Use the cyclic to control airspeed (and the helicopter's attitude) and the anti-torque pedals to maintain heading or to establish a crab angle as necessary to fly a constant ground track.

- Use the anti-torque pedals to maintain trim (coordinated flight). A slip or skid severely degrades climb performance.

To level off from a climb, start decreasing collective about 50 ft (15 m) below the altitude at which you want to level off. Add right anti-torque pedal as you decrease torque to the cruise setting (about 80 percent torque). Use the cyclic to maintain cruising airspeed. Apply forward cyclic to increase speed and aft cyclic to slow down.

Cruise

Under typical conditions, you should set the collective to 80 percent torque for efficient cruising flight. At this power setting, 5 percent below the maximum-allowed continuous power setting, the Bell 206B JetRanger III typically cruises at about 105 kts while burning 25 to 28 gallons of fuel per hour (94 to 106 liters per hour.)

To maintain the desired track over the ground, use the anti-torque pedals to turn the helicopter into the wind and establish the correct crab angle.

To turn, use the cyclic to bank the helicopter.

Use the anti-torque pedals to keep the helicopter in trim—that is, in coordinated flight. If the inclinometer in the turn coordinator shows a slip or a skid, apply left or right pedal pressure as necessary to center the ball.

Descent

To descend at a comfortable rate without building too much speed, you must decrease main rotor pitch by lowering the collective (use the joystick throttle, or press **F2**). Anticipate the need for the right anti-torque pedal as you decrease torque.

The nose drops as you lower collective, so remember that you'll need to add a little aft cyclic (pull the joystick aft, or press the **DOWN ARROW**) to maintain the correct pitch attitude and airspeed. Don't add too much aft cyclic, however: the aircraft will climb.

Note that as you descend, the engine produces more power. As a rule of thumb, expect torque to increase 3 percent per 1,000 ft (305 m) of descent. Monitor the engine instruments and smoothly reduce collective to continue your descent.

To level off from a descent, start increasing collective about 50 ft (15 m) above the altitude at which you want to level off. Add left anti-torque pedal as you increase torque to the cruise setting (about 80 percent torque). Use the cyclic to maintain cruising airspeed. Apply forward cyclic to increase speed and aft cyclic to slow down.

Approach

Approaches in a helicopter have more to do with local traffic and terrain than a need to be at a target speed and configuration. Enter the airport traffic area in a safe manner that avoids obstacles, and follow the landing procedures as described.

Landing

To land the JetRanger III, reverse the procedure for a normal takeoff. That is, fly an approach from a 500-ft (150 m)

traffic pattern, enter a hover at about 3 ft (1 m) above the ground, and then slowly and smoothly lower the aircraft to the ground.

Following this procedure helps you establish good habits and makes it easier to achieve smooth, consistent landings.

Review the Landing checklist on the Kneeboard.

Fly a modified traffic pattern that avoids the flow of fixed-wing traffic.

During the first half of the approach, decrease power by lowering the collective (use the joystick throttle, or press **F2**). During the second half of the approach, you must smoothly increase power to arrive at the 3-foot (1 m) hover just as you set hover power, usually 70 to 75 percent torque.

- Fly the downwind leg at 500 ft (150 m) at 100 kts.
- Turn to the base leg, decelerate to 70 kts, and then descend to 300 ft (90 m).
- Turn final at 300 ft (90 m), and decelerate to 52 to 60 kts.

A descent angle of 10 to 12 degrees provides good obstacle clearance and helps you keep the landing area in sight.

Adjust the collective to control rate of descent. Increase collective (use the joystick throttle, or press **F3**) to reduce the rate of descent; decrease collective (use the joystick throttle or press **F2**) slightly to increase rate of descent.

Use the cyclic (the joystick or ARROW keys) to adjust the rate of closure with your landing spot. Apply slight aft cyclic to reduce the rate of closure; forward pressure increases the rate of closure. The ideal forward rate of travel is that of a normal walk.

Continue the approach until the rate of closure with the landing spot accelerates. Begin dissipating forward speed by applying smooth, slight back pressure on the cyclic. As you decelerate, anticipate the need to decrease collective to maintain altitude.

As airspeed drops to 10 to 15 kts, the aircraft will lose effective translational lift. You must add up collective to compensate for the loss of lift. You'll also need to add left anti-torque pedal pressure as you increase collective pitch.

Transition to the hover over the landing spot. Enter a 3-foot (1 m) hover over the spot where you want to land. Slowly lower the collective and allow the helicopter to settle onto the landing spot. Once the aircraft is down, lower the collective all the way (move the joystick throttle full aft, or press **F1**).

Autorotation

Autorotation in a helicopter is the equivalent of a power-off glide in an airplane. The following procedures will help you land the Bell 206B JetRanger III after a simulated engine failure.

During autorotation, it's important to maintain rotor RPM so you have lift available to cushion the landing. You must also maintain the correct forward speed so that you can reach a suitable landing area and flare to reduce the rate of descent before ground contact.

In the Bell 206B JetRanger III, the best glide ratio is about 4 to 1. That is, the helicopter can fly forward 4 feet for every foot of altitude lost.

To achieve this glide ratio and travel the greatest distance, maintain 69 KIAS, the maximum-distance glide speed. Use the

cyclic (the joystick or ARROW keys) to adjust pitch to maintain best glide.

To descend at the minimum-sink rate, fly at 52 KIAS. You won't cover as much distance, but you'll stay in the air for a longer time. You may want to use the minimum-sink airspeed if you're directly over a landing area.

Here are some tips to help you fly the JetRanger III in an autorotation:

- If the engine fails, you must decrease collective smoothly and immediately to preserve and maintain rotor RPM (use the joystick throttle, or press **F1**). Remember—smoothly. If you abruptly lower the collective, the helicopter will develop a high sink rate. Establish a glide at 52 to 69 KIAS, depending on your selected landing area.
- Stabilized rotor RPM in autorotation at 1,000 ft (305 m) should be 93 to 95 percent under ISA conditions.
- As the helicopter descends to 75 to 50 ft, (23 to 15 m) apply gentle aft cyclic (pull the joystick aft, or press the **DOWN ARROW**) to establish about a 10-degree nose-up attitude

until approximately 15 ft (5 m) above the ground. After ground speed is reduced, apply forward cyclic to level the helicopter.

- Cushion the landing by adding some collective (move the joystick throttle forward, or press **F3**) as required.
- To maintain heading, you'll need to add right pedal (twist the joystick, use the right rudder pedal, or press **ENTER** on the numeric keypad) as you apply collective pitch because mechanical drag in the transmission yaws the nose left. (If you are practicing autorotations and recovering with power, you must add left pedal as you increase power.)
- Make sure you land with the helicopter level and with little or no forward speed or drift.
- After ground contact, center the cyclic and gently lower the collective.
- Remember this sequence: Flare, pitch, level, and cushion.

Straight-in Autorotation

To practice a straight-in autorotation, use the following procedure:

Enter the traffic pattern at 500 ft (152 m) and 70 to 105 KIAS.

Close the throttle to flight idle (press **CTRL+F2**).

Smoothly but quickly, lower the collective to the full-down position. Apply a slight amount of aft cyclic pressure to keep the nose from dropping and to decelerate to 52 to 69 KIAS. Be careful not to jerk the cyclic back and forth, chasing the airspeed.

Keep the helicopter in trim using pedal pressure (use rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad). Control drift using the cyclic. Make sure the skids are straight before entering the flare.

At about 75 ft (23 m), keep your eyes on the landing spot so you can judge the rate of closure. Begin the final deceleration and flare by smoothly increasing aft cyclic pressure. You should be 10 to 15 ft (3 to 4 m) above the ground as the helicopter starts to settle.

As the helicopter settles toward the ground, make sure you establish a level pitch attitude. Smoothly apply up collective to reduce sink rate and cushion the touchdown.

Apply right pedal to keep the nose absolutely straight.

Use cyclic pressure as necessary during this transition to keep the aircraft level and compensate for drift.

Autorotation with 180-Degree Turn

Practicing an autorotation with a 180-degree turn develops your ability to plan ahead and control the helicopter smoothly and precisely.

Begin this maneuver at 500 ft (152 m) and 70 to 105 KIAS.

Establish a downwind leg 150 to 250 ft (46 to 76 m) from the landing area.

Abeam your intended landing spot, enter the autorotation by moving the collective to the full down position (move the joystick throttle full aft, or press **F1**).

Turn to the base leg as you stabilize in the autorotation. Remember to use the cyclic, not the pedals, to turn. Use the pedals to maintain coordinated flight. A slip or a skid causes a drop in airspeed, increases sink rate, and shortens the glide.

Use the cyclic to maintain the proper descent attitude and airspeed at about 60 KIAS. Look out toward the horizon to help you maintain the proper attitude.

Roll out on final with the cyclic, and complete the deceleration, flare, and touchdown as in a straight-in autorotation.

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History of Boeing

In 1903, the same year that the Wright brothers made their revolutionary flight, a young man named William Boeing left Yale's College of Engineering for the West Coast. He made his fortune trading timberlands, moved to Seattle, Washington, and soon became interested in the new field of aviation.

After learning to fly with aviation legend Glenn Martin in 1915, Boeing and a partner decided they could build a better flying machine. On the morning of the first test flight of their B&W floatplane, Boeing became impatient waiting for his pilot and took the controls himself, thus piloting the first flight of a Boeing aircraft.

World War I inaugurated the first production orders for Boeing aircraft. By the end of 1918, 337 people were on the Boeing payroll (a number that would one day swell into the tens of thousands). Fighter pursuit planes were built for the Army Air Service, and the Navy bought 71 NB trainers during this time. With the Model 15 and the P-12/F4B series, Boeing became the leading producer of fighters for the next decade.

Bill Boeing and pilot Eddie Hubbard flew a Boeing C-700 to make the first international airmail delivery in 1919. By 1929, the three-engine, 12-passenger Model 80, Boeing's first model built specifically for passenger transport, was in the air. Boeing was now one of the largest aircraft manufacturers in the country. Fueled by further expansion, the company's interests soon included several airlines, among them the future United Airlines.

An anti-trust breakup of the company in 1934 left Bill Boeing disheartened, and he left the aviation business to raise horses. The company leadership kept the company name and the Boeing vision for the future: a focus on large airliners and bombers.

Boeing's contribution to the war effort during World War II included the construction of thousands of the legendary B-17 Flying Fortress and B-29 Superfortress bombers. Once the war was over, the company turned its attention back to civilian aircraft as well as military development and production. Along with the Stratocruiser (the last propeller-driven plane Boeing would

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build), the company produced America's first swept-wing jet bomber, the B-47, and the giant B-52 bomber (still on the front lines today, though production ceased more than three decades ago).

The demands of the flying public in the post-war world made it clear that jet transports were necessary to haul more people longer distances at faster speeds. Boeing was able to make significant inroads into this market by putting the 707 jetliner into service before Douglas Aircraft Company (later McDonnell Douglas and now part of Boeing) launched their DC-8. Using about one-tenth the fuel of an ocean liner, the \$5-million 707 could carry as many transatlantic passengers a year as the \$30-million *Queen Mary*.

Boeing has continued as a leader in airliner innovation and military/aerospace technology. The company ushered in the jumbo era in the early 1970s with the 747 and continued to develop short-haul airliners—including the world's most successful jetliner, the Boeing 737. Military and aerospace projects have included work on NASA space programs, the cruise missile, and the B-2 bomber. In addition, Boeing aircraft have been the choice for Air Force One for 40 years.

More than 80 percent of the world's jetliners are Boeing aircraft. The company's commercial, military, space, and communications businesses combine to make it the world's largest aerospace manufacturer and the leading exporter of goods from the United States.



Boeing 737-400

One should hardly be surprised that the world's most prolific manufacturer of commercial aircraft is also the producer of the world's most popular jetliner. The 737 became the best-selling commercial jetliner worldwide when orders for it hit 1,831 in June 1987 (surpassing Boeing's own 727 as the previous champ). However, it wasn't always that way; in the first few years of production, there were so few orders that Boeing

737-400 Specifications	U.S.		Metric
Cruise Speed	477 kts	550 mph	885 kph
Engines	CFM56-3C1		
Maximum Range	2,059 nm	2,370 mi	3,810 km
Service Ceiling	36,089 ft		11,000 m
Fuel Capacity	5,311 U.S. gal		20,104 L
Empty Weight-Standard	76,180 lbs		34,550 kg
Maximum Takeoff Weight	138,500 lbs		62,800 kg
Length	120 ft		36.45 m
Wingspan	94 ft, 9 in		25.9 m
Height	36.5 ft		11.13 m
Seating	Seats 147 to 168		
Cargo Capacity	1,373 ft ³		38.9 m ³

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considered canceling the program. They didn't, and the airplane has more than proven itself in over three decades of service.

The reason for the 737's great success is its design flexibility. It lends itself well to modifications that fit the market needs of its customers, and currently, seven different variants are available. The ability to order different versions of the same plane allows an airline to fit the airplane to a particular route and passenger load while maintaining a smaller inventory of support and service equipment for its fleet. And, like all of the planes in this family, the 737-400 has crew commonality with its siblings—a pilot qualified to fly one is qualified to fly all of them.

The short-haul 737s have ranges from 2,600 mi (4,180 km) to 3,800 mi (6,110 km). And, speaking of short, the first model's length was only eight inches greater than its wingspan, giving the airplane a compact look that led to its nickname: Fat Albert.

Derivative models of this line were on the drawing boards before the first 737-100 ever flew. The -200 grew in length over the -100 and was fitted with

progressively more powerful engines, eventually allowing the maximum takeoff weight to increase by nearly 32,000 pounds (14,515 kg). The most important advancement with the next size, the -300, was the use of a new type of engine. The General Electric/Snecma CFM56 produces more power than the old JT8Ds of earlier models while producing far less noise and providing better fuel economy.

Though known as a classic, the -400 is no longer currently produced. It has been replaced on the production line by the -600, -700, -800, and -900, known as the "Next-Generation Boeing 737s." These newer versions of the 737 maintain the stability and reliability of the traditional 737s, like the -400, but have been updated and enhanced for even better performance.

All variants of the 737 will continue to fly for many years to come. From its short and stubby origins to its more elegant stretched versions, the 737 has always been beautiful in the eyes of airline bean counters. Its position in the travel marketplace and in aviation history is assured.

Flight Notes

The Boeing 737-400 is but one variant of the most successful line of jetliners ever built. In all its variants, more than 3,000 737s are flying around the world. The popular twinjet is largely used for short- to medium-range routes. This is a good transition airplane for you to move from corporate-level flying (as in the Learjet) to airline transport flying.

Though you won't find it difficult to get the plane off the ground and fly it, this is not a Cessna. It takes considerable planning to execute a successful, professionally flown flight from takeoff, to cruise, to stable approach and landing.

Required Runway Length

- Takeoff: 5,500 ft (1,676 m), flaps 5
- Landing: 5,500 ft (1,676 m), flaps 30

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

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The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

- Weight: 138,500 lb (62,823 kg)
- Altitude: sea level
- Wind: no headwind
- Temperature: 15° C. Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Engine Startup

The engines are running by default when you begin a flight. If you shut the engines down, it is possible to initiate an auto-startup sequence by pressing **CTRL+E** on your keyboard.

Taxiing

Reverse thrust is not recommended for backing the 737-400 out of parking or at any time during taxiing.

- The -400's response to thrust change is slow, particularly at high gross weights. Idle thrust is adequate for taxiing under most conditions, but you'll need a slightly higher thrust setting to get the aircraft rolling. Allow time for a response after each thrust change before changing the thrust setting again.
- The -400 has a ground speed indication on the HSI. Normal straight taxi speed should not exceed 20 kts. For turns, 8 to 12 kts indicated airspeed (KIAS) speeds are good for dry surfaces.

In Flight Simulator, rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad) are used for directional control during taxiing. Avoid stopping the 737 during turns, as excessive thrust is required to get moving again.

Flaps

The following table lists recommended maneuvering speeds for various flap settings. The minimum flap-retraction altitude is 400 feet, but 1,000 feet complies with most noise abatement procedures. When extending or retracting the flaps, use the next appropriate flap setting depending on whether you're slowing down or speeding up.

Flap Position	< ½ fuel	> ½ fuel
Flaps Up	210	220
Flaps 1	190	220
Flaps 5	170	180
Flaps 10	160	170
Flaps 15	150	160
Flaps 25	140	150

Remember: These are minimum speeds for flap operation. Flying slower than this at bank angles of 40 degrees would initiate the stick shaker. For VFE speeds, see the Kneeboard. Adding 15 to 20 kts to these speeds is recommended if maneuvering with large bank angles, and, in general, provides a good safety margin. On climbout, lowering the nose to give an additional 15 to 20 kts will also give you better forward vision from the cockpit.

In adverse weather conditions, taxi with the wing flaps up and then set takeoff flaps during your Before Takeoff checklist procedure. Likewise, retract the flaps as soon as practicable upon landing.

Flaps are generally not used on the 737-400 for the purpose of increasing the descent rate during the descent or approach phases of flight. Normal descents are made in the clean configuration to pattern or Initial Approach Point (IAP) altitude.

Takeoff

All of the following occurs quite rapidly. Read through the procedure several times before attempting it in the plane so you know what to expect.

Run through the Before Takeoff checklist and set flaps to 5 (press **F7**, or click the flap lever on the panel).

With the aircraft aligned with the runway centerline, advance the throttles (press **F3**, or drag the throttle levers) to approximately 40 percent N_1 . This allows the engines to spool up to a point where uniform acceleration to takeoff thrust will

occur on both engines. The exact amount of initial setting is not as important as setting symmetrical thrust.

As the engines stabilize (this occurs quickly), advance the thrust levers to takeoff thrust—less than or equal to 100 percent N_1 . Final takeoff thrust should be set by the time the aircraft reaches 60 KIAS. Directional control is maintained by use of the rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

Below about 80 KIAS, the momentum developed by the moving aircraft is not sufficient to cause difficulty in stopping the aircraft on the runway.

- V_1 , approximately 141 KIAS, is decision speed. Above this speed, it may not be possible to stop the aircraft on the runway in case of a rejected takeoff (RTO).
- At V_r , approximately 143 KIAS, smoothly pull the stick (or yoke) back to raise the nose to 10 degrees above the horizon. Hold this pitch attitude and be careful not to over-rotate (doing so before liftoff could cause a tail strike).

- At V_2 , approximately 150 to 155 KIAS, the aircraft has reached its takeoff safety speed. This is the minimum safe flying speed if an engine fails. Hold this speed until you get a positive rate of climb.

As soon as the aircraft is showing a positive rate of climb on liftoff (both vertical speed and altitude are increasing), retract the landing gear (press **G**, or drag the landing gear lever). The aircraft will quickly accelerate to $V_2 + 15$.

At 1,000 ft (305 m), reduce flaps from 5 to 1 (press **F6**, or drag the flaps lever). Continue accelerating to 200 KIAS, at which point you may go to flaps up (press **F6** again).

Climb

As you retract the flaps, set climb power of approximately 90 percent N_1 (press **F2**, use the throttle control on your joystick, or drag the thrust levers). Maintain 6- or 7-degrees nose-up pitch attitude to climb at 250 kts until reaching 10,000 ft (3,048 m), and then maintain 280 KIAS to your cruising altitude.

Cruise

Cruise altitude is normally determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

When climbing or descending, take 10 percent of your rate of climb or descent and use that number as your target for the transition. For example, if you're climbing at 1500 FPM, start the transition 150 feet below the target altitude.

You'll find it's much easier to operate the Boeing 737-400 in climb, cruise, and descent if you use the autopilot. The autopilot can hold the altitude, speed, heading, or navaid course you specify. For more information on using the autopilot, see **Using the Autopilot** in **Help**.

Normal cruise speed is Mach 0.74. You can set .74 in the autopilot Mach hold window and engage the Hold button (click the **Mach** button). Set the A/T Arm (click the switch to engage the autothrottles),

and the autothrottles will set power at the proper percent to maintain this cruise speed. The changeover from indicated airspeed to Mach number typically occurs as you climb to altitudes of 20,000 to 30,000 ft (6,000 to 9,000 m).

Remember that your true airspeed is actually much higher in the thin, cold air. You'll have to experiment with power settings to find the setting that maintains the cruise speed you want at the altitude you choose.

Descent

A good descent profile includes knowing where to start down from cruise altitude and planning ahead for the approach. Normal descent is done with idle thrust and clean configuration (no speed brakes). A good rule for determining when to start your descent is the 3-to-1 rule (three miles distance per thousand feet in altitude.) Take your altitude in feet, drop the last three zeros, and multiply by 3.

For example, to descend from a cruise altitude of 35,000 ft (10,668 m) to sea level:

35,000 minus the last three zeros is 35.
 $35 \times 3 = 105$

This means you should begin your descent 105 nautical miles from your destination, maintaining a speed of 250 KIAS (about 45 percent N_1) and a descent rate of 1,500 to 2,000 ft per minute, with thrust set at idle. Add two extra miles for every 10 kts of tailwind, if applicable.

To descend, disengage the autopilot if you turned it on during cruise, or set the airspeed or vertical speed into the autopilot and let it do the flying for you. Reduce power to idle, and lower the nose slightly. The 737-400 is sensitive to pitch, so ease the nose down just a degree or two. Remember not to exceed the regulation speed limit of 250 KIAS below 10,000 ft (3,048 m). Continue this profile down to the beginning of the approach phase of flight.

Deviations from this procedure can result in arriving too high at the destination (requiring circling to descend) or arriving too low and far out (requiring expenditure of extra time and fuel). Plan

to have an initial approach fix regardless of whether or not you're flying an instrument approach.

It takes about 35 seconds and three miles (5.5 km) to decelerate from 290 KIAS to 250 KIAS in level flight without speed brakes. It takes another 35 seconds to slow to 210 KIAS. Plan to arrive at traffic-pattern altitude at the flaps-up maneuvering speed about 12 miles out when landing straight-in, or about eight miles out when entering a downwind approach. A good crosscheck is to be at 10,000 ft AGL (3,048 m), 30 miles (55.5 km) from the airport at 250 KIAS.

Approach

With the venerable Boeing 727, pilots used to say that if you could see the runway, you could land on it. You could come in fast and high and still make the landing by dropping the slats, flaps, and landing gear. Don't try that in this plane!

The key to a successful approach and landing in the -400 is "you gotta slow down to get down." In other words, this airplane doesn't slow down quickly just

because you throw the gear and flaps down. You want to have your aircraft configuration (flaps and landing gear) set and your target speed hit well ahead. Excess speed in the -400 will require a level flight segment to slow down.

If you're high coming into the approach, you can use the speed brakes to increase descent. If possible, avoid using the speed brakes to increase descent when wing flaps are extended. Do not use speed brakes below 1,000 ft AGL.

On an instrument approach, you want to be configured for landing and have your speed nailed by the final approach fix (where you intercept the glideslope), usually about five miles from touchdown.

Set flaps to 1 (press **F7**, or drag the flaps indicator or lever) when airspeed is reduced below the minimum flaps-up maneuvering speed. Normally, this would be when entering the downwind leg or at the initial approach fix, so you should be at the desired airspeed by this point. You can then continue adding flaps as you get down to the speed limits for each setting.

Flaps 30 is the setting for normal landings. At flaps 40, which is used for short runways, the aircraft settles rapidly once you chop the power.

Intercept the glideslope from below, and extend the landing gear (press **G**, or drag the landing gear lever) when the glideslope needle is less than or equal to one dot high.

The proper final approach speed varies with weight, but a good target at typical operating weight is 135 to 140 KIAS.

With landing gear down and flaps at 30 degrees, set the power at 55 to 60 percent N_1 . This configuration should hold airspeed with a good descent angle toward the runway. Use small power adjustments and pitch changes to stay on the glidepath. You're looking for a descent rate of about 700 FPM.

Prior to landing, make sure the speed brake handle is in the ARM position.

Landing

Select a point about 1,000 ft (305 m) past the runway threshold, and aim for it. Adjust your pitch so that the point

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remains stationary in your view out the windscreen.

As the threshold goes out of sight beneath you, shift the visual sighting point to about $\frac{3}{4}$ down the runway. When the aircraft's main wheels are about 15 ft (4.5 m) above the runway, initiate a flare by raising the nose about 3 degrees. Move the thrust levers to idle, and fly the airplane onto the runway.

To assure adequate aft fuselage clearance on landing, fly the airplane onto the runway at the desired touchdown point. DO NOT hold the airplane off the runway for a soft landing.

When the main gear touch, apply the brakes smoothly (press the **PERIOD** key, or press Button 1—typically the trigger—on the joystick).

If you armed the spoilers, they will deploy automatically. If not, move the brake lever into the UP position now. Add reverse thrust (press **F2**, or drag the thrust levers into reverse). Make sure you come out of reverse thrust when airspeed drops below 60 kts.

Once you're clear of the runway and as you taxi to the terminal, retract the flaps (press **F6**, or drag the flaps lever) and lower the spoilers (press the **SLASH** [/], or click the brake lever).



Boeing 747-400

More than 30 years ago, the 747 made its first trip from New York to London. Since then, it's become the standard by which other large passenger jets are judged. Its size, range, speed, and capacity were then, and are now, the best in its class.

The 747-400 model was first introduced in 1985. The first -400 was delivered to Northwest Airlines four years later. It was designed to extend the already

Specifications	U.S.	Metric
Cruise Speed	0.85 Mach 565 mph	910 km/h
Engines	Pratt & Whitney PW4062 63,300 lb Rolls Royce RB211-524H 59,500 lb General Electric CF6-80C2B5F 62,100 lb	28,710 kg 26,990 kg 27,945 kg
Maximum Range	7,325 nm (13,570 km) Maximum Certified	
Operating Altitude	45,100 ft	13747 m
Fuel Capacity	57,285 gal	216,840 L Basic Operating
Weight	403,486 lb	182,020 kg
Length	231 ft, 10 in	70.6 m
Wingspan	211 ft, 5 in	64.4 m
Height	63 ft, 8 in	19.4 m
Seating	Typical 3-class configuration – Up to 416 Typical 2-class configuration – Up to 524 Typical 1-class configuration – N/A	

excellent capacity and range of the original 747, and, using lighter aluminum alloys and hardware adapted from the 757 and 767, it met its goal. Beginning in May 1990, the 747-400 became the only 747 currently in production, which has been an ongoing testament to its success.

The 747 has also captured a number of records. Thanks in part to use of advanced materials, like graphite, to replace heavy metals, and aluminum alloys used in wing skins, stringers, and lower-spar chords, the 747 realized considerable weight savings over the -300. As a result, on June 27, 1988, Northwest Airlines set a new official weight record by reaching an altitude of 2,000 meters at a gross weight of 892,450 lb.

Shortly afterwards, Qantas Airways set the world distance record for commercial airliners by flying a 747-400 from London to Sydney nonstop, a distance of 11,156 miles (18,000 km) in 20 hours, 9 minutes.

The 747-400 can travel 8,430 statute miles (13,570 km) without refueling. That, in addition to its large seating

capacity, makes it the lowest cost per seat-mile of any twin-aisle airplane offered. It has a dispatch reliability rate of 98.8 percent.

Flight Notes

Required Runway Length

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature.

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Engine Startup

The engines are running by default when you begin a flight. If you shut the engines down, it is possible to initiate an auto-startup sequence by pressing **CTRL+E** on your keyboard.

Taxiing

Maximum taxi weight is 853,000 lbs (386,913 kg).

Reverse thrust is forbidden for backing the 747-400 out of parking or at any time during taxiing.

■ The -400's response to thrust change is slow, particularly at high gross weights. Idle thrust is adequate for taxiing under most conditions, but you'll need a slightly higher thrust setting to get the aircraft rolling. Allow time for a response after each thrust change before changing the thrust setting again.

■ The -400 has a ground speed indication on the HSI. Normal straight taxi speed should not exceed 20 knots. For turns, 8 to 12 knots are good for dry surfaces.

In Flight Simulator, rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad) are used for directional control during taxiing. Avoid stopping the 747 during turns, as excessive thrust is required to get moving again.

Flaps

The following table lists recommended maneuvering speeds for various flap settings. The minimum flap-retraction

altitude is 400 feet, but 1,000 feet complies with most noise abatement procedures. When extending or retracting the flaps, use the next appropriate flap setting depending on whether you're slowing down or speeding up.

Flap Position	< ½ fuel	> ½ fuel
Flaps Up	210	220
Flaps 1	190	220
Flaps 5	170	180
Flaps 10	160	170
Flaps 15	150	160
Flaps 25	140	150

Remember, these are minimum speeds for flap operation. Flying slower than this at bank angles of 40 degrees would initiate the stick shaker. For VFE speeds, see the Kneeboard. Adding 15 to 20 knots to these speeds is recommended if maneuvering with large bank angles, and in general, provides a good safety margin. On climbout, lowering the nose to give an additional 15 to 20 knots will also give you better forward vision from the cockpit.

In adverse weather conditions, taxi with the wing flaps up, and then set takeoff flaps during your Before Takeoff checklist procedure. Likewise, retract the flaps as soon as practicable upon landing.

Flaps are generally not used on the 747-400 to increase the descent rate during the descent from en route altitude. Normal descents are made in the clean configuration to pattern or Initial Approach Point (IAP) altitude.

Takeoff

All of the following occurs quite rapidly. Read through the procedure several times before attempting it in the plane so you know what to expect.

Run through the Before Takeoff checklist, and set flaps to 5 (press **F7**, or click the flap lever on the panel).

With the aircraft aligned with the runway centerline, advance the throttles (press **F3**, or drag the throttle levers) to approximately 40 percent N_1 . This allows the engines to spool up to a point where uniform acceleration to takeoff thrust will occur on both engines. The exact amount of initial setting is not as important as setting symmetrical thrust.

As the engines stabilize (this occurs quickly), advance the thrust levers to takeoff thrust—less than or equal to 100 percent N_1 . Final takeoff thrust

should be set by the time the aircraft reaches 60 KIAS. Directional control is maintained by use of the rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

Below about 80 KIAS, it's easy to stop the airplane on the runway using the brakes only.

- V_1 , approximately 159 KIAS, is decision speed. Above V_1 , you probably won't be able to stop the airplane on the runway after an engine failure or other problem.
- At V_r , approximately 177 KIAS, smoothly pull the stick (or yoke) back to raise the nose to 10 degrees above the horizon. Hold this pitch attitude and be careful not to over-rotate (doing so before liftoff could cause a tail strike).
- At V_2 , approximately 188 KIAS, the aircraft has reached its takeoff safety speed. This is the minimum safe flying speed if an engine fails. Hold this speed until you get a positive rate of climb.

As soon as the aircraft is showing a positive rate of climb on liftoff (both vertical speed and altitude are increasing), retract the landing gear (press **G**, or drag the landing gear lever). The aircraft will quickly accelerate to V_2+15 .

At 1,000 ft (305 m), reduce flaps from 5 to 1 (press **F6**, or drag the flaps lever). Continue accelerating to 200 KIAS, at which point you may go to flaps up (press **F6** again).

Climb

As you retract the flaps, set climb power to approximately 90 percent N_1 (press **F2**, use the throttle control on your joystick, or drag the thrust levers). Maintain 6- or 7-degrees nose-up pitch attitude to climb at 250 KIAS to 10,000 feet, then 340 knots to 25,000 feet, then 0.84 Mach to cruise altitude.

Cruise

Cruise altitude is normally determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configu-

ration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

Let's say you've filed a flight plan for FL350. Approaching your cruising altitude, take 10 percent of the rate of climb or descent, and convert that number to feet. For example, if you're climbing or descending at 1000 FPM, start leveling off 100 ft before you reach the target altitude.

You'll find it's much easier to operate the Boeing 747-400 in climb, cruise, and descent if you use the autopilot. The autopilot can hold the altitude, speed, vertical speed, heading, or navaid course you specify.

Normal cruise speed is Mach 0.85. You can set .85 in the autopilot Mach hold window and engage the Hold button (click the Mach button). Set the A/T Arm (click the switch to engage the autothrottles), and the autothrottles will set power at the proper percent to maintain this cruise speed. The changeover from indicated airspeed to Mach number typically occurs as you climb to altitudes of 20,000 to 30,000 ft (6,000 to 9,000 m).

Remember that your true airspeed is actually much higher than your indicated airspeed in the thin, cold air. You'll have to experiment with power settings to find the setting that maintains the cruise speed you want at the altitude you choose.

Descent

A good descent profile includes knowing where to start down from cruise altitude and planning ahead for the approach. Normal descent is done using idle thrust and clean configuration (no speed brakes). A good rule for determining when to start your descent is the 3-to-1 rule (three miles distance per thousand feet in altitude.) Take your altitude in feet, drop the last three zeros, and multiply by 3.

For example, to descend from a cruise altitude of 35,000 ft (10,668 m) to sea level:

35,000 minus the last three zeros is 35.
 $35 \times 3 = 105$.

This means you should begin your descent 105 nautical miles from your destination, maintaining a speed of 250 KIAS (about 45 percent N_1) and a descent rate of 1,500 to 2,000 ft per

minute, with thrust set at idle. Add two extra miles for every 10 knots of tailwind, if applicable.

To descend, disengage the autopilot if you turned it on during cruise, or set the airspeed or vertical speed into the autopilot and let it do the flying for you. Reduce power to idle, and lower the nose slightly. The 747-400 is sensitive to pitch, so ease the nose down just a degree or two. Remember not to exceed the regulation speed limit of 250 KIAS below 10,000 ft (3,048 m). Continue this profile down to the beginning of the approach phase of flight.

Deviations from the above can result in arriving too high at the destination (requiring circling to descend) or arriving too low and far out (requiring expenditure of extra time and fuel). Plan to have an initial approach fix regardless of whether or not you're flying an instrument approach.

It takes about 35 seconds and three miles (5.5 km) to decelerate from 290 KIAS to 250 KIAS in level flight without speed brakes. It takes another 35 seconds to slow to 210 KIAS. Plan to arrive at traffic-pattern altitude at the

flaps-up maneuvering speed about 12 miles out when landing straight-in, or about eight miles out when entering a downwind approach. A good crosscheck is to be at 10,000 ft AGL (3,048 m) 30 miles (55.5 km) from the airport at 250 KIAS.

Approach

The 747-400 won't slow down quickly just because you throw the gear and flaps down. Have your aircraft configuration (flaps and landing gear) set and your target speed hit well in advance. Excess speed in the -400 will require a level flight segment to slow down.

If you're high coming into the approach, you can use the speed brakes to increase descent. If possible, **avoid using the speed brakes to increase descent when wing flaps are extended.** Do not use speed brakes below 1,000 ft AGL.

On an instrument approach, be configured for landing and have your speed nailed by the final approach fix (where you intercept the glideslope), usually about five miles from touchdown.

Set flaps to 1 (press **F7**, or drag the flaps indicator or lever) when airspeed is

reduced below the minimum flaps-up maneuvering speed. Normally, this would be when entering the downwind leg or at the initial approach fix, so you should be at the desired airspeed by this point. You can then continue adding flaps as you get down to the speed limits for each setting.

Flaps 30 is the setting for normal landings. At flaps 40, which is used for short runways, the aircraft settles rapidly once you chop the power.

When the glideslope comes alive, extend the landing gear (press **G**, or drag the landing gear lever.)

The proper final approach speed varies with weight, but a good target speed at typical operating weight is 135 to 140 KIAS.

With landing gear down and flaps at 30 degrees, set the power at 55 to 60 percent N_1 . This configuration should hold airspeed with a good descent angle toward the runway. Use *small* power adjustments and pitch changes to stay on the glidepath. You're looking for a descent rate of about 700 FPM.

Prior to landing, make sure the speed brake handle is in the ARM position.

Landing

Maximum landing weight is 630,000 lbs. Select a point about 1,000 ft (305 m) past the runway threshold, and aim for it. Adjust your pitch so that the point remains stationary in your view out the windscreen.

As the threshold goes out of sight beneath you, shift the visual sighting point to about $\frac{3}{4}$ down the runway. When the aircraft's main wheels are about 15 ft (4.5 m) above the runway, initiate a flare by raising the nose about 3 degrees. Move the thrust levers to idle, and fly the airplane onto the runway.

To assure adequate aft fuselage clearance on landing, fly the airplane onto the runway at the desired touchdown point. DO NOT hold the airplane off the runway for a soft landing.

Set the autobrakes before landing. When the main gear touch down, apply brakes smoothly (press the **PERIOD** key or **Button 1**—typically the trigger—on the joystick).

If you armed the spoilers, they will deploy automatically. If not, move the brake lever into the UP position now. Add reverse thrust (press **F2**, or drag the thrust levers into reverse). Make sure you come out of reverse thrust when air-speed drops below 60 knots.

Retract the flaps (press **F6**, or drag the flaps lever), and lower the spoilers (press **SLASH** [/], or click the brake lever) as you taxi to the terminal.



Boeing 777-300

On the outside, it may resemble the jetliners you’ve seen for years. Inside, however, it’s a whole new bird. The newest plane in the long and proud Boeing family line is the 777, commonly referred to as the “Triple Seven.” This long-range, fuel-efficient twinjet was first delivered in May 1995 to fill a gap in the market between the 747 and 767. It is capable of seating 386 to 550 passengers.

Specifications	U.S.	Metric
Cruise Speed	Mach 0.84	555 mph 893 kmh
Engines (three options)	P&W 4000 RR Trent 800 GE 90 series	
Maximum Range	5,960 nm	6,859 sm 11,038 km
Maximum Operating Altitude	43,100 ft	13,137 m
Typical Cruising Altitude	35,000 ft	
Fuel Capacity	45,200 U.S. gal	171,160 L
Maximum Takeoff Weight-Basic	660,000 lb	299,370 kg
Length	242 ft, 4 in	73.9 m
Wingspan	199 ft, 11 in	60.9 m
Height	60 ft, 8 in	18.5 m
Seating	Seats 386 to 550	
Configurations	Seating ranges from 6- to 10-abreast with two aisles	
Cargo Capacity	7,552 cu ft	213.8 cu m

The genesis of the 777 is unique in Boeing history. From the outset, it was designed with cooperation and input from its future customers. Boeing actually had engineering staff from the airlines working with Boeing engineers at the factory. And the 777 is the first airliner ever to be completely designed on computers. Using Computer Aided Three-Dimensional Interactive Applications (CATIA), every system and piece of the plane was created and fitted together on computers before production began. It worked so well that Boeing didn't need to create a full-scale physical mock-up of the airplane. The result was that after laser-aligning the major sections and wings of the real airplane, the port wingtip was a mere 0.001 inch out of alignment. The fuselage was out of alignment by only 0.023 inch.

One of the distinguishing features of the 777 is its perfectly round fuselage cross-section, as opposed to the more ovoid shape of previous Boeing planes. This gives structural strength and simplicity to the fuselage, making it less prone to fatigue. The plane has an enormous below-deck cargo capacity, even greater than the 747-400 (by weight, not volume).

A striking external feature of this wide-body is the main gear. Larger than that of any other airliner, each main gear of the 777 has six wheels—giving the same pavement loading as a jumbo DC10-30 but with half the parts and less complexity. The left axle of each main can actually be steered up to 8 degrees to aid in nose-gear steering.

The in-flight entertainment system is like nothing any airliner has ever had before. It's the most complex system of its kind ever developed, and with an estimated 250,000 lines of dedicated software code, it's as sophisticated as some airplanes' avionics systems. Each passenger has a choice of up to 12 video channels and 48 audio channels. Each seat has a phone that doubles as a game controller, credit card reader, and modem link. At 9,000 pounds (1,745 kg) for a typical installation, this is some heavyweight entertainment!

Key to the present and future success of the 777 is its flexibility. Designed to be stretched, shortened, and modified in many ways to suit its customers' needs, it can even be ordered with folding wingtips to allow parking at gates designed for

smaller planes. From the extremely powerful new engines to the all-glass cockpit, this airplane has the technology to carry it far into the 21st century.

Flight Notes

The 777, or Triple Seven, is the newest long-range twinjet from Boeing. With a state-of-the-art glass cockpit and fly-by-wire flight controls, this airplane is at the forefront of current transportation technology. While its engines are 40 percent more powerful than those on the 767, they are just as quiet. Flying the 777 will give you a taste of what it's like to handle a large, wide-body airliner.

The 777 is approved for Extended Range Twin-Engine Operations (ETOPS), and you'll want to try some transoceanic flights. On May 30, 1995, the 777 became the first airplane in aviation history to earn Federal Aviation Administration (FAA) approval to fly ETOPS at the same time it entered regular commercial service. On May 4, 1998, the 777-300 achieved another historic milestone by becoming the first commercial airplane to receive type certification and ETOPS approval on the same day.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

Required Runway Length

- Takeoff: 11,000 ft (3,353 m), flaps 5
- Landing: 11,000 ft (3,353 m), flaps 30

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

- Weight: 550,000 lb (249,476 kg)
- Altitude: sea level
- Wind: no headwind
- Temperature: 15° C

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Engine Startup

The engines are running by default when you begin a flight. If you shut the engines down, it is possible to initiate an auto-startup sequence by pressing **CTRL+E** on your keyboard.

Taxiing

Reverse thrust is not recommended at any time during taxiing of the 777-300.

The taxiing technique in the 777 is to allow the airplane to accelerate itself at idle. In other words, unless the aircraft is heavily loaded, idle power will move the plane from a stop into taxi speed. If you need a little power to get it rolling, be conservative. Then bring the thrust levers back to idle. Airplane response to thrust lever movement is slow, particularly at high gross weights.

Avoid taxi speeds greater than 30 kts at idle thrust. Brake to approximately 10 kts, and then release the brakes. The airplane appears to be moving slower than it actually is due to its height above the ground.

The Triple Seven is a long airplane (in fact, the stretch 777 is currently the longest commercial airplane in the world), and the wheels are a long way behind the pilot's seat. One real-world pilot's technique for taxiing onto a runway with the 777 is to taxi towards the opposite side of the runway until his seat

is over the grass on the far side. Then he turns the tiller (nose gear steering) hard so that the nose comes around to the runway centerline.

In Flight Simulator, rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad) are used for directional control during taxiing. Avoid stopping the 777 during turns, as excessive thrust is required to get moving again.

Takeoff

Run through the Before Takeoff checklist, and set flaps to 5 (press **F7**, or drag the flaps lever).

With the aircraft aligned with the runway centerline, advance the thrust levers (press **F3**, or drag the thrust levers) to approximately 1.85 on the engine pressure ratio gauge (EPR). This allows the engines to spool up to a point where uniform acceleration to takeoff thrust will occur on both engines. The exact amount of initial setting is not as important as setting symmetrical thrust.

As the engines stabilize (this occurs quickly), advance the thrust levers to maximum thrust (98 to 100 percent N_1).

- V_1 , approximately 149 kts indicated airspeed (KIAS), is decision speed. Above this speed, it may not be possible to stop the aircraft on the runway in case of a rejected takeoff (RTO).
- At V_r , approximately 153 KIAS, smoothly pull the stick (or yoke) back to raise the nose to 10 degrees above the horizon at approximately 2 degrees per second. Hold this pitch attitude.
- At V_2 , approximately 160 KIAS, the aircraft has reached its takeoff safety speed. This is the minimum safe flying speed if an engine fails. Hold this speed until you get a positive rate of climb.

As soon as the aircraft is showing a positive rate of climb on liftoff (both vertical speed and altitude are increasing), retract the landing gear (press **G**, or drag the landing gear lever). The aircraft will accelerate to 175 to 180 KIAS.

At 1,000 ft (305 m), go from flaps 5 to flaps 1 (press **F6**, or drag the flaps lever). Continue accelerating to 210 KIAS, at which point you go to flaps up (press **F6** again).

Climb

For the climb to cruise altitude, pull the power back to 95 percent N_1 . Climb at 250 KIAS to 10,000 ft (3,048 m). Above 10,000 ft, lower the nose as required to accelerate to 320 KIAS until reaching 0.76 Mach.

Cruise

Cruise altitude is normally determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

When climbing or descending, take 10 percent of your rate of climb or descent and use that number as your target for the transition. For example, if you're climbing at 1500 FPM, start the transition 150 feet below the target altitude.

You'll find it's much easier to operate the Boeing 777-300 in climb, cruise, and descent if you use the autopilot. The autopilot can hold the altitude, speed,

heading, or navaid course you specify. For more information on using the autopilot, see **Using the Autopilot in Help**.

Normal cruise speed is Mach 0.843. (The changeover from indicated airspeed to Mach number typically occurs as you climb to altitudes of 20,000 to 30,000 ft [6,000 to 9,000 m].) Remember that your true airspeed is actually much higher in the thin, cold air.

With a typical power setting of 92.6 percent N_1 , speed will be around 313 KIAS. The fuel flow will be around 4,476 pounds per hour (2,030 kilograms per hour).

Descent

A good descent profile includes knowing when to start down from cruise altitude and planning ahead for the approach. Normal descent is done with idle thrust and clean configuration (no speed brakes). A good rule for determining when to start your descent is the 3-to-1 rule (three miles distance per thousand feet in altitude.) Take your altitude in feet, drop the last three zeros, and multiply by 3.

For example, to descend from a cruise altitude of 31,000 ft (9,449 m) to sea level:

31,000 minus the last three zeros is 31.
 $31 \times 3 = 93$.

This means you should begin your descent 93 nautical miles from your destination. Add two extra miles for every 10 kts of tailwind, if applicable.

To descend, disengage the autopilot if you turned it on during cruise (or you can set airspeed or flight path angle into the autopilot and let it do the flying for you). Bring the thrust levers back to flight idle (use the joystick throttle, press **F1**, or drag the thrust levers), and lower the nose to maintain a speed of 0.84 Mach until you see 310 KIAS.

Then, maintain 270 KIAS during your descent (use pitch to adjust airspeed). This will provide a descent rate of about 1,800 to 2,000 ft per minute.

Approach

Plan to be at 10,000 ft (3,048 m) about 20 miles (32 km) from the airport. You must be at or below 250 KIAS by this point.

At 15 miles, reduce your speed to below 220 KIAS, and go to flaps 1 (press **F7**, or drag the flap lever). Remember: The power is at flight idle, so airspeed adjustment will be done using pitch.

At around 10 miles from touchdown, go to flaps 15 and a speed of 165 KIAS.

Once the glideslope comes alive, extend the landing gear (press **G**, or drag the landing gear lever), then go to flaps 20, arm the speed brakes (press the **SLASH** [/], or drag the speed brake lever), and set the autobrakes (click the autobrakes switch).

As you start down the glideslope, go to flaps 30 and adjust power to maintain a final approach speed of 140 KIAS.

Landing

The proper final approach speed varies with weight, but a good target at typical operating weight is 135 to 140 KIAS. As you cross the threshold at around 50 ft (15 m), bring the power back to idle.

Just above the runway, flare slightly (no more than 3-degrees nose-up), and fly the airplane onto the runway. Remember: The landing gear on the 777 are a long way behind you and you're a long way up in the air even when the aircraft is on the ground.

Once the main gear are down, pull the thrust levers into reverse. The spoilers will deploy automatically if you armed them during approach.

The nose will start down immediately. Don't hold the nose off the runway in the 777. By the time the nose gear contacts the pavement, the reverse thrust will begin to kick in. If you've armed the autobrakes, autobraking will begin automatically.

On the rollout, go to idle reverse at 60 kts. By the time you reach taxi speed, come out of reverse into forward idle. Retract the flaps (press **F6**, or click the flaps lever), and lower the spoilers (press the **SLASH** [/], or click the brake lever) as you taxi to the terminal.

History of Cessna

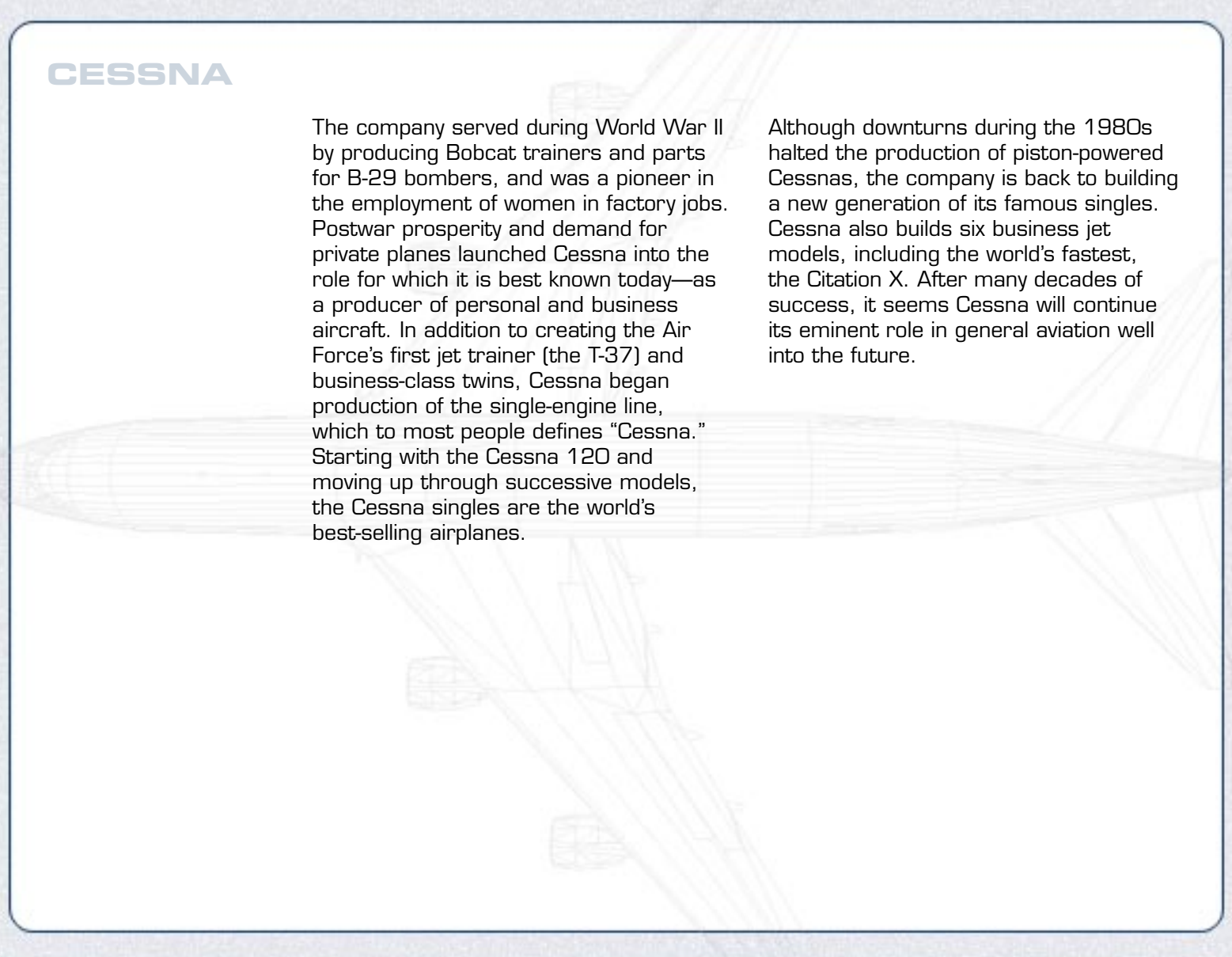
His name is synonymous with light aircraft. Clyde Cessna, one of aviation's adventurous pioneers, started flying in 1911 and began building planes soon after. The first was a tiny monoplane that he named "Silver Wings." Throughout the early teens, he built and crashed a number of aircraft that were either modifications of other designs or designs of his own. He had minor success during this time as a manufacturer and as a pilot, putting on demonstrations at public gatherings for 50 cents a head.

Cessna went back to farming for several years, but in the mid-twenties was enticed to join in an aviation venture with Walter Beech and others. Soon he struck out on his own again, determined to build the first airship with a full-cantilever wing—the Cessna Phantom. The Cessna Aircraft Company was soon building the A-series planes, which were successfully employed in commercial and racing ventures.

Success led to expanded production facilities and development of the DC series. The DC-6A and DC-6B were officially certified on October 29, 1929—the day of the stock market crash, harbinger of the Great Depression. Despite valiant attempts to keep the company alive, the plant doors were closed. Cessna privately continued developing and racing planes with his son until his dear friend Roy Liggett was killed in a plane designed and built by Clyde during a race at which he was a spectator.

Though Clyde's enthusiasm for flying was dampened, that of his nephews was not. After assisting in the resurrection of the company, Clyde relinquished the company helm to his nephew Dwayne Wallace, who would lead Cessna Aircraft Corporation for nearly 40 years. Throughout his tenure, Wallace was a popular figure at Cessna who, in the early days, wasn't above sweeping floors, living on nickel hamburgers, and flying races to win payroll money.

CESSNA

A faint, light blue line drawing of a Cessna aircraft, likely a single-engine model, is visible in the background of the page. The drawing shows the aircraft from a side profile, including the fuselage, wings, and tail section.

The company served during World War II by producing Bobcat trainers and parts for B-29 bombers, and was a pioneer in the employment of women in factory jobs. Postwar prosperity and demand for private planes launched Cessna into the role for which it is best known today—as a producer of personal and business aircraft. In addition to creating the Air Force's first jet trainer (the T-37) and business-class twins, Cessna began production of the single-engine line, which to most people defines “Cessna.” Starting with the Cessna 120 and moving up through successive models, the Cessna singles are the world's best-selling airplanes.

Although downturns during the 1980s halted the production of piston-powered Cessnas, the company is back to building a new generation of its famous singles. Cessna also builds six business jet models, including the world's fastest, the Citation X. After many decades of success, it seems Cessna will continue its eminent role in general aviation well into the future.



Cessna 172SP

This isn't the aviation equivalent of some cheap date you'll be taking out for one wild, adventurous weekend. The Cessna 172 is more like the love of your life—a steady, constant companion to fly with for a long time to come. A stable and trustworthy plane, most pilots have logged at least a few hours in a Cessna 172, since it's the most widely available aircraft in the rental fleet and is used by most flight schools. Since the first prototype was

Specifications	U.S.	Metric
Maximum Speed	126 kts	203 km/hr
Cruise Speed	124 kts	200 km/hr
Engine	Textron Lycoming IO-360-L2A 180 bhp	
Propeller	Macauley Fixed Pitch Two Blade	
Maximum Range	638 nm	
Service Ceiling	14,000 ft	4,267 m
Fuel Capacity	56 gal	212 L
Empty Weight	1,665 lb	1,002 kg
Maximum Gross Weight	2,550 lb	1,157 kg
Length	27 ft, 2 in	8.2 m
Wingspan	36 ft, 1 in	11 m
Height	8 ft, 11 in	2.72 m
Seating	Up to 4	
Useful Load	893 lb	423 kg

completed in 1955, more than 35,000 C172s have been produced, making it the world's most popular single-engine plane. One of Cessna's first tricycle-gear airplanes, the 172 quickly became the favorite of a growing class of business pilots. Its reliability and easy handling (along with thoughtful engineering and structural updates) have ensured its continued popularity for more than 35 years.

The differences between an original 1956 172 and today's version are many, but there are a few similarities. The wing has the same NACA 2412 airfoil that Cessna's been using since production of its 170, and the plane continues to use the same flat-plate ailerons that 172s and 152s have always been known for, making it a steady handler, if not exactly an exciting one.

Updates to the 172 have been carefully chosen and consistently well made. The 172 received its distinctive swept-back tail in 1960 and its helpful wraparound rear window in 1962. In 1964, Cessna began using a 150-hp Lycoming engine rather than the old six-cylinder, air-cooled Continental engines of the original 172s. With the SP comes a further engine update providing an even higher maxi-

mum takeoff weight. With its fuel-injected, 180-hp Textron-Lycoming IO-360, the SP has 20 hp more than even a 172R and a maximum takeoff weight of 2,550 lbs—250 lbs more than the 172R.

172s are famed for their stability. In the 1960s and '70s, Cessna vied for attention and respectability by attempting to build a hardworking airplane that could be easily flown by nearly anyone. With the 172, they undoubtedly succeeded. When properly trimmed, this airplane will fly itself for hours at a time, needing little to no physical guidance from the pilot. And like other Cessnas, 172s don't like stalling, either.

Cessna temporarily stopped manufacturing the 172 in 1986, when market forces and high product-liability premiums forced the company to implement serious cutbacks. Pilots around the world breathed a sigh of relief when, 10 years later, President Bill Clinton enacted the General Aviation Revitalization Act. Cessna celebrated the good news with the completion of a new plant in Independence, Kansas and immediately began production on a new version of the 172. If the new 172SP is any indication, things have only gotten better since then.

Flight Notes

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight on a day with International Standard Atmosphere (ISA) conditions.

Required Runway Length

960 ft at sea level with ISA conditions.

Engine Startup

The engine will be running automatically every time you begin a flight. If you shut the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**. If you want to do the startup procedures manually, use the checklist on the Kneeboard.

Taxiing

While taxiing, the power should be set at approximately 1000 RPM. (Mixture should be full forward.) As you move down the taxiway, use the rudder to turn the nose right and left for directional control. (Twist the joystick; use the rudder pedals; or press **O** or **ENTER** on the numeric keyboard to turn left or right, respectively.)

Important

These instructions are intended for use with Flight Simulator only and are no substitute for using the actual aircraft manual for real-world flight.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Note

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you select "Display Indicated Airspeed" in the Realism Settings dialog box. Speeds listed in the specifications table are shown as true airspeeds.

Note

The length required for both takeoff and landing is a result of a number of factors, including aircraft weight, altitude, headwind, use of flaps, and ambient temperature. Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Flaps

For a normal takeoff, Cessna recommends 0-10 degrees of flaps (at the pilot's discretion). Using 10 degrees of flaps reduces the takeoff roll by approximately 10 percent.

Takeoff

Run through the Before Takeoff checklist, and set flaps at either 0 or 10 degrees (press **F7**, or click the flaps lever), depending on the runway situation.

Align the aircraft with the white runway centerline, and advance the throttle control to full power (use the joystick throttle, or press **F4**).

Climb

Climb with full throttle, no flaps, and a fully rich mixture—approximately 75-85 kts—when below 3,000 ft. Above 3,000 feet, lean the mixture for smooth operation and for maximum RPM.

Cruise

Cruise altitude would normally be determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section. However, a good rule to bear in mind is that an airplane with a normally aspirated engine is most efficient between 6,000-8,000 feet. That altitude range gives the best tradeoff between available power, fuel economy, and true airspeed.

Ideal cruise settings for the 172SP are between 45 and 75 percent power. When above 3,000 feet, lean the mixture approximately $\frac{1}{3}$ of full rich for optimum performance.

Descent and Approach

Reduce power to 2100 RPM, and set the airplane up for a descent rate of approximately 450 feet per minute.

Landing

On final approach, plan for a landing speed of 65 knots with full flaps. Select a point just past the runway threshold, and aim for it. Adjust your pitch so that the point remains stationary in your view out the windscreen. Leave the power at approximately 1500 RPM, and fly the

airplane down to the runway. Keep the nose off the ground, and slowly bring back the throttle completely while you flare just above the runway. Touch down with the back wheels first. With less than full flaps, expect a bit of float in the flare.

Upon touchdown, apply brakes by pressing the **PERIOD** key. Exit the runway, and retract the wing flaps.



Cessna 182S Skylane and Skylane RG

When Cessna saw how well their Model 180 was selling, they looked for a way to make it an even bigger success; the answer was the Model 182. The 182 first flew in 1956, and its big advancement was the patented Land-O-Matic tricycle-landing gear (weren't the fifties grand?), which make landing and ground handling easier, attracting would-be pilots who didn't want to fly taildraggers. During the

Cessna 182S Specifications	U.S.	Metric
Maximum Speed	145 kts 167 mph	269 kmh
Cruise Speed	140 kts 161 mph	259 kmh
Engine	Textron Lycoming IO-540-AB1A5 230 hp	
Propeller	McCauley 3-bladed constant speed	
Maximum Range	968 nm 944 sm	1,519 km
Service Ceiling	18,100 ft	5,517 m
Fuel Capacity	92 U.S. gal	333 L
Empty Weight	1,910 lb	854 kg
Maximum Gross Weight	3,110 lb	1,411 kg
Length	29 ft	8.84 m
Wingspan	36 ft	11 m
Height	9 ft	2.77 m
Seating	Up to 4	
Useful Load	1,200 lbs	557 kg



model's lifespan, it has been beefed up, modified, and released in retractable-gear (RG) and turbo-charged (T) versions. Like all the Cessna piston aircraft, production of the 182 was halted in 1986 due to market forces and the high price of product liability insurance premiums. Now the 182 is back in a new incarnation.

The Cessna 182 Skylane feels and acts like a heavier, more powerful version of its sibling, the 172 Skyhawk. While there is nothing tricky about flying the

Cessna 182RG Specifications	U.S.		Metric
Maximum Speed	160 kts	184 mph	296 kmh
Cruise Speed	156 kts	180 mph	289 kmh
Engine	Textron Lycoming O-540-J3C5D		235 hp
Propeller	McCaughey 2-bladed constant speed		
Maximum Range	1,135 nm	1,306 sm	2,102 km
Service Ceiling	14,300 ft		4,359 m
Fuel Capacity	92 U.S. gal		333 L
Empty Weight	1,910 lb		868 kg
Maximum Gross Weight	3,110 lb		1,411 kg
Length	29 ft		8.84 m
Wingspan	36 ft		11 m
Height	9 ft		2.77 m
Seating	Up to 4		
Useful Load	1,200 lbs		545 kg

182, pilots shouldn't underestimate it; the Skylane doesn't tolerate indifferent pilot technique.

The airplane is a workhorse and a stable platform for flying on instruments. Even with a full tank, the 182 carries a family-size useful load and performs admirably as an aerial sport utility vehicle.

One of the improvements with the new 182 is that it now has a wet wing (the fuel is stored directly inside the wing). Older models had a rubber fuel bladder in the wing that could wrinkle as it aged, creating nice little pockets in which water could accumulate. Water and avgas don't make for a good fuel mix.

Also new is the choice of the Textron Lycoming IO-540 AB1A5 engine (Textron owns Cessna) producing 230 hp at 2400 RPM. This makes the Skylane a fuel-injected airplane for the first time, eliminating the threat of carburetor icing. The three-bladed McCauley prop helps complete the grown-up appearance of the new Skylane. This is not your father's 182.

What isn't new for the Skylane is a retractable-gear version. The RG included in Microsoft® Flight Simulator is based on

earlier models, since Cessna is currently producing only the fixed-gear Skylane. The RG makes a nice transition for pilots desiring a more complex airplane that will get you where you're going 15 kts (25 kmh) faster than the fixed-gear model at top speed.

Over the years, the empty weight of the Skylane has increased, while the useful load has decreased in successive models. Since it has retained the same powerplant output, it has slightly higher maximum and cruise speeds. Range has been extended in all models with larger fuel capacity.

It's easy to see why Microsoft has offered the versatile and time-tested 182 in every version of Flight Simulator since its introduction. It's an aviation legend, both in the world of flight simulation and in the real world.

Flight Notes

As of this writing, Cessna does not make a retractable-gear model of the 182. The 182 RG in Flight Simulator is based on the older R model. The 182 RG is a great airplane for transitioning into more complex aircraft operation. With the

familiar stability and load-hauling capabilities of its fixed-gear sibling, it offers transitioning pilots more complexity and higher cruise speeds.

Required Runway Length

- Takeoff: 1,570 ft (479 m), flaps 20
- Landing: 1,320 ft (402 m), flaps Full

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

- Weight: 3,000 lb (1,361 kg)
- Altitude: sea level
- Wind: no headwind
- Temperature: 15 °C
- Runway: hard surface

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

Engine Startup

The engine is running by default when you begin a flight. If you shut the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**. If you want to do the startup procedures manually, use the checklist on the Kneeboard.

Taxiing

While taxiing, the power should be set at around 1000 RPM (prop and mixture are full forward). As you move down the taxiway, turn the nose right and left for directional control by using the rudder (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

Takeoff

Run through the Before Takeoff checklist, and set flaps at 0, 10, or 20 degrees (press **F7**, or drag the flaps lever), depending on the runway situation. You'll want to use 20 degrees with a short runway; 10 degrees works well for takeoffs on normal runway lengths.

Cowl flaps should be OPEN for takeoff and climb (click the Cowl Flaps lever).

With the aircraft aligned with the runway centerline, advance the throttle control to full power.

At 50 kts indicated airspeed (KIAS), smoothly pull the stick back (using the joystick or yoke, or press the **DOWN ARROW**) to raise the nose to 10 degrees above the horizon. Climb out at 70 to 80 KIAS.

As soon as you have a positive rate of climb on liftoff (both vertical speed and altitude are increasing), retract the landing gear (press **G**, or drag the landing gear lever). Then raise the flaps (press **F6**, or drag the flaps lever). Accelerate to 90 KIAS.

Climb

For the climb to cruise altitude, the recommended parameters are 23 inches manifold pressure or full throttle, whichever is less (press **F2**, or drag the throttle control) and 2400 RPM (press **CTRL+F2**, or drag the prop control). The cowl flaps should remain open. Your climb speed should be 90 to 100 KIAS.

The mixture should stay at full rich (full forward) until above 3,000 ft (914 m). Above 3,000 ft, the mixture should be leaned for maximum efficiency. Use the exhaust gas temperature (EGT) gauge to determine the best mixture of air to fuel.

Cruise

Cruise altitude is normally determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems in place along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

Normal cruise in the 182RG is performed at 55 to 75 percent power. Best power settings (the highest allowable cruise settings) will result in both high cruise speeds and high fuel flow.

Set the manifold pressure at 23 inches (press **F2**, or drag the throttle control) and the propeller RPM at 2400 (press **CTRL+F2**, or drag the prop control).

Lean the mixture (press **CTRL+SHIFT+F2**, or drag the mixture control) until the EGT gauge reaches its peak setting. Lower power settings will result in better fuel flow and range. For better range and fuel economy, lean the mixture to 125° F rich of peak EGT.

Cowl flaps should be CLOSED for cruise and descent (click the Cowl Flaps lever).

Descent

A typical descent in the 182RG involves lowering the nose and reducing power. Two or three degrees nose-down is fine. Set power at about 18 inches of manifold pressure (use the joystick throttle, press **F2**, or drag the throttle control). This will give you a descent rate of about 700 feet per minute (FPM).

Approach

Below 140 KIAS, you can begin extending the flaps, which are good at reducing airspeed. You can also extend the landing gear to reduce speed (140 KIAS or below).

Plan to slow to around 80 KIAS when entering the downwind leg or at your initial approach fix on an instrument approach.

Landing

Final approach with full flaps deployed should be flown at around 65 KIAS. The propeller and mixture controls should be full forward. Carburetor heat should be full ON (drag the Carburetor Heat control aft). On final approach, verify that the landing gear is down.

Select a point past the runway threshold, and aim for it. Adjust your pitch so that the point remains stationary in your view out the windscreen. Leave the power at your final approach setting, and fly the airplane down to the runway. Smoothly reduce power to idle as you flare slightly just before touchdown.

Upon touchdown, bring the power back to idle, apply brakes (press the **PERIOD** key), and exit the runway. Retract the wing flaps (press **F6**), and set the carburetor heat to OFF (full forward).



208B Caravan (Professional Edition only) and 208 Caravan Amphibian

Wherever you want to go, the Cessna Caravan can get you there. First introduced by Cessna in 1985, the Caravan was designed to land nearly anywhere, on land or water. Undoubtedly, it has lived up to its creators' intentions. Whether supplies need to be brought to a flooded village in the mountains of Peru, an injured person needs to be flown out from a remote lake in Alaska, or an

208B Caravan Specifications

	U.S.	Metric
Maximum Speed	175 kts	324 km/hr
Cruise Speed	164 kts	305 km/hr at 20,000 feet
Engine	Pratt & Whitney Canada, Inc., Free Turbine. Flat Rated at 675 Shaft hp PT6A-114A	
Propeller	Three-Bladed, Constant Speed, Full Feathering, Reversible McCauley, 106-inch diameter	
Maximum Range	5.1 hours with maximum cruise at 10,000 feet 6.6 hours with maximum cruise at 18,000 feet 6.4 hours with maximum range at 10,000 feet 7.2 hours with maximum range at 20,000 feet	
Service Ceiling	22,800 ft	
Fuel Capacity	335 gal	
Empty Weight	4,040 lb	1,830 kg
Maximum Gross Weight	8,785 lb	3,980 kg
Length	41 ft, 7 in	
Wingspan	52 ft, 1 in	
Height	15 ft, 5-½ in	
Seating	Up to 14	
Useful Load	4,745 lb	2,150 kg



archaeologist wants access to a tiny site in the African desert, the Caravan has what's needed to do the job.

In the initial design of the Caravan, Cessna took the fuselage of a Model 207 Stationair and enlarged it. However, it didn't take Cessna long to realize that in order to create a plane that provided enough cargo and fuel-carrying space, they'd have to start from close to scratch. They used sections of the 207 in the first prototype, but the ultimate design of the Caravan had no real predecessor.

208 Caravan Amphibian Specifications

	U.S.	Metric
Maximum Speed	175 KIAS	324 km/hr
Cruise Speed	143 KIAS (8,000 lbs), 130 KIAS (6,400 lbs) 117 KIAS (5,200 lbs)	
Engine	Pratt & Whitney Canada, Inc., Free Turbine Flat Rated at 675 Shaft hp PT6A-114A	
Propeller	Three-Bladed, Constant Speed, Full Feathering, Reversible McCauley, 106-inch diameter	
Maximum Range	4.6 hours with maximum cruise at 10,000 feet 5.7 hours with maximum cruise at 20,000 feet 6.8 hours with maximum range at 10,000 feet 8.0 hours with maximum range at 20,000 feet	
Service Ceiling	13,500 ft	4.115 m
Fuel Capacity	335 gal	
Empty Weight	4,895 lb	
Maximum Gross Weight	8,035 lb	
Length	41 ft, 7 in	
Wingspan	52 ft, 1 in	
Height	15 ft, 5-½ in	
Seating	Up to 14	

Caravans have large fuel tanks and tough, sturdy landing gear to ensure the aircraft's reliability on rough, unpaved airstrips. (And that landing gear can easily be replaced with floats in order to handle water landings.) Caravans also sport large wings for quick liftoffs on short, rough runways. One hundred and seventy-four square feet of wing area provide 335 gallons of fuel capacity. The oil-only strut in the nose gear acts as a shock absorber, cushioning the engine from large loads placed onto it by the engine mounts as the airplane rolls over rocks and potholes.

The first amphibious Caravan was certified in March 1986 and was officially rolled out two months later. In the Amphibians, two large floats replace the landing gear. However, each float contains retractable landing gear, making the airplane truly amphibious. Each float can carry 200 pounds of gear inside watertight bulkhead compartments. The Amphibian also has retractable water rudders that provide maneuverability on the water and vertical fins on its horizontal stabilizer that balance the large float surface and provide more control.

The first Caravans were made-to-order for Federal Express, a company that logged a total of one million Caravan hours back in 1996. FedEx has continued to depend on the Caravans' reliability, flexibility, and strength to provide hundreds of small communities around the world with access to overnight delivery service. As for the Amphibians, one of the earliest customers of the floating flyers was the Royal Canadian Mounted Police. These amphibious planes gave the RCMP access to miles of rivers and lakes throughout the provinces for both law enforcement and rescue missions.

Flight Notes

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight on a day with International Standard Atmosphere (ISA) conditions.

Required Runway Length

2,500 ft (765 m), with ISA conditions.

Engine Startup

The engine will be running automatically every time you begin a flight. If you shut the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**. If you want to do the startup procedures manually, use the checklist on the Kneeboard.

Taxiing

Set prop and mixture should be full forward for taxiing. As you move down the taxiway, use the rudder to turn the nose right and left for directional control. (Twist the joystick; use the rudder pedals; or press **O** and **ENTER** on the numeric keyboard to turn left or right, respectively.)

Takeoff

Run through the Before Takeoff checklist found in the Kneeboard (**F10**). Set flaps (press **F7**, or click the flaps lever) between 0 and 20 degrees, depending on the runway situation.

Important

These instructions are intended for use with Flight Simulator only and are no substitute for using the actual aircraft manual for real-world flight.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Note

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you select "Display Indicated Airspeed" in the Realism Settings dialog box. Speeds listed in the specifications table are shown as true airspeeds.

Note

The length required for both takeoff and landing is a result of a number of factors, including aircraft weight, altitude, headwind, use of flaps, and ambient temperature. Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Align the aircraft with the white runway centerline, and advance the throttle to takeoff power (1900 torque).

Climb

Set climb speed for between 110 and 120 KIAS.

Cruise

Cruise altitude would normally be determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

Set your airspeed for 155 KIAS. Set your propeller for 1600–1900 RPM by pressing **CTRL+F2** or **CTRL+F3**.

Descent and Approach

Reduce airspeed to 75-85 KIAS with flaps fully down. Adjust flaps slowly in increments as follows: At 175 KIAS, lower to 10 degrees. At 150 KIAS, lower to 20 degrees. Finally, lower to 30 degrees at 125 KIAS.

Landing

On final approach, plan for a landing speed of 75-85 KIAS with full flaps. Plan to land slightly tail-low.

Amphibian: Hold the control wheel aft as the aircraft slows to taxi speed.

208B: Ease the control wheel forward to lower the bow wheels gently to the runway.

Upon touchdown, bring the power back to idle and lightly apply the brakes by pressing the **PERIOD** key.

EXTRA 300S

History of Extra

Walter Extra is well on his way toward being added to the long list of legends that populate German design and engineering circles. A mechanical engineer whose avocation was aerobatic competition, he won several German National Championships and competed internationally. After flying a modified Pitts Special in the 1982 World Aerobatic Championship, Extra decided to design his own high-performance monoplane. His Extra 230 was in the air the next year.

In 1984, Walter flew the 230 in the World Aerobatic Championship, which focused attention on the new design and sparked orders from other pilots: Extra Flugzeugbau (Aircraft Construction) was born. Aerobatic champion Clint McHenry purchased an Extra 230 and flew it to win the U.S. National Aerobatic Championship in 1986 and 1987. Pete Anderson won the 1990 Championship in his 230. A total of 19 Extra 230s were built, and a number of U.S. Aerobatic Team members flew them at World Aerobatic Championships.

The Extra 260 prototype flew in 1987 with a larger engine than the 230 and a new three-bladed prop. This model incorporated a larger wood wing in addition to carbon-fiber composite tail surfaces and landing gear. Patty Wagstaff won the World Aerobatic Championship flying her 260 three years in a row ('91, '92, '93). Her Extra 260 now resides in the National Air and Space Museum in Washington, D.C.

The prototype 300 model was completed in 1988, and 300s were flown by three different competitors at the World Aerobatic Championship that year. The 300-horsepower Extra was taken through full German and U.S. certification. The FAA certified the 300 with an unprecedented +/- 10 G rating—more Gs than most humans can withstand and remain conscious. More improvements to the Unlimited class 300 were introduced with the single-seat 300S.

Walter Extra builds his planes to be flown by recreational as well as competitive pilots, and all of the Extras have been designed with that vision in mind. With the introduction of the 300L in 1993, Extra took a further step in that direction

EXTRA 300S

with a two-place version of the 300 that is often equipped with full IFR panels and autopilots. To date, this is Extra Flugzeugbau's best-seller. And it's still a stellar aerobatic performer, even with two souls on board.

The slightly smaller and lower-powered Extra 200 is designed for the introductory aerobatic market. It has lower initial acquisition costs and lower operating costs and is a perfect choice for the fixed-base operator (FBO) who wants to offer basic aerobatic courses.

Extra Flugzeugbau entered a new market in 1999 with the Extra 400. The model 400 is a six-place, pressurized, cabin-class plane built to fill a niche between the recreational and corporate light-business aircraft markets. Over 90 percent of the 400 is constructed of carbon-fiber composites, giving it exceptional strength and light weight.

The Extra experience can be summed up in the following words: light weight, high thrust, and performance, performance, performance. While broadening the base of their product line, Extra Flugzeugbau will remain one of the top competitors in the construction of world-class aerobatic aircraft.

EXTRA 300S



Extra 300S

If airplanes were horses, the Extra 300S would be a champion thoroughbred. It is, in fact, designed to be a champion in Unlimited class aerobatic competitions. The 300S combines light weight, a 300-horsepower engine, and exquisite control harmony in an aircraft that has won several World Aerobatic Championships.

A derivative of the two-place model 300, the wing of the single-place 300S was lowered eight inches to provide better

Specifications	U.S.		Metric
Maximum Speed	200 kts	230 mph	370 kmh
Cruise Speed	178 kts	205 mph	330 kmh
Engine	Textron Lycoming AEIO-540 L1B5		300 hp
Propeller	Three-bladed constant speed		
Maximum Range	415 nm	478 sm	769 km
Service Ceiling	16,000 ft		4,877 m
Fuel Capacity	42.3 U.S. gal		160 L
Empty Weight	1,470 lb		667.8 kg
Maximum Gross Weight	2,095 lb		950 kg
Length	23.36 ft		7.12 m
Wingspan	26.25 ft		8 m
Height	8.6 ft		2.62 m
FAA Certified Load Factor	+/- 10 G		
Seating	1		
Useful Load	625 lb		283.5 kg

EXTRA 300S

ground visibility and improve the general appearance of the aircraft. After this anxiously awaited model was introduced in March 1992, three of the four existing production aircraft were flown in the World Championship that July.

The Extra 300S has an incredible roll-rate: 400 degrees per second. Just as impressive is how precisely maneuvers can be executed in the hands of an expert pilot like Patty Wagstaff. Attend one of her airshows, and you'll see a 300S carve paths through the sky like it's on a rail. Most aircraft require the pilot to drive downhill a bit to gather enough inertia for a loop. With the Extra 300S, just pull the stick back in level flight at high cruise power, and it leaps through the vertical, headed for the opposite horizon. This airplane is at home in a roll, loop, tail slide, hammerhead, Cuban Eight, or any other extreme attitude you want to put it into.

A hint of the control sensitivity of the 300S comes with the first movement of the stick. There is no slack or resistance in the control circuit. When you move the controls, the airplane follows instantly.

Long ailerons provide the aerial equivalent of power-assisted rack-and-pinion steering, and fingertip control is all that's needed. Even at steep bank angles, the controls are surprisingly light. Electrically adjustable rudder pedals customize the plane's fit to any pilot, and the bubble canopy provides a roomy, panoramic view of the world whether right-side up or upside down.

As with many taildragger aircraft, visibility over the nose of the 300S is not terrific when on the ground. The standard technique while taxiing is to perform S-turns to see where you're going. When you apply the power for the takeoff run, the tail comes up quickly, followed by the rest of the plane shortly thereafter.

Most 300Ss are purchased by pilots who just want a fast, sporty plane that they can turn upside down on occasion. The rest go to buyers who employ them in competition or for entertaining the crowds at airshows. Whatever motivates them to buy it, owners of the Extra 300S love this high-spirited and well-mannered stallion for its legendary performance.

EXTRA 300S

Flight Notes

The Extra 300S is a single-seat, high-performance aerobatic aircraft manufactured in Dinkslaken, Germany. The aircraft can withstand G loads of ± 10 G, and its large ailerons deliver a roll rate exceeding 400 degrees per second. Think of it as a sports car, not a station wagon.

Remember that this airplane is a taildragger. Because it has a tailwheel, the center of gravity is behind the main wheels. Controlling the Extra on the ground can be like driving a car on icy roads.

Strong, fast, and highly maneuverable, the Extra 300S is your ticket to Flight Simulator aerobatic excitement.

Required Runway Length

- Takeoff: 813 ft (248 m)
- Landing: 1,798 ft (548 m)

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

EXTRA 300S

- Weight: 2,095 lb (950 kg)
- Altitude: sea level
- Wind: no headwind
- Temperature: 15° C
- Runway: hard surface

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Engine Startup

The engine is running by default when you begin a flight. If you shut the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**. If you want to do the startup procedures manually, use the checklist on the Kneeboard.

Taxiing

While taxiing, the power should be set at around 1000 RPM (prop and mixture are full forward). As you move down the taxiway, turn the nose right and left for directional control by using the rudder (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

Flaps

The 300S doesn't have flaps.

Takeoff

Run through the Before Takeoff checklist.

With the aircraft aligned with the runway centerline, advance the throttle control to full power. Keep a slight forward pressure on the stick (use the joystick or yoke, or press the **UP ARROW**), and the tail will come up fairly soon at around 40 kts indicated airspeed (KIAS). Then, rotate slightly nose-up (use the joystick or yoke, or press the **DOWN ARROW**), and the plane will become airborne at around 70 KIAS.

Climb

Here's where the fun starts with the 300S. After takeoff, level out and let the speed build to around 120 KIAS, which will happen quite quickly. Then, check out the performance of this amazing airplane. You can pull up and through the vertical into an Immelmann right over the runway.

Experiment with throttle settings. You'll find the Extra is extremely responsive to throttle changes; this will aid you as you learn to maneuver this little sport plane.

EXTRA 300S

If you're using the Extra to cruise cross-country, reduce power after takeoff to 25 inches of manifold pressure (use the joystick throttle, press **F2**, or drag the throttle control). Raise the nose, and climb out at around 100 KIAS.

Cruise

Cruise altitude would normally be determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

The Extra isn't designed for long cross-country flights, but it will get you there at about 150 kts at typical cruise-power settings.

Try using 24 inches of manifold pressure (use the joystick throttle, press **F2**, or drag the throttle control) and 2400 RPM (press **CTRL+F2**, or drag the prop control). You can fly for about two hours under most conditions and still have a safe fuel reserve.

Landing

Precise speed control is essential for smooth landings in the 300S. Plan to fly your final approach at 80 kts, keeping some power on. If you get much slower, the Extra will start to descend rapidly. Try to land any faster, and you'll float down the runway.

As you enter the traffic pattern, bring the power back to about 15 inches of manifold pressure (use the joystick throttle, press **F2**, or drag the throttle control).

Adjust the pitch attitude of the nose to hold airspeed at 70 kts. If you get a little low, add an inch or two of manifold pressure. If you think you're too high, reduce power by an inch or two.

As you cross over the runway threshold, smoothly reduce power to idle, and hold the nose slightly above the horizon. Let the airplane settle gently onto the runway. Look outside using your peripheral vision to stay lined up until you exit the runway.

Upon touchdown, bring the power back to idle, hold full back pressure on the stick (use the joystick or yoke, or press the **DOWN ARROW**), apply brakes (press the **PERIOD** key), and exit the runway.

LEARJET 45

History of Learjet

When most people think of business jets, they think Learjet. For more than three decades and through a number of corporate changes, Learjet has produced some of the finest aircraft in the world.

William Powell Lear was a 61-year-old millionaire entrepreneur when he began work on development of the Learjet. Dissatisfied with the speed of the propeller-driven craft available to business travelers in the 1950s, he decided to build a corporate-class jet. He wasn't the first to develop a "biz-jet," but he may have been the most audacious.

The first designs were influenced by a Swiss fighter, the P16. Lear hired the Swiss design team, but soon discovered that the pace of life and business in Switzerland wasn't up to his traditional rapid-fire way of getting things done. He moved the project to Wichita, Kansas, and with a new American design team, set about attempting the impossible. Pundits in the aviation business estimated it would take 10 years and \$100 million dollars to accomplish what Lear wanted. He would prove them wrong.

Lear did realize, however, that with the financial resources he had at hand, traditional development processes would not work. They decided not to build a prototype, and the first Learjet was built with the production tooling—a risky method that could not tolerate a major design error. But it worked. On September 15, 1963, only nine months after the move to Wichita, Learjet 001 was rolled out. Just 10 months later, the Learjet was granted a Type Certificate by the FAA.

Learjets have always been designed with performance in mind. Every effort was expended to squeeze more speed and less drag out of the airframe. It sprinted past the competition at 0.82 Mach with a 41,000-ft service ceiling and 1,500-nm range for five to seven passengers, and did it with a smaller price tag.

After selling the company in 1967, Bill Lear went on to other pursuits, including the unfinished Learliner and Learfan aircraft projects. With over 100 inventions to his credit (including the eight-track stereo), he left a rich legacy and an enduring mark on aviation.

LEARJET 45

The next milestone, with the company now under the Gates Learjet banner, was the introduction of the 30 series. For the United States Bicentennial, the company repeated the 1966 round-the-world flight of a Learjet 24 with a Learjet 36. The new, efficient, turbofan model bested the old time by 1.5 hours and used nearly 3,000 gallons less fuel. Learjet got a jet certified to fly at 51,000 feet, an altitude that would allow later models to take advantage of weather, wind, and fuel efficiency up high. The Concorde was the only other civil aircraft certified to such heights.

Today, as a division of Bombardier Aerospace, the company's stars are the Learjet 31A, Learjet 45, and Learjet 60. They are still among the most popular aircraft in their class, and their beautiful, sleek lines are instantly recognizable. Want testimony to the enduring quality of the Learjet name? Point to any business jet and ask the average person what it is. They'll likely say, "It's a Learjet."

LEARJET 45



Learjet 45

The Model 45 is Learjet's first all-new aircraft since Bill Lear's first Model 23. Although it looks like a Learjet, it has only half the parts of a Model 35, reflecting a significant design progression. The parameters set down for the 45 called for it to have the performance of the Learjet 35, the handling of the Learjet 31A, and greater cabin space than the competition.

Specifications	U.S.		Metric	
Cruise Speed	Mach 0.81	464 kts	859 kmh	
Engines	Allied Signal TFE731-20 3,500 lb thrust			
Maximum Range	2,200 nm	2,532 sm	4,074 km	
Service Ceiling	51,000 ft	15,545 m		
Fuel Capacity	6,062 lb	904.8 U.S. gal	2,722 kg	3,341 L
Maximum Gross Weight	20,450 lb		9,276 kg	
Maximum Takeoff Weight - HGW	20,200 lb		9,163 kg	
Length	58.4 ft		17.7 m	
Wingspan	47.8 ft		14.6 m	
Height	14.3 ft		4.3 m	
Seating	Up to 9			
Useful Load	2,650 lb		1,202 kg	

LEARJET 45

This is Learjet's first paperless airplane, designed entirely on a computer screen. In some cases, the computer design files are loaded directly into production milling machines, which allows for an exceptional degree of precision in manufacturing (especially important when major parts that have to fit together are made on different continents!). This reduces not only time in construction but also the rate of rejection of parts (inherent in any manufacturing process).

Like so many ventures today, building Learjets is a cooperative arrangement of various entities. Learjet is responsible for systems and final assembly in the United States; the fuselage is built by Shorts in Ireland; and the wing design and construction is handled by de Havilland in Canada (all Bombardier subsidiaries).

Ease of operation was a key design goal with the new Learjet. In addition to fewer parts, the craft has a built-in maintenance tracking system. A technician can plug a laptop computer into a panel and download a fault list from all of the avionics, engines, and other systems.

The 45's glass cockpit makes for simplified in-flight system management. The Primus 1000 integrated avionics system and engine instrument/crew advisory system (EICAS) has a page for monitoring every major system as well as for displaying primary flight instruments.

Power management usually creates a high workload when flying jets, thus requiring new power settings with changes in weight and ambient conditions. The Learjet 45 takes much of the power management off the pilots' hands by computing it for them. For takeoff, for example, advance the thrust levers three clicks to the takeoff position, feet off the brakes, and you're out of here. During the climb, ease the levers back a notch to the max continuous thrust (MCT) position, and let the digital electronic engine computer (DEEC) worry about the rest.

At 45,000 feet and a weight of 17,000 pounds, the high-speed cruise number is 445 KIAS with a fuel flow of about 1,062 pounds per hour (pph). Back the power down to a long-range cruise setting, and the speed decreases to 408 kts, while

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fuel burn slows to 987 pph. The 45 has a maximum IFR range of about 1,800 nm. With a maximum operating altitude of 51,000 feet, the 45 easily reaches and cruises at 45,000 feet, unlike some lighter jets that are certified to 45,000 feet, but are rarely used at that altitude.

Learjet has shown once again its ability to adapt to the market and produce what the customer wants. In the Model 45, they have crafted a machine that gets the customer there on time and in comfort while keeping the pilots and the corporate flight office happy.

Flight Notes

The Learjet 45 is one of aviation's best answers to the needs of business transportation. Capable of airliner speeds and high-altitude flight, this airplane will get you there fast and in comfort.

After transitioning in Flight Simulator from the complex single-engine airplanes to the King Air, the Learjet makes a logical next step before moving up to the 737, 777, and 747.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

LEARJET 45

Required Runway Length

■ Takeoff: 4,700 ft (1,432 m), flaps 8

■ Landing: 3,200 ft (975 m), flaps 20

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

■ Weight: 20,000 lb (9,072 kg)

■ Altitude: sea level

■ Wind: no headwind

■ Temperature: 15° C

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Engine Startup

The engines are running by default when you begin a flight. If you shut the engines down, it is possible to initiate an auto-startup sequence by pressing **CTRL+E** on your keyboard. If you want to do the startup procedures manually, follow the checklist procedures on the Kneeboard.

Taxiing

To taxi the Learjet, use just enough power to get it rolling, and then bring the thrust levers back to idle. Idle thrust will work fine for keeping you moving.

Takeoff

All of the following occurs quite rapidly. Read through the procedure several times before attempting it in the plane so you know what to expect.

Run through the Before Takeoff checklist, and set flaps to 8 or 20 as desired (press **F7**, or drag the flaps lever). With the aircraft aligned with the runway centerline, advance the throttles (press **F3**, or drag the levers) to approximately 40 percent N_1 . This allows the engines to spool up to a point where uniform acceleration to takeoff thrust will occur on both engines. The exact amount of initial setting is not as important as setting symmetrical thrust.

After the engines are stabilized, advance the thrust levers to takeoff thrust—generally 93 to 96 percent N_1 (less with high outside air temperatures).

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Directional control is maintained by use of the rudder pedals (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

- At V_1 , approximately 136 kts indicated airspeed (KIAS), is decision speed. Above this speed, it may not be possible to stop the aircraft on the runway in case of a rejected takeoff (RTO).
- At V_r , approximately 143 KIAS, smoothly pull the stick back (use the joystick or yoke, or press the **DOWN ARROW**) to raise the nose to 10 degrees above the horizon. Hold this pitch attitude and be careful not to over-rotate.
- At V_2 , approximately 146 KIAS, the aircraft has reached its takeoff safety speed. This is the minimum safe flying speed should an engine fail. Hold this speed until you get a positive rate of climb.

As soon as the aircraft is showing a positive rate of climb (both vertical speed and altitude are increasing), retract the landing gear (press **G** on the keyboard, or drag the landing gear lever). The aircraft will quickly accelerate to the flap-retract-

tion speed. This number is $V_2 + 30$, or about 176 kts. Retract the flaps (press **F6**, or drag the flaps lever).

Climb

After retracting the gear and flaps, you don't need to reduce power unless you level off below 10,000 ft (3,048 m) and you need to remain below FAA speed limits. To remain level at 200 KIAS at 2,000 ft (610 m), for example, pull the power back to 53 to 55 percent N_1 . A power setting of 60 to 63 percent will get you 250 KIAS while level at this altitude.

If you continue your climb above 10,000 ft, leave the power up as long as it remains below the "max continuous temperature" on the interstage turbine temperature gauge (ITT). You should be climbing at 1,800 to 2,000 feet per minute. Learjet drivers run their engines at maximum a good deal of the time.

Increase the pitch attitude to maintain 250 kts until reaching 0.7 Mach. Then, maintain 0.7 Mach for the rest of the climb. The changeover from indicated airspeed to Mach number typically occurs as you climb to altitudes in the high 20s or low 30s.)

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You'll have to increase power as you climb to maintain the profile just described. Like piston engines, turbine powerplants slowly lose power as the air gets thinner.

Cruise

Cruise altitude is normally determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

The Learjet is designed to fly high. You can cruise as high as FL450 (the airplane is certified to 51,000 ft), but the only payoffs for burning the fuel it takes to get there would be getting above a weather system or taking advantage of especially favorable winds.

Let's say you've filed a flight plan for FL350. When you approach your cruising altitude, begin leveling off at about 50 ft (15 m) below your target altitude.

You'll find it's much easier to operate the Learjet in cruise if you use the autopilot. The autopilot can hold the altitude, speed, heading, or navaid course you specify. For more information about using the autopilot, see **Using the Autopilot in Help**.

Normal cruise speed is 0.77 Mach. Set power at around 90 percent N_1 . If you're showing indicated airspeed on the airspeed gauge, the needle will settle down at about 280 KIAS.

Remember that your true airspeed is actually much higher in the thin, cold air. At FL370, you can count on a speed over the ground of about 429 kts (794 km/h, or 494 mph).

In cruise, the Learjet 45 gives its best maximum-weight speed performance at 33,000 ft (10,058 m), where it zips along at 444 KIAS, burning around 1,715 pounds of fuel per hour.

Descent

A good descent profile includes knowing when to start down from cruise altitude and planning ahead for the approach. Normal descent is done with idle thrust and clean configuration (no speed brakes). A good rule for determining

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when to start your descent is the 3-to-1 rule (three miles distance per thousand feet in altitude.) Take your altitude in feet, drop the last three zeros, and multiply by 3.

For example, to descend from a cruise altitude of 35,000 ft (10,668 m) to sea level:

35,000 minus the last three zeros is 35.
 $35 \times 3 = 105$

This means you should begin your descent 105 nautical miles from your destination, maintaining a speed of 250 KIAS and a descent rate of 1,500 to 2,000 ft per minute, with thrust set at flight idle to 53 percent N_1 . Add two extra miles for every 10 kts of tailwind, if applicable.

To descend, disengage the autopilot if you turned it on during cruise (or use the autopilot hold features and let it fly for you). Reduce power to idle, and lower the nose slightly. Remember not to exceed the regulation speed limit of 250 KIAS below 10,000 ft (3,048 m). You may have to adjust power to maintain your speed and rate of descent. Continue this profile down to the beginning of the approach phase of flight.

Deviations from the above can result in arriving too high at the destination (requiring circling to descend) or arriving too low and far out (requiring expenditure of extra time and fuel). Plan to have an initial approach fix regardless of whether or not you're flying an instrument approach.

Approach

A good target speed as you enter the downwind for VFR flight or at your initial approach fix for IFR flight is 200 KIAS. As you begin the approach but before you turn toward the runway, bring the power back, and hold altitude to reduce speed. Extend 8 degrees of flaps. Let the airplane stabilize at 180 kts.

During the first turn toward the runway (either on the base leg or when turning inbound on an ILS), extend 20 degrees of flaps.

Landing

When you're approaching the normal descent point on a visual approach, or one dot below the glideslope approaching the final approach fix on an ILS approach, extend the landing gear.

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Smoothly increase power to maintain 140 kts, your final approach speed. As you intercept the glideslope, set 40 degrees of flaps. This configuration should hold airspeed at 140 kts with a good descent angle toward the runway.

Hold 140 kts all the way down on final approach. Use small power adjustments to stay on the glidepath. Look for a descent rate of about 700 FPM.

At about 50 ft above the runway and past the runway threshold, bring the thrust levers to idle. Hold the pitch attitude you've used during final

approach. Don't try to raise or lower the nose. When you touch down, deploy the spoilers (press the **SLASH** [/]), and add reverse thrust (press **F2**, or drag the thrust levers into the reverse position), and apply brakes.

Make sure you come out of reverse thrust (press **F1**, or drag the thrust levers), and lower the spoilers as airspeed drops below 60 kts. Exit the runway, and taxi to parking.

MOONEY BRAVO

History of Mooney

Like many young men with a passionate interest in aviation in its early days, Al Mooney was something of a gypsy. He worked for a number of aircraft companies before starting his own at the age of 23. And like many young aviation companies, his did not survive the 1929 stock market crash. Mooney later got backing to develop the Culver Cadet, a small, sporty design also modified for use as a drone during World War II. After the war, he was once again leading a company with his name on it. Mooney Aircraft Corporation's first product was a tiny single-place (one seat) plane called the Mooney Mite (M18).

However, the company was haunted by cash and management problems for decades. Al Mooney left in 1953, and successive owners and managers never seemed to find the right formula to create sustained success. Although there were some winners, great faith was placed in models that would never make money, such as the Mooney

Mustang and an association with Mitsubishi's MU-2 turbine twin. Mergers, buyouts, and bankruptcies dogged the manufacturer until its purchase by Republic Steel in 1973.

It's hard to overstate the impact that Republic's acquisition had on both company stability and the Mooney aircraft. In addition to catching an upswing in general aviation sales, Republic staffed Mooney with the right people for the right time. Roy Lopresti, in particular, guided engineering in a relentless quest for speed and quality.

Flush-mounted access panels, new landing gear doors, a more efficient propeller, and aerodynamic seals were only a few of the improvements. By the time Lopresti's team had finished redesigning the Mooney 201, it was 22 mph faster than its predecessor. The cleaner design also gave the planes more range, faster climb, and better glide capabilities. In 1977, the 201 was named "Airplane of the Year" by *Air Progress* magazine.

MOONEY BRAVO

What they didn't change was the Mooney's sex appeal. Al Mooney had felt that the variable-incidence tailplane with its forward-swept vertical stabilizer (the backwards tail, as some wags call it) was more efficient in a stall, although other designers might disagree. Be that as it may, the Mooney's tail and clean lines are what make them instantly recognizable, and the basic design has remained constant.

Mooney has flirted unsuccessfully with pressurized single-engine and turbine single-engine designs. There was even some success pairing a Mooney with a

modified Porsche auto engine. The Eagle, Ovation, and Bravo single-engine models, however, continue to bring the company both accolades and a solid bottom line. Mooney has proven itself capable of quality and success in recent years. With more than a third of its revenue base coming from aerospace contracting, and a reputation for designing and building excellent planes, you can expect this company to continue to be a major player in the civil aircraft market.

MOONEY BRAVO



Mooney Bravo (Professional Edition Only)

Mooneys are built to go fast. A focus on speed seems natural for a company that at one time offered a plane powered by a Porsche engine. Although the partnership with the Germans didn't last, Mooney's commitment to speed certainly has. In keeping with this idea, Mooney has experimented with a number of "big engine" models. The Bravo is Mooney's fastest; with 270 hp all the way to

Specifications	U.S.		Metric
Maximum Speed	220 kts	253 mph	407 kmh
Cruise Speed	195 kts	224 mph	361 kmh
Engine	Textron Lycoming TIO-540-AF1B		270 hp
Propeller	McCauley three-bladed constant speed		
Maximum Range	1,050 nm	1,204 sm	1,945 km
Service Ceiling	25,000 ft		7,620 m
Fuel Capacity	89 U.S. gal		337 L
Empty Weight	2,268 lb		1,029 kg
Maximum Gross Weight	3,368 lb		1,528 kg
Length	26.75 ft		8.15 m
Wingspan	36 ft		11 m
Height	8.33 ft		2.5 m
Seating	Up to 4		
Useful Load	1,100 lb		500 kg

MOONEY BRAVO

25,000 ft, the Bravo can attain speeds up to 220 KTAS, making it the fastest single-engine airplane currently produced.

In 1989, the M-20M TLS (Turbocharged Lycoming Sabre) was introduced. It married the fuselage of the Porsche-powered Mooney PFM to a turbocharged and intercooled Textron Lycoming TIO-540-AF1A six-cylinder engine. Capable of producing 350 horsepower (hp), Mooney limited the M-20M to 270 hp to provide a quieter cabin and longer time between engine overhauls. It also had a three-bladed prop, which added ground clearance. (Besides, pilots find three-bladed props sexy).

Electronically operated Precise Flight speed brakes became standard equipment on the TLS. With its high cruise speeds and high-altitude performance, the speed brakes were a welcome addition. Coming down from altitude, the pilot can leave the power at higher settings to avoid shock-cooling the engine and use the speed brakes to stay at the desired airspeed. Electric rudder trim was also added to compensate for the high torque forces with the big engine.

Only minor engineering changes were incorporated into the plane from 1989 to 1996—testament to a solid initial design.

In mid-1996, Mooney introduced a new version of the TLS. The most significant change in this model was an engine upgrade. Engineers decided that additional cooling lubrication was needed, so the airplane was fitted with the Lycoming TIO-540-AF1B. The engine's "B" designation gave the new Mooney its name: Bravo.

Although turbocharging an engine adds cost and complexity, it gives the airplane more flexibility as a vehicle. You can get higher and go faster when the turbocharger is feeding the engine denser air than it would normally find at higher altitudes. And this is what the Bravo is all about; the ability to get above the bulk of the nasty weather and still achieve 220-knot cruise speeds. At low to medium altitudes, the only thing that will outrun the Bravo is Mooney's own Ovation. Above 10,000 feet, the Bravo will outrun virtually any new production piston single *or twin*, even challenging such accepted twin-engine speed demons as the out-of-production Baron 58P and Aerostar 601P.

MOONEY BRAVO

That's what defines this aircraft's appeal: it's about getting there fast. And in that department, the Bravo stands alone.

Flight Notes

The Bravo is the newest of Mooney's big-engine aircraft. The Bravo is built for speed and looks like it's going fast even when it's standing still. After transitioning to complex aircraft in the 182 RG, the four-place, single-engine Bravo will challenge you with more power, speed, and altitude capability.

Required Runway Length

- Takeoff: 2,000 ft (610 m), flaps 10
- Landing: 2,500 ft (762 m), flaps full

The length required for both takeoff and landing is a result of a number of factors, such as aircraft weight, altitude, headwind, use of flaps, and ambient temperature. The figures here are conservative and assume:

- Weight: 3,200 lb (975 kg)
- Altitude: sea level
- Wind: no headwind

- Temperature: 15° C
- Runway: hard surface

Lower weights and temperatures will result in better performance, as will having a headwind component. Higher altitudes and temperatures will degrade performance.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

MOONEY BRAVO

Engine Startup

The engine is running by default when you begin a flight. If you shut the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**. If you want to do the startup procedures manually, use the checklist on the Kneeboard.

Taxiing

While taxiing, the power should be set at around 1000 RPM (prop and mixture are full forward.) As you move down the taxiway, turn the nose right and left for directional control by using the rudder (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

Takeoff

Run through the Before Takeoff checklist, and set flaps to 10 degrees (press **F7**, or click the flaps lever on the panel).

Cowl flaps should be OPEN for takeoff and climb (click the Cowl Flaps switch).

With the aircraft aligned with the runway centerline, advance the throttle control to full power and monitor the manifold pressure during the initial stage of the

Note

Many factors affect flight planning and aircraft operation, including aircraft weight, weather, and runway surface. The recommended flight parameters listed below are intended to give approximations for flights at maximum takeoff or landing weight under ISA conditions. These instructions are no substitute, however, for using the actual aircraft manual.

takeoff roll (it should remain at or below 38 inches of mercury). Fuel pressure should read a minimum of 24 PSI.

At around 60 kts indicated airspeed (KIAS), smoothly pull the stick back (using the joystick or yoke, or press the **DOWN ARROW**) to raise the nose to 10 degrees above the horizon. Climb out at 85 KIAS.

As soon as you have a positive rate of climb on liftoff (both vertical speed and altitude are increasing), retract the landing gear (press **G** on the keyboard, or click the landing gear lever on the panel). Then, raise the flaps (press **F6**, or drag the flaps lever). Accelerate to 105 KIAS.

MOONEY BRAVO

Climb

For the climb to cruise altitude, the recommended parameters are 2400 RPM (press **CTRL+F2**, or drag the prop control) and 34 inches manifold pressure (press **F2**, or drag the throttle control). The cowl flaps should remain open. Your climb speed should be around 120 KIAS.

For best fuel efficiency, adjust the mixture (press **CTRL+SHIFT+F2**, or drag the mixture control) until the turbine inlet temperature (TIT) gauge reads peak value for the chosen power setting. Changes in altitude or power may require adjustments of TIT. Operation at a TIT in excess of 1,750° F (954° C) is prohibited.

If fluctuations appear on the fuel pressure gauge during prolonged climbs or when you reduce power upon reaching cruise altitude, turn the fuel boost pump on (click the Fuel Boost switch) until the fluctuations cease.

Cruise

Cruise altitude would normally be determined by winds, weather, and other factors. You might want to use these factors in your flight planning if you have created weather systems along your

route. Optimum altitude is the altitude that gives the best fuel economy for a given configuration and gross weight. A complete discussion about choosing altitudes is beyond the scope of this section.

Best power settings will result in both high cruise speeds and high fuel flow.

Set the propeller RPM at 2400 and the manifold pressure at 34 inches. Set the mixture at peak TIT. Lower power settings will result in better fuel flow and range.

For best fuel efficiency, adjust the mixture (press **CTRL+SHIFT+F2**, or drag the mixture control) until TIT reads peak value for the chosen power setting. Changes in altitude or power may require adjustments of TIT. Operation at a TIT in excess of 1,750° F is prohibited.

At altitudes above 22,000 ft (6,706 m) and at manifold pressures above 32 inches, only best power (1,650 degrees TIT) or richer mixture is permitted.

Cowl flaps should be CLOSED for cruise and descent (click the Cowl Flaps lever).

MOONEY BRAVO

Descent

Avoid extended descents at manifold pressure settings below 15 inches, as the engine may cool excessively.

Using a descent from 18,000 ft (5,486 m) as an example, set the propeller at 2000 RPM and the manifold pressure as required to maintain a rate of descent of 500 to 750 feet per minute (fpm). A typical descent is done at around 150 KIAS. Keep the engine leaned to peak TIT during your descent.

In the example above, the descent would take approximately 24 minutes to reach sea level and cover nearly 69 miles (111 km). If necessary, you can leave the power up and deploy the speed brakes to increase your rate of descent.

Approach

Below 110 KIAS, you can begin extending the flaps. The flaps are good at reducing airspeed. They will cause a slightly nose-down pitch attitude when deployed. Extending the landing gear can also reduce speed (140 KIAS or below).

Plan to slow to around 110 KIAS entering the downwind or at your initial approach fix on an instrument approach.

Landing

Final approach with full flaps deployed should be flown at around 75 KIAS. The propeller and mixture controls should be full forward. On final approach, verify that the landing gear is down.

Select a point past the runway threshold, and aim for it. Adjust your pitch so that the point remains stationary in your view out the windscreen. Leave the power at your final approach setting, and fly the airplane down to the runway. Reduce power to idle just before flaring and touch down.

Upon touchdown, bring the power back to idle, apply the brakes (press the **PERIOD** key), and exit the runway. Retract the wing flaps (press **F6**).

SCHWEIZER 2-32

History of Schweizer

The love of soaring: that's the motivation that kept the Schweizer brothers building sailplanes through many years of less-than-soaring sales volume. Although the company's success was largely from manufacturing other products, they maintained a tradition of building some of the world's best sailplanes, even when it didn't always make the best business sense.

As teenaged boys, Ernest, Paul, and William assembled their first glider at home in a barn in 1930. The model 1-1 was launched by manpower (unlike modern gliders, which are towed aloft by powered aircraft, winches, or autotomobiles), and flown successfully by all members of the local soaring club. It was an auspicious beginning.

It wasn't long before the brothers formed the Schweizer Aircraft Company (SAC). Though they became widely respected for their designs and manufacturing acumen, it would be many years before a substantial enough market emerged to support large-scale production of sailplanes for private individuals. However, even during

the lean years, soaring records were set and soaring events were won by pilots flying Schweizer sailplanes. Schweizer aircraft soon became the standard by which sailplane performance was measured.

With the advent of World War II, nearly every company having anything to do with aviation got into defense work. The Schweizer Aircraft Company built parts for many famous aircraft, including the P-40 and P-47 fighters and the C-46 transport, and they built gliders for the Army Air Corps to use in pilot training programs.

After the war, there were thousands of surplus gliders to be had cheaply, which dampened the commercial sailplane market. SAC, based in Elmira, New York, won a lucrative contract to build the welded fuselage for a neighboring company's new machine: the Bell 47 helicopter. SAC eventually built more than 1,000 Bell 47 bodies. The company continued to be called upon by the government and other aircraft manufacturers as an important subcontractor of defense and civilian aircraft projects.

SCHWEIZER 2-32

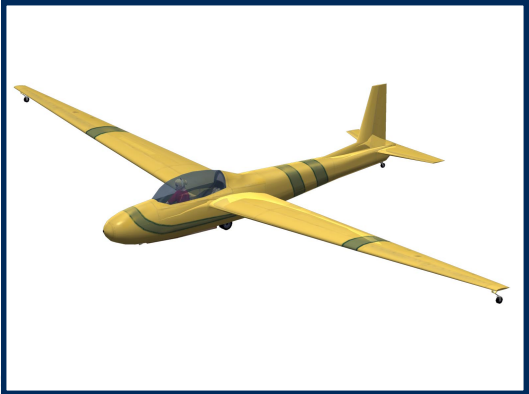
The first truly successful Schweizer glider (in terms of numbers built) was the SGS 1-26. It could be factory assembled or purchased as a kit for assembly by the owner. Over a 25-year production run, 700 of these planes were built. In 1962, SAC introduced the classic SGS 2-32, still considered to be one of the finest sailplanes ever designed.

For nearly 40 years, the company built the Ag Cat, a radial-engine biplane used for spraying crops. They also went into the helicopter business, and today build

three models in that line: the 300C, 300CB, and the 330SP. Still an active defense contractor, their products include the Schweizer SA 2-37A and RU-38 surveillance planes.

Sons of the three Schweizer brothers now run the company. With the passing of the company's command to the next generation, Schweizer Aircraft Corporation is one of the few remaining family-owned aircraft manufacturers in the United States.

SCHWEIZER 2-32



Schweizer SGS 2-32

Through the late 1960s and much of the 1970s, one aircraft stood apart as the world's highest performance multiseat sailplane: the Schweizer SGS 2-32. Many world soaring records were set in 2-32s in both men's and women's categories, including a distance run of 505 miles.

In the early 1960s, it was apparent that European manufacturers were beginning to cut into SAC's position as the premier builder of high-performance sailplanes.

Specifications	U.S.		Metric
Maximum Speed	137 kts	158 mph	254 kmh
Engine	none		
Glide Ratio	36 to 1		
Empty Weight	850 lb		386 kg
Length	26.75 ft		8.78 m
Wingspan	57 ft		18.7 m
Wing Area	180 sq ft		19.37 m ²
Aspect Ratio	18.05		
Maximum L/D (Calculated)	~57 kts	~66 mph	~106 kmh
Minimum Sink (Calculated)	~47 kts	~54 mph	~87 kmh
Seating	Up to 2		
Useful Load	580 lb		264 kg

SCHWEIZER 2-32

The European companies could build quality aircraft at 50 percent of the labor costs of the U.S. manufacturer and deliver them to U.S. shores at a price that Schweizer couldn't match. In order to compete, Schweizer had to produce a superior aircraft.

In 1962, SAC began development of the 2-32. This aircraft took twice as many hours to design, tool, and build as previous Schweizer sailplanes. Initially priced at \$8,000, the production and development costs of the meticulously designed aircraft eventually pushed the price tag up considerably.

The 2-32's 57-foot wingspan provided a glide ratio of 36 to 1, which meant that at an altitude of 1 mile, the plane could glide a distance of 36 miles. The interior was luxurious and comfortable for a sailplane. It had dual flight controls, and though technically a two-seater, it could actually carry two people in the rear in addition to a pilot in the front. A large bubble canopy provided excellent visibility.

The highly efficient wing and aerodynamically clean fuselage of the 2-32 made it a candidate for an early attempt at nonstop flight around the world. Although that

record was not set for many years (in 1986 by the Burt Rutan-designed Voyager), a modified 2-32, sporting a small engine, did set a nonstop distance record of 8,974 miles (14,442 km) in 1969.

When the 1,000th Schweizer sailplane (a 2-32) was built, SAC held 57 percent of the sailplane business in the United States. But this was not to last. The all-metal SAC planes last indefinitely, and by the mid 1970s, they had nearly saturated the market. Sleek new European fiberglass sailplanes had lower prices and carried a certain cachet that domestic sailplanes did not. SAC eventually ceased production of their sailplane line.

When manufacture of the model ended in 1976, a total of only 87 had been delivered. Nevertheless, the 2-32 had already earned a permanent place in soaring history, and remarkably, a 2-32 in good condition today can fetch as much as \$50,000. The model is still a popular choice for commercial soaring rides, and if you go to a local soaring center to take a ride, you may find yourself in a Schweizer 2-32.

SCHWEIZER 2-32

Flight Notes

The Schweizer 2-32 is an all-metal aerobatic sailplane. Though its short production run ended in the mid-seventies, it's still a popular airplane for use in instruction and for scenic rides.

Soaring is a good test of your piloting skills. Your ability to control your airspeed, find rising air, and plan your descent and landing is key to a good flight in this plane.

Required Runway Length

- Takeoff: Use the Slew feature
- Landing: 1,000 ft (305 m)

The length required for landing is a result of a number of factors, such as aircraft weight, ambient temperature, and altitude. The figures here assume:

- Weight: maximum gross weight
- Altitude: sea level
- Wind: no headwind
- Temperature: 15° C
- Runway: hard surface

Lower altitudes, weights, and temperatures will result in better performance, as would a headwind component.

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Engine Startup

The Schweizer 2-32 is a sailplane and has no engine, so it descends unless you fly into an area of rising air. By finding air that is rising as fast as (or faster than) the sailplane is descending, you can maintain (or gain) altitude. Finding rising air is challenging, and the duration of your flights depends on your skill.

Flight Simulator has three good soaring areas. You'll find ridge lift in the Munich, San Francisco, and Seattle scenery areas, where air is forced upward near

SCHWEIZER 2-32

mountains. You'll also find thermals—warm, rising air—near the San Francisco coast and near Lake Chelan on the opposite side of the Cascade Mountains (east side) from Seattle. Choose from several soaring flights designed for the sailplane in the Select Flight dialog box (choose **Select Flight** on the Flights menu).

Taxiing

There is no taxiing in the 2-32.

Flaps

The 2-32 does not have wing flaps.

Takeoff

Use the Slew feature to raise the aircraft to altitude. Press **Y** to activate slewing, and press **F4** to gain altitude. When you reach 3,000 to 4,000 ft, press **Y** to deactivate slewing. The aircraft will pitch down to gain flying speed. Use the spoilers (press the **SLASH** [/] key, or drag the spoiler lever) to control speed while recovering to soaring flight.

Alternatively, you can set your altitude and airspeed in the Map View dialog box. On the **World** menu, select **Map View**.

Then, enter the altitude and airspeed in the appropriate boxes. Because you entered an airspeed, the aircraft won't pitch down when you turn off Slew mode and you won't need to use the spoilers.

Lower the spoilers once you level off (press the **SLASH** [/] key, or drag the spoiler lever). Keep in mind that the Schweizer is sensitive to pitch, so use a light touch on the stick.

Climb

Climbing in the 2-32 requires that you fly in an area of rising air. You must fly the sailplane near a ridge or in an area where the ground surface, heated by the sun, creates thermals. This can be one of the most enjoyable aspects of flying the sailplane—learning how to take advantage of currents of air to remain aloft or to climb. Pay attention to your variometer and altimeter when searching for areas of rising air.

When soaring in rising air, if you're trying to go for distance, fly at maximum L/D, which is approximately 66 mph indicated airspeed (IAS). The Schweizer airspeed

SCHWEIZER 2-32

indicator reads in miles per hour). If you're trying to stay in the lift and just increase altitude, fly at minimum sink, which is approximately 54 mph.

If you lose the lift, you'll want to increase your speed by lowering the nose and then finding rising air again. The amount of increase in airspeed should be about half of your headwind component. If you have a 10-kt headwind, for example, increase your speed by 6 mph.

One of the most challenging sources of lift for the sailplane pilot is a "thermal"—a rising current of warm air that is created in an area where the sun's rays generate more heat than in surrounding areas.

For example, desert areas or brown fields generate more heat than forests and green fields. These heated areas release heat into the atmosphere and create columns of rising air. These columns—thermals—can rise for thousands of feet and produce cumulus clouds if there is sufficient moisture in the air.

Cruise

Cruise is aided by finding areas of rising air. Without an engine, rising air is the only thing that will keep you from heading earthward.

When you can't find rising air, you have to keep in mind the glide ratio of the aircraft. The numbers to remember for the Schweizer are "34 to 1." For every one mile (1,609 m) of altitude, the sailplane can travel 34 miles (54.7 km) in distance.

That's if you have ideal conditions.

You need to include a safety margin for unfavorable winds and other factors; real-world soaring pilots use a safety margin of one-half or two-thirds of the aircraft's actual performance capability.

With that in mind, use "20 to 1" as a good measure for safety. If you slew the 2-32 up to one mile in altitude, you can glide about 20 miles of distance to soar before gravity returns you to terra firma.

SCHWEIZER 2-32

Descent

You only get one shot at landing in a sailplane (except in Flight Simulator, where you can use the Slew feature to gain altitude). Therefore, you must plan your descent so that you arrive over the airport at pattern altitude. It will take some experimentation to learn how far from the airport you can fly and still make a safe landing.

Try using the formula discussed in the “Cruise” section. Use the Slew feature to gain one mile in altitude, and then slew 20 miles away from the airport (you can use the Global Positioning System [GPS] to be precise). See how well you do at getting back to the airport without having to slew again. You want to arrive back at the airport at around 1,000 ft (304.8 m) above the airport elevation.

Approach

If you arrive in the airport vicinity with excess altitude, you can use the spoilers to increase your rate of descent (press the **SLASH** [/] key, or drag the spoiler handle). Fly a normal pattern at around 65 to 70 mph.

Landing

Remember that if you carry excess speed on final, the sailplane will want to keep flying longer than you want it to. If necessary, deploy the spoilers on final to allow you to slow the aircraft and increase your rate of descent.

As you cross the runway threshold, raise the nose slightly to slow to around 50 mph for landing. If you haven't already deployed the spoilers, do so just before touchdown. That will spoil any lift that threatens to keep the sailplane off the ground. Hold a level attitude close to the ground, and let the sailplane settle to a smooth, level touchdown. Do not flare, or you will jam the tailwheel onto the ground, resulting in a rough landing.

Once on the ground, use the rudder for directional control as you roll out (twist the joystick, press the right or left rudder pedal, or press **O** [left] or **ENTER** [right] on the numeric keypad).

SOPWITH F.1 CAMEL

History of Sopwith

Born to privilege, Thomas Octave Murdoch Sopwith could have spent his life playing polo and sailing his 166-ton schooner *Neva*—interests that preceded his passion for aviation. But his intelligence, energy, and curiosity combined well with his engineering education to steer him into pursuits that matched a bounding ambition. In 1910, Sopwith earned British Pilot Certificate no. 31, and before the year was out, he was competing for and setting British aviation records. Shortly after the New Year, he landed a Howard Wright biplane on the grounds of Windsor Castle at the invitation of King George V.

Within two years of earning his pilot certificate, Sopwith was designing his own aircraft and ascending rapidly in the ranks of British aviation. In early 1914, the First Lord of the Admiralty, Winston Churchill, took his first ride in a Sopwith airplane. By then, Sopwith aircraft were already entering into the service of the Royal Flying Corps, which was fortunate: on August 14 of that year, Britain declared war on Germany.

Among the thousands of airplanes built by Sopwith Aviation Company, Ltd. during World War I were such models as the Tabloid, the Strutter, and the Schneider and Baby floatplanes. More famous were the Pup, the Sopwith Triplane, and the most successful fighter of the war, the Sopwith F.1 Camel.

The rugged design and construction of the planes was frequently demonstrated in combat. One pilot had his Strutter set ablaze by anti-aircraft fire. He was able to put the flames out by ripping strips of burning fabric off the plane. He was then attacked by enemy planes, and a severed fuel line forced a landing. The plane was up and flying again the next morning.

After the war, military order cancellations led to the dissolution of the Sopwith Aviation Company. Tom Sopwith became chairman of Hawker Engineering, which absorbed the Sopwith patents. Following a 1935 merger with Siddeley Armstrong, the company became known as Hawker Siddeley Aircraft Company.

SOPWITH F.1 CAMEL

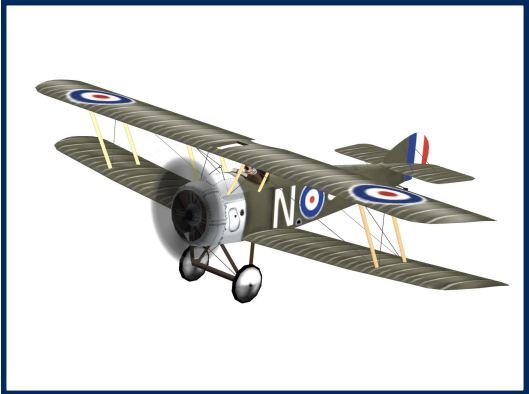
With war clouds gathering once again, Hawker Siddeley joined in the defense of the realm during the Second World War with the Hawker Hurricane (which can be flown in Microsoft™ Combat Flight Simulator), the Typhoon, and the Tempest. From 1939 to 1941, the Hurricane was Britain's front-line fighter. Though the Supermarine Spitfire won more acclaim in the history books, the Hurricane shot down more enemy planes in the Battle of Britain. More than 14,000 were built.

In 1953, Tom Sopwith became Sir Thomas Sopwith, in recognition of his contributions to aviation. In more recent years, Hawker has produced business, military, and transport aircraft. They

developed the widely respected Hawker 125 business jet, which today is owned and built by Raytheon Aircraft. Among the most famous Hawkers is the AV8-B Harrier "jump jet," the world's first vertical takeoff and landing attack aircraft.

In 1977, Hawker Siddeley merged with the British Aircraft Corporation to form British Aerospace (BAE). Employing over 43,000 people, BAE is one of the largest aerospace and defense contractors in Europe and is part of the combined effort to develop the future Eurofighter aircraft.

SOPWITH F.1 CAMEL



Sopwith 2F.1 Camel

In July 1917, the Sopwith Camel entered the fray of World War I aerial combat. Developed by the British as a replacement for the Sopwith Pup, the Camel was an extremely agile and maneuverable airplane. With its two Vickers machine guns, it outgunned the Pup and provided a measure of insurance against losing a fight due to a jammed gun. The humped fairing that covered the machine guns

Specifications	U.S.	Metric
Maximum Speed	99 kts 114 mph	183 kmh
Engine (two options)	110 hp Le Rhone 130 hp Clerget 9b rotary	
Maximum Range	300 m	483 km
Service Ceiling	19,000 ft	5,790.9 m
Empty Weight	956 lb	433 kg
Gross Weight	1,523 lb	690 kg
Length	18.5 ft	5.64 m
Wingspan	26.9 ft	8.20 m
Height	9.083 ft	2.77 m
Seating	1	

SOPWITH F.1 CAMEL

gave the Camel its name. In less than two years' service, the Camel finished the war with 1,294 victories on its tally sheet.

The Camel was the deadliest Allied airplane of World War I for enemy and Allied pilots alike. Four hundred and thirteen Allied pilots suffered combat-related deaths, and 385 died from non-combat-related causes in the Camel. Aces loved it, but it was not a plane for beginners. British Major W. G. Moore explained that "being totally unstable in all directions and very sensitive fore and aft, and much influenced by engine torque, [it] was a deathtrap for the inexperienced pilot. A skilled pilot could not wish for a better mount."

What made the Camel tricky to handle is that much of its mass was concentrated in the front seven feet of the airplane. Although the Camel had incredible turn performance, the airplane's forward center of gravity and the high torque forces from its big rotary engine meant that the plane could easily outmaneuver its unwary pilot. Sudden forward stick movements (which pitch the aircraft's nose down) could actually catapult the

pilot out of his seat if he wasn't strapped in. The plane was also prone to deadly spins, which were little understood at the time (proper Camel spin-recovery techniques not yet having been developed).

Though capable of flying higher, the Camel was most effective at around 12,000 ft (3,658 m), where its maneuverability gave it an advantage over German fighters. In his open cockpit at those altitudes, the pilot was exposed to bitter cold. A pilot remembered, "I flew in a wool-lined leather coat, a red knitted scarf—important to keep out the draught—mask, goggles and mittens, plus long sheepskin thigh boots."

The names of a number of World War I aces are inseparably linked to the Camel. Tradition holds that Canadian Sopwith Camel ace Roy Brown shot down the dreaded German flyer, Manfred von Richtofen (the Red Baron), although it is now generally agreed that von Richtofen was downed by ground fire. Canadian Donald MacLaren scored 54 victories in the Camel. And, when famed cartoonist Charles Schulz chose to send his hero Snoopy up against the Red Baron, Snoopy's steed of choice was, of course, the Sopwith Camel.

SOPWITH F.1 CAMEL

Flight Notes

The Sopwith Camel was the deadliest fighter of World War I. A single-engine biplane made largely of wood and fabric, it could be tricky for the uninitiated to fly, but was a favorite for veteran pilots.

Highly maneuverable, the Camel is a great plane for aerobatic flying. Test your skills at mock air-combat maneuvering.

Required Runway Length

The Camel is capable of taking off and landing on any runway in Flight Simulator.

Engine Startup

The engine is running by default when you begin a flight. If you shut the engine down, you can initiate an auto-startup sequence by pressing **CTRL+E**.

Taxiing

Taxiing in the Camel requires you to make S-turns in order to see where you're going. As you move down the taxiway, turn the nose right and left to see ahead of you while taxiing by using the rudder (twist the joystick, use the rudder pedals, or press **O** [left] or **ENTER** [right] on the numeric keypad).

Note

As with all of the Flight Simulator aircraft, the V-speeds and checklists are located on the Kneeboard. To access the Kneeboard while flying, press **F10**, or select the **Aircraft** menu, and then choose **Kneeboard**.

Important

All speeds given in Flight Notes are indicated airspeeds. If you're using these speeds as reference, be sure that you have the Aircraft Realism Settings set to "Display Indicated Airspeed." Speeds listed in the performance tables are shown as true airspeeds.

Flaps

The Sopwith Camel doesn't have flaps.

Takeoff

Once aligned with the runway centerline, apply power smoothly (press **F3** for incremental increase, **F4** for full throttle on the keyboard, or move the throttle on your joystick). As the airplane begins moving down the runway, push forward on the stick until the tail comes up. This will occur at around 35 to 40 mph indicated airspeed.

SOPWITH F.1 CAMEL

You'll notice the tail coming up because your forward view will suddenly improve as the aircraft changes from a nose-high attitude to a level attitude. Be careful not to give too much forward pressure on the stick at this point, as you can nose the plane over onto the prop.

At about 55 mph, ease the stick back and allow the plane to fly off the runway. Climb out at around 60 to 70 mph.

Climb

Climb to cruise altitudes at 70 mph or above. You don't have an attitude indicator in the Camel, so airspeed is your indicator for climb attitude.

Cruise

The Camel is not an airplane you would use for a long cross-country flight. Its fuel capacity is not large enough for extended flight because it was built as a fighter. Because the Camel doesn't have an autopilot, long flights would be fatiguing, requiring constant attention to straight-and-level flight.

If you do make flights with the Sopwith to the extent of its range, keep in mind that its cruise speed is rather slow. You won't get there fast.

Descent

Descents in the Camel are uncomplicated. You can easily descend at cruise speeds and slow down near the airport in time to set up your landing.

Approach

The approach phase in the Camel can be initiated fairly close to your destination. Even entering the pattern at 90 mph is not a problem, as you can slow the Camel quite quickly. However, it's always a good plan to enter the downwind leg close to your target landing speed.

SOPWITH F.1 CAMEL

Landing

Normal final approach and landing in the Camel should be made at around 60 mph. The trick here is to remember that you're in a taildragger. Your best technique will be to make a "wheel landing." This means you have to fly the airplane onto the main wheels, instead of flaring, as you do in a tricycle-gear airplane.

This will require practice, just as it does for taildragger pilots in the real world. You might find that you bounce quite a bit at first. Try to hit the approach speed precisely, remaining stable at that speed. If possible, make the final approach somewhat flat, rather than steep.

Once on the ground, hold full back pressure on the stick (pull the joystick aft, or press the **DOWN ARROW** key).