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TUTORIAL

If you are already familiar with the basics of flight – either from real life experience, or from playing other sims, you can skip this chapter completely. However, don't subsequently complain that you haven't been informed of something crucial! As for the rest of you, just read on to find out what this flying business is all about!

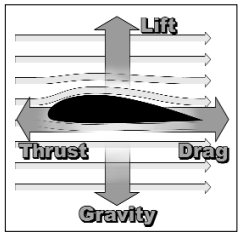
1. Flying Essentials

At this stage in history we are all used to the sight of planes soaring above us. But do you actually know how aircraft manage to get up in the air and stay there? Well, if you're not entirely sure about the answer to that one, there's no need to panic – we won't be smothering you with a lot of old formulas from physics class, which by now you've probably forgotten anyway. What you should know, however, is that a number of forces interact in the whole wonderful business of flying. These forces are as follows:

Thrust – The force that pulls an aircraft forward.

Drag – The resistance of the environment that must be overcome by thrust, before a body can engage in any sort of movement (sound familiar at all?).

Gravity – The force that tries to keep every single object on this earth (plane or no plane) fixed firmly to the ground.



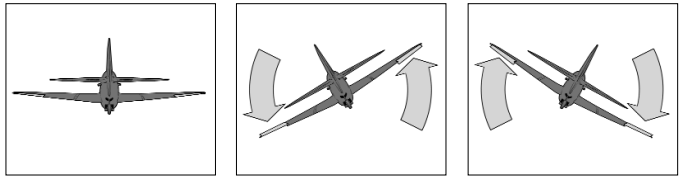
Lift – Generated as air flows around the plane's wings, lifting it upwards.

If a plane has enough thrust, it can overcome drag and start moving. Once sufficient speed has been attained, enough lift will build up under the wings to defy gravity and allow the plane to take off. Simple, isn't it? In reality, things are a little more complex than that, but we'll leave it there for the moment.

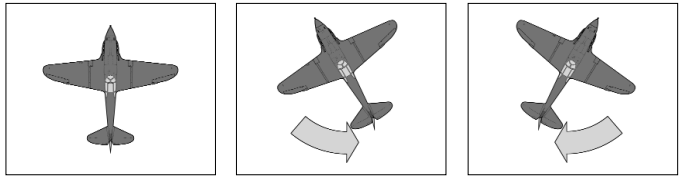
A Plane's Axes of Movement

Unlike ground vehicles, a plane can move up and down, which adds an extra dimension to its movements. Some might argue that a plane can move in TWO extra directions, even though both types of movement concern the same direction. These additional movements are pitch and roll – more on them later.

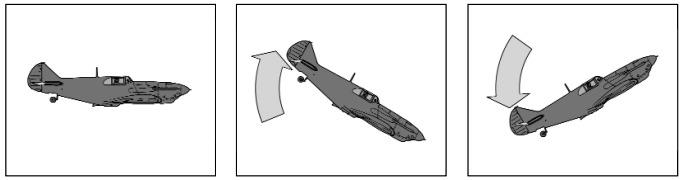
Movement along a plane's three different axes is made possible via special flight control surfaces, which a pilot operates via the stick and rudder pedals. There are different names for the various movement options, and you should take careful note of these, as they are extremely important for making sense of the chapters that follow.



Movement around the plane's roll axis is carried out with the so-called ailerons. They cause the plane to revolve around the direction that its nose is pointing, and allow it to perform turns. This movement is known as rolling (not to be confused with taxiing, which refers to the plane's forward movement on the ground). To move the plane around the roll axis, the pilot moves the stick in the direction he'd like to turn, which can be either left or right.



Turning movements around the yaw axis are known as yawing and are carried out with the rudder. A plane responds to this exactly like a car responds to the steering wheel. A plane is also steered via the rudder when it is on the ground; on modern planes, the rudder is connected to the landing gear, for example. Left rudder allows the plane to be yawed (turned) to the left, and, logically enough, right rudder enables yawing to the right.

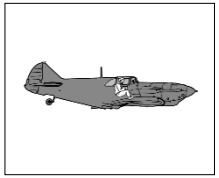


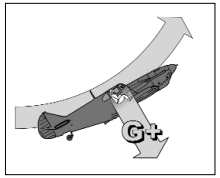
Movements around the pitch axis allow the plane to ascend or descend. This is known as pitching. You pull the stick backwards to pitch the plane upwards, and push the stick forwards to pitch it downwards.

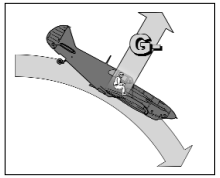
Positive and Negative G-Forces
G-forces begin to take their toll as soon as you start executing high-speed maneuvers and quick changes in direction. The G stands for gravitational and 1G is the basic force of the attraction exerted by the earth. If you fly a tight, high-speed turn, your body cannot keep up with the rapid movement, and you will be forced in the opposite direction by a multiple of the force of attraction. If G-forces become too intense, you can blackout or even lose consciousness. Trained jet pilots can put up with 9G for short periods of time with special equipment, but it's not exactly their idea of fun!

You can experience the effects of negative G-forces if you force your aircraft downwards out of level flight at high speed. You will be practically lifted out of your seat and will be weightless for a short while. If you take things too far, you will have a (literal!) rush of blood to the head and become rather red in the face, to say the least. Your body can deal with positive G-forces better than with negative ones.

When playing IL-2, if your screen goes black in mid-flight, this probably has nothing to do with your graphics card, but with the effects of excessively high positive G-forces. G-forces can be turned off in the Difficulty/Realism menu.







2. Basic Flying Maneuvers

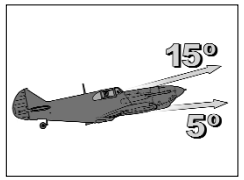
Takeoff
Now that you know which instruments are most important (please take a look at the reference card – the main indicators are Altimeter, Climb, Artificial Horizon, Turn, and Course), you can start thinking about getting your plane into the air. And while you're at it, you can ponder the fact that planes of this era were, for the most part, equipped with a small wheel at the rear – the tail wheel.

Unfortunately, this meant that the plane's nose rose in front of your cockpit, and therefore these planes had a very poor view (if any!) of the ground in front when taxiing or taking off. Try to compensate for this by looking out of the side of the cockpit and using the edge of the runway for orientation. There's no point in moaning – that's just how it's done. Of course, you could always make things nice and simple by switching to one of the external views using the F2 or F7 keys.

Once you are lined up on the runway, you should proceed as follows: extend the flaps to Takeoff level (F key twice). Start to accelerate slowly and check the tachometer to see whether or not the engine is reacting to your movements on the throttle. Now push the throttle lever all the way forward. As your aircraft gains speed, you may have to compensate for the engine's torque by gently applying the rudder. Make sure you keep a close eye on the turn indicator during this process! To begin with, you should keep the stick held towards you in order to exert pressure on the tail wheel and thus prevent a premature takeoff. Once you have attained sufficient speed, press on the stick slightly so as to lift the tail wheel off the ground. Don't press too hard or the propeller may touch the ground. (If you are flying the P-39 Airacobra, forget everything we said about the tail wheel: the P-39 already had the tricycle landing gear that is standard nowadays.)

The aircraft should now build speed quickly. Once you have reached an adequate speed, draw the stick back gently. Make sure you don't pull too hard and do not try to make a sharp turn straight away. This could result in the plane stalling and you will not have enough space beneath you to right yourself in time. First, retract the landing gear (G key) and then the flaps (V key). Monitor your speed closely, and do not pull your nose up too sharply right away. Let your airspeed get above at least 180–200 km/h; then start climbing and make sure that you keep gaining speed and altitude. Once you have reached your desired height, throttle back so as not to overburden the engine and adopt a level flight attitude. Many congratulations – you're flying!

Climbing
To get the aircraft to climb, simply increase the throttle! You will start moving more quickly, and thanks to the increased flow of air over your wings, you will generate more lift. More impatient flight simmers may be tempted to simply pull the stick back. The more you pull, the steeper the plane will climb upwards. A glance at the airspeed indicator will show that you are losing speed at the same time. Lower the nose a little so as not to slow down too much, but make sure that it remains above the horizon. If you are lucky enough to be sitting in a luxury cockpit, you may find an artificial horizon with which you can regulate your angle of ascent. An incline of about 20° generally represents a good compromise between your climb rate and your airspeed.

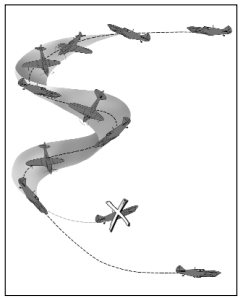


Stalling
If you get carried away pulling back the stick, your speed will ultimately drop to an unacceptable level: the airflow over the wings will reduce and you will find that your plane lacks the necessary lift to keep you in the air. You have stalled the aircraft, gravity has regained its grip on you,

and your next stop will be a rather premature reunion with Mother Earth. In a situation like this, panicking is the very last thing you should do: simply center the stick and let the plane go. Don't carry out any steering operations at all – these are pointless in a situation like this anyway. The nose should be pointing down towards the ground and the aircraft will be dropping rapidly in much the same direction. As this happens, the plane will regain speed, causing the control surfaces to react again. Once you have reached a sufficient airspeed, bring the plane out of its fall and return it to level flight. Test this maneuver out, as you will probably find that you stall at inconvenient moments (like in the heat of battle, for example), and so a certain amount of practice in a non-critical situation will pay off. But please make sure that you always have a sufficient amount of space between your plane and the ground before you embark on a training session…

Spins

If you are really unlucky, you may find that your plane doesn't just stall, but also goes into a spin. Spinning means (among other things) that your plane keeps rotating uncontrollably around its roll axis. A spin occurs when a stall has affected only one wing, in an excessively tight turn for example. Rescuing a plane that has gone into a spin is considerably more difficult than righting an aircraft that has merely stalled, and sometimes it is impossible. The first thing you have to establish is the direction in which the plane is rotating around the roll axis. If you can't identify this, you should have no reservations about switching to an external view via the F2 or F7 keys.



Once you have determined the direction of the spin, you can try your luck at a rescue operation. Move the stick to a neutral position. Under no circumstances should you operate the ailerons (by moving the stick to one side or the other) – this only makes the spin worse! Instead you should step on the rudder in the opposite direction than the one in which the plane is spinning. After that, just wait for the plane to stop spinning. If you can't see any improvement, your best bet is to try again. If the plane has actually stopped spinning, then your battle is almost over: all you have to do is to wait until the plane has picked up sufficient speed for the control surfaces to start reacting again. Then you can put an end to the dive and return to normal flight! Well, it's certainly worked before….

You may be alarmed by how much height you have lost. If you do happen to fall into a spin at low altitude, time really is of the essence and you should bail out without further ado (CTRL + E). Alternatively, you may find that the maneuver described above doesn't actually achieve anything. In some cases you may have fallen into a flat spin, a particularly unpleasant variety in which you find yourself spinning around your yaw axis. Rescuing an aircraft which has fallen into a flat spin is nearly impossible, and abandoning the plane to its fate via CTRL + E is by far your best option.

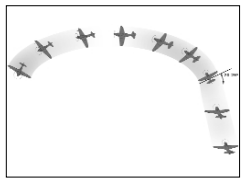
Level Flight

Sounds wonderfully simple, doesn't it? Which is true for the most part, once you have grasped the basics of this skill. Level flight involves flying straight ahead without changing altitude, with all the forces which act upon the plane in balance. This balance means that the plane can fly in a straight line more or less of its own accord, without too much intervention from the pilot. Okay, we said this is relatively simple, but that doesn't mean that an aircraft can just adopt this mode without any help from you! Depending on the load on board (weapons, fuel, personnel, etc.) the plane's center of gravity changes, which in turn has an effect on the flight attitude.

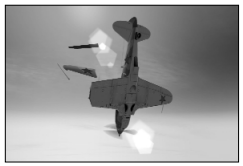
You can, and should, counter these factors by adjusting your aircraft's trimming. This involves fine-tuning the control surfaces to enable a constant, balanced flight attitude. If your plane is dipping to the left slightly, for example, this is not necessarily due to any movement of the stick. Instead, trim the plane to make it lean to the right by holding down the CTRL key and pressing the right arrow key until you have fully countered the lean to the left. If, on the other hand, the plane is inclining upwards, you can try to counter this tendency by simply easing off the gas. Less thrust = less speed = less lift, remember? If that doesn't work, trim your plane by using the CTRL and down arrow keys to make it slightly nose-heavy. Feel free to experiment a little with the trimming, and make sure that you are familiar with the key commands involved (chapter *6*).

Turns

To turn the aircraft, you first have to bank it around the roll axis in the direction in which you wish to turn, logically enough. To do this, gently move the stick in your chosen direction until you have reached an angle of about 20–25°. That's enough for the moment. The plane will describe a gentle curve, forcing the nose down slightly. You should gently move the stick back so as not to lose too much height. Use the rudder and keep a very close eye on the turn indicator; if you want to become a really good pilot, your operation of the rudder should cause the ball in the indicator's spirit level to move as little as possible, remaining in the center of the display. This sort of a turn is known as a coordinated turn: the plane is not forced to one side, but follows the radius of the curve. Bear in mind that although your stick may return to a central position of its own accord, in order to return to level flight you will have to steer it in the opposite direction yourself.

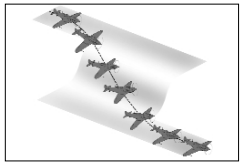


Controlled Descent
'You always get down eventually,' or so the saying goes. Which is true enough, but you have to remember that there are all sorts of ways of getting your feet and your plane back on the ground, some of which are a good deal safer than others. If you just point your plane's nose at the ground, you will gain speed – an awful lot of speed. You will certainly be traveling too fast for the majority of planes from the Second World War period. On your way down, you are likely to feel a little bit shaky, and then it won't be long before parts of the plane are doing their own flying around you. Try explaining that particular strategy to your mechanic, if you are still able to!



You should always prepare for your descent and landing carefully. The first thing you should do is to decelerate. The lower speed will reduce thrust, causing your plane to descend gently. Check your rate of climb on your climb indicator. Then press the stick forward slightly, always keeping the airspeed indicator in view. Depending on the type of plane you are flying, there is a varying range of speeds that can be flown safely at this stage. If you are flying too fast, simply reduce your angle of descent and gently pull the stick towards you. If your cockpit has an artificial horizon, you can use it to verify your flight attitude. You can also try flying broad descending curves, as you automatically slow down when banking. Always watch your speed carefully during this procedure, or you run the risk of stalling.

There is one handy trick that can help you to lose altitude without speeding up: gently roll the plane to one side, and at the same time counter this movement with the rudder so that you don't actually turn. This will mean that you are flying at a slant, but this will be useful in your descent. This maneuver is known as a 'slip' or 'side-slip', and was invented by WW-I pilots to compensate for the fact that their planes were a good deal more fragile than the ones you will meet in IL-2 Sturmovik.



If you and your plane are robust enough, you can use the so-called 'Split-S figure' explained in section 5.4.3. This will expose you to strong G-forces, so don't say you haven't been warned!

If you need to get down to the ground quickly, as in the case of a crash-landing after battle damage, chop your throttle to idle and drop full flaps. Point your nose downwards, which will take more strength than usual as the flaps will generate excessive lift. Keep your nose down to allow your airspeed to drop. Once your speed is below 300 km/h, drop your gear, and then level out as close to the ground as you can. Continue flying forward at a very shallow angle until you touch down.

3. Key Air-Combat Maneuvers

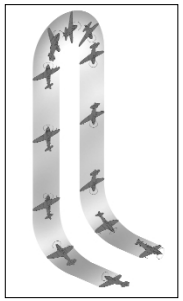
If you have studied the previous sections thoroughly, you should be in a good position to perform clean takeoffs and landings and to squeeze in a few nice, coordinated turns in between. This is admirable, of course, but we trust that you won't be too crestfallen when we tell you that these skills alone are not enough to make you into a flying ace. It may be of some comfort to hear that you are not alone – many of the world's most famous aces put in long hours of practice and made many mistakes before they acquired the talent that set them apart from other pilots. And then, there are some things that can never be learned, abilities that you either have or you don't. For more on this topic, take a look at section 5.5. Don't start turning the pages just yet, though – first of all, we're going to introduce you to the key maneuvers of air combat.

3.1. Offensive Maneuvers

"…you have to get up to a distance of about 70 meters from the target before you can open fire. A big mistake which is often made lies in losing speed when you move up to shoot at the last minute. This doesn't work – the distance simply gets bigger and bigger and you can even lose touch with the target completely. If you shoot from too great a distance away, you just let the enemy know where you are because of the trail your shots leave, and the enemy can frequently get away. Another frequent error lies in gaining ground on the enemy too quickly and then not being able to brake in time, which means that you end up in front of the target.
– John Cunningham, R.A.F. Night Fighter pilot
Quote from: Sims, Edward H., Fighter Tactics and Strategy, 1914–1970.

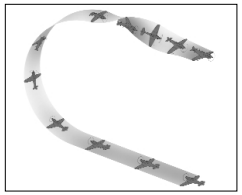
If you will permit us to make a very broad generalization, air-combat maneuvers can be divided into two categories: offensive and defensive maneuvers. An offensive maneuver, for instance in a one-on-one air battle (also known as a dogfight), focuses on shooting down the enemy as quickly as possible. This generally involves taking an opposing pilot by surprise (the ideal situation!) or outmaneuvering him so that you a) get into a good firing position and b) stay out of trouble as much as you can. As is often the case, theory is considerably easier than practice here. But with a little of the latter, you should be able to succeed before too long.

Hammerhead
This maneuver was known as 'Immelmann' in WW-I, named after the famous German ace Max Immelmann. Whether he was really the first pilot to carry out this maneuver is open to question, but what is beyond doubt is that he could perform it to perfection. Since then, however, the terms have changed and in WW-II Immelmann became something completely different.



A typical hammerhead involves flying the plane straight up into the sky until it is about to stall, and then using full rudder to execute a 180° turn about the yaw axis and subsequently going into a dive. The point of this piece of aerial acrobatics is to enable you to tuck yourself behind an aircraft that was flying in the opposite direction as you before you carried out the maneuver. To execute it to perfection, you will need good timing and a good reserve of speed.

To begin, make sure you are flying at an adequate speed. If need be, lower the plane's nose to pick up a little extra speed. Gently but firmly, pull your plane around so that it is climbing straight up. Don't lose sight of your airspeed indicator! Before you lose too much speed and therefore stall, step on the rudder pedals. Did we mention that you should have already decided which way you're planning to turn? Good. Now, turn the plane 180 degrees so that the nose is pointing at the ground, gently using the ailerons as you do so. Pay careful attention to your course indicator or a compass – if everything has gone according to plan, you should now be pointing in exactly the opposite direction than the one in which you started. At the same time, you should also be picking up speed. Recover the plane from the dive once you have reached your desired altitude. In combat situations, you should aim to end up slightly beneath the enemy aircraft, thus putting you out of range of any gunners on board. With any luck, you won't be detected.



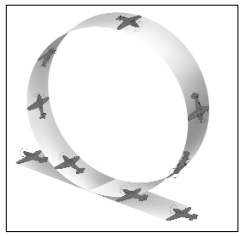
Immelmann

These days the term 'Immelmann' generally refers to a maneuver also known as a 'half-loop'. This also involves trying to change the plane's direction by 180 degrees in as little time as possible, but the pilot achieves this by flying an upwards half-loop instead of the maneuver described above.

Before you begin an Immelmann, you should again make sure that you are traveling at sufficient speed. Keep the wings nice and level, pull back on the stick, and move your plane upwards. While you are climbing, you should roll to one side slightly – again, you choose which side. Keep pulling back on the stick until your plane is flying in the opposite direction than the one in which you started. While you're doing this, you should keep a close eye on the course indicator or the compass. Using the ailerons, turn the plane around the roll axis until you are flying in a normal flight attitude once again. You will now have gained altitude and will gradually pick up speed again, flying in the opposite direction than the one in which you started.

Loop

This well-known maneuver is perhaps the least useful of all in combat – at least that's probably the answer you would get if you could still ask Manfred von Richthofen, the famous 'Red Baron', for his esteemed opinion of looping. There are indeed good reasons not to carry out this maneuver during an air battle; it takes a good deal of time and requires sufficient speed and altitude to complete a full loop. Some pilots, however, cannot get enough of this tactic. You should be acquainted with this particular trick, if only to know how to react should an opponent in front of you decide to try it himself.

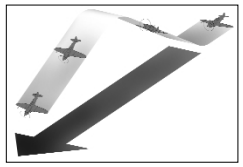


Sufficient speed is essential before attempting a loop. If need be, lower your plane's nose a little to gain speed. Pull the plane up into the sky with its wings level. Keep the stick pulled towards you and just wait until you are traveling in your original direction again. That's it – it's as simple as that! Oh yes, to be on the safe side and make sure that you carve as good a loop as you can, you may find the following trick useful: look to one side from the cockpit and keep your eye on the wing tip. If you get everything right, the tip will describe a perfect circle. Of course, beauty doesn't count for all that much in the sky…but it won't be long before you find that out for yourself!

Yo-Yo's 1: High and Low Yo-Yo's

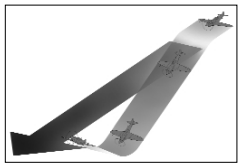
"The Yo-Yo is very difficult to explain. It was first perfected by the well-known Chinese fighter pilot Yo-Yo Noritake. He also found it difficult to explain, being quite devoid of English."
– Squadron Leader K.G. Holland, RAF. Quote from L. Shaw's Fighter Tactics.

These flying configurations may well have amusing names, but the idea behind them is deadly serious. They are offensive maneuvers that address the fact that in air combat, you will rarely be up against an opponent with equivalent performance data. Put simply, never expect that just flying behind your adversary will automatically put you into a good firing position. He could have a faster, more maneuverable plane. Or it could be the other way round and the (apparent) advantages could be on your side, which unfortunately doesn't always make things easier. If you perform a yo-yo maneuver correctly, you can sneak in behind the enemy directly despite the difference in speed or turn performance. And that is often half the battle!



Flying a high yo-yo makes sense if you can travel a good deal faster than your opponent. If you simply fly behind him, you will end up speeding by and thus offering him a perfect opportunity to use your

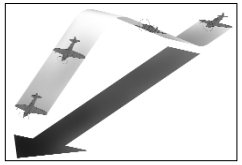
plane for target practice. You'll need an alternative strategy. The trick lies in flying a longer stretch in order to compensate for your extra speed. For a high yo-yo, take your plane up really high so as to lose speed in a controlled way. Lower your nose at a suitable distance from the target and dive down toward your opponent from above.



Not only do you give yourself a height advantage, you also gain speed thanks to the slight drop. This allows you to follow your attack with additional offensive maneuvers and to react to any defensive moves your opponent may make. If you haven't already finished him off, that is!

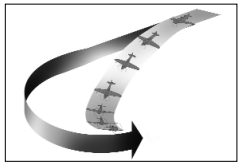
A low yo-yo is a suitable option if the opponent flying in front of you is quicker than you are, as it may enable you to catch up with him and attack him. Gain speed by allowing your plane to descend. This will take you beneath your adversary, whose view of you will be impaired or obscured completely. Once you are close enough and the enemy is almost directly above you, pull your aircraft up. You should have enough surplus speed to be able to get into firing position before your plane slows down and perhaps even stalls.

Yo-yo's 2: Banking



A yo-yo maneuver can also be deployed while banking in order to stay behind an adversary whose plane is more maneuverable than yours. Again, the trick here lies in using space as efficiently as you can in order to make up for any relative disadvantages your plane may have.

Pursue an adversary flying ahead of you and turn at the same time as he does. But instead of trying to follow him directly, pull back on the stick, thus lifting you above your target for a moment. Watch out: you will probably lose sight of him temporarily. Now roll your plane



into a slightly tighter turn, thus moving yourself more sharply into the radius of your opponent's turn. When he has turned a bit further, you will be able to use your height advantage to pounce on him from above and should land right behind him – if you've got all your sums right, that is!

Follow the opponent ahead of you into the turn and push forward on the stick to make your plane descend. Cut back on the throttle so as not to gain too much speed. Then, fly a longer distance before cutting into your enemy's tighter turn radius. Pull back on the stick as you are doing this, lifting your plane straight up. With a little practice you should land right behind your enemy and thus in a good firing position.

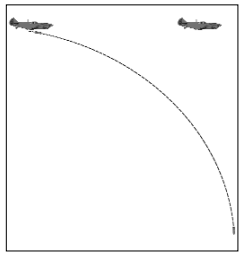
The difference between low and high yo-yo's is difficult to explain. Both can be used in the same situation, often with similar results. In both, you dive and climb, just in a different order. It can be argued that you turn better in a high yo-yo as your plane spends more time at lower speeds – but this is all a matter of an individual plane's characteristics. The truth is, turns are almost never perfectly horizontal in combat. If their opponent is climbing, pilots tend to counter with high yo-yo's. If an opponent is diving or is generally below, a low yo-yo is recommended.

3.2 Attacks on Ground Targets

Right, that's enough about dogfights. In IL-2 Sturmovik, attacks on ground targets play a particularly important role, and the rules for this type of combat are somewhat different. Attacking ground targets is all about trying to score a direct hit in as few attempts as possible while remaining in one piece. As you can no-doubt imagine, the enemy won't exactly welcome your attacks with open arms, and being able to counter his defenses is of prime importance.

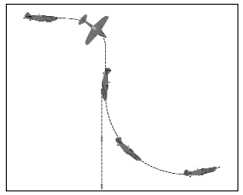
Bombing from High Altitudes

To try and escape fire from ground objects such as tanks, artillery, and flak, you can opt to release your bombs from high altitudes. This strategy certainly helps to protect you, but is, unfortunately, relatively



imprecise, requiring a high degree of skill and practice to be truly successful. What makes dropping bombs from such great heights so difficult is the speed: your bombs won't just drop to the ground in a straight line, but will cover a certain distance in flight depending on the speed at which you were flying when they were released. Large bombers have a bombardier to direct the bombs and release them, but in an IL-2, for instance, you have to handle these duties yourself.

Why not try it? Once you have identified a target, fly towards it at high altitude. As you're making your way towards your goal, you may wish to switch to an external view using the F2 or F7 keys. To hit the target, you will have to release the bombs a long time before you actually fly over it. Have fun practicing!



Dive-Bombing

To improve the accuracy of bombing missions, dive-bombing tactics were developed after the First World War. The idea behind this strategy is to plunge down towards the target in a nearly straight line, so that there is almost no horizontal distance between the target and the plane when the bomb is released. This

release technique was developed by the U.S. Air Force and adopted by the German Luftwaffe, which ultimately led to the development of notorious aircraft such as the Junkers Ju-87 and Ju-88, which were specially adapted for this type of bombing. But that's another story…

To release a bomb in a dive maneuver, approach your target at an adequate altitude. Once you are almost directly above the target, embark on a sharp descent (a dive) and speed towards your target as directly as you can. You are vertically above your target if it remains in the center of your sights and simply seems to rotate even when you are moving your ailerons. Before releasing the bomb, be sure to give yourself enough time to fly to safety. Be prepared for defensive fire and take care, as not every pilot (nor every plane, for that matter) can withstand such high speeds for long. It is a good idea to use anything you can to slow your plane down during a dive attack – flaps, dive brakes, any equipment you have. Don't forget to idle your engine when diving, too!

Low-Level Bombing
IL-2 pilots generally attacked their targets at extremely low altitudes, sometimes dropping to less than 10 meters above the ground! Understandably enough, this sort of height is less than ideal for dropping bombs, as it is highly probable that you will be destroyed along with your target. You may approach your target at the lowest possible altitude, but will then have to climb to a safe height to release your bombs.

Pick out a target and get it into view. Try to fly as quickly as possible to make yourself a hard target for enemy fire. Unfortunately, you can't swerve or dodge that much, as your weapons are simply not modern enough to seek the target themselves. When choosing the moment to drop your bombs, bear in mind the distance that they will travel after being released. Then climb up and away from the target without delay to avoid falling victim to your own bomb. Now focus on continually changing your height and direction to make it as difficult as you can for the enemy to shoot you down. An IL-2 is, admittedly, well armored, but is by no means indestructible! Switch to an external view to take a look at the effects of your handiwork or fly a course which enables you to look out one side of the cockpit at where your bombs have landed. Don't be at all surprised if the first attempt was a failure – you will almost certainly have to make a few practice runs before you score a direct hit.

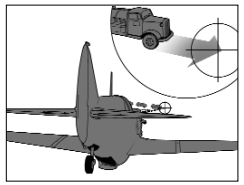
Rocket Attacks on Ground Targets
Almost all versions of the IL-2 are equipped with suspension rails for unguided rockets. What unguided means in practice is that, as we saw with bombing tactics, you have to direct the plane towards the target if you want to achieve a hit with your rockets. And, of course, in doing this, you provide the enemy's ground forces with another wonderful opportunity for target practice. When mounting rocket

attacks, you should again try to move as quickly as you can by approaching at low or medium altitude. Train your sights on the target and release the rockets from an appropriate distance (not too

far away). Bear in mind that your rockets are positioned underneath the wings to the left and right of you and will not necessarily land right in the center of your sights. Once you have fired the rockets or rocket salvos, start climbing again and turn away, swerving and changing your altitude as much as you can to escape enemy fire.

Using On-Board Weapons
The IL-2 has impressive cannon and machine gun capabilities fitted as standard, and so does the German FW-190. But the Messerschmitt Bf-109 can also have powerful additional weapons (which affect the plane's mobility). Attacking ground targets with on-board weapons is similar to using unguided rockets. Set your sights on the target and fly towards it at high speed. Given that the shots from your on-board weapons are not nearly as destructive as rockets, you will probably have to strike several times to destroy or simply damage a target. Take a very close look at your target. You can possibly finish off a truck or a locomotive with a few hits, but if you have set your sights on a heavy tank, you will have to be pretty accurate with your aim and score a direct hit! The colored tracer bullets can help you with your aim – adjust your direction accordingly. In later models of the IL-2, the machine guns were, curiously enough, only included for the purpose of making targeting easier for the far more effective machine cannons! If you move the rudder slightly to the left or right while firing and turn gently around the yaw axis, you can spread your shots more effectively and raise your chances of a hit.

Deflection Shooting
If you try to shoot at a moving target, you will probably notice the following: let's say a truck is traveling in front of you, and you approach it from behind and slightly to the side. You center your sights on it and press the trigger, but you still don't hit the target. The reason for this is simple – even though your bullets are extremely quick, they still have a



certain distance to travel before they arrive at their destination. They will actually hit the place that you have lined up for them, but by the time they make impact the truck will have traveled a little further itself. Of course, you may actually end up hitting the target, but if this is the case then you have probably aimed at a particularly slow truck!

The bottom line is that you should always consider the distance that the target is likely to cover before the bullets arrive and bear this in mind when taking aim. Don't train your sights on the target itself,

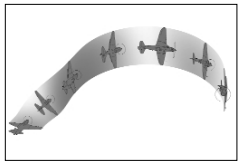
but on a point slightly in front of it. The faster the target is moving, the farther you have to aim in front of it. This is known as deflection shooting. As you can imagine, this technique was not developed specially for attacking ground targets. In any sort of battle, you're not likely to score many hits if you don't put these principles into practice. Even top aces can be frustrated by this, but once you have grasped the underlying principle, a little practice should help you to put this technique to good use.

3.3. Defensive Maneuvers

"...by the way, did you know that the Russian Rata could outmaneuver the Me 109?"
– Joseph Jacobs, Commander of the Jasta7 in Flanders in WW-I. Quote from: Sims, Edward H., Fighter Tactics and Strategy, 1914–1970.

Now that you've read about all the lovely damage you can do in IL-2 Sturmovik, it's time we told you that you're likely to find yourself in at least as many situations where the enemy has his sights trained on you! All is not lost, however – read on to find out how you can get out of the tightest corners and maybe even turn things to your advantage!

Break
Apart from the fact that it's better to avoid risky situations in the first place, any self-respecting pilot should be able to carry out this maneuver in his or her sleep. Fortunately, it is quite simple to perform, as a break is basically a very tight turn. Use this maneuver if you've got the sneaking feeling (or if you're absolutely sure) that the enemy is right behind you.



To perform this maneuver, roll your plane 90 degrees to whichever side you choose and pull the stick towards you. You can also use the rudder gently and cut back the throttle to tighten the turn. If your plane is particularly maneuverable, this may be enough to shake off your pursuer, as he will have to be at the controls of an even more nimble aircraft to get into a good shooting position. But be prepared to carry out a series of maneuvers to shake off your would-be assailant, as one simple break alone is generally not enough. Only a suicidal pilot would perform a series of breaks in alternating directions. Rolling from one direction to the other may take a few seconds, during which time your plane will be flying almost straight and level. This gives your attacker plenty of time to regain any positional advantage he may have lost during your first break turn.

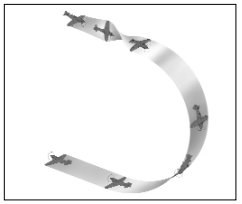
Barrel Roll
A barrel roll means flying in a tight spiral. You can use this maneuver to help you confuse an enemy who is following you. If he wants to score a hit against you, your pursuer will have to follow you in this maneuver; otherwise he will fly past you or above you. A barrel roll may enable you to tuck in behind him and turn the tables!

Move the stick to whichever side you choose and pull back on it slightly. Your plane will start flying a long, narrow spiral. Follow this route until your opponent flies past you. Of course, that's what we hope he'll do. If he manages to stay on your tail, you'll have to think of another defensive maneuver to get rid of that unwanted attention. Try using full rudder, in the same or opposite direction, to make your roll less predictable.

Dive
For this maneuver, it pays to have a thorough knowledge of your own and, if possible, your opponent's machine. Let's say you're flying a Messerschmitt Bf-109 and you come under attack from a MiG-3 that is in hot pursuit…

Placing your trust in your own plane's robust stability and the correspondingly fragile nature of the Soviet pursuer, you simply point your aircraft's nose straight down. You will pick up an awful lot of speed, as will your enemy if he decides to stick with you. You will be able to put up with this for quite some time before you really start to suffer, whereas your adversary will probably start to feel the effects much more quickly. If he has any sense he will abandon his attack completely or hang around for a better opportunity. Which means you're in the clear…for now.

The Split-S
The Split-S is a downwards half-loop. This means that you gain speed while losing height. Ideally, of course, you will have plenty of altitude before attempting this maneuver, which also involves adjusting your course by 180 degrees.



Quickly roll to one side until you are upside down and then pull back hard on the stick. Once you have completed a half-loop, you will have enough speed to make an attempt at flying away from the enemy.

We hope you appreciate that these are merely the most basic defensive maneuvers and that none of them offer a fail-safe method of saving your skin. But if you practice them and acquire a certain amount of proficiency in their execution, you will give yourself a good chance of holding your own in airborne combat. You should also try to combine several maneuvers, flying a Split-S straight after a break, for instance. Have a go at confusing your enemy or entice him into a maneuver from which he will find it difficult to escape by using your aircraft's characteristics to your advantage. Watch and learn: watch your opponents in action and take note of their strategies for getting out of trouble.

Note: For these, who will use fully realistic settings, below is description of the realistic engine management in general (for more details for each aircraft please look in the readme file)

HISTORICAL CAMPAIGN BACKGROUNDS

Before you embark on your career as a pilot, here is a historical overview of the great battles modeled in the game.

On December 18, 1940, Hitler ordered that preparations be made for the so-called "Operation Barbarossa," as the battle for lebensraum (living space) in Eastern Europe came to be known. After the lightning victory (Blitzsieg) over France, there was enormous euphoria in Germany over the "greatest warlord of all time." The German Reich was now in control of the continent from the North Pole to the Spanish border. Hitler was not to be halted, and he was becoming more and more involved in the operational leadership of the Wehrmacht (German Armed Forces). The battle with Russia was planned as a war of annihilation from the very beginning. As Hitler explained in a discussion with the Chief of Staff of the Wehrmacht High Command, Alfred Jodl, "The coming campaign is more than merely a battle of arms; it will become a conflict between two different philosophies." Hitler also stated that the war was to be waged with uncompromising severity – Soviet volunteers were to be liquidated "mercilessly", regardless of whether they were in combat or trying to run away.

On June 22, 1941, the German Armed Forces entered the Soviet Union, breaking the German-Soviet non-aggression pact that Hitler and Stalin had signed on August 23, 1939. National Socialist propaganda declared that the Russian campaign was "in defense of Europe against Bolshevism" and hoped for another lightning victory; Hitler planned to conquer all of Russia in only eight weeks. The army was divided into three groups – one to conquer Leningrad, which would in turn join forces with the second group in the assault on Moscow. The third group was to march towards Kiev in order to gain control of the oil fields in the south. Hitler's insistence on splitting his forces into three relatively weak army groups has been considered by many historians as a first step toward Germany's ultimate defeat.

The German Luftwaffe played a decisive part in this plan, destroying many Soviet aircraft before they even got off the ground. Nevertheless, the initial successes of the Luftwaffe could not hide the fact that it was not equipped for a long battle. Over-hasty mass production of machines that had hardly been tested and the adaptation and misuse of proven models meant that many promising aircraft were not used to their full potential.

The German army marched in with over 3 million soldiers, including 75 percent of the field troops and 61 percent of the Luftwaffe. The invading forces comprised no less than 153 divisions, including 19 of the total 21 tank divisions. Altogether there were 600,000 vehicles, 3,580 tanks, 7,184 guns, and 1,830 aircraft in the Russian campaign. The Soviet forces were represented at the European front by 4.7 million soldiers.

Stalin was unprepared for the German assault, having played down all the obvious signs that an attack was imminent and calling them "mere provocation." The announcement that the Fascist "monstrous cannibal" had attacked caught him unawares, although it was no surprise for many Soviet commanders, including some generals of high command. An order was issued just a few hours before the invasion, warning front-line commanders about imminent "provocation attempts." It did not reach its recipients in time.

Germans soon captured Smolensk and Kiev, attacked Leningrad and took 1.5 million prisoners of war. Refusing to yield to Hitler, the Soviet Union capitulated by the time winter arrived. The non-aggression pact between the Soviet Union and Japan enabled Stalin to call in reinforcements from the East. Not only that, but the Soviets succeeded in evacuating over 1,500 production centers and around 10 million civilians to the East. Hitler had not expected an operation of this scale. The German troops, ill-equipped for the harshness of winter at the Eastern Front and stretched to their limits, found it more and more difficult to organize supplies. Hitler had completely underestimated the determination and might of the Soviet forces, their strength in numbers, and the potential of their armaments.

Hitler ignored the advice of his army's High Command to pool the German forces and press on towards Moscow. Instead, he ordered the capture of Leningrad and the occupation of the Ukraine. The first German troops did not reach the outskirts of Moscow until October 2, 1941, and Hitler instructed them to hold their position. His Chief of Command Walther von Brauchitsch advised the withdrawal of troops to more favorable winter positions, but Hitler again remained firm, not hesitating to take command of the army. The notion of a speedy victory was thus dispelled.

The Germans did succeed in capturing parts of the Soviet supply areas, but this did not lead to a decisive victory in the Caucasus or in Stalingrad during the offensive mounted in the summer of 1942. The German Sixth Army was surrounded at Stalingrad on November 10, 1942, and surrendered on January 31, 1943. Between 1942 and 1943, the German Wehrmacht lost almost a million soldiers. Stalin, Roosevelt, and Churchill held a summit in Yalta to discuss their post-war policies and strategies for achieving a "just and lasting peace." The Red Army captured Berlin, and Hitler committed suicide. On May 8, 1945, Germany capitulated, putting an end to the war in Europe.

1941: Smolensk
The First German Victories – The Battles of Smolensk and Kiev

"The Russians didn't show the same amount of initiative as the enemy pilots at the Western Front. But the elite units of the Red Guard really were very good. Their aircraft were painted in red right up to the cockpit and their pilots had a real taste for battles on the turn. Our Me 109s were better at high altitudes, especially at the beginning of the campaign. We could maybe shoot down five planes in one day – but by the next day, there were just as many there again..."
Günther Rall
Quote from: Sims, Edward H., Fighter Tactics and Strategy, 1914–1970.

Soviet forces were first surrounded in the area of Bialystok-Minsk. Hitler, fearing that their ring around the Soviet troops was too large, wanted to stop the tank groups earlier than planned. At this stage, his general staff were still able to get their way, however. Their tactics proved to be successful, and by the time Minsk had been captured on June 26, 1941, the Wehrmacht's High Command had captured 400,000 prisoners of war and 600 guns and destroyed 2,233 tanks and 4,107 planes, all at a cost of only 150 German aircraft. The sheer numbers given here should have been clear indication of the enormous military strength of the Soviet Union, but Colonel-General Franz Halder predicted that the campaign would be won in two weeks' time.

After the first major battle at Bialystok and Minsk, the central unit of the German army advanced from the north towards Smolensk, "the gateway to Russia," and the Second Panzer Group made its way from the south in an attempt to surround the Soviet troops at the city's western front. The troops then planned to advance towards Moscow in a concentric tank wedge. Meanwhile, the Soviet High Command in the Smolensk area was assembling

42 divisions to prevent the German troops from advancing towards Moscow, which was about 400 km away. Their plan failed. The mobile German troops evaded the Red Army's defensive strongholds of Mogilev and Orsha, Dniepr crossings to the south-west of Moscow. After heavy street battles, the city fell into German hands on July 16, 1941.

In spite of the baking summer sun and the huge dust clouds that hampered their armored vehicles, the Second and Third Panzer Groups and the infantry divisions of the Second Army managed to trap 15 Soviet divisions of the Second Army by July 24. Between Smolensk and Orscha, the Red Army lost around 3,000 tanks and over 300,000 soldiers, who became prisoners of war when the battle ended on August 5.

Despite the triumph at Smolensk, the German military leadership found itself in a severe crisis. Walther von Brauchitsch, Commander-in-Chief of the army, and Chief of General Staff Franz Halder recommended that the central army should advance swiftly towards Moscow. Hitler, on the other hand, favored conquering the Ukraine first, pointing to its oil and raw material deposits, which were of immense strategic importance for Russia. Hitler got his way and ordered units of the Second Army to proceed to the south for the battle of Kiev.

The Second Army of the central group succeeded in capturing Gomel and then formed a cohesive front at the Dniepr with the southern army group. The Seventeenth Army of the southern group captured the bridgehead at Krementchug, creating a base from which to advance northwards to Kiev, 250 km away. Together they encircled 5 armies at the Soviet southern front in a pincer movement. At the same time, the Sixth Army, under the command of Field Marshal Walter von Reichenau, attacked from the west. The ring was closed and Kiev was brought under German control. On September 8, the fighter squadron 51(JG 51), commanded by Werner Mölders, announced their two-thousandth air victory. Fighting in the east of Kiev was to continue until September 26, and led to the surrender of 665,000 Soviet soldiers. The Germans also seized over 880 tanks and 3,700 guns. The morale in the army was high and the Wehrmacht's High Command had every hope that they would be able to advance into the Caucasus before the onset of winter.

1941: Moscow
Operation Typhoon: The March to Moscow

"To fly a combat mission is not a trip under the moon. Every attack, every bombing is a dance with death."
Serafima Amsova-Taranenko
Quote from: Noggle, Ann (1994): A Dance with Death. Texas A&M University Press.

October 2, 1941: The mild autumn weather was still kind to the German troops – Operation Typhoon could begin. On the evening of October 3, the tanks of General Oberst Heinz Guderian took control of Orel at the Oka River, thus cutting off the rail connection between Moscow and Kharkov. At the same time, the Sixth Army under Field Marshal Walter von Reichenau was marching on Kharkov. In the Vyasma-Bryansk area, German troops trapped Moscow's defenders in their pincer attack – surrounding them yet again.

With the support of dive bombers, the units of the Fourth Panzer Group broke through the great Moscow defenses between Tver and Kaluga, overcoming concrete bunkers, anti-tank barriers, minefields, and stationary flamethrower batteries – not to mention the first Siberian troops from Vladivostok. German troops also succeeded in breaking through Soviet defenses in Mozhaisk and Volokolamsk and at the river Nara to the east of Mozhaisk, destroying enemy rocket launcher batteries en route.

So far so good, as far as the German troops were concerned – until the first snowfalls came, that is. These first signs of the bitterly cold Russian winter were followed by another natural obstacle in the shape of mud. The German advance soon ran into difficulties, not only due to the lack of warm winter clothing, but also because the supply of fuel fell victim to the elements, plunging the campaign into a transport crisis. The Soviet rail system provided an additional burden – the Germans first had to adapt the width of the tracks to German standards – Russian tracks were too narrow for German trains.

On October 16, the Germans, now with help from the Fourth Rumanian Army, encircled four Soviet infantry armies and took 100,000 Red Army soldiers prisoner. Just one day later, the battle at Vyasma-Bryansk came to an end. The Wehrmacht's High Command was able to declare the following as either destroyed or vanquished: 67 artillery divisions, six cavalry, seven tank divisions, and six tank brigades! To the south, the Germans captured Stalino in the Donez basin, raising the number of destroyed Soviet divisions to 300. Nevertheless, the Russians kept coming back with stronger guns – as well as the superb T-34 tank and the Katyusha rocket launcher known to the Germans as "Stalin's organ," which were being used more and more frequently.

October 29, 1941: The attempt to capture Tula, approximately 80 km outside of Moscow, ended in failure. The German tanks came under

heavy fire from the anti-tank defenses and flak guns located about 4 km away from the city boundary. Capturing the city from the other direction also failed, as the Fourth Panzer Group were literally stuck in the mud of the Moscow marshes and at the Smolensk-Moscow ridge.

From November 6–12, 1941, the muddy period drew to an end and was replaced by frost. Encouraged, the German troops resumed their assault, but it was only a matter of time until the merciless Russian winter seized the Germans in its icy grip.

Stalin now made the decision to send Siberian and Cossack divisions into battle, as these troops were more than prepared for the harshness of the elements. The stage was now set for the final battle for the second Moscow defense position. The German plan was as follows: to start by capturing Klin, and then turn to the south-east, cut off Moscow from the north, and then block Moscow from Leningrad.

The German troops advanced slowly. Meanwhile, on November 25, the Antikomintern Pact held a summit in Berlin. The German Reich, Italy, Japan, Spain, and Manchuria extended their pact for an additional five years; Bulgaria, Denmark, Finland, Croatia, Rumania, Slovakia, and China also joined the pact, giving Hitler's advisor Joachim von Ribbentrop the confidence to declare the "bolshevist colossus" to be already in ruins. At this stage, the German troops were about 30 km away from the Russian capital.

One day later, the Red Army launched its first major counter-offensive at Rostov. The German troops evacuated the town and General Field Marshal Gerd von Rundstedt asked that they be allowed to retreat. Hitler had no intention of agreeing to his request. Von Rundstedt departed; Hitler replaced him with Field Marshal Hermann von Reichenau.

At temperatures of -38º Celsius, with only their summer uniforms to protect them from the cold, the German troops' morale was sinking by the day. Many troops froze to death, starved, or slaughtered their own horses in order to stay alive. Fuel was becoming scarce and tanks were getting stuck regularly. Not only that, but many engines stalled due to the lack of anti-freeze.

By the mid-December, many units had switched from attack to defense. There were loud cries for a retreat to winter positions – positions which, in fact, did not exist. But Hitler had no time for any signs of weakness or surrender. Instead of sending winter equipment to the front, he sent ammunition. By this time, Hitler had assumed overall command of the army himself, trying to run both the state and the military without advice from anyone. In spite of the phenomenal drain on his men and their lack of resources, Hitler was more determined than ever to hold on, and in apparent denial of the failure of the Blitzkrieg strategy.

Back home, winter clothing was being donated and collected for the troops in the east, but the transport crisis meant that it was impossible to get these supplies where they were needed. Tank production was increased from 125 to 600 units a month, but this extra production impacted the air armaments program negatively. This put a seal on this disastrous state of affairs for the German forces.

The German advance finally came to a standstill 30 km outside of Moscow. Chaotic planning, diverging strategic concepts, and inadequate preparation now took their toll. "All or nothing" was Hitler's new war cry; he hoped to force a swift conclusion after the failure of his original war plan. The next step was clear – Stalingrad or bust.

1942: Stalingrad
Bitter Hand-to-Hand Fighting in a City under Siege

If the two enemies agreed on anything, it was that whoever won the battle at Stalingrad would emerge victorious in the battle for Russia. The siege of Stalingrad, logistically the most important center in the Caucasus and, with its tank factories, the industrial heart of Russia, was a human and material battle the like of which had never been seen before. The trench and positional warfare that marked the battle of Stalingrad led Russian propaganda of the time to refer to the conflict as a "Russian Verdun."

The Sixth Army, Hitler's elite troops under the leadership of General Friedrich Paulus (who was eventually promoted to Field Marshal), were the main combatants in this, the biggest battle of the Eastern campaign. They were supported by sections of the Fourth Panzer Army, who had arrived from the south.

August 10, 1942: The first waves of German troops broke through to the outlying districts of Stalingrad. Nine days later, Paulus ordered an attack. On August23, the first German attack troops reached the banks of the Volga, supported in their quest by the aircraft of the VIII Air Corps of General Martin Fiebig. By October, they had managed to capture 90 percent of the city. The battle was by no means over, though – the ruins of the city provided an ideal hiding place for Soviet sharp-shooters, and many machine gun positions were tucked in its dark alleys. The conflict became more and more gruesome; soldiers battled with bayonets, rifle butts, and even spades as attack followed attack.

The enormous psychological burden was compounded by worries over reinforcements and the cruel Russian winter. As early as September, General Paulus tried to persuade Hitler that Stalingrad could not be conquered: "I cannot change this, it goes beyond the means of human strength." Yet, Hitler stuck to his guns and his officers refused to give up. They motivated their men, pushing them to their limits – and beyond. By mid- October, the German troops occupied the northern part of Stalingrad.

Nevertheless, fresh waves of Soviet troops were already preparing themselves for Operation Uranus. Paulus pleaded with Hitler to allow the German troops to retreat, but to no avail. On November 19, 1942 the Red Army attacked as anticipated. Soviet soldiers encircled the German troops from the north and the south, absolutely determined to force the Germans to surrender. 300,000 men were thus trapped in Stalingrad. Hitler ordered them to hold their position and promised help from the air. General Paulus happily agreed, placing his faith in the Fuhrer's promise.

This was a promise that Hitler had great difficulty in keeping. Not only did the German Luftwaffe have an insufficient number of planes, the aircraft they did have were weakened by the strength of Russian anti-aircraft defenses. Air Fleet 4 did what it could. Transport planes from Tunis and Sicily were called in and adapted from summer to winter conditions as quickly as possible. By December, about 200 Ju-52 aircraft and 100 He-111 bombers with empty bomb compartments had been organized as transports, and by January 1943, the number had grown to 467 aircraft in all. The Sixth Army demanded 700 tons of supply per day, every day. The Luftwaffe at this stage was barely capable of delivering 350 tons – discounting Soviet opposition – and only for a short period of time.

The Russians were tightening their grip on the city and the German troops were fast running out of food and ammunition. At temperatures of up to 40 degrees below zero, they stuck out the siege as best they could. In the words of one officer: "At the end we were so exhausted that we did not even have the strength to stand at our machine guns. We tied shoelaces and pieces of string to the trigger and hung on to them with all our might whenever we had to shoot. In any case, we only fired if we really had to, as we were afraid of blowing our cover."

On December 12, German LVII Panzer Corps set off towards Stalingrad to liberate their besieged comrades. But Operation Winter Storm was a failure and the tank units gave up two weeks later, leaving the Sixth Army under siege and without reinforcements. The situation was becoming more and more hopeless, and the German troops froze to death, starved, or died in battle. The troops in the Kette were not informed of the rescue operation's failure. Besieged Germans listened for distant engine sounds, hoping for the arrival of liberating SS Panzers for many months to come.

On January 10, 1943, the Red Army pressed the powerless Wehrmacht back even further in a major attack, and the German troops could only look on and watch as the Red Army made the most of its guns and "Stalin's organs." At 10 a.m. precisely, they opened up the heaviest barrage of fire in the war in Russia.

On January 21, Paulus radioed the Führer's headquarters with the following message: "Troops without ammunition or food. Signs of disintegration on the southern, northern, and western fronts. 18,000 wounded without the most basic dressings or medicine. Front broken in many places due

to major setbacks. Further defense pointless. Army requests permission to surrender in order to save lives." A little later, the Gumrak airfield also fell into Russian hands and with it any hope of supplies. On January 31, Paulus and his officers surrendered to the Russian forces.

Between November 24, 1942, and January 31, 1943, 488 aircraft and 1,000 men were lost supplying Stalingrad alone. This amounted to five squadrons – more than an entire flying corps. Of the 300,000 German soldiers who had set off to capture Stalingrad, 145,000 died. 45,000 troops, some wounded, some essential specialists, were flown out in time. 90,000 more were taken prisoner by the Russians. Years later, only 6,000 of these returned home.

1943: Kursk
Operation Citadel: The Tank Battles at Kursk

"I came up against the IL-2 at the Eastern Front. We got a message that low-flying fighters were in the area. Our squadron leader led the way, and I then saw the slow-moving IL-2s. I was flying a Bf-109 G. My squadron leader gave me a target instruction with the words 'I hope your teeth are still in good condition!' As for what he meant by that exactly – well, I soon found out, because I used up half my cannon ammo. All the IL-2 planes were destroyed, a total of about eight planes."
– Georg Adam
(Interview, November 2000)

On April 15, 1943, Hitler gave the order for Operation Citadel, the pincer attack on the Kursk bulge (also referred to as the Kursk salient), which was to become the biggest tank battle of WW-II. The Russian front in the Kursk area, which had advanced 100 km to the west, was to be encircled by the central and southern army groups and the Red Army troops destroyed. In a second stage of the operation, the army groups were then supposed to advance into the depths of Russia.

The Soviet High Command got wind of Hitler's plans and had decided as early as March to first fend off the German attack and then to go on the offensive. Within three months, the Red Army set up 8 strongly consolidated and mined lines of defense, running to a total depth of no less than 300 km. In the main defense strip alone, 434,667 tank mines and 7,000 km of wire obstacles were laid.

The German Wehrmacht's 900,000 soldiers were faced with more than 1.3 million Red Army troops. Ten thousand German guns were up against 19,300 on the other side. The Germans had 2,700 tanks and submachine guns at their deposal; the Russians, 3,300. And as far as fighter planes were concerned, the Germans were again outnumbered 2,650 to 2,000. The Messerschmitt Bf-109 G fighter plane was one of the improved models, with its new, powerful 1,700 hp Daimler-Benz engine. The Focke-Wulf FW-190 was also a major

presence at Kursk. The Eighth Flying Corps included 68 ground attack aircraft of the model Hs 129, whose weaponry was extremely useful for anti-tank combat – hence their nickname, "flying can openers."

Even disregarding the 573,000 soldiers, 7,401 guns, and 1,551 tanks and self-propelled weapons at the Steppe Front, the Russian side was clearly far stronger. The German Panzer division had already incurred serious losses in terms of men and materials. Hitler put his trust in the introduction of new tank models such as the Panther, Tiger, and Elefant, even though his favorite, the Panther, had not been tested adequately. The German position coming into Operation Citadel could hardly have been worse. In spite of this, early in the morning of July 5, 1943, Panzer, Panzer grenadier, and infantry divisions of the central and southern army groups initiated the deadly operation.

The German air fleets 4 and 6 started off by attacking the hinterland and then focused on ground combat to clear a path for their tanks. The Germans had control of the Kursk bulge for only a matter of days; in no time at all, they were complaining of fuel shortages. They succeeded in taking a heavily fortified key position at Oboyan in the south, but their assaults on the heights of Ponyri and Teploye failed. The Red Army reacted quickly, launching fierce tank battles in the rolling steppes of the south. The number of German tanks dropped daily, and General Model was wavering. As early as July 9, he spoke of a war of attrition, saying that the massive deployment of tanks was of little real use. To top it all, the Red Army drew on its reserves, and news of the Soviets' partial attacks in the Orel bulge reached Model on July 11. One day later, the Soviets went on the offensive and plunged the Second Panzer Army into a deep crisis. Model had to put a stop to his attacks in order to bolster German defenses in the Orel bulge and to prevent the worst from happening.

This was typical of the whole operation – the Wehrmacht was only able to attack narrow sections of the front in brief bursts, while other areas suffered. The German troops were not only outnumbered by the Soviets, they had inadequate supplies and were fighting on unknown terrain with poor roads. Under these circumstances, it was little wonder that morale was slipping by the day.

The battles continued nevertheless. The tank battle at Prochorovka on July 12, 1943, was undoubtedly the most significant of the Kursk battles, in which 850 Russian and 500 German tanks met, quite unexpectedly for both sides, on the narrowest of battlefields. A second Russian counteroffensive began at Belgorod and Kharkov; the double battle of Donetz and Mius to win back the Donetz basin began on July 17. On August 3, Orel was surrendered by the Germans. Three days later Belgorod, the second prong of the German offensive, was lost. As the battles escalated, the might of the Red Army grew, and the German tanks and weapons grew weaker and weaker. Their withdrawal began at the beginning of September – the Soviet troops were victorious.

Looking back, the battle in the Kursk bulge is often seen as one huge tank conflict, but this was not the case. The conflict should, instead, be seen as a series of individual battles and operations. Opinions differ over the length of the battle. The Russians speak of 50 days; the Germans say no more than nine. The number of losses on both sides is also a matter of debate. The Russians claim to have destroyed 4,605 German armored vehicles and to have captured 521, but the Russian figure of Tigers destroyed in the Kursk bulge (146) greatly exceeds the number of these tanks actually deployed by the Germans. Germany reported a total loss of 33 Tiger 1 tanks. It is extremely difficult, if not impossible, to track down reliable figures on Soviet losses, as the U.S.S.R. was always reluctant to have its military strength questioned. One thing is certain, however: the personnel and material losses of the Red Army far exceeded those of the Germans.

1944: The Crimea
From the War in the Crimea to the Red Army's March into Berlin

The Ukraine had already been lost. The Seventeenth Army, which had been supplied only by sea since November 1, 1943, was alone in defending the isolated bastion of the Crimea. Hitler was furious and blamed High Commanders General Field Marshal Erich von Manstein and General Field Marshal Ewald von Kleist, who were promptly dismissed to the 'second division' of German military leaders.

The Fourth Ukrainian Front commenced its dual offensive in April 1944 with the aim of liquidating this German outpost. On May 9, the Russians regained Sebastopol. "Admiral Black Sea" Vice-Admiral Brinkmann and "Sea Commander Crimea" Rear Admiral Schulz ordered the evacuation far too late, and coastal batteries destroyed their guns on the sea voyage to Rumania.

This was followed by a break in fighting. On June 22, 1944, the skies were filled with sound: hundreds of bombers and fighter planes were pounding the German artillery positions, and thousands of Stalin's Organs filled the air with their wailing. The Red Army's breakthrough at Vitebsk split the Third Army Front and divided it into two parts, making all attempts at escape futile.

The Russian tank units continued with their advance. The gateway onto Belarus was wide open as vast gaps in the front appeared. Once the front had been penetrated, the Russian advance came up against very little opposition. Hitler had lost his overview of what was happening long ago, and insisted on defending German lines. Yet even he realized that he was no longer in a position to lead, but merely to patch things up at the edges. To add insult to injury, in July 1944, 50,000 German prisoners of war were marched through

the streets of Moscow as evidence of the victory over the "fascist German forces of occupation."

By July 1944, the Soviet troops had advanced as far as the Vistula. Despite this, Hitler took additional defense measures in September, calling on all men between 16 and 60 to join the so-called Volkssturm, or German Territorial Army. They were given a crash course in operating bazookas as German cities were fortified. Every man had to join up or face execution. Meanwhile, the Soviet advance continued relentlessly, and the first Soviet troops made it into East Prussia in October.

Both German and Soviet commanders regarded the Crimean peninsula as an important tactical objective, while in reality it may not have been. In his decision to defend Crimea, Hitler pointed out its importance as a potential staging point of air attacks against Romanian oil fields, even though Soviet tanks were already approaching those fields by land. The main objectives of the war lay far away from Crimea, but both sides committed tremendous troops and resources to the war there and both suffered heavy losses. The point of these losses is questionable at best, especially for the Germans.

1945: Berlin

When Soviet and American soldiers shook hands at Torgau on the River Elbe on April 25, 1945, the symbolic effect was clear – it was only a matter of time until the end of the war in Europe. The Red Army had already made it as far as the center of Berlin, and Adolf Hitler committed suicide on April 30. He had nominated Grand Admiral Karl Dönitz as his successor, who planned to offer a partial surrender to the Western forces. Dönitz hoped that the Germans would then be able to continue the battle against the Red Army with the Western powers as allies. He hoped in vain. At midnight on May 8, 1945, a ceasefire was declared. Germany surrendered unconditionally to the Allied Forces. The German Reich lay in ruins; the terrible nightmare of world domination had been brought to an end after 12 years of appalling human rights abuses perpetrated by the National Socialist regime. Yet, for this victory, the world had paid a dear price.

A VERY IMPORTANT NOTICE ABOUT THE GAME: We do not claim to have given absolutely accurate coverage of history or any subdivision of it in all the battles of the war. However, we have done our best to keep our scenarios in line with the events that occurred in real life.

FLYABLE AIRCRAFT GUIDE

Berezniak-Isaev BI-1

Engine: 1,100 kg/s
Take-Off Speed: 180 km/h
Landing Speed: 165 km/h
Combat Engine Setting: N/A
Prop Pitch Control: N/A
Mixture Control: N/A
Boost: No
Supercharger: N/A

Pilot Notes:
BI-1 is a rocket interceptor that is equipped with very little fuel. Its range is therefore very limited. In most situations, you will climb on full power to meet the enemy, make one or two firing passes, and glide back to base with empty tanks.

The throttle lever also works as an engine on/off switch. Moving the throttle to idle switches the engine off; opening the throttle turns the engine back on.

BI-1 is not a turn fighter and almost any plane in the game will out-turn it. However, it has good low-speed characteristics, and at full power it can out-climb and out-dive anything. Bombers are your primary target, and fighters are usually too nimble a target for the BI-1.

The two ShVAK cannon on the BI-1 have only 45 shells, each of which gives less than one second of continuous fire. Open fire only at point blank range.

Best performance altitude is between 0 and 5,000 meters. Performance begins to deteriorate above 5,000 meters.

Polikarpov I-153
(M-62 and I-153P)

Engine: 800 HP
Take-Off Speed: 145 km/h
Landing Speed: 130 km/h
Combat Engine Setting: 2,200 RPM
Best Cruise: 1,600 RPM
Economy Cruise: 1,400 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
I-153 is an exceptional turn fighter that can literally fly circles around faster German planes. It can turn on a dime at almost any speed; unfortunately, it has a very low top speed of only 366 km/h at sea level.

The best tactic against enemy fighters is to stay horizontal and attack the enemy with passes from his frontal quarter, denying him the opportunity to fire by coming in slightly from the side.

Against bombers, I-153 is not very effective, as many bombers can simply outrun the Chaika. For slow-flying bombers, don't waste airspeed on maneuvers and hang back in the bomber's rear quarter. I-153 presents a very small profile for a bomber gunner so staying at respectable distance should keep you safe.

When used as ground attack, bombs and rockets should be fired in 15–45 degree dives. I-153 is a rather stable gunnery platform with armament sufficient to bring down any target at ranges under 300 meters.

Supercharger speeds need to be switched at around 1,500 meters. Best performance altitude is between 0 and 2,500 meters. Performance begins to deteriorate above 2,500 meters.

Polikarpov I-16
(Tip 18 and Tip 24)

Engine: 1,500 HP
Take-Off Speed: 150 km/h
Landing Speed: 145 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 1,850 RPM
Economy Cruise: 1,600 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
Excellent turn fighter with adequate performance for 1941. In capable hands, it can fight Bf-109E on equal terms, and Bf-109F with slight disadvantage. Both energy and angles tactics can be used against these planes at altitudes up to 3,500 meters. I-16 is inferior to later German fighters; I-153 tactics should be used against those.

I-16 Tip 24 has very strong armament, while I-16 Tip 18 has a rather weak armament which may be ineffective against well-armored targets.

Supercharger speeds need to be switched at around 1,500 meters. Best performance altitude is between 0 and 3,500 meters. Performance begins to deteriorate above 3,500 meters.

I-16 gear can only be operated manually. In order to raise or lower it, you will need to bind the corresponding keys in the Controls section and then keep pressing them until the gear lights on the dashboard come on (red = down, green = up).

Ilyushin IL-2 Single Seat
(1941 First, Second and Third Series)

Engine: 1,500 HP
Take-Off Speed: 150 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 2,100 RPM
Best Cruise: 1,800 RPM
Economy Cruise: 1,600 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

Pilot Notes:
Outstanding ground-attack plane that can also defend itself in air-to-air combat.

Primary means of attacking ground targets is in 15–45 degree dives starting from 500 or 1,000 meters. Rockets should be fired from 200 meters or less. Bombs should be dropped from 100 meters or above without delay, or from any altitude with 3+ second delay. Machine guns and cannons are ineffective against tanks, but very effective against softer targets.

IL-2's armament is extremely effective against all aerial targets. Enemy fighters can be brought down by IL-2s working in pairs or in larger groups. In one-on-one against an enemy fighter, IL-2 does not stand much of a chance, but in capable hands, it can be very challenging to bring down.

Il-2 single-seats are capable of a loop or a chandelle at speeds above 350 km/h, but will decelerate to below their stall speed by the top of the loop. Therefore, when attacked by an enemy fighter, stay at extremely low altitudes and use energy tactics in the horizontal pane. Causing the enemy to overshoot, or extending and attacking head-on are the best tactics.

IL-2 Two-Seaters
(1941 Field Mod, all 1942 and 1943 Models)

Engine: 1,500 HP
Take-Off Speed: 160 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 2,000 RPM
Best Cruise: 1,800 RPM
Economy Cruise: 1,700 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

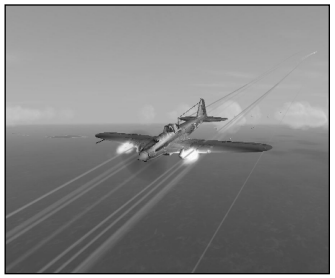
Pilot Notes:
Two-seater IL-2s are heavier, slower, and less maneuverable than the single-seat variants. Most maneuvers should be restricted to the horizontal pane. All two-seaters except the 1941 Field Mod bleed off excessive speed in hard turns, especially with external ordnance. In most conditions, no more than 1.5-2 G turns should be used. All two-seaters are incapable of a loop or a chandelle at speeds below 360 km/h, and will decelerate to below their stall speed by the top of the loop.

Primary means of attacking ground targets is in 15–45 degree dives starting from 500 or 1,000 meters. Rockets should be fired from 200 meters or less. Bombs should be dropped from 100 meters or above without delay, or from any altitude with 3+ second delay.

Machine guns and cannons of all Il-2 two-seaters except the IL-2M3 are marginally effective against tanks and very effective against softer targets. IL-2M3's 37mm cannon are very effective against all enemy tanks. (Tanks are best attacked from the rear where their armor is the weakest.)

When attacked by enemy fighters, the rear gunner is the best defense. Dive to ground level and maneuver to keep the enemy fighter within the rear gunner's defensive arc. Causing the enemy to overshoot, or extending and attacking head-on will work if the enemy allows you to do that.

Ilyushin IL-2I



Engine: 1,500 HP
Take-Off Speed: 150 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 2,100 RPM
Best Cruise: 1,800 RPM
Economy Cruise: 1,600 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

Pilot Notes:
IL-2I is the heavy interceptor version of the IL-2 ground attack. The onboard armament is brutally effective against all air targets. IL-2's armor is also very effective at stopping small-caliber rounds of bomber defensive gunners.

The only problems with Il-2 as a fighter are its weight, speed, and maneuverability. In these aspects, it's significantly inferior to all dedicated fighters, and therefore regular anti-bomber tactics cannot generally be used.

A good tactic is to set convergence to 400–500 meters and fire at bombers from beyond their effective defensive fire range. Otherwise, IL-2I can attack bombers from directly behind at speeds at least 50 km/h greater than the bombers', then extend ahead of the formation, turn around, and attack head-on. During such attacks, airspeed should be watched constantly: IL-2I does not accelerate that well and therefore if you let yourself get too slow you may never catch up to the enemy's fast bombers.

In combat against enemy fighters, IL-2I is generally at a disadvantage. Use energy tactics in the horizontal pane. Causing the enemy to overshoot, or extending and attacking head-on are the best tactics.

Ilyushin IL-2T

Engine: 1,500 HP
Take-Off Speed: 160 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 2,000 RPM
Best Cruise: 1,800 RPM
Economy Cruise: 1,700 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

Pilot Notes:
Il-2T is the torpedo version of the IL-2. All guns except two 7.62 machine guns are removed; therefore, the only effective means of destroying enemy targets is the single torpedo carried under the fuselage.

All torpedo runs should be performed at speeds below 350 km/h and altitudes under 100 meters. Torpedoes are best dropped from 500 meters or more away from flak-equipped ships. After attack, immediately turn back and fly home at low level.

Hawker Hurricane
(Mk I, IIB, IIC and Field Mod)

Engine: 1,030 HP
Take-Off Speed: 150 km/h / 85 kts
Landing Speed: 145 km/h / 80 kts
Combat Engine Setting: 3,000 RPM
Best Cruise: 2,650 RPM
Economy Cruise: 2,500 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
Hurricane is generally inferior to all 1941 fighters, and inadequate against all 1942 and later fighters. It is mostly effective against bombers or as a ground-attack plane.

Hurricane has regretful acceleration and dive characteristics, and therefore, should generally be used in horizontal combat. Be aware that all instrumentation in the Hurricane is not metric but imperial; therefore, you will need to learn to convert feet to meters and miles to kilometers when flying using instruments.

Hurricane is a rather stable gunnery platform with armament sufficient to bring down any target at ranges less than 300 meters.

Supercharger speeds should be set to speed 2 in combat or in climb if boost is 2–5 psi below max; otherwise use speed 1. Best performance altitude is between 1,500 and 2,800 meters for speed 1 and 4,500 and 6,500 for speed 2; worst performance, between 3,000 and 4,500 meters

LaGG-3
(LaGG-3 1941, LaGG-3 1943 and LaGG-3IT)

Engine: 1,500 HP
Take-Off Speed: 150 km/h
Landing Speed: 140 km/h
Combat Engine Setting: 2,750 RPM
Best Cruise: 2,300 RPM
Economy Cruise: 2,100 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
LaGG-3 is somewhat inferior to contemporary German fighters; however, in capable hands, it can beat almost any opponent.

The key to winning aerial combat with the LaGG-3 is to get the German fighter to slow down and commit to a turning fight or rolling scissors. These fights are LaGG's strong point, and the Germans will usually lose. In vertical combat, LaGG is inadequate and will usually be brought down easily.

LaGG-3 is a stable gunnery platform with armament sufficient to bring down any target at ranges under 300 meters. LaGG-3IT is equipped with a rapid-firing 37mm cannon, which can be absolutely brutal against both air and ground targets.

Supercharger speeds need to be switched at around 3,000 meters. Best performance altitude is between 1,000 and 2,500 meters; worst performance, above 4,000 meters

Lavochkin La-5
(La-5 and La-5F)

Engine: 1,850 HP
Take-Off Speed: 170 km/h
Landing Speed: 165 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 2,100 RPM
Economy Cruise: 1,950 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

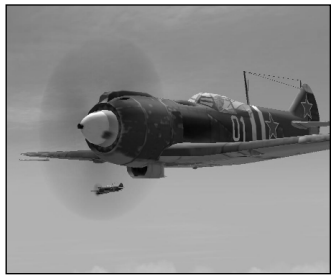
Pilot Notes:
La-5 is somewhat inferior to contemporary German fighters; however, in capable hands, it can defeat almost any opponent. In general, these radial versions of the LaGG-3 are less capable than the 1943 version of the LaGG.

The key to winning aerial combat with the La-5 is to get the German fighter to slow down and commit to turning fight or rolling scissors. These fights are the La-5's strong point, and the Germans will usually lose. In vertical combat, the La-5 is inadequate against Bf-109G and later. It will usually be defeated by the more capable German fighters.

La-5 is an excellent gunnery platform, as its twin ShVAK cannons are installed in the nose and therefore are effective at any range, regardless of convergence at distances up to 300 meters for fighters, and 500 meters for bombers.

Supercharger speeds need to be switched at around 3,500 meters. Second speed can be used on take-off; however, it needs to be switched off at 100–150 meters. Best performance altitude is between 1,000 and 2,500 meters; worst performance, above 4,000 meters.

Lavochkin La-5FN



Engine: 1,850 HP
Take-Off Speed: 160 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 2,100 RPM
Economy Cruise: 2,000 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: Yes, 10-minute maximum
Supercharger: Two Speed

Pilot Notes:
An excellent dogfighter with good all-around performance, the La-5FN can be used as an energy or angles fighter against BF-109s up to G6, and also all FW-190A and F. It is best used as an angles fighter against later 109s, FW-190D, and Me-262.

La-5FN is a very stable gun platform. Best results can be achieved at ranges under 200 meters by aiming at the enemy's engine and/or cockpit area.

Even though it's equipped with a radial engine, the La-5FN can easily overheat in combat, especially when using boost. Make sure to fully open the radiator as soon as you can afford losing speed. La-5FN will not easily stall at slow speeds due to the leading edge slats; however, you can enter a vicious high-speed spin if you yank the stick too hard at speeds above 400 km/h.

Supercharger speeds need to be switched at 4,500 meters. La-5FN will not perform well at higher altitudes and speed 1; at lower altitudes and speed 2, engine damage will occur. Best performance altitude is between 1,500 and 2,800 meters for speed 1, and 4,500 and 6,500 for speed 2. Worst performance is between 3,000 and 4,500 meters

Lavochkin La-7
(La-7 2x20m and La-7 3x20mm)

Engine: 1,850 HP
Take-Off Speed: 165 km/h
Landing Speed: 160 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 2,100 RPM
Economy Cruise: 2,000 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
An excellent fighter with great all-around performance, La-7 is clearly superior in one-on-one dogfights to most pre-1944 fighters in the world in both energy and angles tactics. Outstanding climb, acceleration, and diving characteristics.

The La-7 is a very stable gun platform. Best results can be achieved at ranges under 200 meters by aiming at the enemy's engine and/or cockpit area.

Even though it's equipped with a radial engine, the La-7 can easily overheat in combat, especially when using boost. Make sure to fully open the radiator as soon as you can afford losing speed. La-7 will not easily stall at slow speeds due to the leading edge slats; however, you can enter a vicious high-speed spin if you yank the sick too hard at speeds above 400 km/h.

Supercharger speeds need to be switched at 4,500 meters. La-7 will not perform well at higher altitudes and speed 1; at lower altitudes and speed 2, engine damage will occur. Best performance altitude is between 1,500 and 2,800 meters for speed 1, and 4,500 and 6,500 for speed 2. Worst performance is between 3,000 and 4,500 meters.

Mikoyan-Gurevich MiG-3
(MiG-3 1940, MiG-3 1941,
MiG-3U, MiG-3UD, MiG-3 AM-38)

Engine: 1,200 HP
Take-Off Speed: 165 km/h
Landing Speed: 160 km/h
Combat Engine Setting: 2,200 RPM
Best Cruise: 1,850 RPM
Economy Cruise: 1,750 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

Pilot Notes:
MiG-3 1941 versions are generally inferior to all 1941 and 1942 fighters, and inadequate against all 1943 and later fighters.

MiG-3's low altitude performance is ferocious, and it should never be used as an angles fighter below 5,000 meters. MiG-3 will easily stall at lower altitudes from rough maneuvers. It should be flown very gently.

Most MiG-3 variants have very weak armament and usually need a 2–3 second burst at a vulnerable area to bring down a target.

Best performance altitude is above 4,500 meters; worst performance, under 1,000 meters.

Bell P-39 "Airacobra"
(P-39N-1, P-39Q-1, P-39Q-10)

Engine: 1,200 HP
Take-Off Speed: 160 km/h / 95 kts
Landing Speed: 155 km/h / 85 kts
Combat Engine Setting: 3,000 RPM
Best Cruise: 2,600 RPM
Economy Cruise: 2,500 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

Pilot Notes:
An adequate dogfighter with good all-around performance. However, P-39 will easily stall from rough handling, and therefore should be flown very gently, especially in horizontal maneuvers.

P-39 is an excellent gunnery platform. While the wing .50-caliber machine guns are not very effective, the nose 37mm cannon is very powerful and can bring down most targets in a few hits.

Best performance altitude is between 1,500 and 3,000 meters. Performance begins to deteriorate above 5,000 meters.

Curtiss P-40
(P-40E, P-40M, P-40 Field Mod)

Engine: 1,200 HP
Take-Off Speed: 160 km/h / 95 kts
Landing Speed: 155 km/h / 85 kts
Combat Engine Setting: 3,000 RPM
Best Cruise: 2,600 RPM
Economy Cruise: 2,500 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: No

Pilot Notes:
P-40 is somewhat inferior to contemporary German fighters; however, in capable hands it can win a fight against almost any opponent.

The key to winning aerial combat with the P-40 is to get the German fighter to slow down and commit to a turning fight or rolling scissors. These fights are P-40's strong point, and the Germans will usually lose. In vertical combat, P-40 can still defeat a FW-190, but a Bf-109G and above is greatly superior to the P-40 in the vertical.

P-40 is a stable gunnery platform. The wing machine guns are best used at the convergence range, and usually take a 2–3 second burst to bring down a target.

Best performance altitude is between 1,000 and 3,500 meters; worst performance, above 6,000 meters.

Republic P-47 "Thunderbolt"
(P-47D-10, P-47D-27)

Engine: 2,000 HP
Take-Off Speed: 175 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 3,000 RPM
Best Cruise: 2,550 RPM
Economy Cruise: 2,400 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: Yes, 5-minute maximum
Supercharger: Two Speed

Pilot Notes:
P-47 is best used as an energy fighter against most fighters, with the possible exception of the Me-262. It is second to none in power dives and will lose any opponent in a dive with enough altitude. When starting a high-speed dive with a 109 at the same altitude and airspeed, a P-47 can actually out-climb most 109s in a subsequent zoom climb and end up at higher altitudes.

Primary means of attacking ground targets is in 15–45 degree dives. Rockets should be fired from 200 meters or less. Bombs should be dropped from 100 meters or above without delay, or from any altitude with 3+ second delay. Machine guns are ineffective against tanks but very effective against softer ground targets.

P-47 is a very stable gunnery platform. The wing machine guns are best used at the convergence range, and usually take a 2–3 second burst to bring down a target.

Supercharger speeds need to be switched at 4,500 meters. Best performance altitude is between 3,500 and 4,800 meters for speed 1, and 6,500 and 7,500 for speed 2. Worst performance is between 0 and 2,000 meters.

TB-3

Engine: 4 x 715 HP
Take-Off Speed: 100 km/h
Landing Speed: 95 km/h
Combat Engine Setting: 1,400 RPM
Best Cruise: 1,200 RPM
Economy Cruise: 1,150 RPM
Prop Pitch Control: None
Mixture Control: None
Boost: No
Supercharger: No

Pilot Notes:
TB-3 is a very slow heavy bomber. Its climb and accelerations are poor, but it's a very stable and accurate bombing platform at lower speeds and altitudes. Generally, all bombing missions should be performed from 500–1,000 meters and speeds around 150 km/h.

TB-3 is a very sturdy airplane and can take a lot of hits in the wings and the fuselage. However, the crew is exposed to enemy fire, and the engines are rather easily set on fire. Each M-17 engine is equipped with a multiple-charge fire extinguisher, which should be used the moment the engine catches fire. Occasionally, you will be able to extinguish the fire and regain full control of the engine.

TB-3 can easily fly on two engines, and glide to normal landing for short distances even on one engine.

Early Yakovlev Fighters
(Yak-1, Yak-1B, Yak-7)

Engine: 1,180 HP
Take-Off Speed: 165 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 2,800 RPM
Best Cruise: 2,300 RPM
Economy Cruise: 2,150 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
Yak-1 is inferior to contemporary German fighters in the vertical and superior in horizontal combat. In capable hands, it can win a fight against almost any opponent.

The key to winning aerial combat with the Yak is to get the German fighter to slow down and commit to a turning fight or rolling scissors. These fights are Yak-1's strong point, and the Germans will usually lose. In vertical combat, Yak can still fend for itself, but a victory is more easily achieved in the horizontal.

Yak is a stable gunnery platform with armament sufficient to bring down any target at ranges under 300 meters.

Supercharger speeds need to be switched at around 2,000 meters. Best performance altitude is between 500 and 3,000 meters; worst performance, above 4,000 meters.

Late Yakovlev Fighters
(Yak-9, Yak-9T, Yak-9K, Yak-9U, Yak-9D, Yak-3)

Engine: 1,180 HP
Take-Off Speed: 165 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 2,800 RPM
Best Cruise: 2,300 RPM
Economy Cruise: 2,150 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

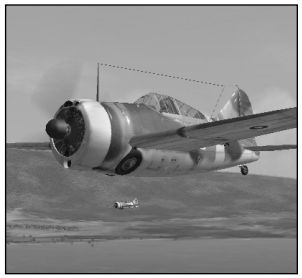
Pilot Notes:
1943 and later Yak fighters are excellent dogfighters with great all-around performance. They can be used as energy or angles fighters against BF-109s up to G6, and also all FW-190A and F. They are best used as angles fighters against later 109s, FW-190D, and Me-262.

Yaks are very stable gun platforms. Best results can be achieved at ranges under 200 meters by aiming at the enemy's engine and/or cockpit area.

Yaks will not easily stall at slow speeds and will usually not enter a high-speed stall unless flown improperly.

Supercharger speeds need to be switched at around 2,000 meters. Best performance altitude is between 500 and 2,800 meters; worst performance, above 4,500 meters.

Brewster Buffalo



Engine: 1,850 HP
Take-Off Speed: 140 km/h
Landing Speed: 135 km/h
Combat Engine Setting: No RPM gauge
Best Cruise: No RPM gauge
Economy Cruise: No RPM gauge
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: No
Supercharger: Two Speed

Pilot Notes:
B-239 is a decent dogfighter against most pre-1943 Soviet fighters; however, it really begins to feel inferior against the likes of the La-5FN, Yak-9, or Yak-3. Brewster will out-turn almost any plane in a high-G instantaneous turn; however, it will bleed off excessive amounts of speed in sustained turns. Your best bet against enemy fighters is to stay fast and not get involved in prolonged turning engagements, especially at low altitudes.

B-239's armament is not particularly strong, but it is adequate against most planes, with the possible exception of the IL-2. You will usually need at least a 1-second burst in a vulnerable area to bring your target down. Just like machine-gun only planes, the best target is the pilot.

Brewster can stall rather easily if handled roughly; however, when it is handled with care, it can be a very tough opponent.

Supercharger speeds need to be switched at around 3,000 meters. Best performance altitude is between 500 and 2,800 meters; worst performance, above 4,500 meters.

Bf-109E
(Bf-109E-4, Bf-109E-4/B,
Bf-109E-7/B, Bf-109E-7/Z)

Engine: 1,175 HP
Take-Off Speed: 165 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 2,200 RPM
Best Cruise: 2,000 RPM
Economy Cruise: 1,900 RPM
Prop Pitch Control: Manual
Mixture Control: Manual
Boost: Yes, 5-minute maximum
Supercharger: Auto

Pilot Notes:
The Emil version of the Messerschmitt 109 was made famous during the Battle of Britain in 1940. By the summer of 1941, it was becoming obsolete; however, it can fare quite well against even more obsolete Soviet fighters that face it during that period. Its main (and often only) advantage lies in its superior speed.

Emil stands absolutely no chance in a turning fight against an I-153 or a well-flown I-16; however, in a high-speed vertical fight, it can handle them with ease. Your best combat tactic is to fly at a high altitude, climb at least 500 meters above the Soviet fighters after you see them, and then gain even more speed in a dive as you attack. Coming in at 500 km/h or so should almost guarantee that you'll leave the engagement area without a scratch; and whether you can score a kill is, of course, up to your gunnery skills.

Emil's armament is not one of its strongest points. In addition to two rifle-caliber machine guns, it is armed with twin 20mm MG FF cannons that have a rather slow rate of fire. Their location in the wings means you may not get great results when firing outside of convergence range. However, an accurate burst from all weapons at a vulnerable area should deal with any target with ease.

Emil does not stall easily; however, that does not mean you can yank the joystick all over the cockpit. Fly it gently and don't do any rough maneuvers.

When used for ground attack, bombs should be dropped in a 45-degree dive, using the red line on the side of the canopy as dive angle reference.

Bf-109F
(Bf-109F-2, Bf-109F-4)

Engine: 1,200 HP
Take-Off Speed: 170 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 2,100 RPM
Economy Cruise: 2,000 RPM
Prop Pitch Control: Auto/Manual
Mixture Control: Manual
Boost: No
Supercharger: Auto

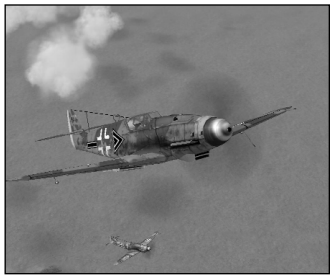
Pilot Notes:
Bf-109F is a highly improved version of the Emil. You can really feel the added power and reduced drag; Franz is almost 100 km/h faster. Capable pilots can dogfight most Soviet planes even in high-G turning fights; however, the easiest way to win is still by keeping your airspeed up. Few 1941 and 1942 Soviet planes can achieve 500 km/h in level flight, and their acceleration above 400 km/h is really inferior to that of your 109F. So keep your airspeed up, fly higher than the Soviets, and you can come down on them time after time with almost absolute impunity.

The armament on the Franz however is not very good. F-2 is armed with a single 15mm, and F-4 with a single 20mm nose cannon. While its location in the nose makes aiming from any distance very easy, its slow rate of fire and rather small caliber often make its effects less than perfect. Much more than with any other plane, you should take care to aim at a vulnerable spot – cockpit, engine, fuel tank – to bring down your target in one burst.

109 is not a very stable gunnery platform under 350 km/h, and you may find your aim getting thrown off and your rounds scattering too much when firing at slow speeds. Accelerate to 350 km/h or more, and your bursts should be much more accurate.

It's very hard to stall or spin the Franz, but it certainly has been done by some less-capable pilots who were too rough with their crate.

Bf-109G and K
(Bf-109G2, Bf-109G6, Bf-109G6/AS, Bf-109G10, Bf-109G14, Bf-109K-4)



Engine: 1,355 HP
Take-Off Speed: 170 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 2,100 RPM
Economy Cruise: 2,000 RPM
Prop Pitch Control: Auto/ Manual
Mixture Control: Manual
Boost: No
Supercharger: Auto

Pilot Notes:
The Gustav model of the 109 shows an incredible ability to keep the fighter's design a step ahead of most contemporary enemy planes. With the possible exception of the 1943 G-6, you will never feel inferior to any contemporary enemy fighter in your new 109 model. The same engagement strategies apply here as to the Franz and Emil. Feel free to enter an angles fight with the enemy if you feel confident enough. If you're looking for an easy victory, stay above 450 km/h in a fight and attack the enemy in 500 km/h+ dives, and you should be able to defeat almost any opponent.

109's armament is always enough to bring down a fighter, but can sometimes be a bit insufficient against better-armored bombers like the IL-2. When you know you'll have to face targets like that, make sure to grab underwing gun pods or a 30mm MK-108 cannon in the nose. With the gun pods or the MK-108, you will bring down any target with a single accurate burst.

109 is not a very stable gunnery platform under 350 km/h and you may find your aim getting thrown off and your rounds scattering too much when firing at slow speeds. Accelerate to 350 km/h or more and your bursts should be much more accurate.

It's very hard to stall or spin the 109, but it certainly has been done by some less-capable pilots who were too rough with their crate.

FW-190A and F
(FW-190A4, FW-190A5, FW-190A8, FW-190A9, FW-190F8)

Engine: 1,780 HP
Take-Off Speed: 175 km/h
Landing Speed: 160 km/h
Combat Engine Setting: 2,500 RPM
Best Cruise: 2,100 RPM
Economy Cruise: 2,000 RPM
Prop Pitch Control: Auto
Mixture Control: Auto
Boost: No
Supercharger: No

Pilot Notes:
While on the Western Front, the famous 190 showed itself to be superior to pretty much everything in the sky; on the Eastern Front, it does not enjoy such a clear advantage. Most of the dogfights occur at lower altitudes, where the Focke-Wulf does not yet begin to shine.

The 190 should use energy tactics against most Soviet fighters, as they'll usually out-turn the 190 rather easily. Its main advantage, however, is its phenomenal roll rate. High-speed rolling scissors rarely end in anything but a clear victory for the 190.

The 190's armament is again phenomenal. It packs a tremendous amount of firepower in its wings, and any plane unlucky enough to get caught in the 190's gun sight will really feel the results. Even the Il-2's armor cannot stop the awesome power of the 190's salvo, and when firing all guns, you don't even have to aim at a vulnerable spot. The 190 will do its victim in, no matter where it hits it.

The 190's slow speed stall characteristics can be vicious; however, a gentle handling of the stick and a good eye on the airspeed indicator should keep you out of trouble.

When used for ground attack, 190 again is an excellent performer. It can drop bombs from level flight or in a dive; and it can destroy most armored vehicles with strafing passes. The 190's armor will usually protect you against enemy flak. Just keep in mind that you're not flying an IL-2, you're flying a fighter bomber – don't let yourself hang over the battlefield at 250 km/h. Speed up and stay fast during your attacks; you'll live longer.

FW-190D-9
(FW-190D-9 1944,
FW-190D-9 1945)

Engine: 1,776 HP
Take-Off Speed: 170 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 3,000 RPM
Best Cruise: 2,600 RPM
Economy Cruise: 2,500 RPM
Prop Pitch Control: Auto/Manual
Mixture Control: Auto
Boost: No
Supercharger: Auto

Pilot Notes:
The FW-190D-9, the long-nosed 190, is the ultimate version of what many consider the best fighter of WWII. It really is an excellent all-around fighter with great performance characteristics and easy handling. In capable hands, it will defeat any other fighter of the war. The only planes that can give it trouble are the La-7 and Yak-3 or 9, which can gain an upper hand in low-altitude turning engagements. However, at higher altitudes and higher airspeeds, FW-190D-9 is any fighter pilot's dream.

Its four-cannon armament is brutal against all enemy planes. Be aware that your 20mms are located in the wings; therefore, convergence should become a concern. An accurate burst at a convergence distance will cause pretty much anything to instantly go down.

Heinkel He-111
(He-111H-2 and He-111H-6)

Engine: 2x1,100 HP
Take-Off Speed: 160 km/h
Landing Speed: 150 km/h
Combat Engine Setting: 2,600 RPM
Best Cruise: 2,200 RPM
Economy Cruise: 2,100 RPM
Prop Pitch Control: Manual
Mixture Control: No
Boost: No
Supercharger: Two Speed

Pilot Notes:
He-111 is a good German bomber that nevertheless started to become obsolete by mid-1943. By 1944, it has become very vulnerable to enemy fighters and should not be used in high-threat environments.

He-111's excellent bombsight gives you a wide window of opportunity in choosing your target altitude and airspeed. You can attack at 50 meters above ground and 450 km/h, or 4,000 meters and 250 km/h. It's best, however, to fly faster in the areas protected with flak, as He-111 is not very well armored.

The engines are not equipped with fire extinguishers, so once an engine catches fire, you should immediately turn it off and feather the prop. If one of the fuel tanks catches fire, an explosion is imminent, and you should bail out immediately.

He-111 can fly on land normally even on one engine; so, if you successfully shut one down after receiving battle damage, you should jettison your bomb load and proceed back home.

Ju-87 Bombers
(Ju-87B-2 and Ju-87D-3)

Engine: 1,200 HP
Take-Off Speed: 160 km/h
Landing Speed: 155 km/h
Combat Engine Setting: 2,650 RPM
Best Cruise: 2,200 RPM
Economy Cruise: 2,050 RPM
Prop Pitch Control: Manual
Mixture Control: No
Boost: No
Supercharger: Two Speed

Pilot Notes:
Ju-87 Stuka is the most famous dive bomber in the world, and quite likely the most widely recognizable symbol of WWII. It is, however, not as glamorous as it may seem. It's slow and rather vulnerable, and does not have much offensive power. However, it is an excellent dive bomber, and in capable hands, every diving attack will result in a kill.

The standard way to dive bomb is to sight the target through the floor window, drop dive brakes, chop throttle, and roll over to an inverted position. After that, place the target in your crosshairs and release the bombs at minimum of 500 meters of altitude. Retract the dive brake, throttle up, and head home. Ju-87's two rifle-caliber machine guns are barely adequate for strafing soft targets, but in areas protected by flak and especially enemy fighters, a Ju-87 will not last long.

When you do have an enemy fighter on your tail, Ju-87 will prove surprisingly maneuverable at low speeds. Late Soviet fighters can't even fly as slow as the Ju-87 near stall speed. You won't be able to clearly outmaneuver most fighters, but you should easily be able to avoid their passes, and constantly keep them in your rear gunner's field of fire.

Junkers Ju-87G-1

Engine: 1,400 HP
Take-Off Speed: 170 km/h
Landing Speed: 160 km/h
Combat Engine Setting: 2,650 RPM
Best Cruise: 2,200 RPM
Economy Cruise: 2,050 RPM
Prop Pitch Control: Manual
Mixture Control: No
Boost: No
Supercharger: Two Speed

Pilot Notes:
Ju-87G looks like a Stuka, sounds like a Stuka, and flies like a Stuka – however, it's anything but. Instead of bombs, the Ju-87G is equipped with two 37mm gun pods under the wings that are specifically designed to destroy enemy tanks. A single shot at the enemy tank's rear will crack it open. Ju-87G is slower and much less maneuverable than a regular Stuka; therefore, you should try to stay at low levels to avoid enemy flak and fighters.

Attacks are best initiated from 500 meters or so, in 15–45 degree dives. Remember that the cannons are located under your wings; therefore, convergence becomes very important when firing at small targets like tanks. When firing outside convergence range, your rounds are very likely to impact near the tank on both sides without hitting it.

When attacked by enemy fighters, the rear gunner is the best defense. Dive to ground level and maneuver to keep the enemy fighter within the rear gunner's defensive arc.

If you can cause the enemy to overshoot or extend, attacking head-on with your 37mms should bring an end to any Soviet fighter.

Messerschmitt Me-262A

Engine: 2 x 900 kg/s
Take-Off Speed: 195 km/h
Landing Speed: 180 km/h
Prop Pitch Control: N/A
Mixture Control: No
Boost: No
Supercharger: No

Pilot Notes:
Me-262 is the fastest plane in Forgotten Battles; however, it's probably one of the most difficult to fly. Me-262's weakest point is its engines. A single rough movement of the throttle can cause your engine to cease or flame out. Be extremely gentle with the throttles and move them very slowly, constantly monitoring the RPM and engine temperature.

Me-262 is not very maneuverable and it will loose a lot of speed in a turn. Your only advantage in combat is speed, so keep it up. Stay above 550 km/h when attacking enemy fighters, and you should be all right.

Me-262's armament is absolutely the most effective combination in the skies. Four 30mm MK-108s located in the nose require no convergence, and will destroy any target with a single hit. The cannons' power is enough to allow you to take pot shots at bombers beyond their defensive gunners' range. Remember that you only have 100 shells in the upper, and 80 in the lower pair of guns. So don't waste your ammo.

GAME GLOSSARY

Common

AI – Artificial Intelligence. In the game industry, this term is used to define computer-controlled units.
FM – Flight model
DM – Damage model
QMB – Quick Mission Builder
FMB – Full Mission Builder
Recon – Reconnaissance

Campaign

Ranks and Awards

If you enlisted in campaigns for Hungary or Finland, you need to know the translations of the military ranks and awards that will be shown on several of screens during gameplay.

Hungarian equivalent of German ranks:

Zászlós – No equal rank
Hadnagy – Leiutenant
F_hadnagy – Oberleutnant
Százados – Hauptmann
_rnagy – Major
Alezredes – Oberstleutnant
Ezredes – Oberst

Hungarian awards:

Bronz Vitézségi Érem – Bronz Award for Bravery
Kis Ezüst Vitézségi Érem – Small Silver Award for Bravery
Nagy Ezüst Vitézségi Érem – Big Silver Award for Bravery
Arany Vitézségi Érem – Gold Award for Bravery
Signum Laudis – Signum Laudis (Lat.)
Magyar Érdemrend Lovagkeresztje hadiszalagon kardokkal – Hungarian Knightcross Award with Swords
Magyar Érdemrend Tisztikeresztje a hadidíszítménnyel és kardokkal – Hungarian Officers Cross Award with Swords
Magyar Tiszti Arany Vitézségi Érem - Hungarian Officers Golden Award for Bravery

Finnish equivalent of U.S. ranks:

Kersantti - Sergeant
Ylikersantti - Staff Sergeant
Vääpeli - Warrant Officer
Lentomestari - Chief Warrant Officer
Vänrikki - Second Lieutenant
Luutnantti - Lieutenant
Kapteeni - Captain

Finnish awards:
2. luokan Vapaudenmitali - Medal of Freedom, Second Class
1. luokan Vapaudenmitali - Medal of Freedom, First Class
4. luokan Vapaudenristi - Cross of Freedom, Fourth Class
4. luokan Vapaudenristi tammenlehvien kera - Cross of Freedom, Fourth Class with Oak Leaves
3. luokan Vapaudenristi - Cross of Freedom, Third class
2. luokan Vapaudenristi - Cross of Freedom, Second Class
2. luokan Mannerheimristi - Mannerheim Cross, Second Class
2. luokan Mannerheimristi solkineen - Mannerheim Cross, Second Class with Marshal's Rods

For the View Object Menu
VVS or VVS RKKA – Soviet Air Force
Luftwaffe – German Air Force
NII VVS – Military research institute, where all Soviet, lend-lease, or captured aircraft were tested during or after the war. When we were developing our simulator, we used this data in conjunction with original sources from aircraft manufacturers.
Combat Turn – Maneuver in which a plane reverses direction and gains altitude without losing a great deal of airspeed. In general, a climbing, 180º turn.

For the Full Mission Builder
Flak – Anti-aircraft artillery and machine guns
AA – Anti-aircraft artillery and machine guns
AAA – Anti-aircraft artillery
Glissade – Landing trajectory of aircraft
Born Place – Home base where your aircraft is "born" into a multiplayer session

Russian Car Column Designations
Rus. Supply Car Column Type I
GAZ-67
2 x ZIS-5 Medical
5 x ZIS-5

Rus. Supply Car Column Type II
Willis MB
6 x Studebecker Truck
3 x ZIS-6 Fuel

Rus. Command Staff Car Column
GAZ-67t
GAZ M1
ZIS-5 AA
2 x ZIS-5
ZIS-5 Radio

Rus. Katyusha Car Column
GAZ-67t
6 x Katyusha
2 x ZIS-5
ZIS-6 Fuel

Rus. Studebecker RL Column
Willis MBt
6 x Studebecker Rocket Launcher
ZIS-5 AA
2 x Studebecker Truck

German Car Column Designations
Ger. Supply Car Column Type I
BMW Bike
Sd.Kfz.251
5 x Opel Blitz 6700A
Opel Blitz 6700A Medical
Opel Blitz 6700A Radio
Opel Blitz Maultier AA

Ger. Supply Car Column Type II
Kuebelwagen VW82t
Opel Blitz 36S
Opel Blitz Maultier AA
2 x Opel Blitz Maultier
Opel Blitz 6700A Fuel
2 x Opel Blitz 36S

Ger. Command Staff Car Column
Pz.IIF
Sd.Kfz.251
Opel Kadett
Opel Blitz Maultier AA
Opel Blitz Maultier
Sd.Kfz.251

Ger. Motorcycle Column
6 x BMW Bike
Opel Blitz 6700A Fuel
2 x Opel Blitz 36S
Sd.Kfz.251
2 x RSO

Ger. Fuel Supply Car Column
Kuebelwagen VW82
6 x Opel Blitz 6700A Fuel
Opel Blitz Maultier AA

Russian and German Train Designations

Fuel Train/AA
Steam engine
Coal tender
Flat car/AA
8 x Tank car

Freight Train
Steam engine
Coal tender
8 x Box car

Freight Train/AA
Steam engine
Coal tender
Flat car/AA
8 x Box car

Ammunition Train
Steam engine
Coal tender
8 x Box car/Explosives

Ammunition Train/AA
Steam engine
Coal tender
Flat car/AA
8 x Box car/Explosives

Freight and Fuel Train
Steam engine
Coal tender
4 x Box car
4 x Tank car

Equipment Type I Train/AA
Steam engine
Coal tender
Flat car/AA
7 x Flat car/Equipment Type I
Flat car/AA

Equipment Type II Train/AA
Steam engine
Coal tender
Flat car/AA
7 x Flat car/Equipment Type II
Flat car/AA

Equipment Type III Train/AA
Steam engine
Coal tender
Flat car/AA
7 x Flat car/Equipment Type III
Flat car/AA

Passenger Train
Steam engine
Coal tender
8 x Passenger car

Command Staff Train/AA
Steam engine
Coal tender
Flat car/AA
4 x Passenger car
Flat car/AA

WEAPON Loadout Comments (Bombs and Rockets):

SC 50
Type: General purpose bomb
Weight: 55.5 kg

SC 70
Type: General purpose bomb
Weight: 72 kg

SC 250
Type: General purpose bomb
Weight: 229 kg

SC 500
Type: General purpose bomb
Weight: 500 kg

SD 500
Type: Fragmentation bomb
Weight: 535 kg

PTAB-2,5
Type: Anti-tank bomb
Weight: 1.5 kg

AO-25
Type: General purpose bomb
Wight: 25 kg

FAB-50
Type: General purpose bomb
Wight: 50 kg

FAB-100
Type: General purpose bomb
Wight: 100 kg

FAB-250
Type: General purpose bomb
Wight: 250 kg

AJ-2 Ampoules
Type: Like napalm
Weight: 2 Kg

VAP-250
Type: Like napalm (phosphorus)
Weight: 250 Kg

RS-82, RS-132, M-13 – Rockets with demolition warhead
BRS-82, BRS-132 – anti-armor rockets

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• Considerable technical data on the trials of the NII VVS. These cannot all be listed here.
• Original manufacturing data.
• Complete technical descriptions and blueprints for most model aircraft.

Note: We strongly recommend that you read the book series: Black Cross–Red Star. The Air War over the Eastern Front.