FLIGHT SCHOOL
handbook

FLYING CLASSROOM: A FORMATION OF AT-6 "TEXAN" TRAINERS.

Air Force Historical Research Agency Photo

Basic Flight

If you make assumptions about how an airplane works you put your machine, your life, and your country at risk. Practice and study every aspect of flight and combat, and when you go to sleep--dream it.

* * *

Air Combat

Dropping a bomb onto a moving target--it seems like you'll never get it right. Your troops are depending on you to clear out the hornets nest impeding their advance. What can you do? Plenty!

BASIC FLIGHT

FIRST THINGS FIRST

You're about to take on a huge responsibility by participating in the greatest struggle so far in the 20th century. Are you up to it? Your country and your squadron mates are counting on you, so we're going to get you up to speed.

You've been assigned to the tactical air support role, which means you'll be flying low where you're vulnerable to enemy antiaircraft guns. Give yourself a fighting chance by first going through training. Military flight training consists of these three steps:

1. First, you'll read this handbook.

2. Then you'll watch movies that show several basic combat maneuvers you need to master.

3. Finally, you'll practice what you've learned by actually flying.

When you're done training, you'll know how to handle a powerful airplane and how to use it to hit the enemy hard.

The Flight School handbook

Read this handbook and study the diagrams to learn the basics of flight, how your plane works and flies, and how to execute combat maneuvers. If you're a novice, begin with the basics of flight; if you're an experienced flyer, jump right into the air combat training section so we can use you as soon as possible. If you understand the material in this handbook, you'll be a better fighter. Read it now!

The movies

After you've read the handbook, **watch the training movies.** (You can access them in the CFS3 Training Materials section of online Help.) These movies demonstrate two tactical air combat and two dogfighting maneuvers that can be applied in a variety of situations.

The training missions

Finally, **get in the plane and practice** tactical air combat maneuvers, such as dive bombing, strafing, and level bombing. You'll use these skills to aid the ground soldiers as they advance. Practice the maneuvers until they're second nature so you don't have to think about them when you're in combat. Here are some tips for getting up to speed quickly:

- **Study the Quick Reference Card.** Memorize key commands to help you do things quickly when time is of the essence.

- **Familiarize yourself with the instrument panel.** Roll the cursor over each instrument to see both what it is and its current reading.

- **Use the Free Flight option.** (Click the Quick Combat tab, and then click Free Flight.) Use Free Flight to practice both basic and combat maneuvers without getting shot at. You need to master these maneuvers to stay alive and help us WIN!

- **Fly some training missions.** (Click the Missions tab, and then select a mission from the Training tab.) By flying training missions, you can practice what you've learned, but with the heat turned up a notch.

- **Practice your level bombing skills.** Level bombing means you must fly level over the target, which can be difficult when you're being shot at. You'll need to switch between three positions: cockpit, gunner, and bombardier. You can fly your plane from the cockpit, but you can also jump to a gunner position and defend, or jump to the bombardier position and drop your load on the target. Dropping a bomb load while looking through a bombsight is tougher than it might seem. Practice!

Time is wasting so get busy. We've got an important mission and we need you!

The instrument panel in your aircraft provides key information about your position and your aircraft's health, among other things. It may look confusing and foreign at first, but you'll come to rely on it after you get used to it. Every aircraft has a different panel, but for the most part, each panel features the same basic elements.

- **Gauges:** Each aircraft has its own set of gauges that indicate how your aircraft is performing and where you're going.

- **Mouse rollover Help:** While you fly, you can find out an instrument's name by pointing to the instrument with the mouse.

Although there area several aircraft for each nationality in Microsoft® Combat Flight Simulator 3, you only need to learn three basic instrument sets. The accompanying images show the basic set of instruments for American, German, and British aircraft.

* * *

	AMERICAN	GERMAN	BRITISH
ARTIFICIAL HORIZON			
AIRSPEED			
ALTIMETER			
HEADING INDICATOR			

FLIGHT CONTROLS

You control an airplane's movement with the stick and rudder pedals. In Combat Flight Simulator 3 (CFS3), the stick and rudder are simulated by the joystick and rudder pedals (both optional), and the keyboard. No matter what your setup, you'll use these controls to move control surfaces that cause the airplane to turn, climb, and descend.
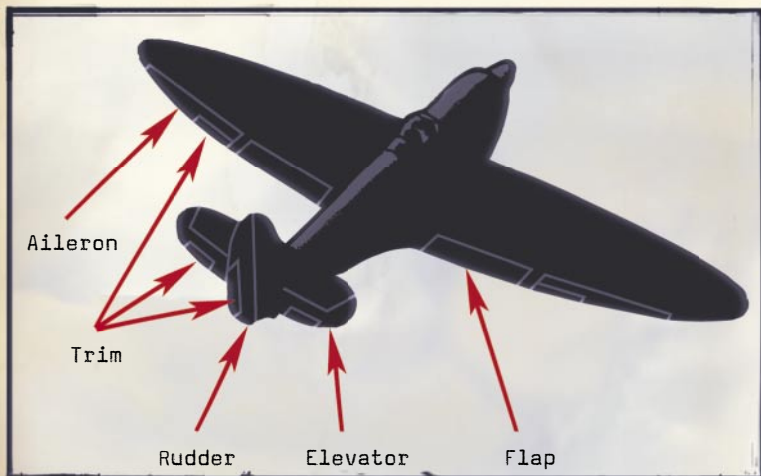
PRIMARY CONTROL SURFACES

Ailerons

Moving the stick left and right moves your plane's ailerons. These hinged rectangular surfaces are located on the trailing edges of the wings near the wing tips, and they control your plane's banking (rolling) motion.

The ailerons move in opposite directions. If you move the stick left, the left aileron moves up, reducing lift (upward force) on the left wing. At the same time the right aileron moves down, increasing lift on the right wing. The result? The airplane banks (rolls) to the left. When the wings reach the angle of bank you want, center the stick. Banking with the ailerons is what **causes a plane to turn.**

Note: All keyboard commands noted in this manual are the default Combat Flight Simulator 3 combat keyboard commands. If you want to change your settings to your own keyboard commands or to Microsoft Flight Simulator keyboard commands, click Control Options on the Options tab and follow the prompts.

Aileron

Trim

Rudder   Elevator   Flap

ACTION	JOYSTICK	KEYBOARD (NUM LOCK ON)
Bank left/ Left aileron	Move joystick left	Num Pad 4
Bank right/ Right aileron	Move joystick right	Num Pad 6
Stop banking/ Center ailerons	Center joystick	Num Pad 5

Rudder

Pushing the rudder pedals moves your plane's rudder. The rudder is a hinged surface located on the vertical stabilizer of the tail. It controls your craft's yawing (pivoting) motion to the left and right. The rudder is used to **counteract your plane's tendency to yaw** in the direction opposite a turn, and to **counteract your engine's torque.** (Learn more about the effects of torque in "A few words about torque" later in this handbook.)

ACTION	JOYSTICK/RUDDER PEDALS	KEYBOARD (NUM LOCK OFF)
Yaw left/ Left rudder	Twist joystick left (not all joysticks twist) or press left rudder pedal	Num Pad 0
Yaw right/ Right rudder	Twist joystick right or press right rudder pedal	Num Pad ENTER
Yaw center/ Neutralize rudder	Center joystick or center rudder pedals	Num Pad 5

Elevator

Moving the stick forward and backward moves your plane's elevator. This hinged surface is located on the horizontal stabilizer of the tail and controls your airplane's pitch (up and down) motion. Moving the stick forward **decreases** pitch attitude (lowers the nose), while moving it back **increases** pitch attitude (raises the nose). **The elevator controls pitch attitude, but it doesn't necessarily make your plane climb or descend.** You'll learn why in "Basic Flight Maneuvers" later in this handbook.

ACTION	JOYSTICK	KEYBOARD (NUM LOCK OFF)
Pitch up	Move joystick back	Num Pad 2
Pitch down	Move joystick forward	Num Pad 8

SECONDARY CONTROL SURFACES

Trim

Trim tabs are small, hinged surfaces on the elevator, rudder, and ailerons that help you maintain specific control positions without needing to exert pressure on the controls. Moving a trim tab one way deflects the elevator, rudder, or aileron the other way. When your airplane is properly trimmed, you can fly "hands off," applying only occasional, small control-pressures to compensate for the occasional bump or minor changes in heading. (On some aircraft, elevator trim moves the entire elevator slightly, instead of moving a tab on it.)

Use trim to relieve control pressure, not to fly. If you want to change the airplane's attitude (position relative to the horizon), first move the stick or rudder and change the power setting if necessary. Then, after the airplane stabilizes, trim off the pressure.

ACTION	KEYBOARD (NUM LOCK OFF)
Aileron trim left	CTRL+Num Pad 4
Aileron trim right	CTRL+Num Pad 6
Rudder trim left	CTRL+Num Pad 0
Rudder trim right	CTRL+Num Pad ENTER
Elevator trim up	Num Pad 1
Elevator trim down	Num Pad 7

Flaps

Flaps are hinged surfaces on the trailing edges of the wings, next to the fuselage. They are usually used during takeoff and landing. When extended, the flaps increase lift by helping the wings deflect more air downward, which means your plane can ascend more rapidly. They also increase drag (the resistance of the air), allowing your aircraft to descend more steeply without building up speed.

The flaps are extended in increments, which vary depending on the aircraft. As you extend or retract the flaps, **be prepared for changes in pitch.** The nose will rise or fall from the resulting change in lift. Add forward- or back-pressure on the stick to maintain the pitch attitude you want, and after the airspeed stabilizes, use elevator trim to relieve that pressure.

ACTION	KEYBOARD
Retract flaps fully	SHIFT+V key
Retract flaps in increments	V key
Extend flaps fully	SHIFT+F
Extend flaps in increments	F key

ENGINE CONTROLS

To start the engine automatically, press the E key: You'll see the controls move, and then you'll hear the engine start. If you'd rather do all the work yourself, you can start the engine manually. For details, see the next section in this handbook, "Starting the engine."

Your aircraft has three basic engine controls:

- **Throttle** control lever (the control that has the most direct effect on power)
- **Propeller** control lever (to adjust the prop's pitch angle and thus the prop's rotation speed)
- **Mixture** control lever (to adjust the air/fuel mixture as the airplane climbs and descends)

All three levers can be controlled with the keyboard. You can also control the throttle with a slider or wheel on your joystick (optional).

ACTION	COMMAND
Engine auto-start	E key
Throttle (decrease)	− (MINUS SIGN)
Throttle (increase)	= (EQUAL SIGN)
10% throttle	Keyboard 1
20% throttle	Keyboard 2
30% throttle	Keyboard 3
40% throttle	Keyboard 4
50% throttle	Keyboard 5
60% throttle	Keyboard 6
70% throttle	Keyboard 7
80% throttle	Keyboard 8
90% throttle	Keyboard 9
100% throttle	Keyboard 0
Prop (decrease rpm)	SHIFT+− (MINUS SIGN)
Prop (increase rpm)	SHIFT+= (EQUAL SIGN)
Prop (min pitch)	CTRL+F6
Prop (max pitch)	CTRL+F7
Mixture (lean)	CTRL+− (MINUS SIGN)
Mixture (enrich)	CTRL+= (EQUAL SIGN)
Mixture (idle cutoff)	CTRL+SHIFT+F6
Mixture (full rich)	CTRL+SHIFT+F7
Engage War Emergency Power (WEP) or Water/Methanol-Water injection (toggle)	W key

Starting the engine

In most missions you'll start on the runway, all lined up and ready to go. Start your engine, and follow your squadron mates into the sky!

To automatically start the engine

- Press the E key.

To manually start the engine

1. Set the prop control lever to the **Max. pitch** position (CTRL+F7).

2. Set the mixture control lever to the **Full Rich** position (CTRL+SHIFT+F7). If you're flying a jet, instead move the fuel valve to **On** (CTRL+SHIFT+F7).

3. Set the throttle control lever to the **Idle** position, and then move it forward just a bit (MINUS and EQUAL keys).

4. Turn the battery switch to **On** (CTRL+B).

5. If your aircraft has a magneto, click the Magneto switch to move it to the **Both** position (CTRL+M or SHIFT+M).

6. Engage the starter and then release it (CTRL+S).

Throttle control lever

The throttle regulates the amount of fuel and air that enters the engine cylinders. When fully open, the throttle allows the maximum amount of fuel and air to enter the system to produce maximum power. When the throttle is closed, only a small amount of fuel and air can get in, and the engine produces minimum power.

To open the throttle, move the control lever forward. To close it, pull it backward. The **manifold pressure gauge** on the instrument panel shows the pressure of the air moving into the engine's cylinders, and it gives an approximate measurement of engine power. Generally speaking, the higher the manifold pressure, the more power you have.

Propeller control lever

Adjusting the propeller in an airplane is a lot like using gears in a car. In low gear the engine turns fast to get you moving. Once you're underway, there's no need to use a lot of power, so you shift to a higher gear to make more efficient use of less power. In an airplane, the propeller control lever indirectly changes the angle at which the propeller blades meet the air, which affects how fast the engine turns. The **tachometer** on the instrument panel shows how fast your engine is turning.

During takeoff, in combat, and during landing (in case you need to abort and take off again) you'll need every bit of power your engine can develop. So during these three phases of flight, keep the propeller lever forward: the angle of the blades will be low, slicing through the air easily so you can get the engine's full power (like using a low gear in a car). During cruise, you can pull the propeller lever backward a bit: the angle of the blades will increase and take a bigger bite out of the air, making more efficient use of the engine's power (like using a high gear in a car).

Because your aircraft has a constant-speed propeller, any time you change the throttle setting a governor automatically adjusts the angle of the blades to maintain that speed. This reduces your workload!

Note: The default setting of your airplane's prop control lever is the forward (high speed) position. Don't change this setting if you don't need to. As a fighter pilot, you'll want this setting most of the time. Leaving the prop control lever forward during cruising flight means you'll fly less efficiently and use more fuel, but it won't cause any damage.

Mixture control lever

Because your aircraft's engine operates over a wide range of altitudes, you can adjust the air/fuel mixture for maximum efficiency as you **climb** into less dense air or **descend** into more dense air. A mixture that is too rich contains too much fuel for the amount of air available at that altitude and will cause the engine to run rough and lose power. The solution is to "lean the mixture." As you climb, make the mixture leaner by pulling the mixture control lever backward. Don't lean the mixture too much, though--a mixture that is too lean can cause the engine to overheat or cause detonation (a sudden, explosive combustion of fuel within the cylinders).

Note: By default, mixture control is handled automatically in Combat Flight Simulator. To adjust the mixture manually, click Realism Options on the Options tab, and in the Aircraft section clear the Auto mixture check box.

P-38 LIGHTNING BANKS FOR BOMB RUN.

TAXIING

When you're taxiing, remember that if you're flying a taildragger (an aircraft with a tailwheel instead of tricycle landing gear), it's hard to see over the nose when you're on the ground. To get a good view, make gentle S-turns by using the rudder pedals, and look to either side. Aircraft with tricycle landing gear are easier to manage on the ground--you can see over the nose so you just use the rudder to steer the aircraft.

Note: When auto-rudder is set to On, you can steer by moving the stick left and right—the ailerons and the rudder are connected. To turn auto-rudder on or off, click Realism Options on the Options tab, and in the Aircraft section select or clear the Auto-rudder check box.

To taxi

1. Hold the stick back to keep the tailwheel on the ground (with a taildragger).

2. Taxi with the throttle at idle and use the brakes as little as possible.

3. To turn sharply, brake just on the side you're turning toward (press the COMMA for the left brake or the PERIOD for the right brake).

4. When you reach the runway, stop at a right angle and scan the sky for any approaching aircraft.

TAKING OFF

Taking off is something even experienced pilots get excited about. But don't lose your head during this critical stage of flight. Every plane performs differently during takeoff, so use the checklists in online Help for specific aircraft specs. Here are some general guidelines:

To take off (taildragger)

1. Line up on the runway. LOCK THE TAILWHEEL (SHIFT+L). This is important as the airplane's left turning tendency is exaggerated in a tailwheel airplane.

2. Incrementally add some flaps if appropriate in your airplane (press the F key).

3. Make sure the prop control lever is in the full **forward** position (default setting), and then smoothly advance the throttle to takeoff power.

   See "Engine Controls" earlier in this handbook for details. **Do not jam the throttle forward, or torque effect may cause loss of control!**

4. Maintain back-pressure on the stick to keep the tailwheel on the ground until your rudder becomes effective.

5. Slowly ease forward on the stick so the tail rises.

6. At your aircraft's takeoff speed, gently pull back on the stick and fly the plane off the runway.

7. Once airborne, retract the landing gear (press the G key) and flaps (press the V key repeatedly until the flaps are fully retracted).

8. Adjust your pitch attitude to climb out at your plane's best-climb speed.

To take off (tricycle landing gear)

1. Line up on the runway.

2. Incrementally add some flaps if appropriate in your airplane (press the F key).

3. Make sure the prop control lever is in the full **forward** position (default setting), and then smoothly advance the throttle to takeoff power.

   See "Engine Controls" earlier in this handbook for details.

4. At your aircraft's takeoff speed, pull back on the stick so the nose rises.

5. Once airborne, retract the landing gear (press the G key) and flaps (press the V key repeatedly until the flaps are fully retracted).

6. Adjust your pitch attitude to climb out at your plane's best-climb speed.

Air Force Historical
Research Agency Photo

XIX TAC THUNDERBOLT
LANDS ON A NEW AIRSTRIP
IN FRANCE.

LANDING

A good landing starts with a good approach, and that means setting up with the right speed and configuration. Every plane lands differently, so check the online Help checklists for best approach speeds, gear extension speeds, and flap settings. Here are some general guidelines:

To land (taildragger)

1. Slow your plane down to its maximum gear-extension speed.

2. Lower the landing gear (press the G key) and start a shallow 500-foot-per-minute descent toward the runway. Watch the descent rate by looking at the runway and occasionally glance at the rate of climb/descent indicator on the instrument panel.

Note: If your hydraulic system is damaged, you may need to manually pump the landing gear down (press SHIFT+G key repeatedly).

3. Incrementally add flaps to steepen the approach (press the F key).

4. Maintain the approach speed recommended for your aircraft, and use pitch to control airspeed. To speed up, move the stick forward slightly to lower the nose. To slow down, gently pull the stick back.

5. Pick a touchdown point and use the throttle to control descent rate. If the touchdown point appears to move down your windscreen, decrease power: you're too high. If the touchdown point seems to move up, add power: you're too low.

6. As you cross the end of the runway, ease the throttle back to idle.

7. Flare about 20 feet above the runway by pulling back slowly on the stick to raise the nose slightly, and touch down in a nose-high, "three-point" attitude. All three wheels should contact the ground at the same moment. Hold the stick full back after you touch down.

8. During and after touchdown, maintain directional control with the rudder. (If auto-rudder is on, then move the stick left and right--the ailerons and the rudder are connected.)

9. After the aircraft has slowed to walking speed, apply the brakes (press the B key).

10. Unlock the tailwheel to taxi (SHIFT+L).

To land (tricycle landing gear)

1. Slow your plane down to its maximum gear-extension speed.

2. Lower the landing gear (press the G key) and start a shallow 500-foot-per-minute descent toward the runway. Watch the rate of climb/descent **indicator** on the instrument panel.

Note: *If your hydraulic system is damaged, you may need to manually pump the landing gear down (press the SHIFT+G keys).*

3. Incrementally add flaps to steepen the approach (press the F key).

4. Maintain the approach speed recommended for your aircraft, and use pitch to control airspeed. To speed up, move the stick forward slightly to lower the nose. To slow down, gently pull the stick back.

5. Pick a touchdown point and use the throttle to control descent rate. If the touchdown point appears to move down your windscreen, decrease power: you're too high. If the touchdown point seems to move up, add power: you're too low.

6. As you fly across the end of the runway, ease the throttle back to idle.

7. Flare about 20 feet above the runway by pulling back slowly on the stick to raise the nose slightly, and touch down on the main landing gear first. After you touch down, hold the stick full back to keep the nose wheel off the ground until it gently settles as you slow.

Note: *With tricycle gear aircraft, you don't want all three wheels touching simultaneously—you'll bounce.*

8. During and after touchdown, maintain directional control with the rudder. (If auto-rudder is on, then move the stick left and right--the ailerons and the rudder are connected.)

9. After the aircraft has slowed to walking speed, apply the brakes (press the B key).

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USING CHECKLISTS

Good pilots don't rely solely on memory. As you fly, you can view checklists for takeoff, cruise, descent, and landing to help you with these important phases of flight. To display the checklist, press F1 to display Help, and then click the link for the checklist you want to use.

BASIC FLIGHT MANEUVERS

There are four basic maneuvers to master: flying straight-and-level, turning, climbing, and descending. Practice these maneuvers in Free Flight so you don't get shot down.

HAWKER TYPHOON IN FLIGHT.

Air Force Historical Research Agency Photo

B-26S OVER THE COAST OF FRANCE.

Air Force Historical Research Agency Photo

FLYING STRAIGHT-AND-LEVEL

Flying straight-and-level may look simple, but it's one of the more difficult maneuvers to master. Because hotshot pilots like to be in control, they overdo it most of the time and interfere with their airplane's basic stability. Like a balancing act, straight-and-level flight requires that you make smooth, small corrections to keep from wobbling all over the sky. There are two components to flying straight-and-level: holding a constant altitude and holding a constant heading

Hold a constant altitude

Keep an eye on the **altimeter.** If your altitude starts to change, make small, smooth corrections on the throttle or the stick. Use the stick to correct deviations of less than 100 feet. If your altitude has deviated more than 100 feet, you may want to add or reduce power a bit. Use elevator trim to keep the pitch attitude where you want it.

To slow down without losing altitude

- Reduce power and keep the nose from falling by gently pulling back on the stick.

To speed up without gaining altitude

- Add power and keep the nose from rising by gently pushing forward on the stick.

Hold a constant heading

Check the **heading indicator** on the instrument panel frequently to make sure the nose is pointed in the right direction. Crosscheck the turn indicator and the wing tips to hold the wings level and to correct minor deviations. Pick a point on the horizon and keep flying toward it. Use aileron trim and rudder trim if available to make the job easier.

TURNING

You might think that the faster you go, the faster you can turn. But flying fast in a turn means more centrifugal force, and that means a bigger turn radius. The result? The turn takes longer! So sometimes to turn faster you'll need to fly slower. How fast you can turn (and how much sky you can do it in) depends on your bank angle and your airspeed. How well you can turn depends on your ability to simultaneously bank the wings and add both rudder and up-elevator while you "paint the horizon" with the nose of the plane.

Bank the wings

Move the stick right or left to manipulate the ailerons and initiate a bank. Center the stick when you reach the bank angle you want. By banking the wings, you deflect some of their vertical lift sideways. This part of the airplane's total lift is called the "horizontal component of lift," and it is this force that pushes the plane around in a turn.

Add some rudder

Your plane will have a tendency to yaw (pivot) opposite the turn. So as you bank, apply some rudder pressure in the same direction as the turn using rudder pedals, a joystick that supports rudder control, or the keyboard (press the numeric keypad 0 key for left rudder or the keypad ENTER key for right rudder). As you bank left, add a little left rudder, and vice versa. How much rudder? Just enough to keep the ball/needle in the turn indicator centered. In theory, you could skid an airplane through a turn without banking using just the rudder, but it's an inefficient and uncomfortable way to change direction. (In combat, though, you can use skidding to confuse an enemy on your tail.)

Note: Auto-rudder is automatically set to Off if rudder controls are detected. Otherwise auto-rudder is automatically set to On. When auto-rudder is set to On, the rudder moves automatically to maintain coordinated flight in turns, making your airplane easier to fly. To turn auto-rudder on or off, click Realism Options on the Options tab, and in the Aircraft section select or clear the Auto-rudder check box.

Use some up-elevator

Because some of the lift is deflected sideways in a turn, you need to raise the nose slightly to generate more lift. Add a little back-pressure on the stick as you roll into a turn. The steeper the turn, the more up-elevator pressure you add to maintain altitude. You might even need to add some power. As you roll out of the turn, remember to relax the back-pressure on the stick.

"Paint the horizon"

To maintain level flight as you turn (or to turn while climbing or descending at a constant speed and rate), "paint the horizon" with the nose--keep the pitch attitude the same after you've started the turn. In general, if the nose moves up as you're turning, you climb. If it moves down, you descend.

* * *

CLIMBING

There are two ways to get your aircraft to go up--by using momentum or by using excess thrust.

Use momentum

Pull back on the stick to create a "hill" and your airplane will start to climb. You'll go higher but you'll also slow down--just like climbing a hill on a bicycle. Pulling back on the stick to go up means you **trade airspeed for altitude.**

Use excess thrust

A sustained climb is made possible by using thrust to pull your plane up the "hill." Set the steepness of the "hill" by pulling back on the stick. Then add power with the throttle to pull yourself up, just like pedaling a bike faster. Using excess thrust is a way to **gain altitude without losing airspeed.**

Every aircraft has a best-climb speed. With full power, this is the speed where the airplane gains altitude fastest in a sustained climb. Adjust your speed by raising or lowering the nose.

<p align="center">* * *</p>

DESCENDING

There are two ways to get your aircraft to descend— by diving or by reducing power.

Dive

Push forward on the stick to make a steep "hill" to dive down. As you descend, your speed will increase. Pushing forward on the stick to go down means you **trade altitude for airspeed.** Be careful! If the air traveling over your wings in a high-speed dive exceeds the speed of sound, your control surfaces may lose their effectiveness and you may not be able to pull out of the dive.

Reduce power

To descend more slowly than in a dive, make a shallow "hill" with the stick (or leave the stick where it is), and reduce your throttle a bit. When the engine stops producing enough thrust to maintain level flight, your plane will start to glide slowly toward the ground. Descending at low power is a way to **lose altitude without gaining airspeed.**

Every aircraft has a best-glide speed. If the engine quits, this is the speed that lets the airplane glide the farthest. Adjust your speed by raising or lowering the nose.

DON'T STALL!

A stall has nothing to do with an airplane's engine sputtering. **You can stall at any airspeed**--even when the plane is in a fast dive!

A stall has to do with the angle of attack--the angle at which a wing meets the oncoming air (not the angle of the wing to the ground). If you increase the angle of attack too much, the wings won't generate enough lift to counteract the plane's weight--so you stall--your plane starts to fall toward the ground. (See "Why it All Works" later in this handbook.)

A wing always stalls at the same critical angle of attack, at any attitude, no matter how fast or slow you're flying. More fuel and more ammunition make the plane weigh more. But so does maneuvering. In a turn, for example, centrifugal force will push you into your seat, so it's as if both you and the airplane are heavier. Then you need more lift to offset that weight and maintain level flight. To get the additional lift, you have to increase the angle of attack--but that puts you closer to the **critical** angle of attack--and a stall.

So go easy on the stick when you're maneuvering. Just because you're going fast doesn't mean you can't stall!

Warning signs

A stall near the ground can be deadly. But you can learn to sense one coming and prevent it. As the air flowing over the top of the wings gets turbulent, you'll feel a slight shaking or buffeting, and you'll see a red stall light illuminate on the instrument panel. Immediately reduce the angle of your climb or dive.

Recover promptly

The only way to recover from or prevent a stall is to **reduce the angle of attack.** Apply forward-pressure on the stick, and add some throttle to compensate for the loss of altitude. If you continue to pull back on the stick (the intuitive thing to do, since your nose is dropping!), your ship will not recover. If one wing drops before the other, the stall may become a spin.

* * *

DON'T SPIN!

You go into a spin when one wing stalls more than the other wing. The plane corkscrews toward the ground at a steep angle of descent and at a low airspeed. Sound scary? It's no big deal once you've done a few. But understand that for an airplane to spin it must first be stalled. Avoid a stall and you'll avoid a spin.

Note: When auto-rudder is set to On, it's unlikely a stall will develop into a spin. To turn auto-rudder on or off, click Realism Options on the Options tab, and in the Aircraft section select or clear the Auto-rudder check box.

You don't have many options if you get into a spin close to the ground. Press the **O** key three times (that's the letter O) and bail out! If you think you have enough altitude to recover (at least 5,000 feet in most aircraft), here's what to do.

To maneuver out of a spin

A handy acronym to remember to help you handle spins is PARE:

P Power off

A Ailerons neutral

R Rudder opposite of the direction of spin

E Elevator forward to brake the stall

1. Reduce the throttle.

2. Center the stick--that neutralizes the ailerons.

3. Apply full rudder opposite the direction of your spin.

4. Relax the back-pressure on the stick to decrease the angle of attack and break the stall. (In some planes you'll have to "pop" the stick forward sharply.) As soon as the rotation stops, neutralize the rudder.

As your airspeed builds after recovery, smoothly pull back on the stick to recover from the dive. As the pitch attitude returns to level flight, smoothly add power to maintain your airspeed.

There are four forces that affect an airplane in flight, and they act in pairs: **lift** opposes **weight**, and **thrust** opposes **drag**. To get your crate to behave like you want it to, you've got to manage these four forces. Understanding them makes it easier.
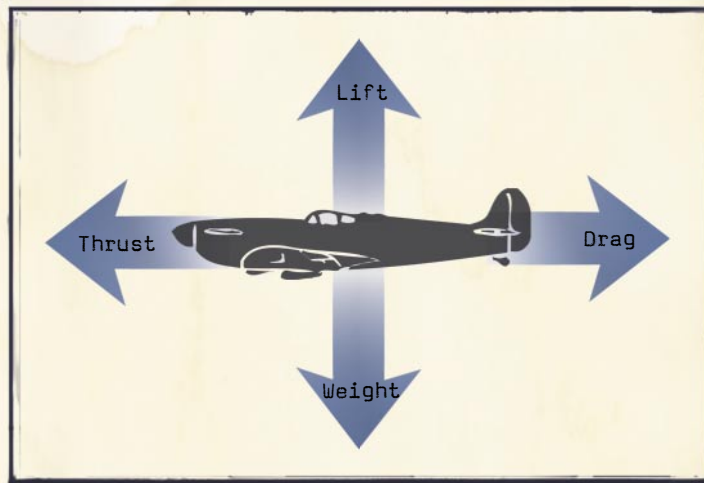

Air Force Historical
Research Agency Photo

AN EARLY ALLISON-POWERED MUSTANG SPORTS A CAMO PAINT JOB.

LIFT

Lift is the upward force produced by a wing as it moves through the air. It's the force that counteracts the gravity of an airplane's weight.

How a wing works

Ask engineers how a wing works and they'll go on about circulation theory, the shape of the wing, and Bernoulli's Theorem. They'll talk your ear off, but the most useful explanation for a combat pilot learning to fly in a hurry is admittedly simplistic: a wing keeps an airplane up by **deflecting the air down**.

The angle that matters most

The angle at which a wing meets the air is called the **angle of attack**. This is not the angle between the airplane's nose and the horizon. It's the difference between where your wing is pointing and where it's actually going.

Changing the amount of lift

You can control the amount of lift a wing generates by adjusting two things: speed and angle of attack. To produce a certain amount of lift at low speeds, the air must be deflected using a large angle of attack. To produce the same amount of lift at high speeds, the air must be deflected using a small angle of attack. If the speed is very low, the angle of attack you'll need to maintain lift will be so large at a certain point (the critical angle of attack) that the air cannot flow smoothly over the wing, and the wing will stall.

You can also add lift by extending the flaps, which increase the curvature of the wing. With the flaps extended, more air is deflected downward, so there is more lift. Flaps also cause an increase in drag.

Playing with lift

Think about what happens to your hand when you stick it out the window of a moving automobile, letting it get bounced around by the wind. If the car speeds up, you can reduce the angle of your hand relative to the wind (the angle of attack) to keep it from blowing upward. If the car slows down, you can increase the angle of your hand to keep it from falling downward. If you increase the angle of your hand too much, it will stop generating lift, and fall (stall).

WEIGHT

Weight opposes lift--it's the downward force caused by gravity pulling an airplane toward the center of the earth.

For your ship to fly, the wings must develop enough lift to counteract its weight. The real weight of your aircraft changes as fuel and ammunition are used up. But changes in apparent gravity (measured in G-forces) are caused by maneuvering. For example, a level turn with a 60-degree bank puts a 2-G load on the plane and its pilot. Both seem to weigh twice as much as they do when in straight-and-level flight--and in a way they do--because of the increase in apparent gravity.

Compensating for G-forces

During maneuvers, you have to adjust the amount of lift to compensate for the changes in weight caused by G-forces. To stay level during a steeply banked turn, for example, you'll need to raise the nose slightly (increase the angle of attack) and add more power (thrust) to produce more lift to balance you out.

Blackout and redout

Most maneuvers create only slight, brief G-forces. But combat maneuvers produce strong, rapidly changing G-forces that can be uncomfortable, or even incapacitating.

Positive Gs: Rapid pull-ups and steeply banked, level turns create positive G-forces that act toward your feet. As the blood circulation to your brain decreases, your visual field narrows and you may experience blackout: You'll lose color vision and eventually lose consciousness.

Negative Gs: Rapid pushovers and certain aerobatic maneuvers create negative G-forces that act toward your head. As the forces increase, you'll experience discomfort, headache, "redout" caused by excessive blood flow to your eyes, and even unconsciousness. Most pilots have a harder time handling negative Gs than positive Gs.

To turn the redout and blackout on or off in Combat Flight Simulator 3, click the **Realism Options** on the Options tab, and then in the Visuals section select or clear the **G-effects** check box.

THRUST

Thrust is the forward force provided by an airplane's propeller or a jet engine's exhaust, and it is opposed by drag (the resistance of the air as the airplane moves through it).

An airplane's propeller creates thrust in the same way its wings create lift: air is deflected backward, so the propeller (and the aircraft) move forward. The more powerful the engine (and the bigger the propeller), the greater the thrust, and the faster the airplane can fly. Thrust is also the most important factor in determining a plane's ability to climb.

* * *

DRAG

Drag is the rearward-pulling force that opposes thrust, and it has two components: parasite drag and induced drag.

Parasite drag

Parasite drag is caused by friction between the air and an airplane's structure. The more things there are sticking out into the airflow (antennas, landing gear, bombs, etc.), the higher the parasite drag. Your plane is designed to have as little parasite drag as possible, but the faster you go, the more there will be.

Induced drag

As the angle of attack increases, lift pulls an airplane upward and backward. The upward component of lift is called "effective lift"; the backward component is called "induced drag." Effective lift counteracts weight to keep the airplane flying. Induced drag counteracts thrust and slows the airplane down. The slower you go (the bigger the angle of attack), the greater the induced drag. Eventually, you'll need to add more power to generate the lift necessary to remain aloft.

Playing with induced drag

You can understand how induced drag works by sticking your hand out the car window again. If you hold your hand relatively flat (at a low angle of attack), your hand gets pushed upward and slightly backward. As you increase the angle of attack, you'll notice an increase in both the upward force (effective lift) and in the backward force (induced drag). Increase the angle too much and your hand will stall.

A few words about torque

"Torque" is a catch-all term used to describe your plane's tendency to yaw and bank in either one direction or the other at certain power settings. A fighter's powerful engine and big propeller make this effect very pronounced, especially when the throttle's on high but the airspeed is low (as during takeoff). To counter these turning tendencies, you'll need to use the rudder and ailerons, although torque can be used to your advantage in a dogfight.

What causes torque? Four phenomena--reactive force, spiraling slipstream, gyroscopic precession, and P factor.

Reactive force

When the powerful engine of a fighter plane turns the propeller in one direction, there is an equal and opposite force that makes the plane roll in the other direction. When your throttle's high but your airspeed's low (as during takeoff), the plane will roll in a direction opposite to the rotation of the prop. This effect is most pronounced during acceleration.

Spiraling slipstream

A propeller's spiraling slipstream (the air mass that the propeller propels behind it) hits one side of the tail and causes the nose of the plane to yaw (rotate left or right around the vertical axis) in the same direction that the reactive force causes it to roll. The result? An even stronger tendency to turn.

Gyroscopic precession

Because it's big and spins rapidly, your plane's propeller behaves like a gyroscope. This makes it subject to the effects of gyroscopic precession. When a force acts on a gyroscope, the gyroscope behaves as if the force were applied at a point 90 degrees in the direction of rotation. If your plane's propeller turns clockwise (viewed from the cockpit), then when the tail comes up on the takeoff run--the nose goes down--and gyroscopic precession makes the plane swerve to the left.

P factor

A propeller is a bunch of small wings moving around a crankshaft. Each propeller blade produces a certain amount of thrust. When an airplane is flying at a high angle of attack, the downward-moving propeller blades have higher angles of attack and produce more thrust than the upward-moving blades. The result is asymmetric propeller loading--or P factor--which creates a yawing motion.

BASIC AEROBATIC MANEUVERS

There's flying an airplane, and then there's flying an airplane in combat. Get familiar with these basic aerobatic moves before you learn combat maneuvers and you'll have a fighting chance! Practice these maneuvers in Free Flight so you don't get shot down.
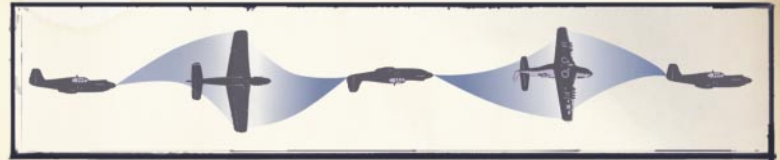
For information on air combat maneuvers, see "Basic Air Combat Maneuvers" and "Tactical Air Combat Maneuvers" later in this handbook.

AILERON ROLL

Purpose

Rarely used on its own in battle, the aileron roll is worth learning because it's part of many combat maneuvers.
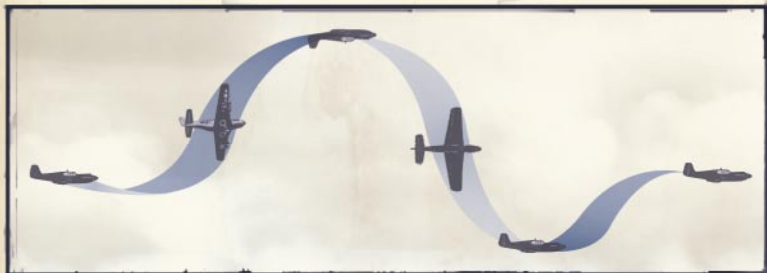

To perform

Raise the nose slightly. Pick a reference point on the horizon, then smoothly push the stick all the way to one side and hold it there. Use the stick to keep the nose on the reference point, then center the stick as the wings approach level again. Practice stopping the roll partway through for a half-roll. That's an easy way to get inverted quickly.

BARREL ROLL

Purpose

This basic aerobatic maneuver can be used in combat to shake an enemy from your tail. You'll corkscrew through the sky and lose airspeed, causing your opponent to fly right by.
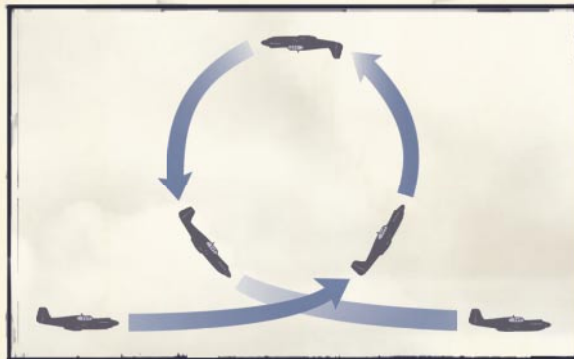
To perform

Raise the nose, bank sharply left or right, and gently pull back on the stick to maintain the roll. Hold the sideways-pressure on the stick as you roll inverted, then center it when you return to level flight. During this move, the stick is essentially in the left- or right-rear position. The nose will draw a circle on the horizon instead of rotating around a point, as in an aileron roll. If you do a barrel roll perfectly, you won't lose any altitude.

LOOP OVER

Purpose

Commonly referred to as a "loop," this move is a way to make a vertical circle in the sky and end up back where you started. Practicing loops will help you get accustomed to unusual pitch attitudes, rapidly changing airspeeds, and the effects of G-forces.
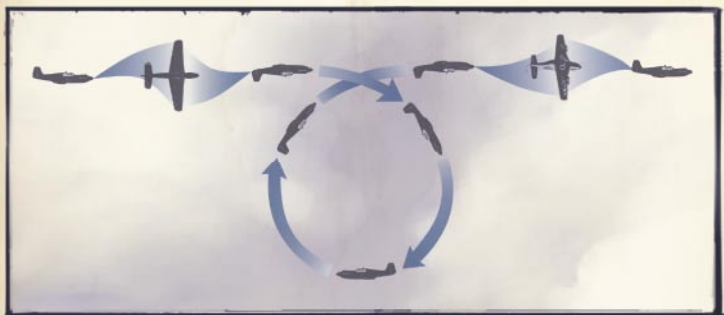
To perform

Make sure you have enough airspeed or you'll stall at the top of the loop. Slowly pull back on the stick. As you climb, you'll lose airspeed. Once inverted, ease off on the stick. As you start down the back side, add a little back-pressure and reduce the throttle.

Tip: Watch your left wingtip to see where in the loop you are. The wing should draw a circle on the horizon.

LOOP UNDER

Purpose

A loop under is basically a reverse loop over, but it's more useful in combat since you gain speed early. Your airspeed has to be high to do a loop over, but your **plane** has to be high to do a loop under--or you'll hit the ground! Make sure you have enough altitude before you try this one, and don't pull too many negative Gs. The negative G-loads most aircraft can handle are half that of the positive G-loads.

To perform

Do a half-aileron roll to get inverted, and then pull back on the stick smoothly. You'll gain airspeed, which will let you start up the other side of the loop. As you start to climb, keep back-pressure on the stick. You'll slow down as you become inverted. Push forward on the stick slightly to stop the loop, and then finish the maneuver with another half-aileron roll. You should end up flying in the same direction and at the same altitude as when you started.

AIR COMBAT

TOOLS OF THE TRADE

USING VIEWS

You can use a joystick or keyboard commands to see everything you'd see from the cockpit of a real airplane--and more. Different views serve different purposes. Experiment with them in Quick Combat to learn your favorite views for tracking the enemy. For a list of all of the views and view commands, see the "View Commands" table on the Quick Reference Card.

Note: All keystrokes referred to in this handbook are the Microsoft® Combat Flight Simulator 3 combat key commands. If you want to change your key commands to Flight Simulator settings or your own customized keystrokes, go to the Control Options screen (click Control Options from the Options tab).

In combat, you'll probably use several of the following views at various times. Press F4 to cycle through the main views (all of the views except Full and Padlock views).

Virtual Cockpit view

Virtual Cockpit view is the default view; it puts you right in the pilot's seat. (Press F3 to cycle between Full view and Virtual Cockpit view.)

Spot view

Spot view shows you an outside view of your aircraft. You can position the view anywhere around your own aircraft (use the arrow keys on the keyboard or the hat switch on your joystick).

Chase view

Chase view puts you behind your aircraft (press CTRL+F4 to toggle on and off). Press the TAB key to cycle between a chase view of your aircraft and other aircraft.

Float view

Float view puts you outside your aircraft and the camera seems to float as the aircraft moves (as opposed to the fixed camera in Spot view).

Flyby view

In flyby view your aircraft flies past as though filmed from a stationary camera.

Player Target view

In Player Target view the camera follows the current target as seen relative to an external view of your aircraft. You must press the TAB key to target an object.

Full view

Full view provides the best visibility by hiding the instrument panel (press F3 to toggle on and off). When used with the Heads Up Display (HUD), it gives you most of the important information you need. (Press F5 to display the HUD.)

Padlock view

Padlock view locks your view onto the currently selected enemy and puts yellow brackets around the plane for easy identification (press the **ACCENT** key to toggle on and off). The padlocked aircraft also appears as a yellow dot on the Tactical Display (see "Using the Tactical Display" later in this section of the handbook). To lock onto a different target, press the **TAB** key. To cycle backwards through the available targets, press **SHIFT+TAB**.

Although it takes some practice to use Padlock view effectively, it's a good way to stay on the enemy's tail once you're there. When you exit Padlock view, the last padlocked target still appears as a yellow dot on the Tactical Display, and the Enemy Indicator points toward it (see "Using the Enemy Indicator" later in this section of the handbook). To cancel the target, press **SHIFT+`** (**SHIFT+ACCENT**).

Moving eyepoint

The eyepoint is where your eyes are looking from in the cockpit. Moving the eyepoint around in the virtual cockpit view is useful to see over the cockpit when landing or getting a different vantage point on anything you're trying to view. Experiment with these commands.

ACTION	COMMAND
Move eyepoint up	**SHIFT+ENTER**
Move eyepoint down	**SHIFT+BACKSPACE**
Move eyepoint backward	**CTRL+ENTER**
Move eyepoint forward	**CTRL+BACKSPACE**
Move eyepoint left	**CTRL+SHIFT+BACKSPACE**
Move eyepoint right	**CTRL+SHIFT+ENTER**
Return eyepoint to the default forward view	**SHIFT+CTRL+SPACE**

Zooming in and out

Using the zoom commands helps you see distant targets:

- Press the **LEFT BRACKET** (**[**) to zoom out.
- Press the **RIGHT BRACKET** (**]**) to zoom in.

GETTING A GOOD LOOK

You can use the controls on a joystick or the numeric keypad to look around as you fly. Experiment with the numeric keypad view commands—they're easy to use.

When in Cockpit or Full view

The default view is straight ahead. To look elsewhere, use your joystick's hat switch (on top of the joystick) or the number keys on the numeric keypad. For a list of all view commands, see the "View Commands" table on the Quick Reference Card.

In most views, you have two ways to look around: panning and snap-to. Panning provides you with a smooth continuous view. Snap-to jumps to a particular view, such as a 90-degree side view. (Toggle Num Lock to switch between these two options.)

* * *

USING THE HEADS UP DISPLAY

The Heads Up Display (HUD) gives you important information without the need to look at the entire instrument panel. The HUD shows your pitch and bank status, as well as information about your heading, altitude, speed, flap and gear positions, available ammunition (guns, cannon, rockets, bombs), and fuel. Press **F5** to toggle the HUD on or off.

To move any element of the HUD to any position in the CFS3 window, drag the element to the location where you want it. To change the measurement system the HUD uses (between meters and feet), press the **U** key.

USING THE ENEMY INDICATOR

The Enemy Indicator is a cone that points to the nearest enemy aircraft or to an aircraft you have "padlocked" in Padlock view (see "Using Views" earlier in this section of the handbook). To find the enemy plane, turn in the direction the Enemy Indicator is pointing. When the enemy aircraft is visible through the front windscreen, the Enemy Indicator disappears. The Enemy Indicator is on by default. Press the **I** key to toggle it on or off. Press **TAB** to cycle through the enemy targets. Press **CTRL+TAB** to cycle through friendly targets to check wingmen positions.

USING THE TACTICAL DISPLAY

The Tactical Display helps you keep track of friendly and enemy aircraft, ships, vehicles, or other surface targets. The display appears in the upper-left corner of the screen, but you can drag it anywhere on the screen. The Tactical Display is on by default. Press **SHIFT+T** to toggle it on or off. Press **CTRL+SHIFT+T** to cycle the range of the Tactical Display.

With this feature you can see the tactical situations of these areas: Buildings, Ships, Vehicles, Aircraft, and All. Press the **T** key to cycle through the views. In the Tactical Display, your aircraft is represented by an airplane symbol (two intersecting lines), friendly aircraft by a blue dot in the center of the screen, and enemy aircraft by a red dot. A padlocked aircraft appears as a yellow dot (see "Using Views" earlier in this section of the handbook). If you're not engaged in combat, the Tactical Display shows information about waypoints in the mission.

DISPLAYING AIRCRAFT LABELS

With aircraft labels turned on, it's much easier to spot and keep track of other planes. By watching the distance change you can tell whether an enemy aircraft is getting closer to you or farther away and if it's within range of your guns.

To display or hide aircraft labels, press **CTRL**+**SHIFT**+**L**. When labels are displayed, you'll see the name of each pilot in your formation, as well as the type of each enemy aircraft you see. You'll also see the distance between you and the other aircraft, in meters or feet. (Press the **U** key to toggle between meters and feet.)
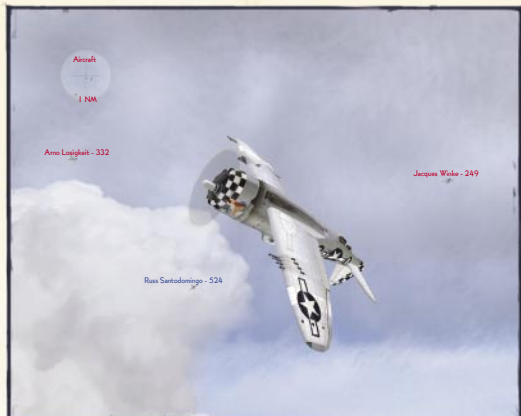
USING GUNSIGHTS

The aircraft in Combat Flight Simulator 3 feature a reflector gunsight that consists of a circle with crosshairs and a center aiming point—all projected onto a glass screen. To hit the target, take your own aircraft's movement and that of the enemy's into account: once you're within range, position the center of the gunsight where you figure the enemy will be when the bullets land. Then fire!

USING WEAPONS

The types of aircraft and missions that you fly determine the variety of weapons at your disposal. To change the weapons loadout, go to the **Aircraft** tab prior to beginning the mission, select your aircraft, and then on the Aircraft Information Panel, adjust the loadout. Note that these weapons aren't guided. You have to aim carefully, and it takes a lot of practice to hit the target.

You can also choose **Unlimited weapons** by clicking **Realism Options** on the **Options** tab. This feature is handy while you're learning--once you get to be a better shot, you might want to change this setting to a more realistic level. You can use four types of weapons to battle the enemy:

- **Guns** are used for attacking other aircraft and for strafing ground targets, including parked aircraft and "soft-skinned" vehicles.
- **Cannon** pack a heavier punch and have less range than guns, but they are used for the same purposes: air-to-air combat and strafing. The weight and explosive force of a cannon's projectile makes ships and armored vehicles, including tanks, vulnerable.
- **Rockets** are used in air-to-air attacks on bombers, or against tough ground targets, including structures and tanks.
- **Bombs** are used to attack bridges, ships, airfields, tanks, and other targets.

Here are the commands you need to fire your weapons.

ACTION	COMMAND
Fire guns	**SHIFT+SPACEBAR**
Fire cannon	**CTRL+SPACEBAR**/Joystick Button **2**
Fire guns and cannon	**SPACEBAR**/Joystick Button **1**
Fire/drop ordnance	**ENTER**
Cycle ordnance type	**BACKSPACE**

GROUND ATTACK PHILOSOPHY

You need to perfect your ground attack techniques—— your ground troops are depending on you! During close air support missions, you're often going to be down in the heat, smoke, and debris that ground forces eat and you'd better get used to it. Your ability to see targets and deliver ordnance ahead of your own forces can pave the way for your advancing ground units. By taking advantage of "targets of opportunity," you can set the enemy's fighting forces back considerably, and by attacking rail and shipping, you can disrupt their supply of materiel.

Allied and Axis forces use a number of middle- and low-level ground attack techniques. When coordinating with ground troops or tank columns, a controller on the ground, in a tank, or in a spotter plane directs the attacking aircraft to their targets. Fighter-bombers or medium bombers sweep in to knock out the opposition so the ground units can advance.

Depending on the situation and the resistance expected, the attacking force assembles in different formations. At mid-level altitudes, the aircraft in your squadron should form up close to concentrate their bombs on the target. Intense antiaircraft fire, however, dictates that you use a loose formation in level flight and then switch to a tighter formation during the short run over the target.

When you fly a fighter-bomber for close air support, stay in a looser formation. And when you return to base after escort or fighter-bomber missions, spend your remaining ammo on trains, convoys, airfields, and other targets of opportunity. Whenever you're close to the ground, watch for small arms fire—the ratio of losses for ground attack compared to aerial combat is about five to one.

CAA-NRC COMMITTEE ON SELECTION AND TRAINING OF AIRCRAFT PILOTS, 1942

Know your airplane

Every aircraft has strengths and weaknesses. Make sure you know yours and those of the enemy aircraft you're most likely to encounter. Knowing you can out climb, out accelerate, outturn, or outgun your foe changes the way you fly. So does knowing your own plane's vulnerabilities. For plane specs, see "Aircraft" in the *Machines of War* handbook.

Keep your head on a swivel

Visualizing the positions and movements of fast-moving objects in a three-dimensional space is difficult. But it's what separates fighter pilots from fighter aces. Being a good shot is a useless skill if you can't keep track of the enemy. (In Combat Flight Simulator, you can use joystick and keyboard commands to scan the sky rapidly. To learn more, see "Using Views" earlier in this handbook.)

Use the element of surprise

When you come in from behind or below the enemy he can't see you; dropping in from above gives you the potential for greater speed. While you're closing in, use the enemy's blind spots to your advantage. Come out of the sun or the clouds with your guns blazing so you can shoot him down before he even knows you're there.

Stay one move ahead of the enemy

A good fighter pilot's actions in the present are dictated by his prediction of the future. If you merely react to your opponent's actions you will be shot down. If you anticipate his actions and respond intuitively without hesitation, you will emerge the victor.

Trade altitude and airspeed

Are you flying too fast? Pull back on the stick and you'll slow down as you climb. Be careful though: pulling up to shake the enemy off your tail is a dangerous move! Your airspeed will drop quickly, and a slow ship under fire is a sitting duck.

Are you flying too slowly? Nose your ship over into a dive to gain some airspeed. Trading altitude and airspeed is an essential part of all aerial combat maneuvers.

Fly slower to turn faster

When you ride a bicycle around a corner quickly you want to go fast, but not too fast--it's the same with your aircraft. At fast speeds, centrifugal force causes the plane's turn **radius** to increase and its turn **rate** to decrease. Every ship has a speed at which maximum-performance turns are possible. In general, though, a slower-flying aircraft will outturn a faster-flying one.

Turn into your opponent

Turning into the enemy's direction of movement increases the angle between your movement and his guns, making you harder to hit. Turning away decreases the angle, making you an easier target--and making it much easier for him to get on your tail.

Use deflection shooting

Attacking an enemy aircraft from in front or behind is easy. Just aim and shoot when you're close enough to hit the target. Attacking from other angles is more complicated. You must coordinate your shooting with your speed, and fire ahead of the target so that he runs into your bullets. This difficult skill is called "deflection shooting," and it is the mark of a good combat pilot. Learning it is essential to your success.

Don't shoot until he fills your windscreen

Wait until you're so close that you're sure you'll hit him--you'll save ammunition. This strategy takes less concentration than deflection shooting, but it isn't always practical--especially if you're meeting the enemy head on!

Never stop an attack once you've initiated it

If you run away when you're within range of the enemy, it's easier for him to get a shot at you. Courage is not the absence of fear; it's action in the face of fear. If you've decided to attack, be courageous and follow through. Cowardice at close range will get you killed.

THE FIVE STAGES OF AERIAL COMBAT

1. **Detecting**

   Find the enemy before he finds you, so that you have the advantage of surprise. Most pilots who are shot down never see their attackers.

2. **Closing**

   Once you've detected the enemy, move into a position close enough to shoot him down--without being discovered.

3. **Attacking**

   When you're close enough to shoot the enemy, commence the attack. If you fire too soon you'll waste ammunition, and he might see you coming. Remember: your weapons don't move. To aim, you must move your entire plane and use a deflection angle. If you fail to defeat your enemy, you'll need to maneuver.

4. **Maneuvering**

   Dogfighting is a test of skill in which each opponent tries to get into a position to fire. Maneuvering means dogfighting. Many novice combat pilots think that dogfighting is the way all aerial combat occurs, but combat veterans will tell you that dogfighting **should be avoided** if possible. If you're successful at detecting, closing in on, and attacking your enemy, you won't need to dogfight with him. You should maneuver when any of the following occurs after the attack:

   - Neither side has gained an advantage during detection.
   - The enemy sees and successfully evades during your closing.
   - Your attack fails to down the enemy aircraft.

5. **Disengaging**

   Disengaging means putting space between you and the enemy so you're out of the fight. You can disengage on purpose or by accident. Be careful though: just because you want to leave doesn't mean the fight will end.

AIR-TO-AIR COMBAT STRATEGIES

Forget about the old "knights of the air" mythology. In air-to-air combat, it's fast, dirty work that is often over in seconds. The loser has usually lost before they knew what hit them. You must gain the dominant position above and behind the enemy through surprise or by the use of maneuvers.

General tactics

1. In the **first pass,** it is usually best to make an overhead attack from behind. In a situation where you are able to make an overhead attack from behind, but instead carry out an overhead attack from the front, maneuvering for the second pass will be comparatively difficult and you may end up in a disadvantageous position. Furthermore, if your altitude is insufficient, it is best to pursue from the lower rear rather than head-on.

2. In **close combat,** achieve mastery of those tactics which are your own strong points. After gradually reaching proficiency, you will discover your own characteristics in battle. When you fight with your favorite tactics, victory will be easy. When you become aware of these tactics, study and master them at once. When in battle, it is important to entice the enemy into your favorite battle tactics, and make them fight on your terms.

3. When you are suddenly **head-on** with the enemy, plan to be resolute in the attack. Never abandon the line of fire too soon to start maneuvering for the second pass. (In the training period, for safety's sake do not execute a head-on attack.)

4. During air combat it is essential to maintain **altitude.** However, do not mindlessly concentrate on the altitude, thereby making essential maneuvers impossible because your airspeed has dramatically dropped during a climb. It is particularly important to pay attention to selecting the opportune time to make changes of altitude and speed while approaching the enemy.

5. Air combat is generally easy against an enemy who is fighting and losing altitude. The enemy who fights while maintaining his altitude by skill in maneuvering at **lower speed** is formidable. (In a rough and tumble fight it is essential to maintain all your speed.) When you advance on a second enemy or when you go to the aid of an ally, keep in mind the fact that altitude is better than a stout heart.

Counter-attack

When you have been attacked by the enemy plane, unless the performance of the enemy plane is inferior or the pilot's ability very poor, it is difficult to regain your position in one counter-attack. However, always try to regain your position while continuing your counter-attacks.

Disrupt the enemy's firing line as much as you can by diving. After avoiding their first pass, maneuver so that you will be under the enemy.

As soon as the enemy plane starts his run, start a steep dive immediately and cause the enemy's firing angle to be depressed. The enemy will break off the attack because his speed is excessive and firing is difficult; as soon as you see him pulling out, turn toward him and maneuver so that you are in pursuit.

When you find yourself under attack, use the following formulas for counter-attack:

- **Against the overhead attack from behind.** When the enemy tries to make a run at you, gun your engine and avoid the line of fire by turns or abrupt maneuvers just before the approaching enemy reaches effective distance, and strive to regain gradually the advantage.

- **Against the belly attack from behind.** Though you can counter-attack by means of a slanting loop, you are often a good target for a long period when in a climbing position, so twist away as soon as possible.

- **Against a belly attack from the front.** By utilizing maximum climbing power, seize the dominant position above the enemy and counter-attack with an overhead attack from behind.

When you have tried to counter-attack and have been unsuccessful because of the enemy's maneuvering skill, or when as in training, ideal counter-attacks cannot be made because of their danger, it is important that you hang on, and strive with your utmost to regain the advantage while keeping the enemy from attacking, and then make a sound counter-attack.

COMING IN UNDER THE ENEMY

When there is a large altitude difference, make attack impossible by climbing; take a position beneath the enemy (almost directly below), and match your flight pattern with the enemy's flight. By following the enemy's maneuvers you can ordinarily make it impossible for the enemy to half-roll and attack, and you can recover the altitude difference gradually. When the enemy turns, maneuver by flying somewhat to his outside so that he cannot see you. You can also recover the altitude difference by heading the same way.

Important: If you're attacking bombers, be very aware of where their gunners are. The gunners are positioned to protect the bomber against attacks from any side.

Measures to take when you are being closely pursued

1. First, always have as your principal object the avoidance of the line of fire, and by the use of your total capacities and abilities strive to extend the interval between the planes gradually. In this situation, straight-line maneuvers should be absolutely avoided!

2. Ordinary aerobatics will have little effect. By making particularly good use of the rudder, maneuver exaggeratedly and confuse the enemy.

3. Even if you gradually extend the interval, consider the turning radius and do not plan to pursue until the situation is such that an even battle can be expected from the start.

4. Remember, if you are getting hit, whatever you are doing is wrong. Do something radical and do it fast! It can't make things worse.

Level dogfighting

In this type of battle particularly, incomplete turning maneuvers have a fatal consequence. The plane, which must be perfectly controlled while it turns continuously, will step-by-step close in on the enemy and finally be able to seize the dominant position. If you learn the following tips, you can follow through to success:

- Keep in mind that although you have been pounced upon from somewhere to the rear, you will never be fired upon when the sights and eyes of the enemy are not aligned. When an enemy is behind you but to one side or the other in a level dogfight always turn toward your enemy, even though that brings you in front of his guns. If you turn toward him, you give him the most difficult possible shot and increase the chance he will overshoot. If you turn away from him, you give him the perfect opportunity to fall in behind you for an easy shot.

- When you are about to shift to vertical dogfighting from level dogfighting, lower the plane's nose slowly, accelerate, and maintain your turn. When the enemy plane follows and starts to dive, still maintain your turn, climb steeply and make a slanting loop. In case the turns become very sharp when you are wide open, there are many situations where you must pull back on the control column with both hands and increase the turning speed. In this situation, changing the angle of inclination of the tail elevator (trim tabs), that is, putting them at a "down" position, generally makes piloting easier.

- During turns, aiming and firing are usually difficult, but when you get an opportunity, shift to aiming and shoot immediately. When it is difficult to fire, shift your attention to turning maneuvers without letting the enemy plane escape.

Vertical dogfighting

Your fighting ability will be shown for what it is in this type of combat. The so-called "ace" is often made in this type of warfare. It is easy to get into a disadvantageous position and lose altitude if you maneuver clumsily and are fooled by the deceptive maneuvers of the enemy. Keep the advantage by learning the following strategies well enough to do in your sleep:

- When you try to shoot down the enemy plane with one pass, do not be anxious to pursue the track of the enemy plane too strictly. Keep in mind that the quickest method of shooting down the enemy is to wait for a firing opportunity by maneuvering little by little into a superior position.

- Although it is difficult to size up a situation instantly, do not yield a foot when coming face to face with the enemy.

- Getting out of a bad situation by means of a true loop is generally difficult. You should use the slanting loop. A skillful "twist" in the middle of a slanting loop is extremely effective. It is important that you understand it through practice and experimentation.

- The key to vertical dogfighting lies in closing in on the enemy's rear by degrees while deceiving the enemy with changes of the plane's fore and aft line, and banking.

Air Force Historical Research Agency Photo

AN UPGRADED TYPHOON WITH BUBBLE CANOPY, ROCKETS, AND CANNON.

BASIC AIR COMBAT MANEUVERS

The following maneuvers have been in use since pilots started trying to shoot each other down. Study them and know how to use them automatically. Be aware that some of these are intended for flight in the fighter-bombers but not the medium bombers.

Before executing any violent maneuvers in the fighter-bombers, be sure to drop any external fuel tanks (press **CTRL**+**SHIFT**+**D**). Put some positive forces on the wings by turning or climbing slightly while dropping the tanks.

Remember the ultimate maxim of aerial combat: **Lose sight, lose the fight!**

HIGH SIDE ATTACK

Purpose

This maneuver gets you very close to your target and forces your opponent to dip his nose to return fire, thus risking a head-on collision.

Drawbacks

You need to have lots of room to execute your dive and maintain a fast speed so that the enemy won't get a shot at you before and after the attack.

To perform

Start your attack from well above and ahead of the bandit. The dive starts about 1,000 feet to one side of the target. Get in a steep dive abeam of the target so that you're shooting at a 45-degree deflection angle both in the vertical plane and at the four o'clock or eight o'clock position (figure your target's nose is pointed at twelve o'clock.) You should be above and to one side of your target. After firing, make your recovery beneath the target, using the speed you got from the dive to zoom back up to get ahead--and in position--for the next run. Use Quick Combat dogfighting or the Training Missions to practice this maneuver.

OVERHEAD ATTACK

Purpose

The overhead attack gives you the best chance of hitting your enemy without taking any damage yourself. This slashing attack requires precision and a proper setup before you make your run. This attack is the safest way to attack a bomber and avoid the bomber's multiple gunners.

Drawbacks

Getting set up above your enemy is key. A smart opponent won't let you do this easily, and he may climb toward you. Once you make this run, you'll have a second or two at most to get your shot off before you get by him. You need to fly this maneuver quickly--a slow or tentative overhead attack gives an opponent a chance to turn onto your tail. Also, make sure you don't dive and pull out too fast. Your controls can lock up, and you can black out if you pull up too quickly. If you find yourself blacking out or losing control of the aircraft, relax the back-pressure, and reduce throttle to reduce your airspeed.

To perform

Climb to at least 2,000 feet above your opponent, and then roll onto your back before pulling through into a vertical dive. At about 600 feet, open fire, making sure you lead your target as necessary. Then pull out smoothly to get back above your target. Don't pull up so quickly as to give your opponent a quick shot at you--remember to get clear of his guns before pulling up. Use Quick Combat dogfighting or the Training Missions to practice this maneuver.

IMMELMANN

Purpose

The Immelmann maneuver is a good way to gain altitude over an enemy while turning toward him, and a good move to pull after performing a high-speed pass.

Drawbacks

Because of the loss of speed toward the top of the maneuver, avoid using the Immelmann when you are within an enemy pilot's gun range--you'll be a stalling duck if you're not careful.

To perform

The Immelmann is basically a half loop with a half roll on top. After you've passed the enemy, pull back gently on the stick, apply full throttle, and start climbing straight up. Make sure you have plenty of speed. Meanwhile, look behind you to see what the bandit is doing and start planning your turn toward him. Before you enter a stall, do a half aileron roll toward the enemy and look for the chance to drop in toward him. If you time it right, you'll get in his six o'clock position (right behind him) or you should be able to get a decent deflection shot at him.

Watch the movie of this maneuver (see the Training Movies section of online Help), and then use Quick Combat dogfighting or the Training Missions to practice.

SPLIT-S

Purpose

The Split-S is a vertical break. You roll inverted and perform a half loop. Difficult to follow, this maneuver is a very strong defensive move in a pinch. It's also good for jumping an enemy below you who is traveling in the opposite direction; a classic maneuver that trades altitude for speed.

Drawbacks

You need altitude to perform the Split-S, and if you dive too fast, you might damage your control surfaces or overstress the aircraft as you pull out of the dive.

To perform

If you find an attacker on your six o'clock, roll inverted and pull back hard on the stick. To avoid gaining too much airspeed, throttle back as your plane dives. As you follow through the half loop and the horizon appears in front of you, increase power and be ready to turn back into your attacker. If you find that you're still at a disadvantage, consider performing another Split-S or, if you have the momentum, use your superior speed to put distance between you and your attacker. But whatever you do, don't fly straight-and-level!

Watch the movie of this maneuver (see the Training Movies section of online Help), and then use Quick Combat dogfighting or the Training Missions to practice.

Close air support is just that: close. The pilot
has to be at low altitude or down near the ground to
effectively identify and hit his target (as opposed to
strategic bombing done at 20,000-30,000 feet). Getting
away after the pull out can be very tricky, exposing
you to all sorts of hair-raising expressions of enemy
displeasure. When enemy lines are close to allied lines,
it becomes all the more confusing as it requires very
rapid identification of the target at high speed and low
altitude in all sorts of weather and lighting conditions.
The type of maneuver required depends on the mission.
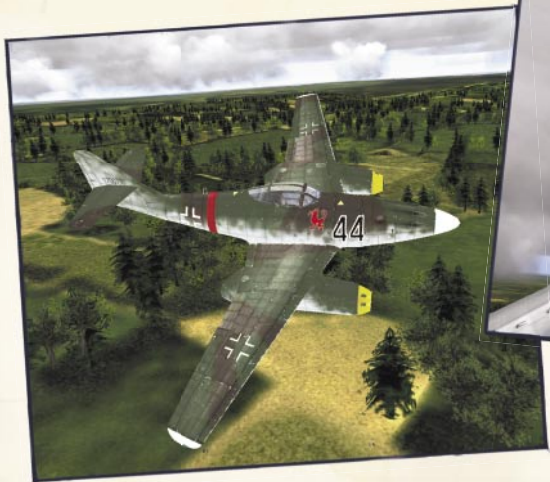
DIVE-BOMBING (FIGHTER-BOMBER)

Purpose

Dive-bombing is the most accurate way to put fighter-bomber ordnance on target as you're pointing the ordnance more directly at the target. It may also result in less exposure to the accuracy of hostile fire compared to giving the enemy a level target moving at a steady speed.

Drawbacks

Fighters can carry bombs, but their performance can be negatively affected by the additional weight. While on the bombing run, the aircraft is vulnerable to ground fire, and it's an easier target to hit. Pilots flying the P-47s and P-51s describe using them for dive bombing as "by guess and by God" since the aircrafts' large noses obscure the target. Some pilots develop a timing system to gauge the drop point after the target disappears beneath the nose, depending on dive angles. While P-51s are used for dive-bombing, structural failure in sharp pull outs is a threat, so P-51s mostly use shallow angles of attack or glide bombing.
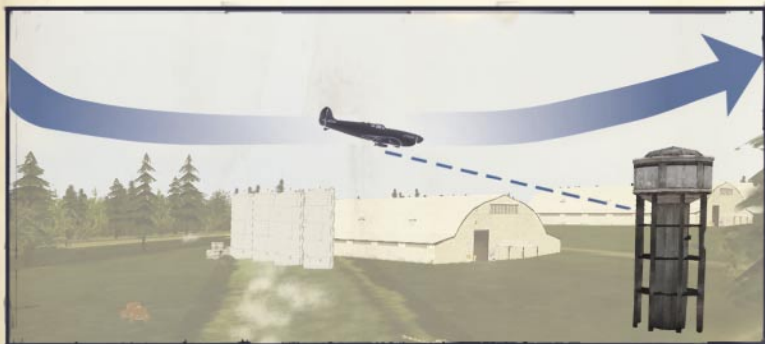
To perform

From 10,000 to 15,000 feet, dive at an angle between 45 and 70 degrees towards the target. As you pick up airspeed, make gentle turns to stay on target, and throttle back as necessary to avoid excessive speed. At around 3,000 feet, release the bomb—visualize dropping it straight onto the target, like a "pickle into a pickle barrel." Because you're not diving straight down, you may need to compensate by aiming slightly behind the target. Once you release the bomb, pull back on the stick gently to pull out of the dive, and ease off the throttle if your airspeed is high. Be careful—if you pull back too hard too quickly, you may stall or damage your plane. After you pull out of the dive, add power and either level out or climb away from the target. Don't get careless checking to see if your bomb hit—enemy fighters or flak could catch you in this vulnerable moment.

Watch the movie of this maneuver (see the Training Movies section of online Help), and then use Quick Combat or the Training Missions to practice.

STRAFING

Purpose

Strafe to attack ground targets and avoid ground fire. With so many "targets of opportunity" in the European theater, you'll be called on quite often to make strafing runs against enemy ground targets.

Drawbacks

Strafing is very dangerous because you're so low to the ground. The margin for error is small--you could get hit by ground fire or miscalculate in a maneuver and crash.

To perform

The key to strafing is to stay as low as possible, giving the enemy very little to shoot at. Stay under a hundred feet if you can, and start firing when your target comes into range. You may need to pop up slightly before shooting and momentarily drop the nose to make the guns bear on the target--but not for long, or you'll be part of the landscape! Stay low until you're clear of ground fire. Fly as fast as your plane will go!

Watch the movie of this maneuver (see the Training Movies section of online Help), and then use Quick Combat dogfighting or the Training Missions to practice.

GLIDE-BOMBING (FIGHTER-BOMBER)

Purpose

Glide-bombing is used against shipping and rail targets, as well as bridges and other fixed targets where the pilot wants the bomb to slam into the side of the target. This technique requires less skill than does dive-bombing.

Drawbacks

Glide-bombing runs are performed at slower speeds and a shallower profile than dive-bombing runs. This technique requires the pilot to come in very low--100 to 1,000 feet--making the aircraft very vulnerable to ground fire. It's standard practice to hit any defensive gunnery before making the bomb run.

To perform

Approach the target at 100 to 1000 feet releasing just prior to reaching the target. The bomb will glide in at a gentle angle. Practice this technique to get a feel for the best timing on the release. Use Quick Combat or the Training Missions to practice this maneuver.

VIEW THROUGH THE BOMBSIGHT ON A LEVEL BOMBING MISSION.

LEVEL BOMBING, LOW ALTITUDE (MEDIUM BOMBER)

Purpose

Low-altitude level bombing with medium-sized aircraft is used for hitting ships and ground targets. The ability to go in low increases accuracy and mitigates some problems caused by weather at mid to upper altitudes.

Drawbacks

At slower airspeeds, medium bombers present a larger target to ground defenses. Although pilots can maneuver defensively at their own discretion, the tree-top altitudes provide little safety margin to effectively do so.

To perform

Form up into assigned groups over the takeoff base. En route, keep the flight at around 50 feet to avoid radar detection. Approximately five minutes from the target, increase speed to combat cruise. Navigate by ded reckoning and landmarks to the target. (You paid attention during the briefing, right?) Remember that your formation is part of your defense.

Press F7 to go to the bombardier seat. You're still in control of the aircraft and your view is through the bombsight. Press BACKSPACE to select ordnance, align the crosshairs on the target, and press ENTER to drop the bombs. Stay in formation during and after the attack. Use Quick Combat or the Training Missions to practice this maneuver.

Press the LEFT BRACKET ([) to zoom out. Press the RIGHT BRACKET (]) to zoom in.

LEVEL BOMBING, MEDIUM ALTITUDE (MEDIUM BOMBER)

Purpose

Medium-altitude level bombing with medium-sized aircraft is used primarily for hitting ground targets. For slower aircraft in formations, this offers a degree of protection (however marginal) from ground fire.

Drawbacks

At slower airspeeds, medium bombers present a larger target to ground defenses. Flak is always a danger on these missions.

To perform

Form up into assigned groups over the takeoff base and climb to the assigned altitude (10,000-14,000 feet). The basic formation element is a three-plane vee, combining two elements into a flight. Three flights comprise the standard 18-plane group.

The attack from the IP (initial point) to the target will usually be a straight path with a right turn after the drop.

Press F7 to go to the bombardier seat. You're still in control of the aircraft and your view is through the bombsight. Press BACKSPACE to select ordnance, align the crosshairs on the target, and press ENTER to drop ordnance. Stay in formation during and after the attack. Use Quick Combat or the Training Missions to practice this maneuver.

ATTACKING SURFACE TARGETS WITH ROCKETS

Purpose

Rockets are used to deliver a small but powerful tactical punch with, in theory, greater accuracy than a bomb dropped from altitude. Rockets don't have internal guidance and need to be aimed carefully, but they are useful when the enemy and allied lines are very close to one another.

Drawbacks

These weapons are of recent development and their accuracy leaves something to be desired. The rockets are launched in shallow dives of not more than 30 degrees at a range of something more than 1,000 feet. The tricky trajectory of these projectiles makes them very difficult to aim, and pilots don't much like their low accuracy—but many call the five-inch HVAR "Holy Moses" because of its destructive power.

To perform

Launch the rockets in shallow dives of not more than 30 degrees at a range of slightly more than 1,000 feet. Use Quick Combat or the Training Missions to practice this maneuver.

AIRFIELD ATTACK PROCEDURES

Purpose

It's an obvious advantage to damage enemy airfields and hit their aircraft when they're most vulnerable—on the ground. Try this technique with your squadron mates in Multiplayer.

Drawbacks

Strafing airfields is very dangerous for all the reasons any strafing is dangerous. Airfields are also very well protected, causing the airman's medical condition known as "pucker factor."

To perform

A typical technique is to attack the airfield in groups of three squadrons. Approach the field at low-level, having descended several miles out from cruising altitude. Squadron one should pull up about a mile from the airfield, climbing to an altitude where they can get the attention of the ground defenses but be out of range of small arms fire. They should continue up to fly top cover for the other squadrons or engage in mock dive bombing to gauge the enemy's reaction.

The ground defenses may also open themselves up to detection by the two other approaching squadrons. Squadron two should attack gun emplacements and antiaircraft batteries as it crosses the airfield and then continue flying low until out of range. Then it should pull up to fly cover as Squadron three comes in to hit parked aircraft and airfield installations. Finally, Squadron one makes their run on the airfield with the other two squadrons flying protection.

A FEW TIPS...

Maybe you've practiced and tested, and you still can't hit the target, even when it's clearly in your sights. Not only does the enemy get away, but he clamps onto your tail to shoot you down.

First, a question: Are you flying missions or just quick combats? Quick Combat is a good place to practice before attempting a mission. Here are some tips for mission success:

- Check your six o'clock--make sure there's no enemy behind you! You've heard this over and over again, but you really HAVE to check it--at least every five seconds.
- If you're having trouble with visibility, try flying in HUD view for a while (press **F5**). This view improves not only your lower 12 o'clock position view (normally blocked by the panel), but also lets you see behind you much better.
- Have the Tactical Display on (press **SHIFT+T** to toggle on and off): that's another great way to tell if enemy planes are behind you.

If you have enemy planes in your sights and they seem to slip away, a few things could be going on. Consider these factors:

- If you're not directly behind them, you have to lead them: shoot a little in front of the plane so your bullets arrive at the same time the plane does and meet the target.
- Sometimes, when you're flying at a steep upward angle toward a plane above you and concentrating on the enemy plane, you don't realize your own plane stalls and points downward. Remember, your plane is not a jet or a rocket. You have to fly the plane while you're fighting.

- Yes, you DO have to get very close before you shoot. Your wing guns are angled so the bullets converge at approximately 300 yards, though sometimes you can still hit targets from two or three times that range. The convergence point is where they do the most damage. You can watch the bullet pattern on the ground as guideline to whether you are close enough.

Not easy, is it? But if you keep these things in mind and practice in Quick Combat until they become second nature, you won't be so frustrated, and you'll definitely have more fun.

Note: since you don't have the physical feedback a real pilot has, use the HUD and Tactical Display to help you!

TIPS AND TRICKS FOR SPECIFIC AIRCRAFT

All the planes in Combat Flight Simulator are great fighter aircraft, but it takes pilot skill and experience to capitalize on the best traits of each one and to overcome the strengths or to capitalize on the weaknesses of enemy aircraft. For more specific information about each aircraft, see the *Machines of War* handbook.

TELLING FRIEND FROM FOE

No matter how much you study aircraft recognition manuals, it's easy to make mistakes in the heat of battle. Take a second look at planes you're about to escort or attack to make sure you know whether they're friend or foe. In the tactical air war, here are some aircraft similarities to watch for:

Axis pilots

- If you spot a group of what looks like Mustangs and plan to attack from behind, make sure they're not Bf 109s.

American pilots

- If you spot a group of what looks like Bf 109s and plan to attack from behind, make sure they're not Mustangs.

- Don't mistake the Ju 88 for a British Mosquito. Both are medium bombers with a bubble nose.

- The Fw 190 can be mistaken for a razorback P-47.

Air Force Historical Research Agency Photo

IS THIS HALFTRACK-MOUNTED AA GUN AN ENEMY ASSET? THINK TWICE, BUT THINK FAST.