Contents

"The War is lost. Our world is reduced to rubble."
Heinz Knoke, German ace.

The skies over the European community hold no secrets and tell no lies. Once, the air was filled with the rumble of mighty aerial armadas and the roar of powerful engines. Today, the sky remains silent.

No airborne markers reveal to the passing tourist the scenes of fierce battles and harsh losses. Battles on the ground leave deep scars in the earth, scars that remain for all to see. But the sky displays no wounds.

Only in the memories of an aging generation are those battles remembered. Only the survivors carry with them the scars of the days when thousands of planes roamed over Europe, when the Allied and German air forces locked heads in a desperate struggle that determined the fate of nations for years to come.

The world had never witnessed such a war and probably never will again. Of the vast, majestic formations of Allied bombers that once stretched over Germany from horizon to horizon, only a few remain today. Most met their doom in scrapyard incinerators where they were forged into the metal that rebuilt Europe. An ironic end.

Men from all walks of life ranged over Europe in those aluminum beasts. They were bankers, businessmen, furniture store clerks, novelists, movie stars, and college students. But war cast their ambitions aside. In the names of their countries they were thrown into a crucible that changed them forever. For those who survived, the war became the high-water mark that they would remember with pride in their autumn years.

Aces Over Europe pays homage to these men and to the incredible feats they performed.

Historical Overview

Two Bf 109s head to intercept an Allied formation. Courtesy National Air & Space Museum, Smithsonian Institution

The Early Years

"I have nothing to offer but blood, toil, tears and sweat."
Winston Churchill,
May 13, 1940

Aircrew relaxing in a Quonset hut. Courtesy National Air & Space Museum, Smithsonian Institution

The grim path that led to Europe's virtual destruction began in September, 1939. Throughout that year, Adolf Hitler harassed his Polish neighbors, making categorical demands that he knew were unacceptable. Finally, after staging a fake Polish attack on a German radio station, he launched his panzer divisions against the hapless country. The Polish army resisted bravely, many dying at their posts. But they could not slow the tidal wave of tanks, half-tracks, and swarming Stuka dive-bombers that swept over the countryside. In a campaign that lasted just over two weeks, the Germans emerged victorious.

Hitler won the battle, but had unleashed the forces that would seal his doom.

Two days after the September 3, 1939 attack on Poland, France, and Britain declared war on Germany. At first, these two nations seemed to be paper tigers. They watched the Poles succumb to the Wehrmacht without attempting to provide aid. Indeed, for months after, the British and French stood on the defensive, like sheep waiting for slaughter.

He 111s, the standard Luftwaffe medium bomber in 1940 and the scourge of the early war years. Courtesy National Air & Space Museum, Smithsonian Institution

The Germans waited until the spring of 1940 to launch their next offensive. In March, they stormed Norway and conquered that country while the Allies bickered over how to handle the situation. But this was just a warm up. The heaviest blows fell in May when the Wehrmacht raced into Holland and Belgium. Allied armies swung to meet them along the Dyle River, but they never had a chance.

As the cream of the French and British armies slogged forward in Belgium, German tank divisions rumbled through the Ardennes Forest and materialized in northern France. The Allies were caught totally by surprise. Before they could react, Heinz Guderian's panzers crossed the Meuse River at Sedan and drove on to the English Channel. The Allies fought desperately, but the bulk of their troops in the north were pinned against the coast at the town of Dunkirk. The British managed to evacuate most of their men from the pocket with a patchwork rescue fleet that included everything from destroyers to pleasure yachts.

A few weeks later, the sound of German hobnail boots echoed through the streets of Paris. Politically in crisis and physically pounded by the incomparable German Army, France sued for peace in June.

England now stood alone.

WWII Europe

The Germans realized they had to control the skies over the English Channel if any attempt to invade the island nation was to succeed. Goering's Luftwaffe now faced its greatest challenge: the defeat of the Royal Air Force. Throughout the summer of 1940, swarms of Messerschmitts, Heinkels, and Spitfires dueled for control of the sky above southern England.

Things looked bleak for the British toward the end of August. They were losing pilots faster than they could replace them. Their air defense network was hit hard, and the Germans were systematically destroying the pre-war Fighter Command airfields.

Then Hitler made a critical mistake and ordered his Luftwaffe to bomb London into rubble. As London absorbed the Luftwaffe's bombs, Fighter Command rebuilt and resupplied its airfields and squadrons. The RAF soon was hitting back with a strength and ferocity never before seen. By October 1940 it became clear that the Luftwaffe had lost. The invasion of Great Britain was canceled. Hitler, frustrated with this setback, turned east and ordered his army to destroy the Soviet Union.

Operation Barbarossa, Hitler's attack on Russia, commenced on June 22, 1941. For the next four years, Germany and Russia would see an entire generation of men die on the steppes of Eastern Europe. The two armies clashed in a titanic land fight on a scale the world had never seen. By war's end, the fighting in the East had claimed between 25 and 30 million lives.

The Desert Fox

Erwin Rommel earned a reputation for audacity and dash as a division commander during the Battle of France in 1940. At the head of the famed German 7th Panzer Division, he drove deep behind Allied lines, appearing in the rear of dazed French and British units. By the end of the campaign, his single division had captured 100,000 men and 450 tanks for the loss of 1,646 men and 42 tanks. His brilliant tactical strokes made him an instant celebrity in Germany. Hitler courted him, considering Rommel one of his best generals. The admiration was reciprocated, as

the general considered Hitler a great leader.

In 1941, Rommel was sent to North Africa to stave off the defeat of Italian forces in Libya. Even though he was charged with a strictly defensive mission, he launched a crushing offensive against the British that drove them clear back to the Egyptian border. For the next two years, Rommel would battle back and forth against a legion of British generals, many of whom had their careers ruined by him. His wily, clever attacks and skillful defensive actions in North Africa earned him the nickname "the Desert Fox."

After Allied superiority in men and material overwhelmed the Axis in Africa, Rommel returned to Europe and was charged with the occupation of Northern Italy after Mussolini's fall. At the end of 1943, Hitler sent Rommel to France and ordered him to beef up the anti-invasion defenses.

By this time, Rommel had become seriously disillusioned with Hitler and his military incompetence. He grew more and more convinced that Hitler had cost Germany the war, and that there was no longer any way to win it. To Rommel it seemed that Hitler had a death wish for himself and was determined to take Germany down with him. As a result, the Desert Fox grew bitter and pessimistic, which in turn alienated Hitler. At one point, during a meeting in 1944, Rommel confronted Hitler point-blank and demanded to hear the dictator's plan to win the war.

In June, after the Allies landed at Normandy, Rommel pleaded for replacements for the tremendous losses his units had suffered. When only a trickle arrived, he asked Hitler repeatedly for permission to withdraw to the Rhine. The Führer ordered him to hold to the last man, an order the Desert Fox thought totally ridiculous.

As his despair over Hitler's actions grew, Rommel began to get involved in the plot to depose him. Though he did not want to see Hitler assassinated, he did want to see him taken into custody and put on trial for crimes against Germany.

A month later, on July 17, an Allied plane strafed Rommel's staff car, killing his driver. Rommel suffered a fractured skull in the ensuing crash. Three days later, the attempted assassination and coup against Hitler failed, and the Gestapo started rounding up the conspirators. One officer, under torture, implicated Rommel in the plot. The Desert Fox was doomed.

On October 14, 1944, two generals with an SS escort arrived at Rommel's home near Ulm, where he had been recovering from his wounds. The generals gave Rommel a choice: he could either stand trial before the People's Court for treason, or he could commit suicide. Rommel chose the trial. Dismayed at his choice, his visitors reminded him that should he be found guilty, his wife and son would suffer the consequences as well. Reluctantly, Rommel chose to commit suicide to save his family. Later that afternoon, he swallowed a cyanide capsule and died instantly. The cause of death was officially listed as a brain seizure.

Hitler gave Rommel a state funeral and sent his wife a flattering eulogy of her husband. The full truth of the death of the Desert Fox did not come out until many years after the war.

The Air War in the West

"Ack-Ack here, Ack-Ack there,
Bloody fighters everywhere.
Hardships you bastards,
You don't know what hardships are."
American squadron song

For the next three years, the RAF and Luftwaffe fought an aerial battle of attrition. Each side sent out daylight pinprick raids across the Channel, doing what damage they could to keep the pressure on the enemy. As soon as the sun dipped under the horizon, the bombers would come. Sometimes over a thousand British Halifaxes, Lancasters, and Wellingtons waded through the night skies to burn Germany's cities with their deadly incendiary loads. Bomber Command, led by Air Marshal Sir Arthur Harris, would spend the next four years trying to prove valid the theories of Giulio Douhet.

Douhet had been an Italian officer who grasped the potential of air power after the First World War. Throughout the inter-war years, he prophesied on the role of the airplane in future wars. Taking the Great War as his model, he presumed that if war again broke out in Europe, the ground armies would be locked in stalemate. The stalemate could be broken only by huge formations of "Battle" planes that would cross the front lines to lay entire cities to waste. By smothering the enemy's civilian centers with bombs, Douhet argued the war would become so terrible that the common people would rise against their government, overthrow it with revolution, then sue for peace.

Sir Arthur "Bomber" Harris set out in 1940 to prove Douhet's theories valid. For five years, Bomber Command sortied nightly to set fire to the great German cities, but no revolution toppled the Third Reich. The Lancasters alone did not win the war, as Harris had argued. Douhet's theories, when subjected to practical application, were shown to be bankrupt. In fact, there is considerable evidence to show the bombings did nothing but antagonize the German people, galvanizing them to work harder for their country.

Though Germany was pounded at night, she lay unmolested during the day. No British bomber ventured into Luftwaffe skies while the sun still shone. To do so was suicide. The Germans had learned that lesson over England in 1940.

Over There

That situation changed when the Americans arrived. Committed to the concept of pinpoint strategic bombing as espoused in the United States by Billy Mitchell, Ira Eaker, and Carl Spaatz, the United States Army Air Force was determined to use its bombers in the daylight.

Ira Eaker, perhaps the greatest of the USAAF's bomber generals. Courtesy National Air & Space Museum, Smithsonian Institution

For years these American apostles of pinpoint bombing had claimed that by destroying an enemy's industrial infrastructure, the war could be won by airpower alone. During the 1920s and '30s, the Army Air Corps, as it was then called, defined itself almost exclusively on this premise. As tactical doctrine began to be developed, the Air Corps' equipment needs soon became clear. To survive missions deep into enemy territory, a bomber had to be capable of defending itself. Some argued that
fighters should escort bombers to their targets and back, but, since no single-engine plane of the

day was capable of flying the distances required, that idea was dropped. Rather than focusing on building a long-range fighter, the Air Corps spent its energies working on the ultimate daylight bomber.

An airman examining a bullet hole in his plane. Courtesy National Air & Space Museum, Smithsonian Institution

In 1935, the first one rolled off the production line. Called the Boeing Model 299, the plane embodied strategic doctrine in every way. With multiple gun positions scattered along the plane's fuselage, theorists argued it could protect itself from interceptors and did not need friendly fighter escort as long as it flew in tight, protective formations. With the super-accurate Norden Bombsight mounted in the nose, it could drop its bombs with precision never before seen. A bombardier once quipped, "We can drop a bomb into a pickle barrel from 20,000 ft."

When full production began on the Model 299, the Air Corps apostles had at last a plane capable of fulfilling their prophecies. That plane, when it reached production, was designated the B-17 Flying Fortress.

When the United States entered the war in December 1941, one of the Army Air Force's top priorities was to establish a force that could crush the German industrial base to rubble. That force, the 8th Air Force, set up shop in East Anglia in early 1942. For the next year, the 8th Air Force leadership struggled to build a bomber force capable of inflicting serious damage to the Germans.

They failed for several reasons. First, the invasion of North Africa drained away many of the units slated for the 8th. Second, the demands of a multi-front war meant that nobody got the equipment and men they needed until the United States kicked mobilization into high gear. It would take time for that to happen, and the 8th was forced to make do.

In early January 1943, Ira Eaker, the 8th Air Force commanding officer, ordered the 8th to begin the bombing of Nazi Europe. Initial attacks in the summer of 1942 demonstrated that the B-17 had the power to fight off German interceptors, confirming the pre-war theories. But those raids struck mainly at lightly defended targets in France. Attacking Germany would be another matter.

On March 4, 1943, the Flying Forts were sent on one of their deepest penetration missions to date. Their target was the German city of Hamm. The bombers hit the target, but took several losses. One B-17, piloted by Lt. Aaron Cuddeback, sustained severe flak damage over the target. Cuddeback fought to keep the crippled bomber in the air but, in the end, he had to ditch in the North Sea. His crew got out and into their rafts, but no one came to rescue them. A slow death by exposure was to be their fate.

Just a few months previously, Lt. Cuddeback had been a college student back in the States. He wanted to fly so badly that when the Army rejected him for flight training (because he could not look cross-eyed) he returned home and spent the next two weeks staring at himself in a mirror, trying to learn to look cross-eyed. He succeeded.

Battle damage on an American bomber.

Lt. Aaron Cuddeback died on his sixth combat mission over Europe. His fate was to be shared by some 26,000 other young Americans. It soon became clear that the bombing campaign would not be a quick victory. Luftwaffe defenses demonstrated plenty of teeth during the early 1943 raids and the American squadrons took a beating. By midsummer, the life expectancy of a B-17 crew member averaged eight missions. To be rotated home required 25 missions. To the young gunners, navigators and pilots, the future seemed bleak. Morale suffered severely as a result. The strain of missions began to tell on the men as they watched their comrades go down in flames over the Continent. For some, the strain proved too much, as in this account by historian Ian Hawkins:

> "Following the Bremen Raid (October 1943), a young replacement B-17 commander flying his first mission as a copilot had returned to Horam at the controls of a heavily damaged and barely flyable Fortress. The bomber's experienced pilot, a veteran of 23 previous raids, had finally cracked at a critical stage in the mission. As he was led slowly and gently to the waiting ambulance, a pitiful, stumbling wreck, his glazed eyes bore mute testimony that he had taken more than enough and that he had no more to give."

Spook Bender was a B-17 pilot that squadron mates considered cursed. Practically every mission saw Spook dragging his brutalized Fortress back home with an engine out, holes in the fuselage, and great flak gashes torn in the wings. Miraculously, none of his crew received a wound while flying with him. Nevertheless, the stress of constant battle damage began to unhinge Spook. He began to chatter incessantly about "Them Focke-Wulfs" and flak. To calm his nerves, his friends took him to the movies one night in Ipswich. The news clip before the film featured a series of aerial shots of B-17s getting blown out of the sky over Germany. Bender began screaming to his crew, "Shoot! Shoot! Shoot!" as he dived underneath the theater's balcony seats.

Nonetheless, he was ordered to keep flying. Later, on a routine test flight, he froze at the controls of his B-17. No amount of coaxing could get him to release his grip on the yoke and the crew had to physically overpower him to get the plane landed. That incident was enough for the squadron commanding officer. Spook was sent to a nearby hospital, where he suffered a complete breakdown a few weeks later. He was soon sent back to the States; there, at age 25, he died of a heart attack.

The bombing continued, and the men adapted the best that they could.

Bloody Summer and Beyond

"Down in the Ruhr Valley, flying so low,
Some chairborne bastard said we must go
Flak loves big bombers, fighters do too;
P-47 boys, what's happened to you?
Write me a letter, send it to me
Send it, 'Care of Luftstalag 3.' "
Squadron Song

An airman comforts a wounded comrade within a B-17

The summer of 1943 opened with the largest 8th Air Force raids to date. The bombers singled-out aircraft factories and ball bearing plants as their primary targets. Deep penetration raids were made, some as far into Germany as Muenster, Schweinfurt, and Bremen. Each morning, the bombers would form into tight formations over the rolling English countryside, only to return in straggling, ragged driblets, engines out, crewmen wounded, morale cracked.

Clearly, the pressure on the Germans could not be maintained; the cost was too great. Something had to be done, and the 8th Air Force Command cast about for an answer. The resounding cry from the bombardment groups for escort fighters finally made an impression on the high command. A long-range fighter capable of roaming all the way to central Germany and back needed to be developed. Unescorted B-17s were sure to get slaughtered by the expert Luftwaffe interceptors, even in tight, mutually supporting formations.

Meanwhile, the campaign had reached its crisis. In October, the 8th Air Force took its worst beating of the war. Its raids to Muenster, Schweinfurt, and Regensberg had all but wiped out the operational strength of its best bomber groups. Entire squadrons were blasted from the sky on these raids. The 8th was a spent force, licking its grievous wounds in the foggy sanctuary of East Anglia. Word came from above to cancel deep penetration missions until escorts could be arranged. For the moment, the crews stood down. The bombers just could not get through. So much for pre-war doctrine. It was time to head back to the drawing board.

Taking On The Fort

When Boeing built the B-17 Flying Fortress, everyone from the designers to air strategists fully expected that it would live up to its name. Bristling with multiple machine guns and flying in close formations that concentrated its defensive fire, the B-17 was certain to battle its way through swarms of enemy fighters.

It didn't quite work out that way, as the Americans discovered over targets like Schweinfurt and Regensburg in 1943. The Luftwaffe pilots quickly changed their tactics to exploit the chink in the Fortress's machine gun armor. German flyers found out fast that the traditional method of attacking a bomber from behind invited catastrophe with the B-17, as its tail, ball, and top turret guns kept it well protected from rear attack. With only a few guns capable of firing forward, however, the B-17s could not defend themselves well against frontal assaults.

Frontal attacks, had other advantages, too, for the Focke-Wulfs could more easily rake the B-17's cockpit and engines with 20mm cannon fire. This advantage did have a price, however, as this maneuver was extremely difficult. The closure rate reached almost 600 mph in the head-on attacks, giving the Luftwaffe pilots only seconds to line up on their targets and fire.

To address this problem, the B-17G model was fitted with a remote-controlled, twin-gun turret tucked under the "chin" of the plane. Its two .50-caliber machine guns increased the frontal firepower by 50 percent and helped keep the Bf 109s and Fw 190s at bay.

The Other Side

"One pilot from each of the fighter wings… will be tried by court marshal for cowardice in the face of the enemy."
Hermann Goering

For the Germans, the summer and fall of 1943 represented the historical apex of the Luftwaffe's fighter forces. They repeatedly assaulted the 8th Air Force, and the blows were beginning to get results. In October, the Americans suspended operations against targets in Germany, granting the jagdgeschwaders a brief but needed respite.

Hermann Goering conferring with two of his top young aces, Walter Nowotny (left) and Adolf Galland (right). Courtesy National Air & Space Museum, Smithsonian Institution

General Adolf Galland, the overall commander of Germany's fighter forces, realized this lull foreshadowed an even more vigorous campaign against his country. He also realized that the Americans could smash through his fighter defenses if they began building their strength. He called on Hitler and Hermann Goering, head of the Luftwaffe, to focus aircraft production entirely on fighters. Specifically, he wanted only the Focke-Wulf 190 and the brand-new Messerschmitt 262 jet fighter to be manufactured.

Initially, he received considerable opposition to his plan and it never was fully implemented. He did succeed in getting Germany's aircraft production restructured to build fighters almost exclusively. By mid-1944, the plants in Regensberg, Bremen, and Stuttgart were cranking out hundreds of Messerschmitt 109s and Focke-Wulf 190s at rates unprecedented in German history. Would it be enough to defeat the Americans? The next few months would reveal the answer.

The Messerschmitt 262

A Messerschmitt 262 pilot buzzes his airdrome. Courtesy National Air & Space Museum, Smithsonian Institution

Adolf Galland walked away from the flight line with a huge grin etched on his face. He had just spent the better part of an hour knifing through the sky in the Luftwaffe's latest experimental fighter, the Messerschmitt 262. Powered by twin Junkers Jumo turbojet engines, the aircraft could maintain speeds 100 mph faster than any other aircraft in the air. This was the plane that would smash the American bomber stream and win back air superiority for the embattled Luftwaffe. Galland's fighter pilots needed the Me 262 right away, and in vast numbers. He left the airfield that day resolved to do whatever it took to get the jet into large scale production.

According to Galland, even his best efforts proved to be insufficient in the face of severe political in-fighting, bureaucratic slow-downs, and irrational decisions by Hitler. After the war, Galland repeatedly argued that had he been allowed to press the 262 immediately into production in 1943, the war in the air might have had a different outcome. Many historians have concurred with Galland and have reinforced the premise that the production delays on the plane were the result of institutional problems. The facts, however, tell a different story.

A squadron of Me 262s preparing for take-off. Courtesy National Air & Space Museum, Smithsonian Institution

The Messerschmitt 262 was, for its designers, a walk down a darkened lane. The new aircraft explored uncharted territory. Its top speed of 540 mph was faster than anything they had previously experienced, and the effects of such speed on the airframe were unknown and needed to be researched. The prototype that Adolf Galland flew suffered from a myriad of design and technical bugs that prevented it from going into serious production. It would take some time to iron out the kinks in such a technically advanced plane.

The engines were a continual problem. The heat generated inside the Junkers Jumo turbojets was greater than anything previously seen in engine development. Initially, nickel and chromium served as the primary alloys in construction, and seemed to work well. Unfortunately for Germany, these metals were too scarce to be used for mass production. The Junkers design team headed back to the drawing board to attempt to work around their nation's grievous material shortages. Though they developed some clever solutions to their problems, none of them truly worked and the engines remained the weak point for the Messerschmitt 262.

After flying the prototype Messerschmitt 262 in early 1943 Adolf Galland concluded that the new jet aircraft could be ready for production almost immediately. The truth is that even Willy Messerschmitt did not anticipate full scale production beginning until November 1944 at the earliest. Post-war claims that the Me 262 could have been in production by 1943 are spurious. Likewise are the claims that the Nazi bureaucracy and even Adolf Hitler obstructed the development of the jet and delayed its production by months. Some claim that Hitler's insistence on producing the aircraft as a fast bomber caused delays. This too is untrue, as the 262 had been designed from the start to carry bombs and only needed the addition of bomb racks to be bomber capable.

A squadron of Me 262s at the end of the war. The 262 has been grossly misrepresented by post-war writers. Courtesy National Air & Space Museum, Smithsonian Institution

When the 262 reached operational status as an interceptor, first with Kommando Nowotny, then later with III Gruppe, JG-7, the plane failed to shine. In combat, the jet units suffered extremely high losses, usually matching those of the piston-engined outfits that served alongside them. Poor training, new Allied tactics, and mechanical failures account for the high loss rate. The jets did occasionally cause serious damage to the isolated B-17 or B-24 group, but they could in no way slow the flow of Allied aircraft over Germany. In the end, the Me 262 was an incredibly fast machine that suffered from mediocre maneuverability, a terrible rate of acceleration, and occasional catastrophic engine failure. Such actual problems stand in stark contrast to the 262's post-war reputation as a supposed deadly effective interceptor.

The remarkable fact that the Messerschmitt 262 reached full-scale production by the end of the war is a testament to the determination and ability of the German aircraft industry. Messerschmitt labored under the most severe conditions imaginable to push the jet fighter out the factory doors and into the field. Constant bombings, disruption of supply and communications, and a shortage of critical materials all had to be overcome before the fighter could become operational.

Instead of being the potential war-winning instrument post-war writers have called it, the Messerschmitt 262 served only as an eleventh hour harbinger of the future, and secured its place in history as a result.

The Dam Bursts

"We have embarked on a great crusade . . .
We will accept nothing except full victory . . ."
Dwight D. Eisenhower

New Year's Day 1944 was celebrated with much enthusiasm throughout Europe. In Germany, though, the new year offered dismal prospects. With darkness as their ally, the British bombing campaign succeeded in smashing to rubble some of the Reich's most important cities. Downtown Hamburg lay in ruins, victim of a firestorm that bordered on nuclear proportions. Cologne and Berlin were hit by the merciless incendiary attacks.

The strafing of a German armored column, as seen from the gun camera of an Allied plane. Note the Panzer IV towards the bottom of the picture. Courtesy National Air & Space Museum, Smithsonian Institution

In the Mediterranean, the Germans were driven from Sicily and Southern Italy. They managed to establish a defensive line south of Rome, but troops there were outnumbered, exhausted, and under-equipped. They were holding, but only for the moment.

In the Soviet Union, the German Army suffered repeated defeat at the hands of the resurgent Red Army. More than a million men fell to Russian bullets in the previous year. The failed Wehrmacht offensive at Kursk in the summer of 1943 broke the back of the panzer divisions. The Russians, with their incredible strategic mobility, launched blistering offensives with overwhelming numbers of men and material. The Red Army was gradually pushing the hated Germans from the Rodina, back into Eastern Europe and the frontiers of the Reich itself. Already suffering from critical manpower shortages, the Germans had nothing more to throw into the cauldron of the Eastern Front.

In the West, the Allies prepared for the invasion of the Continent. Not a day passed without a troop- laden convoy arriving in Britain from the States to deliver divisions of fresh GIs. Others arrived packed to the gunwales with tanks, ammunition, and oil. England became one gigantic staging base, a springboard for the invasion of France.

The build-up in Britain did not get overlooked on the other side of the Channel. The Germans knew the invasion was coming, they just didn't know when or where. To defeat it, the Wehrmacht constructed a network of concrete and steel bunkers, blockhouses, and artillery positions along the coast from the Franco-Spanish border to the coves and inlets of Southwest Holland. Suffering from critical shortages of material, particularly concrete, these emplacements were spread thinly along the vast coastline. Beach defenses, such as minefields, anti-boat guns, and tank traps, had yet to be put in place. Yet, work continued on them at an almost peacetime pace.

Enter Erwin Rommel. The Desert Fox, as the Allies called him, established a sterling reputation during his four years of combat command. During the 1940 French campaign, he commanded the 7th Panzer Division, forming the spear of the German drive to the Channel. His men inspired such terror into the hearts of Allied troops that they nicknamed his unit "The Ghost Division". In 1941, Hitler ordered him to command a small expeditionary force in Libya. Sent to support the sagging Italians there, he quickly took the offensive against the British, in direct violation of his orders. Over the next two years, he repeatedly thrashed the best units of the British army. In the process, he ruined the careers of many English generals. His bold, lightning-quick attacks, and slashing, paralyzing turning movements regularly tore into the British 8th Army. In the end, however, his chaotic supply situation proved his undoing, and the combined might of the British and Americans crushed his once-mighty Afrika Korps by February 1943.

A lion cub explores the wing of a Bf 109. Courtesy National Air & Space Museum, Smithsonian Institution

Hitler then ordered Rommel to take over the defenses along the French coast. What Rommel saw when he arrived chilled his blood. The "Atlantic Wall" was nothing more than an elaborate ruse created by Goebbel's master propaganda machine. He stormed through his command areas on sudden inspection trips, blasting his men out of their lethargy and into furious action. Up until Rommel's arrival, assignment to the French coast had been one of the few easy postings in the German Army. The luxuries of wartime France had made many Wehrmacht units degenerate into flabby, soft occupational troops. Rommel demanded lean, honed combat-ready regiments, and he got them. For the next half year, he drove his men into a frenzy of mine laying, ditch digging, and concrete pouring. They laid a million mines a month through the first half of 1944. The troops strung barbed wire, built anti-landing craft defenses, reinforced trenches, cleared fields of fire, and flooded fields that could be used by airborne assault troops.

But while he muscled-up the Atlantic Wall, Rommel managed to stir resentment among his most important superiors. Having suffered under Allied air superiority in North Africa, he knew how devastating the attacks could be to his divisions. Aware that the Luftwaffe was far too weak in the west to stop the American and British air armadas, he formulated a plan that would minimize the effect the enemy planes would have on his men. Rather than keeping his best panzer divisions in the rear as reserves ready to move to the point of the Allied invasion, he wanted to deploy his panzer units directly behind the beaches of Normandy and Brittany. This way, they would not be as vulnerable to fighter-bomber attacks as they advanced to contact. If the units were placed far behind the front, they would have a long way to march to get into battle. While they moved, Rommel knew they would be strafed, bombed, and rocketed. The Desert Fox's strategy was to stop the Allies on the beaches and throw them back into the sea.

A German pilot seated in his Bf 109 with his pet dog. Courtesy National Air & Space Museum, Smithsonian Institution

His superiors, however, disagreed, most notably Field Marshall von Rundstedt. Von Rundstedt was an aging, tired man who had been called out of retirement to serve his country yet again. In many ways, time had passed him by, and he failed to grasp some of the most important elements of modern warfare. In particular, he underestimated the devastation that Allied aircraft could wreak on his command. He opted against Rommel's plan of a forward defense, favoring the more standard deployment in depth, with reserves sequestered carefully in the rear to stop any breakthroughs at the front. When the Allies landed, the mighty armored reserves would blow the Anglo-American troops off the beaches. Victory would be secured.

As the argument raged between the two leaders, Hitler became involved. A compromise was reached. Some panzer divisions were deployed well forward, per Rommel's wishes, and some were kept in the rear, per von Rundstedt's. The cost of this compromise, however, was control over their own troops. Hitler announced that the panzers could not move anywhere without his express permission. The arrangement sabotaged any chance of an organized counterattack once the Allies landed, and it contributed greatly to the success of the D-Day invasion. Once again Hitler made a decision that inched him closer to the day when he would take his own life below the shattered streets of the German capital.

The Air War Continues: Big Week to Berlin

"Stand to your glasses steady,
This world is a world of lies
Here's a health to the dead already
Hurrah for the next man to die."
Air Corps Squadron Song

The men loved their new birds. For months, they trained in Oregon with ragged, beat-up P-39 Airacobras that wheezed and coughed like patients from a TB ward. Now, at last, they received a thoroughbred. The planes were American, but built to British specifications. Powered at first by a whiny, under powered Allison engine, someone decided to mate the airframe to a British Merlin. The hybrid worked beautifully and the graceful, speedy plane was christened Mustang II by the British. To the Americans, the laminar-flow winged beast was simply called P-51.

The men of the 354th Fighter Group were the first to receive the Merlin-engined version. While the new planes still suffered from teething troubles, the pilots cared little. For them, it was love at first sight. Soon, they could be seen flat-hatting their new birds over the lush countryside around the base at Salem. Then, all too suddenly, their commander told them to pack their gear. They were shipping out.

The 354th Fighter Group became the first unit to fly the P-51B in the European Theater. In honor of this, the group was christened the Pioneer Mustangs. Assigned to the 9th Air Force, a newly formed tactical organization, the group spent most of the winter flying escort missions for the 8th AF's bombers. The Germans received a rude shock when the long-legged fighters appeared deep over Germany, strafing airfields and shielding the B-17s from Luftwaffe interceptors. More P-51 groups would follow in the 354th's footsteps, changing the nature of the war over Germany.

P-51. Courtesy National Air & Space Museum, Smithsonian Institution

With the new Mustangs, the 8th Air Force staff at last possessed a weapon that could maul the Luftwaffe in its own backyard. The brass realized that to win the strategic bombing campaign, they needed to win control of the skies over Germany. With the P-51, they could do just that. For the next six months, the 8th busied itself with its new purpose: smashing the German Luftwaffe.

To do it, Carl Spaatz, the 8th's new commander, decided to use the B-17s as bait. He had to lure the Luftwaffe into a battle of attrition, a battle that he knew the Americans could not lose. The new strategy needed targets that the German fighters would defend at all costs. Spaatz's staff studied the problem and selected aircraft factories as the targets. The Germans had to fight for them for fear that their aircraft production would be compromised or wiped out. Soon, orders were sent down the pipeline organizing the bomber groups for a full scale campaign that would come to be known as "Big Week."

Big Week kicked off on February 20 and lasted until the end of the month. It would be remembered as the most concentrated attack on a single industry during the entire war.

As predicted, the Germans rose to stop the raids. Messerschmitts and Focke-Wulfs ripped into the bomber formations, exacting a costly toll. The Mustangs and Thunderbolts patrolling the bomber stream were often overwhelmed, though when they caught the Luftwaffe's interceptors, they bloodied them well.

By the end of the battle, about 400 B-17s and B-24s had been blown out of the sky. Hundreds more returned home crippled, with gaping holes in their aluminum hides. Nevertheless, Big Week

was a strategic Allied victory. It forced the Germans to disperse their aircraft production into smaller, underground factories. Though the rate of aircraft production increased in the ensuing months, it failed to resume its pre-Big Week potential until late in the year. Also, the Luftwaffe fighter squadrons were bled white by the gigantic aerial clashes. About 280 German fighters fell during the week, with many of the pilots dying or suffering serious wounds. The rate of attrition could not be maintained, and the Luftwaffe began to break under the strain.

Big Week was the first step to wresting control of the air away from the Luftwaffe.

The end of a B-17. Courtesy National Air & Space Museum, Smithsonian Institution

By now, Spaatz and his staff were mesmerized with the idea of a war of attrition over Germany. General Fred Anderson, one of the key architects of the bombing campaign, displayed almost unbelievable callousness when it came to the safety of the bomber crews. In March he ordered the B-24 groups to hit Berlin even though they could not fly high enough to avoid the thick flak concentration around the capital. Someone exclaimed to him, "God! They'll just get killed in them." Anderson stared at the man and blurted, "Well?"

The war of attrition had begun, and the men in charge were committed to seeing it through, no matter how bloody it became.

Then came Berlin.

The word sent shivers of terror through bomber crews' spines. It conjured images of clouds of interceptors swarming over the bomber stream, flak so thick it blackened the sky, and B-17s falling like autumn leaves. Berlin, the crews whispered, was a death sentence. "Scared? Hell, yes, we were scared! We were puckered!" related one B-17 crewman.

The sentence was carried out on March 6, 1944. The bombers had been ordered to Berlin several times in March, but each time bad weather hampered the raids. Most of the B-17s never got to the city, having turned back once they ran into thick overcast. March 6 was different. Originally, General Jimmy Doolittle, the 8th Bomber Command C.O., wanted to give his men a leave to let them rest. Their morale had dropped considerably as losses remained high. B-17s were disappearing during missions, only to turn up intact in neutral Sweden and Switzerland. He knew his men were desperate for a break in the slaughter, but he was overruled by Anderson and Spaatz.

On March 6, the bombers headed for Berlin.

The raid was well protected. Some 770 escorting fighters weaved over the flanks of the combat boxes, vigilant for Luftwaffe fighters. The Germans, realizing their capital was endangered, launched everything they had at the bomber stream, including many night fighter groups. The biggest air battle to date had begun.

The sky blossomed with scores of ivory-colored parachutes. Bf 109s fell out of the sun in deadly head-on passes, clawing down entire B-17 formations. But the Luftwaffe paid the price for its success. With Mustangs and Thunderbolts seemingly everywhere, few geschwaders escaped unscathed. Heinz Knocke, a German ace who flew that day, wrote:

> "When we attempt to attack a formation of Liberators over the Luneburg Heath, we are surprised by approximately forty Thunderbolts. In the ensuing dogfight, our two wingmen are shot down. After a wild chase right down to ground level, the Commanding Officer and I finally escape with great difficulty."

Colonel Don Blakeslee, one of the most experienced American fighter pilots in Europe, led his 4th Fighter Group into the fray at 23,000 feet. Just after reaching the rendezvous point with the bombers, the sky fell on Blakeslee's men. Somebody cried out, "Huns! Millions of 'em!" over the R/T. Sure enough, almost 80 black-crossed fighters dropped out of the sun to mix it up with the 4th. The Americans waded into the fight, trying desperately to keep the bombers safe. Small melees of Mustangs and Messerschmitts dotted the sky. Four P-51s were lost, but the Americans had downed 13 Germans.

The raid reached Berlin, bombed its targets, and lumbered for home. Like flies swarming over a herd of cattle, German fighters harried the Americans every inch of the way back. When the B-17s finally straggled into the fields of East Anglia, the 8th airmen knew they had taken a pounding. When the counting was done, some 69 B-17s and 24s were numbered lost over Germany. Almost 800 men were killed, wounded, or missing.

The Luftwaffe suffered severely as well. Americans claimed 81 Germans were blasted out of the sky. Squadron messes all over the Third Reich proved to be dismal, depressing places. Empty seats bore mute testimony to the ferocity of the day's fight. Again, Heinz Knocke:

> "It has become very silent in the crew room. Jonny Fest and I sit there alone in our two armchairs until far into the night. We do not speak much. The pile of cigarette butts in the ashtray grows steadily as we extinguish one cigarette after another. Jonny keeps staring in a distraught way at the pictures on the wall. To me, it seems as if we might expect to see the faces move and hear the familiar voices of our late comrades break the silence in the room. . . ."

The fight would continue. The losses would rise. But both sides would struggle on, locked in a fight that would largely determine the fate of the Third Reich.

The Terrible Twins

Captains Don Gentile and John T. Godfrey flew with a bunch that Hermann Goering called the "Debden Gangsters," an allusion to their English base. Between them, they racked up nearly 40 combat kills.

The two pilots played tag-team against the Luftwaffe, using tactics that American Vietnam-era pilots would emulate years later. Flying with the vaunted 4th Fighter Group, Gentile and Godfrey practiced aerial combat a bit differently from their peers. Whoever first spotted the target and was in the best position, took on the lead role, while the other fell behind to protect his partner's tail.

First flying P-47 Thunderbolts with the 4th, later switching to the P-51 Mustang, the Gentile-Godfrey combination was so effective that Goering is said to have sworn he'd give up two squadrons for their capture. During a March 1944 mission over Berlin, the team broke up an attack on a B-17 formation, and downed six planes between them. On the flight back, they personally escorted a crippled Fortress safely home.

In mid-1944, the duo was split up. Gentile, after buzzing a collection of newspapermen, accidentally plowed his Mustang into the ground. The 4th's C.O., Colonel Blakeslee, exploded when he saw Gentile's flat-hatting screw-up. Within a few days, he sent Gentile back to the States for good. Godfrey also went home, but managed to finagle a new tour. He returned to England and flew several missions until he was accidentally shot down by his wingman while strafing a runway. He spent several months in a POW camp, but escaped just before the war ended. After the war, Gentile died in a jet crash, and Godfrey died of a muscle disease in the late 1950s.

Enter TacAir

"Help! Help! Help!
I'm being clobbered!
Down here by the railroad tracks!
Two 190s chase me around
And we're damn near the ground!
Tell them I got two if I don't make it back."
4th Fighter Group Song in honor of Don Gentile

For three years, the Royal Air Force fought a tit-for-tat daylight campaign against the Luftwaffe in France. Both sides sent hit-and-run raids over their opponent's airfields in low altitude, pinprick attacks that did little but annoy the enemy. Still, it was the best that both sides could do at the time. The bulk of the RAF effort was placed in the night-bombing campaigns, while the bulk of the Luftwaffe fought for survival in Russia and the Reich. Only a couple of fighter wings remained in France to hold the line against the resurgent British. The war they fought over the English Channel and the rocky coastline of Britain and France became a very personal one. Units got to know their enemies and signs of chivalry made a limited comeback. Nevertheless, the battles they fought were as indecisive as they were costly.

April 1, 1944, would change all that.

Allied planners knew they had to disrupt the Wehrmacht in France if D-Day were to have any chance at success. Bunkers needed to be blasted, forts leveled. Radar posts, naval bases, gun emplacements, and tank concentrations all had to be softened up. Command of the air over France had to be established so the vulnerable invasion fleet could be free from air attack. It was a monumental task to do in just a few months, and the unpleasant assignment fell largely to the American 9th and the British 2nd Tactical Air Forces.

RAF pilots lounge near a Spitfire. Notice the squadron's mascot. Courtesy National Air & Space Museum, Smithsonian Institution

Battles raged within the Allied camp over how best to employ the formidable air power arrayed against Germany. The strategic bomber leaders, Harris and Spaatz, wanted to keep the pressure on the Reich by continuing deep penetration raids. They felt that the tactical units alone could achieve what the ground commanders expected.

Others argued that to ensure the success of Operation Overlord (the D-Day invasion), the Allies needed to use strategic bombers against targets in France. Eisenhower listened to both sides, then made his decision. Like many of his decisions, it was a compromise. The long-range bombers would continue to pound Germany, but would also devote a good portion of their effort against targets in France.

With the decision made, the air leaders settled down to formulate a plan. To secure the beaches once the troops stormed ashore, the Allies had to isolate the forward German units from their supplies. By bombing rail yards, bridges, and road junctions in northern and central France, this isolation could be achieved. Since most of the Wehrmacht units lacked trucks and transport vehicles, they depended on the rail lines to move reinforcements and supplies to the front. A major coup could be secured if the Allies denied them the use of those lines. Supreme Headquarters, Allied Expeditionary Force (SHAEF) worried that an attack on marshaling yards would cause massive French casualties, something that might prove politically damaging. Several test missions were flown by Bomber Command to determine whether civilian losses could be minimized. The tests succeeded beyond everyone's expectations, and a vast portion of Allied airpower was turned loose in France.

As the heavy bombers cratered vital marshaling yards, the RAF fighter-bombers ravaged Noball and Crossbow targets, namely V-1 buzz bomb sites and radar installation along the French and Belgian coasts. Attacking from hedge-top level, the RAF fighters suffered serious losses in the face of heavy, accurate anti-aircraft fire. One such attack against a V-1 site was described by ace Pierre Closterman:

Pierre Closterman. Courtesy Imperial War Museum, London

"Like a fan spreading out, all the Spitfires turned on their backs one after the other and dived straight down. This time, the flak opened fire straight away. Clusters of tracers began to come up towards us. Shells burst to left and right, and just above our heads a ring of fine white puffs from the 20mm guns began to form, scarcely visible against the streaky cirrus clouds. I had only just begun to get the target in my sights when the first bombs were already exploding on the ground -- a quick flash followed by a cloud of dust and fragments."

Meanwhile, low-flying Mosquitos, Tempests, and Typhoons swarmed over the North Sea, slashing into German supply convoys bound out of Norway and loaded with precious iron ore. The German Navy did not have enough escorts to protect the helpless freighters and cargo ships, leaving them terribly exposed as they bobbed their way to ports on the Continent. The rocket-firing Royal Air Force fighters devastated their enemy's sea lanes with wave-top assaults. Soon, nothing could set sail from Norway in daylight without risking blazing cannon fire and murderous rocket strikes.

The Reich, already short of iron ore, suffered severely from the attacks. The material shortage grew increasingly grave, causing disruptions in production schedules and forcing the Germans to find alternate materials with which to supply their war machine.

A coastal command Mosquito attacks shipping in a Norwegian fjord. Courtesy National Air & Space Museum, Smithsonian Institution

In early May, American fighters from the 8th and 9th Air Forces were thrown into the campaign in France. Spaatz and General Brereton, the 9th's commander, divided France into zones of operation. The long-legged Mustangs and Lightnings were given the task of smashing the French rail network east of Paris, while the region directly behind the invasion beaches became the hunting ground of the Thunderbolt squadrons. Sweeping across the French countryside, the American fighters laid waste to locomotives, rolling stock, and rail bridges in a series of attacks christened Operation Chattanooga Choo-Choo. By the end of May, more than 500 locomotives had been damaged. Thousands of passenger cars, box cars, and flat cars were destroyed as well. Rail traffic in France dropped to 35 percent of its March capacity.

The Germans, secure behind concrete fortifications that flanked the beaches, did not expect such an attack and had no counter for it. There was just too much track to defend, too many bridges to patrol, and too many cities with vital rail yards that needed protection. On June 3, a German report detailed the damage:

"Paris has been systematically cut off from long-distance traffic, and the most important bridges over the lower Seine have been destroyed one after another. It is only by exerting the greatest efforts that purely military traffic. . . can be kept moving."

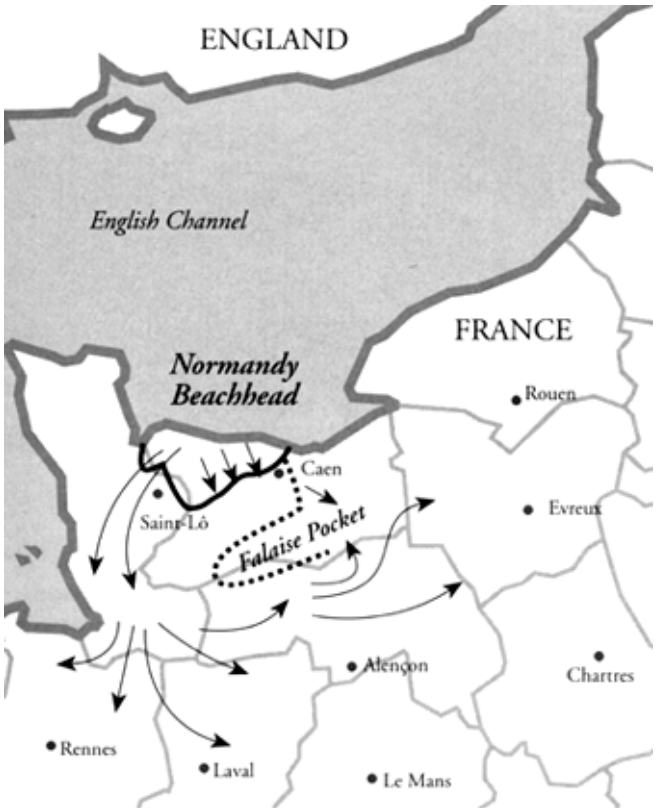
The end of a German locomotive. Europe's locomotives and rolling stock supply were virtually wiped-out in the last years of the war by the Allied air attack. Courtesy National Air & Space Museum, Smithsonian Institution

Williamson Murray, the foremost historian on the World War II Luftwaffe, concluded that, "The success of these interdiction efforts was a major contribution to the winning of World War II." Without the French rail net, the Germans were forced to fight in Normandy without fuel, ammunition, reinforcements, or replacements. The destruction of the German supply lines ensured the victory of the Allied invasion. Airpower, the pre-war handmaiden to the other military branches, was finally proven decisive.

The cost of this victory was incredibly high for the American and RAF squadrons. The Allies lost 2,000 aircraft between April 1 and June 5, and a staggering 12,000 pilots and air crewmen. But new faces soon replaced those young men downed over France and Germany, swelling the Allied ranks to unprecedented numbers. The invasion was on, and the fate of millions hung in the balance.

Operation Overlord

"All you could see was wakes. No one had ever seen so many ships before. . . You had to be awed that you were a part of a thing that was so much greater than you."
Paratroopers from the 101st Airborne



Normandy Beachhead and the Break-out

They shaved their heads a few hours before boarding the stocky C-47s. Some left a narrow strip of hair along the crest of their skulls, as had the Mohawk Indians of years past. Others had buddies brush war paint onto their cheeks and under their eyes, giving the young Americans a fearsome appearance. The men of the 101st Airborne were about to form the spearpoint of the Normandy invasion.

At 2030 hours, the paratroopers began climbing aboard their transports, girding themselves for the trial ahead. Nobody sang, nobody cheered. Each man was lost in his own thoughts. For most of the troops, it would be their first combat jump. The C-47s, each carrying a full stick of paratroopers, lumbered down the runway and clawed into the murky night sky.

Operation Overlord had begun.


The beach defenses constructed by Rommel's troops in France. Courtesy National Air & Space Museum, Smithsonian Institution

The invasion of Normandy ranks as one of the most massive, complicated military operations in human history. Thousands of man hours were devoted to planning shipping routes for more than 6,000 vessels alone. The task of coordinating the thousands of men on land, air and sea boggles the imagination. Yet it was done and done well. The Normandy Operation can be considered Eisenhower's greatest military achievement.

The plan was to land five reinforced divisions at the base of the Cotetin Peninsula along a front of some 60 miles on the first day of the invasion. The Americans were given two beaches, code named Utah and Omaha, on the right flank. Responsibility for two beaches, Gold and Sword, fell to the British. The Canadians, as part of the British I Corps, would land between Gold and Sword at Beach Juno. To support the men as they waded ashore, the U.S. and Great Britain would deploy 6,483 vessels and 12,000 aircraft.

To face this huge force, the Luftwaffe could barely muster 600 operational aircraft. These planes

were nearly exclusively fighters. Most of the Luftwaffe's 500-odd ground attack aircraft were arrayed against the Russians and their expected summer offensive.

The assault on the Normandy beaches would be preceded by a massive Allied paratrooper drop involving one British and two American airborne divisions. Each division would capture vital bridges, road crossings, and gun emplacements that otherwise could be used by the Wehrmacht to organize a counterattack against the men on the beaches. The assault would take place at night. It was a very dangerous maneuver, but deemed necessary by SHAEF's planners. After landing in France, the paratroops were to hold their objectives throughout the night and morning until troops from the beachhead arrived to relieve them.

To persuade the Germans that the invasion force was not destined for Normandy, the Allied intelligence forces did everything to convince their Abwehr counterparts that the targeted beaches lay near Pas De Calais. Phantom armies, complete with fake wooden equipment, dotted the countryside near the Straits of Dover. Radio messages beamed to the Germans revealed that America's greatest armored general, George S. Patton Jr., commanded the troops across from Calais. Bombing attacks pounded the defenses around that French town, contributing further bogus evidence to the Nazi intelligence forces.

The deception worked better than any Allied officer envisioned. For weeks after the Normandy landings, Hitler continued to insist that the attack was a diversion and that the main effort would hit Calais any day. On D-Day itself, the Wehrmacht was so confused, disorganized and hamstrung by its command structure that it could not bring its forces to bear against the Allied threat. The ruse had succeeded and saved thousands of Allied lives.

The Invasion Is On!

After several days of particularly grim weather that had already scrubbed one invasion attempt, Allied meteorologists predicted that on June 6, a small break in the storm would clear the skies over France. Upon hearing the news, Eisenhower took a walk into the English countryside, pondering the incredible responsibility placed on his shoulders. Should he order the troops to go? If he did and the weather closed in, disaster would strike the soldiers. Air cover would be impossible, and landing of supplies would prove impractical in heavy seas. Yet, if he delayed further, the next favorable tides would be several weeks away. He couldn't wait that long. He walked back to his headquarters and gave the green light. The invasion was on for June 6.

D-Day as seen from a GI's perspective. Courtesy National Air & Space Museum, Smithsonian Institution

The night of June 5 found the skies above western France busier than any Los Angeles freeway. Thousands of planes rumbled over Normandy, most of them carrying the paratroops from the 82nd, 101st, and 1st Airborne Divisions. As the C-47s approached the drop zones, heavy flak blasted away, scattering the formations. Nervous transport pilots ordered their paratroops to jump miles from where they were supposed to be released, and high winds blew the troops all over the countryside. Many of the American men destined to land behind Utah beach fell into huge fields flooded by the Germans and were drowned. An entire company dropped into the town of St. Mere Eglise just as the townsfolk were fighting a fire. The helpless men were caught in their chutes by the German garrison and slaughtered. In the morning, dead paratroopers festooned the trees and buildings around the town, a grisly scene for the Allied men who later liberated the village.

Though dispersed and far from their objectives, most of the paratroops organized themselves as best they could and attacked anything German they found. Patrols were ambushed, staff cars blown off the road, artillery emplacements assaulted, and bridges stormed. The confused Germans

had no idea what was going on, especially after dozens of paratrooper sightings flooded their local headquarters. One German general was even ambushed and killed by a squad of American troopers as he returned from a staff meeting. In fact, the dispersion of the airborne units proved a blessing in disguise. The Wehrmacht simply could not decipher what the Allies intended, and so they failed to react in time to stop the landings.

At Sword, Juno, and Gold beaches on the morning of June 6, all went comparatively well. Resistance was stiff in some isolated instances, but the defenders usually found themselves totally overwhelmed. With the beaches secured, the British troops should have pushed inland as far as possible. Instead, after training for months to expect heavy resistance on the beaches, the men dug in, content with consolidating their hold on the stretches of sand a few hundred yards to their rear.

The Americans were not so lucky. The landing at Utah got off to a rocky start. Stiff currents dragged the assault boats miles off course, and the first wave of troops stormed the wrong beach. Rather than trying to take the original objective, the on-site commanders decided to detour the rest of the landing force to the beach that the troops had captured accidentally. The mistake turned out to be most fortuitous, as the original beach area was heavily defended by a solid German unit.

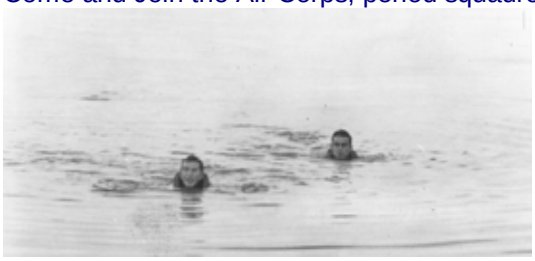
The scene along the beaches of Normandy on June 6, 1944. Courtesy National Air & Space Museum, Smithsonian Institution

At Omaha, the Americans took a beating. A crack Wehrmacht division, the 352nd, was ensconced on a steep hill that overlooked the invasion beach. Wading ashore, the GIs ranks were swept with a firestorm of machine gun bullets and mortar shells. The engineers who were ordered to clear lanes through beach obstacles in preparation for succeeding assault waves arrived on the beach without their equipment. They went to work with what little they had, but were cut down by German machine guns. The situation was grim for much of the morning, as American troops remained pinned at the base of the hill. Finally, with help from off-shore destroyers, the infantry managed to break out, take the hill, and force the 352nd to retire inland. It was a bloody beach to capture. More than 4,000 Americans fell to secure it.

By the end of June 6, the Allies had 23,000 paratroopers, and 75,215 British and 57,000 American soldiers on the Continent. If they could hang on to their tiny beachhead, Hitler's Third Reich was doomed.

Airpower and D-Day
"Come and join the Air Force and get your flying pay
You never have to work at all, just fly around all day
While others toil and study hard and soon grow old and blind
We'll take to the air without a care and you will never mind!"

"You're flying over the ocean, you hear your engine spit
You see the prop come to a stop, the goddamn engine's quit
The ship won't float, you cannot swim, the shore is miles behind
Oh what a dish for the crabs and fish, but you will never mind."
Come and Join the Air Corps, period squadron song



Rescue at sea. Courtesy National Air & Space Museum, Smithsonian Institution

Rescue at sea. Courtesy National Air & Space Museum, Smithsonian Institution

It was their third mission of the day and the pilots sat slumped in their cockpits, utterly exhausted. The 4th had been strafing ground targets in Normandy since first light, and now, with the sun setting, they had been called on for one more mission. Blue Flight lifted from the field at Debden and winged eastward, toward the growing battle in France. Soon after reaching their patrol station near Rouen, one of the pilots caught sight of about 20 German vehicles plodding down a shaded French lane. Blue Flight rolled over and raced to attack them. Their .50-caliber machine guns were just chopping into the Wehrmacht trucks when the P-51s received a rude shock. They failed to spot the staffel of Messerschmitt 109s lurking in the area, and that mistake proved to be their undoing. The 109s pounced on the surprised Americans, cannon rounds blowing the Mustangs out of the sky. In seconds, all four American planes were smoking wreckage littering the French countryside. Only one pilot survived to tell the tale. For weeks, he evaded capture and finally managed to reach Allied lines.

All together, the ill-fated dusk mission cost seven pilots from the 4th.

A PBY pulls a downed air crew out of the Adriatic. Courtesy National Air & Space Museum, Smithsonian Institution

Throughout the day, the Allied air forces flooded the skies over France with fighters and bombers. Some, such as the P-38 groups, flew air cover for the ships, fending off the few attacks the Luftwaffe made during the day. Others, such as the Mustangs and Thunderbolts, ranged over the Wehrmacht's rear areas, blasting anything that moved. Typhoons and Tempests from the 2nd Tactical Air Force blasted German emplacements, tanks, and troops close to the front, paving the way for friendly ground troops to advance. So devastating were these attacks that the German soldiers looked to the sky constantly, terrified they'd hear the sizzling sound of Allied rockets knifing toward them at any moment.

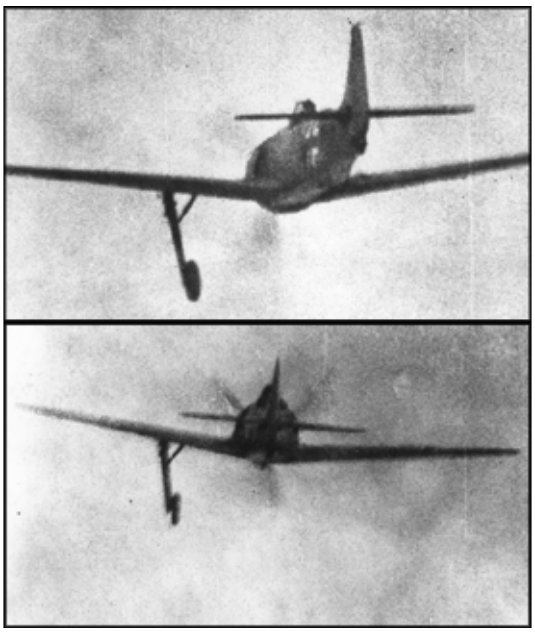
The fighter-bombers had a field day. The Germans tried to reinforce their beleaguered troops covering the beaches and ordered thousands of men, hundreds of vehicles, and dozens of tanks to proceed down the French road network toward Caen. It was virtual suicide to fill the highways with so many men in broad daylight, and the Allies made the Germans pay dearly for the decision.

The Wehrmacht units faced hordes of rocket-firing fighters every step of the way. Panzer Lehr, the strongest German division in France, lost 80 tanks, trucks, and half-tracks on June 6 alone. Its commander described his route to the front as a "fighter-bomber racecourse."

Planning, preparation, and huge numbers in the air had paid off. The Allies seized almost total control of the air over the beachhead. The Germans could not even move a horse-drawn cart without attracting a strafing, diving Tempest. Despite all, the Wehrmacht continued to fight

desperately, hoping against hope that the Luftwaffe would keep the dreaded Jabos off their backs.

The Luftwaffe had its work cut out for it.

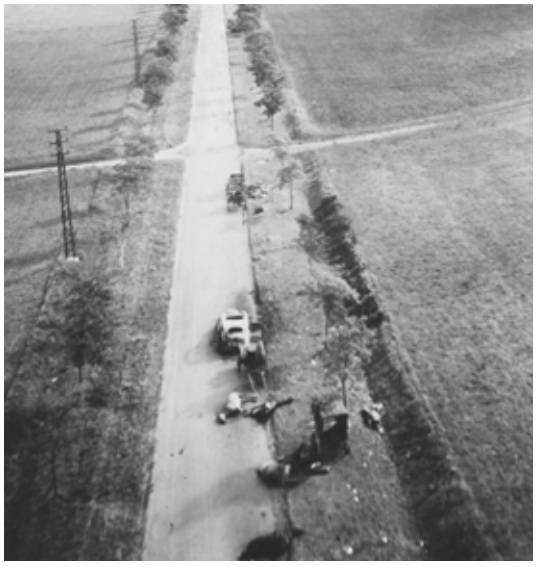


An Fw 190's last moments captured on film by a gun camera. Courtesy National Air & Space Museum, Smithsonian Institution

On a small field outside the steel-producing city of Lille, Hauptman "Pips" Priller dropped his phone into its cradle. He had just received news that the Americans and British had landed on the beaches before Caen. He was ordered to throw his geschwader, JG-26, against the Allied landing craft. Unfortunately, he and his wingman were the only available men for the mission. Nevertheless, he strapped on his flying boots and wandered out to his Focke-Wulf. A few moments later, he and his wingman raced down the runway, climbing into the morning sky. The two Fockes hugged the hedgerows and treetops, hoping to evade the gaggles of Allied fighters over the area. As they approached the invasion beach, they climbed into a thick, dark cloud. When they emerged, they were confronted with an awesome sight. The sea below was filled with thousands of ships stretching to the horizon and beyond. The beach was covered with tanks, trucks, soldiers, and stacks of equipment. Priller chose to strafe the beach, rather than risk the massed AA fire from the ships offshore. He and his wingman, Heinz Wodarzyk, shot across Sword beach, throttles firewalled, guns flaming. One pass and they broke up and into the clouds, their duty done.

Two Focke-Wulfs were about all the once-mighty Luftwaffe could throw at the D-Day landings. Everywhere else, when units were ordered against the beaches, they found themselves hopelessly overwhelmed by scores of Allied fighters before they even neared the target area. Altogether, about 100 sorties against the beaches were made, 70 by single-engined fighters. The Luftwaffe lost 39 aircraft in these attacks.

To say the least, the Luftwaffe's performance was abysmal.



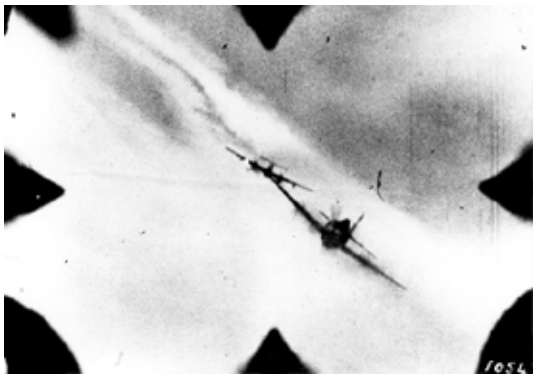
A strafing attack on horse-drawn wagons, seen from the gun camera of an Allied fighter. A good portion of the Wehrmacht relied on horse-drawn carts for delivery of supplies. Courtesy National Air & Space Museum, Smithsonian Institution

Reinforcements were on the way for the units in France. Orders came to shift most of the fighter units from Luftflotte Reich to Luftflotte 3. Within a few days of the invasion, whole geschwaders made their way to the airfields around Paris. The fields where they touched down lacked repair facilities, hangars, revetments, and, often, service vehicles. Nevertheless, the Luftwaffe pinned its hopes on these units, counting on them to support the Wehrmacht as they struggled to contain the Allied beachhead.

The ensuing months saw the Luftwaffe and Allied air forces wage a vicious, bloody air campaign for control of the skies above the hedgerows and pastures of Normandy. Both sides threw every plane and pilot into the fray. Entire units were chopped to pieces in the terrible aerial battles. There was no respite for them; the next day they would fly again, the formations getting smaller and smaller as their comrades died. Whoever had air superiority was bound to control the ground campaign. Both sides knew it and decimated each other fighting for it.

Wolf Pack vs. Abbeville Boys

Hundreds of individual air units distinguished themselves during World War II, but two seem to stand out. The USAAF's 56th Fighter Group, nicknamed the "Wolf Pack," tallied the most air-to-air kills of any American fighter group in Europe, ending the war with 671.5 victories. The Wolf Pack arrived in Europe with a fresh batch of Republic P-47 Thunderbolts, and a fresh group of pilots just out of flight school. Their first few missions in the spring of 1943 served as a dose of reality for the young American aviators. Each time they encountered the veteran Luftwaffe, the 56th came away with a bloody nose. Gradually, however, the Wolf Pack developed into a potent force, and soon some of the top American aces emerged from the group. Dave Schilling, Francis Gabreski, Robert S. Johnson, and Hub Zemke all served with the Wolf Pack during their tours.



Gun camera footage of a P-47 and a Messerschmitt 110. Courtesy National Air & Space Museum, Smithsonian Institution

Facing the 56th from across the English Channel was perhaps the most famous and feared Luftwaffe Jagdgeschwader, JG-26. Called the "Abbeville Boys" or "The Yellow Nosed Bastards" after their French airbase and their jaunty yellow cowlings, JG-26 claimed more than 2,700 Allied aircraft destroyed during its five years of combat. Some of the Luftwaffe's most famous aces, including Adolf Galland, Pips Priller, and Addi Glunz, flew at one time or another with the Abbeville Boys.

The Wolf Pack and JG-26 saw much of each other during the summer and fall of 1944. They traded blows, took their losses, and continued to fight on, neither scoring a knock-out punch. The two sides gained considerable respect for one another, so much so in fact that at one point all new pilots in the Wolf Pack had orders to break for home if the dreaded yellow-nosed Focke-Wulfs appeared on the scene.

Breakout!

"The utter hopelessness of my existence as a pilot had never stood out so clearly before my eyes. I knew my time would come. Each mission was a challenge to fate. . ."
Willi Hielmann, III/JG-54.

German planes burn in an airfield's dispersal area. Courtesy National Air & Space Museum, Smithsonian Institution

For two months, the Allied army bludgeoned their way forward through appalling terrain. For nearly 1,000 years, Normandy had been partitioned into private fields framed by thick, impenetrable hedgerows. The Germans fortified each hedgerow, fought for each yard. Tanks and infantry pummeled each other from point-blank range.

Rommel realized that if the Allies broke through the thin Wehrmacht cordon, Germany itself would be threatened. He organized the defense as best he could, forcing the advancing Americans and British to pay for every inch of ground with the blood of their men. In select areas, crack SS panzer units stabbed into the Allied lines, hoping that their counterattacks would throw the enemy off balance. In one such battle, a single German tank crew wiped out more than 20 British and American tanks.

With their advance stalled, the British improvised. Their army was pinned between Caen and the beaches, unable to advance farther than a few hundred yards. Then, the strategic bombers were called in. They flew along the front and carpeted the German lines with 500-pound bombs. The ground shook. Tanks, trucks, and anti-tank guns were blown high in the air. The German units collapsed under the bombardment. Successful as the aerial pounding proved, the Tommies fighting through the hedgerows did not exploit the gaps blown in the Wehrmacht lines, and crucial reinforcements were allowed to arrive and fill the holes.

The new tactic would be tried again with much more impressive results.

B-26s flying through flak. Courtesy National Air & Space Museum, Smithsonian Institution

To the south of the British, the Americans were unable to penetrate the German defenses. The hedgerows proved infernos of whirling steel, anti-tank shot, and machine-gun fire that engulfed and annihilated entire units. General Omar Bradley's men needed help desperately. He turned to the 8th Air Force.

Starting July 20, Bradley's men, specifically "Lightning" Joe Collins' 7th Corps, would launch a concentrated assault against the German defenses in front of St. Lô. Nicknamed Operation Cobra, the attack was to start with a massive B-17 raid that would saturate the German units with bombs.

The first air attack failed. The B-17s dropped many of their bombs on American comrades by accident. But later attacks virtually annihilated the Panzer Lehr Division, paving the way for a massive American breakout. Lehr's commander later described the horrific bombing attack:

> "After an hour I had no communication with anybody, even by radio. By noon nothing was visible but dust and smoke. My front lines looked like the surface of the moon and at least 70 percent of my troops were knocked-out, dead, wounded, crazed or numbed."

By the end of the month, the German lines in front of the Americans had ruptured completely. Patton's 3rd Army broke through the remaining defenses and fanned out behind the remaining Germans. The British maintained the pressure to the north, preventing the Germans from sending reinforcements to fight Patton.

Sherman tank. Courtesy National Air & Space Museum, Smithsonian Institution

Then, in a frenzy of desperation, Hitler made a decisive error. He ordered the best surviving panzer divisions to assault the Americans at Mortain and Avaranches, hoping to pinch the American breakout off at its base. The attack drew the cream of the 5th Panzer Army into a huge trap. By early August, with the panzer assault blunted, the Americans swept behind the Germans and threatened to surround them entirely. What followed became known as the Battle for the Falaise Pocket. The Germans tried frantically to extricate themselves, throwing their units into a storm of Allied firepower to keep their escape route open. Thousands of vehicles jammed the roads, all headed north for freedom. Allied fighter-bombers swirled over the congested roads, using bombs and rockets to turn the narrow avenues into charnel houses. Wrote Charles Demoulin, a Belgian Tempest pilot:

> "We take off at dawn, squadron strength; targets are 'anything that moves' within a five mile radius of Falaise. Three sorties that day a bridge destroyed, two dozen tanks and fifty-odd trucks. Flak is lively. The Germans. . . are wiped out like those little clay pipes in a shooting gallery."

Falaise doomed the German Army in France. It lost most of its tanks, support equipment and some 70,000 men. The Americans lost 29,000. The straggling remnants of the 5th Panzer Army crossed the Seine on improvised pontoon bridges and streamed eastward, the Americans hot on their heels. Paris was liberated August 25 and the entire city went wild with joy. But the Allies pressed on, bent on obliterating the remainder of the German army. The Wehrmacht fled to the Frontier, seeking sanctuary in the old fortifications along the German border. Safely behind these, the high command planned to turn and fight to the end to keep the Allies from crossing the Rhine.

American GIs and civilians at Metz, France. Courtesy National Air & Space Museum, Smithsonian Institution

The Allied advance degenerated from a dashing sword stroke into a series of fitful thrusts forward. Constant supply problems plagued the armored divisions as the Normandy beaches proved incapable of supporting the needed supply traffic. Patton, whose Army blazed eastward, its tanks throwing great plumes of dust behind them, screamed for more supplies. They would not come.

The End of Luftflotte 3

"That was the end of all our dreams. . ."
Anonymous German pilot

An Fw 190 falls before the guns of an American fighter. Courtesy National Air & Space Museum, Smithsonian Institution

Throughout the battles of June and July, the Luftwaffe bled its geschwaders dry trying to support the Wehrmacht. Thousands of young aviators fell in the struggle, and now the Reich had no more aerial reserves. From a peak of almost 1,000 fighters, Luftflotte 3 possessed 75 operational fighters by the end of August. The summer fighting had cost the geschwaders in France 200 percent of their operational strength. In August, Luftflotte 3 had 482 fighters blown from the sky. Luftflotte Reich lost an additional 375 fighters. The total represented 44.2 percent of the entire Luftwaffe fighter force, just for the month of August. With such a staggering attrition rate, the Luftwaffe was swept from the sky.

At the end of August, the shattered remains of the fighter wings retreated from France to bases inside the Reich. There they would lick their wounds, train new pilots, and receive new equipment.

A mechanic labors over the Daimler-Benz engine of this Bf 109. Courtesy National Air & Space Museum, Smithsonian Institution

For the Allies, their defeat of the French-based Luftwaffe did not come easy. The grueling summer battles claimed thousands of airmen. Against V-1 sites alone, the British and Americans lost 3,000 men. In June, during the first 25 days of the campaign, 7,000 fliers died and 1,508 planes were lost. The destruction of Luftflotte 3 was critical in ensuring the success of the Normandy invasion and breakout, but the Allies paid a gruesome price with the lives of some of their most experienced aviators.

Operation Market-Garden

Conceived as a brilliant spear thrust into the Ruhr Valley to end the war before Christmas 1944, Operation Market-Garden has gone down in history as Field Marshall Bernard Law Montgomery's most foolish exercise.

The pontoon bridge over the Elbe where Russian and American troops linked up toward the end of the war. Courtesy National Air & Space Museum, Smithsonian Institution

Montgomery convinced Eisenhower to give him all the available supplies on the continent to press an attack through Holland that would capture a bridgehead over the Rhine River. To do this, he would employ the First Allied Airborne Army in a massive paratroop drop. Three bridgeheads would be established; the first at Eindhoven by the 101st Airborne, the second at Nijmegen by the 82nd Airborne, and the last at Arnhem, which would secure the Rhine bridges. The last task, by far the most difficult, would be carried out by Britain's 1st Airborne Division and a Polish paratroop brigade.

To support the paratroops, an entire British armored corps would push northeastward along a single, narrow road, linking up with each bridgehead. Montgomery anticipated that the area would be lightly defended and the Germans caught flat-footed. With a bridge over the Rhine captured intact, Montgomery argued that Germany would be doomed.

His argument persuaded Eisenhower, who gave the orders to stop Patton's Shermans and transfer all available supplies from the Americans to the British. Market-Garden was a go.

September 17 saw massive formations of Allied transports lumber over the Low Countries, thousands of parachutes mushrooming behind them. Fighter-bombers skirted the flanks of the great armada, blasting flak concentrations and shielding the transports from German interceptors. The bridgeheads at Eindhoven and Nijmegen were established, but several bridges were lost and precious time was wasted as pontoon bridges were erected.

Liberating Aachen. Courtesy National Air & Space Museum, Smithsonian Institution

The 1st Airborne dropped outside of Arnhem and embarked on an epic battle that ranks with the Alamo, the Cameroon, and Rourke's Drift as one of history's greatest last stands.

The British tank units pushing from the south encountered heavy resistance. The narrow road they were advancing on was well defended with camouflaged anti-tank weapons. It would be days before Arnhem could be relieved.

In the center of the town, defending the one bridge they had captured, a battalion from the 1st Airborne fought furiously against crack SS panzer units. Colonel Frost's men were soon surrounded. They holed up in the buildings near the bridge, battling with the black-clad SS troops for every floor, room, and window. Artillery pounded their positions, and downtown Arnhem was blasted to rubble.

They held out for seven days against terrible odds. But no help came. The British tank columns that were supposed to relieve them were stalled on the south bank of the Rhine, themselves battling for their lives against elite German troops. On September 24, Frost's men hoisted a white flag. The battered, shell-shocked paras had held out against daunting odds, but their fate was sealed. Slowly, they trudged east, hands held high, to be herded into POW camps for the duration of the war.

Market-Garden failed catastrophically. In addition to losing the bridge, the British now had to defend the heavily fortified corridor they had opened up from Eindhoven to Arnhem. The expansion of the pocket occupied the English troops for the better part of the fall and winter.

Rover Joe

The Germans may have debuted close air support tactics in the early stages of the war, but it was the Allies that developed close support into a deadly effective battlefield weapon.

By the time American and British ground forces reached France, ground-to-air control and communication had been refined by three years of fighting in North Africa, Sicily, and Italy. An air officer, usually assigned at the battalion level, accompanied the forward troops and, using his radio, called in air strikes. Called "Rover Joes" by the ground troops, these air controllers also took to the air in light aircraft, such as Stinson Grasshoppers, to scout for targets, particularly when the front was fluid.

The tactical aircraft, ranging from P-47s and Tempest and Typhoon fighter-bombers to A-20 light bombers, orbited a particular area until an F.O. called them in to hit a target. The air controller fed the pilots up-to-date information on the position of friendly forces, while the troops themselves marked their lines with everything from smoke to fluorescent panels.

A Mixed Bag

A long line of German POWs thread their way through Aachen. Courtesy National Air & Space Museum, Smithsonian Institution

The 1944 German Army on the Western Front looked vastly different than the one that marched victoriously through Paris only four years earlier. Back then, the German Army was fit, well-trained, and superbly equipped. After France's surrender, though, a posting to that country meant a soft and easy life for the average German soldier, especially in light of the later horrors on the Eastern Front. Since other theaters took priority over the Atlantic coast, the divisions in Normandy received poor equipment and low-quality recruits. By 1944, the panzer divisions were composed of a bewildering variety of tanks and armored vehicles. Some of the Wehrmacht regiments went into battle driving 1940 vintage captured French tanks, such as the S-35. Others drove captured Russian, British, and American trucks that had been refurbished and repaired in Germany. Only a few lucky units received first-rate equipment fresh from the factories in Germany. Some of the Waffen SS formations, for example, were fortunate to receive powerful Tigers and Panthers as their main armored weapons.

The quality of some infantry units was often suspect as well. A few of the German divisions were actually fleshed out with captured Russian soldiers who elected to fight for Germany rather than waste away in some POW camp. Most of the infantry divisions had no trucks or means of transportation, forcing them to rely solely on the French rail net for their mobility. This proved to be a serious handicap, as the men were forced to reach the front lines on foot power alone.

On the other end of the spectrum were some crack infantry units that caused the Allies great grief during the Normandy landings. The 352nd Infantry which Division which protected the approaches from Omaha Beach, was one of these outstanding formations. They fought like wildcats, despite a lack of support, supplies, and air cover.

Captured Germans smile for the camera at Aachen in October 1944. Courtesy National Air & Space Museum, Smithsonian Institution

All in all, the German armies in France were a patchwork quilt of improvised equipment and bottom of the barrel recruits, meshed with a sprinkling of veteran units using the latest and most potent weapons available to the Reich. Despite the inconsistency, the Wehrmacht fought fiercely, delaying the Allied advance out of the Normandy Beachhead for two and a half months.

Germany Besieged

"Each morning we pilots had breakfast together, and the replacements would come in. The older pilots regarded the young newcomers as though they had only days to live. . . Most of the new pilots flew only two or three missions before they were shot down."
Lt. Hans-Ulrich Flade, II/JG-27

B-26s flying above the clouds. Courtesy National Air & Space Museum, Smithsonian Institution

For Carl Spaatz, commander of the American strategic bombing effort in Europe, the summer of 1944 marked a turning point in the daylight campaign against Germany. While some of his effort had to be in support of the French invasion, the 8th Air Force spent most of its time ravaging a new target type -- oil refineries. After the attrition battles of Big Week and Berlin, the 8th jumped off on its new assignment in May targeting the oil and aviation gas refineries at Leuna. The raids succeeded beyond all expectation. While the bulk of the Luftwaffe's interceptor force spent the summer pointlessly throwing itself into the infernos of France, the B-17s and B-24s paraded over Germany's largest cities virtually unopposed, except for flak.
One by one they wiped out the major refineries throughout Germany and Poland.

The effect was immediate and decisive. By the end of July, the heavies had knocked out 98 percent of Germany's aviation fuel production. At summer's end, the Reich could barely turn out 120 tons of avgas, nowhere near the bare minimum requirements. The Luftwaffe, fresh from its disaster in France, now faced complete fuel starvation. Sorties decreased as the geschwaders ran out of juice. Some squadrons scrounged the countryside for fuel, often stealing it if they had to. Pilots were ordered to chop their throttles as soon as they landed rather than taxiing to their hardstands. Oxen started appearing around Luftwaffe bases. The ground crews used them to move aircraft, rather than squandering precious fuel by pulling the aircraft with trucks as had been the practice.

The fuel shortage affected the entire Reich. Slowly, inexorably, its war machine ground to a halt, for the modern army depends more on oil and gas than any other supply.

The Germans implemented desperate measures in a frenzied effort to conserve fuel. The tank industry began to mount wood-burning engines in its armored vehicles. Some 50 of these odd tanks saw action before the end of the war. Hitler's Reich was hanging on the ropes, its weakest economic link smashed by the might of the American bomber groups. Still, the Germans would not quit. They would not be cowed. Instead, they attacked.

Ardennes Christmas

"They've got us surrounded. . . the poor bastards."
101st Airborne medic

Ardennes Offensive

On December 16, the weight of three entire German armies, one an SS panzer army, smashed through the Ardennes Forest into Hodges' depleted 1st American Army. Hitler had ordered the last remaining fuel stocks expended in this final offensive. The goal of the thrust was to split the American and British Armies by capturing Antwerp. The panzer units were expected to capture plenty of fuel as they advanced on Allied supply dumps. This would keep them going once German reserves were exhausted.

Initially, the attack succeeded. Lt. Dave Knox, a temporary company commander in the 30th Infantry Division, faced one of the early attacks. His company bore the brunt of a determined attack by SS troops. While his company held firm, the ones on his flanks collapsed, forcing his men to fall back. As they did, the Germans swarmed all over them. The embattled Americans fled to a nearby forest, ducking and weaving through the German units to return to Allied lines some hours later.

Many other GIs spent the cold days before Christmas surrounded by Germans. Many managed to elude capture, like Knox and his men, but others were less fortunate. At Malmedy, the Germans massacred an entire field full of POWs. Only a few survived to tell of it. The advance continued.

At Bastogne, the Germans ran into stiff opposition. The 101st Airborne Division was dug in around the town and had orders to defend it to the last. When the German commander sent the 101st men a note demanding their surrender, the Americans answered "Nuts," galvanizing the weary Allied troops to stand fast. Indeed, the 101st stood fast and, in doing so, completely disrupted the German plan of attack. By the end of the month, the offensive ground to a halt. Allied resistance combined with an exhaustion of fuel reserves sabotaged the German panzer armies.

Throughout January, the Americans reduced the German salient and prepared to cross the Rhine. The Thousand Year Reich had but five months to live.

Bodenplatte

"Our New Year's Eve party was cut short by a briefing. . ."
Dieter Krageloh, JG-26

A few hours before dawn on New Year's Day, 1945, Luftwaffe airfields all over western Germany sprang to life. Pilots, many of whom had been drinking heavily the previous evening, were roused

from their cots and told to report for duty. Maps were passed around as short briefings sketched the day's mission. For many staffeln, only the commanders knew what was going on. As pilots strapped into their birds, commanders sprinted down the flight lines shouting, "Just form up and follow me!" Without a clue to their destination or purpose, the men of Luftflotte Reich embarked on the greatest fighter-bomber raid of the war.

Goering made many promises over the past month to help the panzer armies attacking in the Ardennes. He wanted his jagdgeschwaders to pound the Allied airbases on the Continent, smashing the Allied ability to bring its TacAir squadrons against the Tigers and Panthers fighting in Belgium. The plan evolved into one massive strike utilizing every fighter unit left to the Reich. Called Operation Bodenplatte (Mortar Baseplate), the attack would come on January 1, 1945.

Lt. Col. John C. Meyer. Courtesy National Air & Space Museum, Smithsonian Institution

John Meyer, one of the top aces in the 8th Air Force, warmed up his Mustang on his group's new airfield outside of Asch, Belgium. He had convinced his superiors to allow his men to get in some extra combat time and he was just about to lead a dawn patrol over the Rhine. Suddenly, a throng of Messerschmitts tore over the field, flames spitting from their noses as they strafed the grounded Americans. Meyer reacted quickly to the unexpected threat. He taxied his P-51 to the runway, slammed the throttle to the copper coil, and clawed into the air. The sky around him swarmed with targets. Messerschmitts and Focke-Wulfs arched past his silver fighter. Before he even raised his gear, two of the iron-crossed crates had fallen to his guns. Another would succumb to his fire a few minutes later.

JG-11 took a beating in its low-level assault on Asch. Almost 50 percent of its ill-trained and befuddled pilots died in the hedge-hopping battle over the airfield. Its high losses were all too typical for the German fighter arm that morning.

All over Belgium the last vestiges of the Luftwaffe's interceptor force were smashed to pieces in furious dogfights. The stunned survivors limped back to their bases in Germany; more than one third of the force had been shot down. It was small consolation that they destroyed hundreds of Allied aircraft scattered around the Belgian airfields. Few Allied pilots were killed, and the aircraft were easily replaced. The intended hammer blow misfired, costing the Germans their fighter force.

It was a defeat that broke the spine of the jagdgruppen. Never again would they rise to meet the Allied bombers with the vast numbers of the January raids. Yet, without fuel, replacement pilots, spare parts, and lubricants, the fighter wings continued the fight. When they had foraged enough gas for a mission, the 109s and 190s would be airborne again, facing the awe-inspiring might of the American bomber stream. The inexperienced, under-trained Germans could not hope to dent the rock-steady B-17 formations, and, when they tried, the 109s were slaughtered.

Still, they fought on for pride and to protect their families that endured the rain of bombs the B-17s unleashed over their cities.

The Drive into Germany

"What a way to end the war."
1st Lt. Dave Knox, 30th Inf. Div., after getting cut-off and surrounded by an SS counter-attack.

After the failure of the Ardennes Offensive, the German collapse came swiftly. In the East, the Russians stormed into East Prussia and Hungary. Vienna was threatened, and it was only a matter of time before Berlin would be engulfed in the fighting. In the West, the Allies prepared to cross the Rhine and stab the Nazi heartland with their armored daggers.

Throughout February, the Allies pressed toward the approaches to the Rhine. The Colmar Pocket was wiped out, costing the Germans virtually an entire army. That cleared the last Wehrmacht troops out of France, paving the way east. Next, the Rhineland was assaulted by Hodges 1st Army. The Germans recoiled from the blow, but continued to fight fiercely.

Then, on March 7, the dam burst.

The remains of the Remagen Bridge, as seen just after the war. Courtesy National Air & Space Museum, Smithsonian Institution

Advancing eastward toward the town of Remagen, the American 9th Armored Division managed to capture an intact bridge across the Rhine. The Ludendorf Bridge, as the Germans had named it, was the highway into Germany that the Allies needed. Quick reactions to this unexpected windfall served to establish a bridgehead on the east bank of the river. When Hitler learned that the Americans had crossed into Germany proper, he flew into a rage. He ordered all available men, tanks, and planes thrown at the bridgehead. The Americans could not be allowed to exploit their success.

The Germans tried everything to destroy the Remagen Bridge. They sent frogmen down the Rhine armed with explosives. The Americans machine-gunned them in the water. V-2 rockets targeted the bridge, but proved too inaccurate to do any harm. The Luftwaffe's latest aircraft, the Messerschmitt 262 and the Arado 234, were flung at the bridge throughout the month. Nothing worked. Though the spans took heavy damage, the bridge remained standing. Every hour that it stood, vehicles, men, and supplies poured into Remagen enlarging the bridgehead. The 9th Armored soon poised to deliver the fatal wound on the Wehrmacht. When the Ludendorf Bridge finally collapsed into the Rhine, it happened far too late to save Germany. Already, the river had been breached in other places, and American pontoon bridges soon appeared up and down the Rhine.

For the next two months, the Allied armored fingers spread through Germany, crushing all opposition in their way. The Allies achieved success in the east as well. The Russians took Vienna, then moved to surround Berlin. On April 22, the Russians reached the German capital. The fighting raged from house to house. Old men and teenage boys were thrown into the murderous fire in a futile attempt to stall the Red Army. SS troopers roamed throughout German-held, areas killing suspected German traitors in a senseless frenzy of violence. Thousands of German civilians died when the Berlin subway was flooded. When shells began falling around the Reich Chancellory

building, Hitler knew the end had come. On April 30, the infamous Nazi dictator took his own life deep below the streets of Berlin in his command bunker.

On May 7, Germany surrendered to the Western Allies. The next day, they surrendered to the Soviet Union. The war Hitler had started, the initiative that had engulfed the world in a war so vast and terrible that millions would be killed, had at last come to an end. Europe lay prostrate, its cities rubble, its infrastructure a twisted ruin.

The Bridge at Remagen

"Shove everything you can across it," said General Omar Bradley when he heard that the 1st Army had captured an intact bridge spanning the Rhine at Remagen. The Americans had negotiated the last major natural obstacle in the West. If they could hold the bridge and pour men across the Rhine, they might open a quick way to Berlin.

As soon as the news reached Reichsmarschall Goering, he instructed the Luftwaffe to throw everything it had at the bridge. On March 9, 1945, two days after the Americans had taken the damaged but still usable bridge, a trio of Arado Ar 234 jet bombers from Kampfgruppe 76 attacked. But, in the hail of flak from the American guns surrounding the bridge, one of the jets fell. On the 11th, another pair of Ar 234s returned, but with no greater success than their predecessors. The bridge, bracketed by near misses, still stood.

On March 12, 18 Arados bombed from higher altitude, and on the 13th, 19 Ar 234s followed suit. The bridge held.

Eleven Arados returned on March 14, the first day of clear weather since the bridge had been taken. Relying on their speed and low-level dive-bombing techniques, the Ar 234s came in, but the heavy Allied fighter cover over the bridge was too much. Four jets were shot down.

Three days later, the bridge at Remagen, weakened by near misses and heavy traffic, fell into the Rhine. Its capture had meant little to the course of the campaign. In the end, the bridge's best footnote was as the target of the war's most intensive attack by jet bombers. The record stands, unlike the bridge, even now.

A Look Back

"No Statesman of the Second World War was foolish enough to claim, as those of the First had done, that it was being fought as a 'war to end all wars.' That, nevertheless, may have been its abiding effect."
John Kleegan

Years have passed since the roar of Merlin engines echoed across the farms and fields of Western Europe. The great bomber bases of East Anglia grow more and more dilapidated as attacks from the elements now compromise their concrete skin. Weeds grow in the cracks of the runways. The once busy Quonset huts are bare and silent. The fleets of B-17s and B-24s have long since been forged into cars, houses, and factory equipment over the past four decades. The terrible scars that the Allied bombing campaign ripped into Europe have healed. The heaps of rubble that characterized almost every German town have been replaced by modern structures, illustrating the nation's economic resurgence. Divided for almost 50 years, East and West Germany have torn down their Cold War walls to reunite and build a better future together. The two great superpowers that emerged from the war have seen their power transform. The Soviet Union is no more, replaced by volatile reemerging nations that squabble amongst themselves. America remains the sole superpower, but its influence is changing as the world moves to a multi-polar political structure.

It took the world 50 years to recover from the Second World War. What lessons can be learned?

Decorating a home-bound B-17. Courtesy National Air & Space Museum, Smithsonian Institution

America's air force emerged from the war convinced of the validity of strategic bombing. The Air Force would fight the same strategic air war two more times: once in Korea, once in Vietnam. In both cases, strategic bombing served no real purpose. Korea and Vietnam did not support their own war machines, the Soviets and Chinese did. The campaigns failed, as they could not hope to defeat a surrogate army with the principles developed in World War II.

In fact, almost every post-war historian became mesmerized with strategic bombing. Many say that it alone caused Germany's defeat. A few go as far as claiming that Germany lost the war because it lacked a four-engined bomber and a strategic bombing doctrine. Only recently has this view begun to change.

The struggle in the skies over Europe was actually two separate wars, the tactical and strategic. The strategic campaign accomplished two things. First, in the spring of 1944, when the American leadership launched its war of attrition against the Luftwaffe, the 8th Air Force conquered the skies over Germany. Though the total defeat of the Luftwaffe would not come until early 1945, the jagdgeschwaders could not protect their nation's heartland. They stayed on the defensive, with the Americans rooting them out mercilessly, hunting them down even on the most remote grass airfield. By winning air superiority over Europe, the USAAF secured the aerial flanks and ensured the success of Eisenhower's Normandy invasion. To some historians, especially Stephen McFarland and Wesley Phillips Newton, this was the most significant contribution the 8th Air Force made.

A GI gazes into the water from a railroad bridge destroyed by tactical bombing. Courtesy National Air & Space Museum, Smithsonian Institution

But the strategic campaign succeeded in one other aspect. Though its true German production reached record levels in 1944, the freshly minted planes and tanks arrived on the front lines without fuel to run them. Starting in May 1944, the Americans laid waste to the entire German oil refinery industry. Synthetic oil plants, aviation gas refineries, and other targets were deluged with American bombs. By the end of the summer, the Reich's legions were doomed to grind to a halt from fuel starvation. The old maxim "A great general studies logistics" rang all too true, and Carl Spaatz deserves considerable credit for exploiting this German logistical weakness. In some areas of fuel refining, the bombers destroyed almost 98 percent of the Reich's production abilities. Without gas to fly their planes, train their pilots, and move their tanks, the German military machine collapsed. To most historians, this is the greatest contribution the 8th Air Force made during the war.

But the air war was not limited to the strategic battles over Germany. By 1944, the Americans and British had learned to appreciate the power of battlefield air superiority. With their awesome resources, they amassed two complete tactical air forces in time for the D-Day landings. Their role in the ultimate success of the French campaign and the drive into Germany cannot be underestimated. The Wehrmacht in 1944 possessed better equipment, well-trained combat veterans, and an excellent officer corps. The Allies, especially the Americans, landed in Normandy with thousands of green troops fighting with outdated tanks and armored vehicles. The brutal fighting that began in the Normandy hedgerows could have turned ugly for the Allies if they had not possessed the skies over France.

The rocket-toting Tempests, Thunderbolts, and Typhoons that roamed the battlefields proved to be the key ingredient to success on the ground. The Germans could not bring the true weight of their army to bear on the struggling Allied troops. They tried, but their units were engulfed in a hurricane of rocket and cannon fire long before they ever reached the front. In time, the Allied air forces learned to cooperate closely with the regiments on the ground. When heavy opposition was encountered, the Allied troops would call for air strikes, and watch as the formidable Tigers and Panthers were blasted to wreckage by the deadly fighter bombers. TacAir ensured the victory on land and saved the lives of untold American and British soldiers.

A bridge reduced to rubble. Courtesy National Air & Space Museum, Smithsonian Institution

And what of the Germans? The Luftwaffe learned that it could not win a defensive war in the air. There would be no aerial Verdun, just a slow and widening hemorrhage in the heart of the German air force. The interceptor force, overwhelmed as it was with the fighting over the Reich, was called upon to fight the tactical war over France as well. The dual role it was forced to play in the summer of 1944 stretched it beyond the limit of endurance. That it continued to fight on, occasionally winning small victories, is a testament to the resiliency of the Luftwaffe. But by 1945, the Germans were out of tricks. With no fuel, half-trained pilots, and faced with odds of 10 to 1 whenever they took flight, the Luftwaffe's fighter corps snapped under the strain.

Today, only a few men remain who once jousted in the skies of France and Germany. The planes they flew have long since been scrapped, except for a shrinking number in museum collections and private hands. But the scenes of thousands of bombers streaming across Europe are forever etched in their minds. To most, it was the climax of their lives, an unforgettable trial by fire that scattered them to the far horizons of the world. These illustrious, surviving aces are all that link the post-war generations to the most incredible aerial war ever fought.

Air Combat Tactics Over Europe

A finger four of P-51s. Courtesy National Air & Space Museum, Smithsonian Institution

The lone silver Mustang skittered through the sky, dodging in and out of scattered cumulus clouds. The pilot's sharp eyes scanned the sky in search of German fighters lurking near the cloud base. Sunlight flashed suddenly on metal both ahead and below. The telltale sign of an aircraft!

Captain Max Lamb, an ace with the 354th Fighter Group, focused on the reflection. A 109 for sure! He checked his tail, then dove for the solitary German fighter. It was to be an easy kill. A surprised foe could not react in time to avoid death. But this Luftwaffe pilot was no recent training school graduate. He was good. He spotted the Mustang knifing down on him and reacted instantly.

Lamb saw the Messerschmitt break up and into his attack. Instead of a vulnerable tail, the American now faced the deadly, flame-spewing nose of Germany's most notorious fighter. Tracers arched out from the 109. Max laid on the gun trigger. The six-fifties bucked, spraying the German with lead.

The two fighters barreled toward each other, guns blazing. Neither pilot flinched. Each knew that to do so meant surrendering the initiative to the enemy. Still, if neither broke from this head-on pass, they would both surely die when their aircraft collided. Finally, the German lost his nerve, breaking left. Lamb tucked the stick into his stomach and kicked over the rudder in hot pursuit. But the German knew his trade. Although Max arrowed in behind him, he allowed the American only a fleeting shot before spiraling down toward the French countryside, trading height for airspeed.

The two pilots dueled for 20 minutes, swirling around each other in tight turns. When one pilot climbed, the other zoomed in pursuit. Their planes were evenly matched, and the battle became a test of skill. The pursuit that started at 20,000 feet carried them down to the treetops and hedgerows.

Max was too busy to turn his heater off, and in the warmer, low-altitude air his cockpit began to feel like an incinerator. Sweat poured from his brow, dripped around his goggles, and cascaded down his cheeks. This German was the best he had ever faced. With the rest of his unit miles away escorting bombers, he knew he would get no help.

The Mustang turned slightly better than the 109. Slowly, it closed in on the German. Lamb managed to get the fleeing German in his sights for a brief, high deflection shot. The 109's cowling sparkled as the .50-caliber rounds smacked home. The German knew he had to move quickly or die, and he pulled the stick back, climbing for altitude. The P-51 broke out of its turn and took chase.

Soon, both planes were on the verge of stalling. The Mustang stalled first, briefly giving the German the upper hand. He rolled into a tight turn and headed for Lamb's fighter. Before he could open fire, the P-51 dodged out of the way.

A dogfight between a P-47 and a Bf 109. Courtesy National Air & Space Museum, Smithsonian Institution

The damage to the Messerschmitt's engine started to tell. The German's plane trailed a thick, ebony plume of smoke. Lamb, sensing the turning tide, tore into the 109 while snapping out short bursts. The German watched a hail of lead pepper his fighter. Once again, he yanked the nose up and raced heavenward with Max hot on his tail. The end was near! The German threw back his canopy and climbed toward the wing. He was going to bail out! Then, he glanced behind him and looked down the barrels of the pursuing Mustang's machine guns. Max had brought his plane to point-blank range right behind the 109's tail. The 109 pilot, fearing he was about to be strafed, decided he'd rather go out fighting. He climbed back into his breezy cockpit, rolled his fighter away, and renewed the fight.

But the damage done to the Messerschmitt would be the deciding factor. The engine exploded in flames, forcing the German to belly land the crippled fighter in a field. As soon as his plane came to a halt, he leapt from the cockpit and sprinted for a nearby grove of trees, expecting to be strafed at any moment.

Instead, as he ran along he watched the silver Mustang zoom by, its wings only a few feet off the ground. He saw Lamb in the cockpit. The American saluted him, rocked his wings, and headed for home. This German was too good to die helpless on the ground, Lamb thought. Perhaps they'd meet again, but he hoped not. Next time he might not be so lucky.

Max Lamb's amazing solo combat in the summer of 1944 exemplifies both the common and uncommon of air fighting over Europe during the last two years of the war. By 1944, one-on-one dogfights were a rare occurrence. Much more common were aerial duels involving dozens, scores, and even hundreds of aircraft. In fact, Lamb was not expected to engage in combat on the day he encountered the 109. He was flying as a spare with the rest of his group and, when nobody aborted, he was to return to Lashenden. It was sheer chance that the two pilots blundered into each other.

The chivalry Max displayed also was more unusual than most post-war accounts would have us believe. By 1939, the concept of Total War had seeped into air combat, leaving little room for mercy. Both sides strafed parachutes; both sides killed pilots on the ground. It was all part of totally defeating your opponent.

The P-38 was considered a failure as a fighter in Europe. By mid-1944, all 8th Air Force Lightning groups converted to P-51s. Courtesy National Air & Space Museum, Smithsonian Institution

This single battle of Lamb's perfectly illustrates the nature of dogfighting over Europe. The aircraft of the RAF, USAAF, and Luftwaffe all performed similarly. The top speeds of the Spitfire IX, Messerschmitt 109, and P-51 fell within about 40 mph of one another, not a significant difference. This level playing field left no major weaknesses to exploit as the Americans had done so effectively against the Japanese in the Pacific. In that theater, the radically different aircraft design philosophies of the Japanese and Americans created a gross disparity in performance.

The Japanese fighters were incredibly maneuverable, but slow and vulnerable. The Americans went for speed and firepower, with less emphasis on maneuverability. Both sides exploited the inequities in the air. In turning melees, the Japanese held all the cards and the Americans routinely were defeated. After numerous thrashings, they learned to remove this Japanese advantage by not playing that game. Instead of dogfighting, they would make slashing, hit and run attacks maximizing their speed and diving abilities and negating Japanese maneuverability.

In Europe, however, no such gross inequities existed. The planes deployed had only slight performance advantages, explaining why the European war differed so drastically from the fighting in the Pacific. Swirling, turning dogfights over the skies of France and Germany were commonplace. In many ways, the fighting recalled the days of the Fokker Triplane and Sopwith Camel. The dogfight, obsolete in the Pacific, remained the critical element in air fighting over Europe. Pilot skill, always a key aspect of air combat, became even more important with the near-parity of the vehicles.

A flak hit dooms a B-26. Courtesy National Air & Space Museum, Smithsonian Institution

Teamwork, emerging at the squadron level as early as 1918, became institutionalized. The RAF, USAAF, and Luftwaffe all used similar fighter formations, much as they did in 1918. The basic formation consisted of a four-plane flight with two elements each. Called the Finger Four in the USAAF and the Schwarm in the Luftwaffe, it was first developed and used by the Germans in the Spanish Civil War. By 1944, all the major combatants had adopted it as standard.

In other ways, the war over Europe introduced revolutionary changes to air warfare. Both sides employed an intricate ground control network for offensive and defensive patrols. Radar behind the lines became the long-range eyes of fighter squadrons. Controllers could vector patrolling friendlies toward targets out of their visual range. In Germany, the controller network organized massed attacks on American daylight bomber formations. By the end of the war, ground control formed an integral part of the fighting above the Continent.

Massed bomber formations of 1,000 planes or more first made their appearance over England in 1940, reaching their apogee in 1944 with the continuous Allied bombing campaign. To deal with the bomber threat to Germany, the Luftwaffe completely reoriented its doctrine and developed new counter-tactics. Head-on passes by massive formations of fighters proved the most effective way to deal with the American daylight threat. The B-17s and B-24s had weak forward armament and, once the Germans discovered this, they exploited it to its fullest.

Mustang

No other single aircraft made such a difference in the air war over Europe. The P-51 Mustang, which showed up in strength in early 1944, put the nail in the Luftwaffe's coffin. Not only could it escort bombers all the way to their targets and back, but its high performance meant that it could dogfight the attacking Bf 109s and Fw 190s on more than equal terms. After the RAF conducted field trials with a P-51B and captured Bf 109s and Fw 190s, it generated a comparative report that outlined the strengths of this important airplane:

Against the Bf 109G: "The Mustang can always catch the Bf 109G, except in any sort of climb. In defense, a steep turn should be the first maneuver, followed, if necessary, by a dive. If above 25,000 feet, keep above by climbing or all-out level flight."

Against the Fw 190: "In the attack, a high speed should be maintained or regained in order to regain the height initiative. Dogfighting is not altogether recommended. Do not attempt to climb away without at least 250 mph showing initially."

A quartet of P-51s. Courtesy National Air & Space Museum, Smithsonian Institution

A quartet of P-51s. Courtesy National Air & Space Museum, Smithsonian Institution

American Fighter Doctrine

Francis S. Gabreski. Courtesy National Air & Space Museum, Smithsonian Institution

In 1944, the USAAF employed fighters in three ways: escort, air superiority, and ground attack. Of the three, escort missions were the most essential to the 8th Air Force. The hard lessons of 1943 drove home the need to protect B-17s and B-24s as they winged toward targets in Germany. Initially, fighter groups were positioned close to the bomber boxes with orders to stick with the heavies. The fighters were not even allowed to pursue Germans below 18,000 feet (B-17s flew between 20,000 and 25,000). This gave the average German pilot an easy way to disengage if he found himself embroiled in a dogfight with American escorts. With the Mustangs, Lightnings, and Thunderbolts tied to the bombers, the fighters had very little flexibility. Tactically, the Americans were on the defensive, reacting to what the Germans threw at them. Even then, they could only attempt to drive the 109s and 190s away; in effect the Mustangs became shields, rather than swords.

By the middle of 1944 this policy was abolished. The fighters would not provide close escort. Rather, they would patrol the bomber stream searching for German interceptors. Pilots were cut loose from their strict procedures and told to chase the Germans all over the sky. The 18,000 foot ban was dropped and soon the pilots were reporting kills taking place at hedgetop level.

Don Beerbower, one of the hottest P-51 pilots in the ETO, poses for the camera. He was shot down during a strafing run in the spring of 1944. Courtesy National Air & Space Museum, Smithsonian Institution

To keep the Germans off guard, several fighter groups would range along the flanks of the bomber streams searching out Luftwaffe units. These sweeps often caught the interceptors in the middle of forming up for massed attacks on the bombers. The Americans would wade into the confused German staffeln and thoroughly disrupt their attacks. The results were immediate and impressive. Bomber losses went down, Luftwaffe losses went up.

Then, the 8th added one more twist. Once released from escort duty, the fighter pilots were ordered to head for the deck and strafe any German airfield they could find. To encourage the pilots, planes caught on the ground were counted as kills. Soon the Luftwaffe had no place to hide. Even their training units came under attack. More than once, a squadron of Mustangs stumbled into a gaggle of circling biplane trainers deep in Germany. The ensuing carnage created many Allied aces.

Free-ranging fighter sweeps formed another element in USAAF fighter operations. These were meant to catch the Germans off guard whenever possible, preventing them from recovering the initiative in the air. No longer were Americans taking the defensive role. Now, they were making the Germans react to their moves. The fighter sweeps drained away the strength of the Luftwaffe like an open wound. The losses were steady and extremely heavy.

Americans would range over the front in France or the airfields in Germany looking for anything to shoot. In time, even trucks, staff cars, trains, and individual soldiers became targets as the Luftwaffe made fewer and fewer appearances. These sweeps helped the Allies capture air superiority over Germany, allowing American bombers to soar freely over the Reich's heartland.

Before the war started, the Americans focused almost exclusively on strategic bombing. Tactical ground support and interdiction were largely ignored. Thus, by mid-war, the Americans had not yet developed a dedicated ground attack aircraft as the Germans, Russians, and Italians had done so long before.

When this deficiency shook the Air Force leadership out of their infatuation with strategic bombing, the only solution was to hang bombs on the existing fighters. As it turned out, most of these planes made excellent fighter-bomber platforms, especially the P-47 Thunderbolt. From mid-1943 onward, it was common to see American fighters with rockets and bombs slung under their wings ripping into German tank convoys. Tactical air power developed from a neglected stepchild into a major player. Its domination over the battlefields of France and the Low Countries served as one of the keys to the defeat of the Wehrmacht in the West.

Special Ops

The bulk of the air war in Europe consisted of run-of-the-mill raids, but special operations missions also played an important part in the success of the Allied air campaign.

On February 18, 1944, 19 Mosquitos from three squadrons of the RAF's 2nd Tactical Air Force attempted a jail break. The target was a Gestapo jail in Amiens, where several hundred members of the French Resistance were imprisoned. Using low-level bombing attacks, the Mosquitos successfully breached the walls of the prison and more than 250 men escaped.

Germany, too, had its share of secret missions. The Luftwaffe's Kampfgeschwader 200, often used captured Allied aircraft to drop agents behind enemy lines and sported several B-17s in its collection. In early January 1945, plans were made to use one of these captured B-17s in an attempt to join an American formation as it left the European coast, then shoot down "real" Forts when they went into their landing pattern over England. In the end, though it appears the Germans made a number of such attempts, nothing came of them, perhaps because American crewmen were often suspicious of "strange" B-17s that tried to join their groups.

British Fighter Doctrine

A Spitfire and a P-38. Courtesy National Air & Space Museum, Smithsonian Institution

With the RAF conducting strategic bombing at night, the British had no need for a daylight long-range escort fighter. Consequently, the Spitfires, Tempests, and Typhoons served as a tactical battlefield force, a role for which they were well suited. Spitfires conducted sweeps and patrols over France until the invasion of Normandy in June. Thereafter, they would range behind the front lines, intercepting German aircraft assigned to bomb Allied positions, or tangling with standing German patrols. In many ways, this type of fighting looked a great deal like the patrols over the front during World War I.

When the Messerschmitt 262 entered service in the fall of 1944, British units on the Continent had no counter for the high speed planes. The jets would race over the frontier, cross the front, and pummel an airfield or troop concentration with 1,000-pound bombs.

Before the RAF could intercept, the jets would dash back to safety in Germany. These hit and run raids annoyed the RAF to no end, though they did little serious damage. Much energy was invested in countering the jets, and a new approach was gradually developed.

First, the standing patrols were increased. As the Me 262s rarely flew above treetop level, they never appeared on radar. British fighters had to be in the right place at the right time to catch them; without any ground control support, a successful intercept was a matter of luck. The increase in the number of patrols had only a marginal affect on the 262 raids.

A formation of Hawker Typhoons on patrol. Courtesy National Air & Space Museum, Smithsonian Institution

The real breakthrough came when the RAF decided to post standing patrols over the airdromes used by the Messerschmitt 262s. This way, the Spitfires and Tempests caught the jets when they were most vulnerable, during take-off or landing. To counter this, the Germans assigned several geschwaders of Focke-Wulfs to cover the major jet bases during the day.

This type of defensive patrol served to drain strength away from the German interceptor force and did not succeed in keeping the RAF off the jets. By the end of the war, the Messerschmitt 262 squadrons were under constant surveillance and attack by British and American fighters. They suffered heavy losses and their combat performance was seriously impaired.

As the Spitfires cleared Luftwaffe aircraft from the sky near the battlefield, Tempests and Typhoons pounded German ground positions in support of Allied armies. Perhaps the most deadly fighter-bomber of the war, the Tempest became the scourge of the German panzer division. If caught in the open on a country lane or sprawling meadow, the German tanks were easy targets for the rocket-armed British fighters.

As close support operations became well coordinated, the Typhoon and Tempest units often kept standing patrols over the Allied lines. Flights would then be called in to strike a particular target chosen by a local army commander. In essence, the fighter-bomber had turned into a quick response artillery platform. With excellent communication and cooperation with the soldiers on the ground, this type of fighting proved devastatingly effective.

A. G. Malan. Courtesy Imperial War Museum, London

Johnnie Johnson. Courtesy Imperial War Museum, London

Luftwaffe Fighter Doctrine

By 1944, the Luftwaffe fighter force had one purpose -- to stop the Allied strategic bombing

campaign. To accomplish this, production shifted away from creating medium bombers and ground attack aircraft and focused almost exclusively on building fighters.

A German pilot on his Bf 109 describes his latest combat by flying with his hands. Courtesy National Air & Space Museum, Smithsonian Institution

In the fall of 1943 the jagdgeschwaders scored several convincing but indecisive victories over the American 8th Air Force. In fact, the blood-letting the Germans gave the American Flying Fortress groups served only to bring about the Luftwaffe's doom in the long run. The heavy losses suffered by the bombers finally persuaded the 8th Air Force command that a long-range escort fighter was needed to ensure the success of the bombing campaign. By spring 1944, the 8th Air Force had plenty of P-51 Mustangs in its inventory and its critical need had been filled. When American fighters began appearing in the skies above Berlin in March 1944, the writing was on the wall for the Luftwaffe.

To stop the bombers, the Luftwaffe developed a number of tactics. First, fighters were ordered not to engage American escorts. Rather, they were to evade the Mustangs and Thunderbolts by maneuvering into gaps in the escort screen. With the escorts out of position, German fighters could then sweep down onto the bomber boxes and wreak havoc. This was no easy feat and, more often than not, the jagdgeschwaders would still lock horns with the American fighters.

To counter this, the Germans adopted a tactic in which one jagdgruppe would be designated bomber killers and one or two others would fly escort for them. With this tactic, American fighters could be engaged and distracted while part of the German formation went after the bombers. This tactic often proved quite successful.

The sight dreaded by all 8th Air Force bomber crews: a Focke-Wulf 190A. Courtesy National Air & Space Museum, Smithsonian Institution

But destroying the bombers was no easy task. The firepower of the combat box was as awe inspiring as it was dangerous. Hundreds of machine guns protected each formation and these guns could be brought to bear at any clock position. To counter this, the Germans developed two tactics. The most common attack procedure was to fly parallel with a bomber box, and gradually pull ahead. Then, from a position well above and in front of the bombers, the German formation would execute a 180-degree turn and charge down at the front of the combat box. As the two formations converged, the fighters would spray cannon fire into the bombers' vulnerable cockpits and engine mounts. When the geschwader finished their run, they would dive through the combat box, heading for the deck with their throttles firewalled to avoid being caught by any American fighters.

The other attack method employed aerial rockets. These weapons were ad hoc gadgets roundly detested by the pilots. The early ones, the Gr. 21s, were nothing more than converted Wehrmacht mortar rounds with a small rocket engine attached. Two could be mounted under the wings of an

Fw 190 or Bf 109 in heavy, cumbersome launch tubes.

Gunther Rall. Courtesy National Archives, #242-HLB-6831-19

The Gr. 21 was a failure for several reasons. The tubes were so bulky that they severely reduced the performance of the 109s and 190s. Dogfighting while equipped with the rocket tubes was practically suicide, so the interceptors themselves had to be escorted to keep Allied fighters off their backs. In addition, the Gr. 21 proved almost impossible to aim. The pilots had to fire them at an upward angle so they would drop down into a bomber formation. Hits were so infrequent that the jagdgeschwaders started phasing out the weapon in 1944. Still, if even one of the rockets landed amidst a B-17 formation, it could cause considerable damage, as one rocket could take down three or four bombers.

In April 1945, the Messerschmitt 262 units received a new rocket type called the R4M. These pencil-thin missiles were fired in volleys of up to 24, and the Germans soon discovered they were deadly effective. Fortunately for the Allies, the weapon arrived too late to affect the course of the air war as the Luftwaffe was all but driven from the skies with Russian troops approaching Berlin by the time the rockets reached operational status.

The Junkers 188 was an evolution of the Ju 88. Courtesy National Air & Space Museum, Smithsonian Institution

When the Allies invaded Normandy in June 1944, the Luftwaffe fighters in the West were thrust into a new role. Almost all the German ground attack units, called Schlastastaffeln, were fighting the Russians on the Eastern Front and could not be spared for action in France. Thus, the Messerschmitts and Focke-Wulfs from Luftflotte Reich were ordered to take up the slack. The pilots had not been trained in ground attack tactics, so their performance in this unfamiliar role left much to be desired. Most often the Jagdgeschwaders failed even to reach the assigned targets, claiming the Allied defenses were too strong to penetrate.

The Mistel was one of the last ditch weapons of the Luftwaffe. A pilot in the piggy-back fighter would guide an explosive-laden bomber, via remote control, into an Allied target. Courtesy National Air & Space Museum, Smithsonian Institution

The pilots suffered from another handicap as well. The Luftwaffe had failed to develop an adequate tank-busting rocket, making close support missions against Allied armor almost worthless in the West. The geschwaders tried attacking tanks with the old Gr. 21s, but they were too inaccurate to score many hits. Other units experimented with skipping delayed action bombs off the ground and into the sides of Allied tanks. This tactic worked best, though to do it accurately the Focke-Wulfs had to fly at 20-30 feet in the face of fierce anti-aircraft fire. The Luftwaffe's failure to employ its air power against the advancing armies in France cost the Wehrmacht dearly throughout 1944. Attempts to turn its interceptors into fighter-bombers served only to weaken the already harried units and further the decline of the Luftwaffe.

The Role of the Jets

In the summer of 1944, Germans began deploying the Messerschmitt 262 and the Arado 234 in small numbers. Tactics for both aircraft were developed quickly under adverse combat conditions. Several test Kommandos were formed to execute this difficult task. The Me 262 units soon discovered that the standard bomber attack tactics were not feasible in the new jet. Head-on attacks would not work as the closure rate between aircraft reached 700 mph. Pilots did not have enough time to aim and fire their cannon. Overhead passes would not work either, for similar reasons.

Me 262. Courtesy National Air & Space Museum, Smithsonian Institution

The Me 262 pilots learned that the best approach to bomber attacks was from the rear. They would race up above and behind a bomber box at high speed, then dive down about a mile astern of the American formation. They would then set up their attack runs, fire rocket and cannon volleys while still out of range of the bomber's defensive machine guns, then break off to head for home.

The Arado 234 entered service as a light bomber in December 1944. Originally, the plane was supposed to be used as a level bombing platform. A bombsight was mounted in the Arados nose, but to get to it, the pilot had to wrench the control yoke to the right, climb out of his seat, and curl up in the nose. Since no one else was in the plane to fly it, the setup invited disaster. The bombsight was probably never used in combat. Instead, pilots would reverse the periscope and put the crosshairs on their target. If the plane was in a shallow dive, the periscope sight proved fairly accurate. The shallow, high-speed dive from above 10,000 feet became one of the most widely used tactics by Arado 234 squadrons.

Each service used their fighters in slightly different ways during the Second World War. The prime task for American fighters was the protection of the bomber stream. For the British, air superiority

over the battlefield was the primary mission. The Germans, forced onto the defensive by late 1942, adopted a reactive stance in the West. To counter the Allied air offensive, the Luftwaffe deployed the bulk of their jagdgeschwaders in Germany to serve as an interceptor force. Even with new tactics and new weapons, however, their fighter groups never had a chance at stopping the American daylight bombing raids. There were simply too many Allied aircraft to stop.

The war over Western Europe turned into a massive battle of attrition by the beginning of 1944. Each side trying to execute its mission objectives, took heavy losses. The deciding factor would be which side had the greater resources to replace losses.

As it happened, the American Army Air Force had the greatest pool of resources. The British, after five years of war, were running into severe and insoluble manpower shortages by 1944. The Germans faced similar shortages. The Luftwaffe began losing an incredible number of pilots beginning in January 1944. These losses, sometimes approaching 1,000 pilots a month, doomed the German air force. With their veteran pilots depleted, they accelerated training programs to make up the difference. By doing so, however, they created a cadre of aviators so inexperienced that they proved to be nearly useless against Allied fighters, and German losses increased.

This vicious circle had decimated the Luftwaffe by the end of 1944. Each graduating class from the training schools was less qualified and suffered a higher loss rate in combat than its predecessor. There was no way to escape this turn of events, and it doomed the Luftwaffe to a total, bloody defeat.

II. Reference

Refueling P-47s on a grass strip in France. Courtesy National Air & Space Museum, Smithsonian Institution

Aircraft Specifications & Color Plates

Lockheed P-38J Lightning

Color illustration available

USAAF Fighter Bomber

The P-38J was one of the later models of the Lightning to see combat in Europe. It was a stable, smooth aircraft with few quirks, but its one major foible was often fatal. In steep dives, the P-38 would go so fast that it would approach the speed of sound. The shock waves of such velocity would often rip the tail apart, causing the Lightning to disintegrate. When one entered such a dive, the stick seemed to be rooted in cement and nothing the pilot could do would effect a pull out. If the plane withstood such a dive long enough, the heavier air at lower altitudes would allow the pilot to finally pull-out of the dive, but this usually took several thousand feet. The P-38J possessed special flaps that allowed it to turn very tightly for a twin-engined aircraft. These flaps could be dropped at speeds up to about 250 mph in level flight to assist with turning maneuvers. Above 20,000 feet, the Lightning rolled very well, better than the Bf 109G at high speeds. Because the propellers rotated in opposite directions, the P-38J did not spin when stalled and there was no significant amount of torque either way in level flight. Though it could not climb as steeply as some of its German opponents, it could climb faster at certain altitudes, and it could out-dive just about anything except perhaps the P-47 Thunderbolt.

In Europe, the P-38 suffered from many technical problems associated with the cold weather it was forced to fly in. As a result, the 8th Air Force was much more interested in the P-51. Most of the 8th's Lightning groups converted to the Mustang by the fall of 1944. The 9th Air Force, however, continued to use its P-38s in ground attack roles until the end of the war.

Specifications for the P-38J Lightning
Type: High-altitude fighter/ fighter bomber
Nickname: Fork-Tailed Devil
Introduced: October 1942
Length: 37 ft 10 in
Wingspan: 52 ft
Crew: 1
Weight Empty: 12,780 lbs
Weight Loaded: 17,400 lbs
Power Plant: Two Allison liquid-cooled engines, at 1,425 hp each
Armament: One 20mm cannon and four .50-caliber machine guns
Ordnance: 2,000 pounds of bombs, or two 500-pound bombs and 10 rockets
Top Speed: 414 mph
Range: 475 miles
With drop tanks: 2,260 miles
Ceiling: 44,000 ft
Climb Rate: 3,200 ft/min
Maneuverability: Average
Firepower: Good
Durability: Excellent

A P-38 returns from a mission. Courtesy National Air & Space Museum, Smithsonian Institution

Republic P-47D Thunderbolt

Color illustration available

USAAF Fighter Bomber

The P-47 was perhaps the most rugged single seat fighter of WWII. While it could not climb very steeply or quickly, it could dive like a brick. Some Thunderbolt pilots claim to have nearly reached

Mach one in dives from above 25,000 feet. In high speed stalls, the P-47 had a tendency to flip and needed more than 1,000 feet to recover. Though not as nimble a fighter as its prime opponents, the Fw 190 and the Bf 109, it could out-dive anything in the air, with the possible exception of the P-38. Later, when more maneuverable fighters became available, the P-47 was increasingly used as a ground attack fighter, a role for which the plane was well suited.

Specifications for the P-47D
Type: Fighter bomber
Nickname: The Jug
Introduced: April 1943
Length: 36 ft
Wingspan: 40 ft 9 in
Crew: 1
Weight Empty: 9,900 lbs
Weight Loaded: 13,500 lbs
Power Plant: Pratt & Whitney R-2800-9 air-cooled radial with two-stage supercharger, at 2,535 hp
Armament: Eight .50-caliber machine guns
Ordnance: 2,500 pounds of bombs, or 500 pounds of bombs and 10 rockets
Top Speed: 420 mph
Range: 640 miles,
With drop tanks: 925 miles
Ceiling: 42,000 ft
Climb Rate: 2,750 ft/min
Maneuverability: Average
Firepower: Excellent
Durability: Excellent

Courtesy National Air & Space Museum, Smithsonian Institution

North American P-51D Mustang

USAAF Fighter Bomber

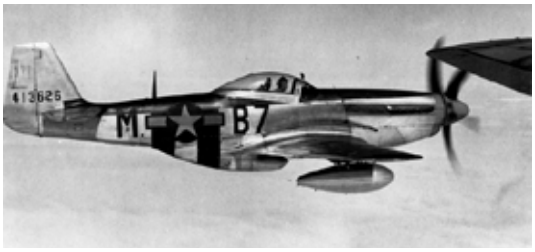
Color illustration available

The Mustang was the outstanding American fighter of WWII. Its long-range performance ensured the continuation of the strategic bombing campaign in Europe and concomitantly dealt the death blow to the Luftwaffe. The plane possessed some nasty habits, however, and proved to be difficult to fly. Since it had a great deal of horsepower in a fairly light airframe, any sudden application of throttle could cause the plane to torque-roll violently, sometimes twisting into a spin. At low altitudes, such an action was usually fatal. To avoid this, the pilot had to apply throttle gradually and compensate for the torque by using the rudder and ailerons. Because of the laminar flow wing, the Mustang had very little drag, making it very fast, with the ability to quickly accelerate to its max speed.

Against the Luftwaffe's finest, the P-51 stacked-up well. It could turn inside the Bf 109G and the Fw 190A, and could climb with both aircraft. Its main asset was its speed, maneuverability, and incredible range.

Specifications for the P-51D

Type: Long-range escort fighter/fighter bomber
Introduced: November 1943
Length: 32 ft 3 in
Wingspan: 37 ft
Crew: 1
Weight Empty: 7,125 lbs
Weight Loaded: 10,100 lbs
Power Plant: Rolls Royce Merlin (Packard) liquid-cooled engine, at 1,510 hp
Armament: Six .50-caliber machine guns
Ordnance: 2,000 pounds of bombs or eight rockets
Top Speed: 437 mph
Range: 950 miles,
With drop tanks: 2,080 miles
Ceiling: 41,900 ft
Climb Rate: 3,125 ft/min
Maneuverability: Excellent
Firepower: Good
Durability: Good



Courtesy National Air & Space Museum, Smithsonian Institution

Boeing B-17G Flying Fortress

USAAF Bomber

Color illustration available

The B-17G served as the standard USAAF bomber during World War II in the skies over Europe. Its solid construction and wide wing area gave it the ability to absorb huge amounts of battle damage and still get its crew home. Its large wing also made it a very stable bombing platform from above 20,000 feet. This allowed for great accuracy, and facilitated the close formation flying the American tactics necessitated. The G model was the first to introduce a chin turret equipped with two .50-caliber machine guns. This additional turret was designed to give the Flying Fortress better protection against head-on attacks.

Specifications for the B-17G
Type: Heavy bomber
Nickname: Fort
Introduced: 1939-40
Length: 73 ft 9 in
Wingspan: 103 ft 9 in
Crew: 10
Weight Empty: 34,000 lbs
Weight Loaded: 55,000 lbs
Power Plant: Four Wright R-1820-97 air-cooled radials at 1,200 hp at 25,000 ft each
Armament: Ten .50-caliber machine guns
Ordnance: 4,000 pounds of bombs (typical load)
Top Speed: 287 mph
Range: 1,377 miles
Ceiling: 30,600 ft
Climb Rate: Poor
Maneuverability: Poor
Firepower: Good
Durability: Excellent

Courtesy National Air & Space Museum, Smithsonian Institution

B-24 Liberator

USAAF and RAF Bomber

Color illustration available

While not as durable or maneuverable as the B-17, the B-24 could carry a larger bomb load for a longer distance at a higher altitude. It was said that the wings on the Liberator were so thin that in flight they bowed slightly from the weight of the fuselage.

By early 1944, the B-24J had replaced most of the earlier variants of the Liberator. The new version carried a power turret in the nose that held two 50 caliber machine guns. The added firepower made head-on attacks by Luftwaffe fighters much more dangerous. The B-24 remained in service with several 8th Air Force bomb groups until the end of the war.

Specifications for the B-24J
Type: Heavy bomber
Introduced: Late 1943
Length: 66 ft
Wingspan: 110 ft
Crew: 8-10
Weight Empty: 38,000 lbs
Weight Loaded: 56,000 lbs
Power Plant: Four Pratt and Whitney R-1830-43 air-cooled radials, at 1,200 hp each
Armament: Ten .50-caliber machine guns
Ordnance: 5,000 pounds of bombs
Top Speed: 278 mph
Range: 1,700 miles
Ceiling: 28,000 ft
Climb Rate: Fair
Maneuverability: Poor
Firepower: Good
Durability: Good

Head-on view of a late model B-24. Courtesy National Air & Space Museum, Smithsonian Institution

North American B-25 Mitchell

RAF Bomber

Color illustration available

Over France, the B-25 was used exclusively by the RAF formations. The standard USAAF medium bomber used by the 9th Air Force was the B-26 Marauder. The B-25 was a durable, maneuverable bomber with a powerful defensive armament. The RAF used the B-25 to bomb bridges, rail yards, and other tactical targets from an altitude of 10,000 - 15,000 feet.

Specifications for the B-25B
Type: Medium bomber
Introduced: 1941
Length: 52 ft
Wingspan: 67 ft
Crew: 6
Weight Empty: 21,100 lbs
Weight Loaded: 33,500 lbs
Power Plant: Two Wright-Cyclone air-cooled radials, at 1,700 hp each
Armament: Six .50-caliber machine guns
Ordnance: 3,000 pounds of bombs

Courtesy Foto Consortium

Top Speed: 275 mph
Range: 1,275 miles
Ceiling: 25,000 ft
Climb Rate: 1,100 ft/min
Maneuverability: Poor
Firepower: Good
Durability: Excellent

Martin B-26 Marauder

USAAF Bomber

Color illustration available

The B-26 Marauder was the standard 9th Air Force medium bomber deployed in Europe during the war. Its tricky handling characteristics and high stall speed earned it a reputation as a pilot killer early on in its career. Pilots looking upon its short, stubby wings and sleek fuselage for the first time christened the bomber the Flying Prostitute since it had no visible means of support! Fast and heavily armed, the B-26 was a formidable adversary in the skies above France and the Low Countries.

Specifications for the B-26
Type: Medium bomber
Nickname: Widow Maker
Introduced: Late 1941
Length: 58 ft 3 in
Wingspan: 65 ft
Crew: 7
Weight Empty: 22,380 lbs
Weight Loaded: 34,000
Power Plant: Two Pratt & Whitney R-2800 air-cooled radials, at 2,000 hp each
Armament: Eleven .50-caliber machine guns
Ordnance: 4,000 pounds of bombs
Top Speed: 317 mph
Range: 1,150 miles
Ceiling: 23,000 ft
Climb Rate: 1,250 ft/min
Maneuverability: Poor
Firepower: Good
Durability: Excellent

Courtesy National Air & Space Museum, Smithsonian Institution

Hawker Typhoon

RAF Fighter Bomber

Color illustration available

The Hawker Typhoon served as the RAF's principle ground attack fighter from late 1943 until the end of the war. Fast, heavily armed, and capable of inflicting massive damage to vehicle columns, the Typhoon became the scourge of the German armies in France by D-Day. Though it was an excellent attack aircraft, it did not serve effectively as an air superiority fighter, as the Bf 109 and the Fw 190 could both outmaneuver it. It did possess a slight speed advantage, which helped it escape from dangerous situations.

Specifications for the Typhoon 1B

Type: Fighter Bomber
Nickname: Tiffie
Introduced: Late 1941
Length: 31 ft 11 in
Wingspan: 41 ft 7 in
Crew: 1
Weight Empty: 8,840 lbs
Weight Loaded: 11,141 lbs
Power Plant: Napier Sabre IIb 24-cylinder sleeve-valve in-line liquid-cooled engine, at 2,200 hp
Armament: Four 20mm cannons
Ordnance: 2,000 pounds of bombs or 16 rockets
Top Speed: 422 mph
Range: 980 miles
Ceiling: 31,800 ft
Climb Rate: 3,900 ft/min
Maneuverability: Good
Firepower: Excellent
Durability: Good

A Hawker Typhoon. The four 20mm cannon this plane carried gave it immense firepower. Courtesy National Air & Space Museum, Smithsonian Institution

Hawker Tempest

RAF Fighter Bomber

Color illustration available

The Hawker Tempest was a further development of the Typhoon model. The primary difference between the two aircraft was that the Tempest employed a slightly different wing. Though not as maneuverable as many of the Luftwaffe fighters it faced, the Tempest ranks as one of the fastest and best fighters of the war.

Specifications for the Tempest V
Type: Fighter Bomber
Introduced: Spring 1944
Length: 33 ft 8 in
Wingspan: 41 ft
Crew: 1
Weight Empty: 8,969 lbs
Weight Loaded: 11,411 lbs
Power Plant: Napier Sabre IIb 24-cylinder sleeve-valve in-line liquid-cooled engine, at 2,200 hp
Armament: Four 20mm cannons
Ordnance: 2,000 pounds of bombs or 16 rockets
Top Speed: 442 mph
Range: 980 miles
Ceiling: 33,200 ft
Climb Rate: 3,360 ft/min
Maneuverability: Good
Firepower: Excellent
Durability: Good

Tempest V. Courtesy National Air & Space Museum, Smithsonian Institution

Supermarine Spitfire

RAF Fighter

Color illustration available

The Spitfire was one of the true classic fighter designs to see action in World War II. Powered by the high performance Merlin, then later Griffon liquid-cooled engines, later variants could reach speeds well over 400 mph. Few aircraft could outrun a Spitfire in level flight. The newer models used during the last year of the war retained all the Spitfire's legendary maneuverability and incredible rate of climb. The Mark XIV especially possessed excellent climbing characteristics, a decent roll rate, and the ability to carry rockets. Without a doubt, this was one of the best fighters of the war in Europe.

Specifications for the Spitfire IX, XIV
Type: Fighter
Nickname: Spit
Introduced: Early 1944
Length: 32 ft 2 in
Wingspan: 36 ft 10 in
Crew: 1
Weight Empty: 5,816 lbs (IX), 6,576 lbs (XIV)
Weight Loaded: 7,500 lbs (IX), 8,475 lbs (XIV)
Power Plant: Rolls Royce Merlin liquid-cooled engine, at 1,650 hp (IX); Griffon liquid-cooled supercharged engine, at 2,035 hp (XIV)
Armament: Two 20mm cannons and four .303-caliber machine guns
Ordnance: 500 pounds of bombs (IX), 1,000 pounds of bombs or eight rockets (XIV)
Top Speed: 416 mph (IX), 439 mph (XIV)
Range: 460 miles
With drop tanks: 850 miles
Ceiling: 43,000 ft
Climb Rate: 3,950 ft/min (IX), 4,580 ft/min (XIV)
Maneuverability: Excellent
Firepower: Good
Durability: Good

Courtesy National Air & Space Museum, Smithsonian Institution

DeHaviland Mosquito

RAF Fighter Bomber

Color illustration available

The Mosquito VI served as the RAF's primary pinpoint fighter bomber from its original deployment in 1943 until the end of the war. The Luftwaffe soon discovered that the Mosquito was nearly impossible to intercept since it possessed a top speed of 425 mph. This asset meant the RAF plane could speed into occupied Europe, hit its target, and run away before the Germans had time to respond. While it was not as maneuverable as the Luftwaffe's day fighters, the Mark VI could usually run away from a fight if need be. With its excellent bomb load and heavy armament, the Mosquito proved to be a devastating weapon.

Specifications for the Mosquito VI, XVIII

Type: Fighter Bomber
Nickname: The Wooden Wonder, Tsetse (XVIII)
Introduced: Early 1943 (VI), Late 1943 (XVIII)
Length: 40 ft 6 in
Wingspan: 54 ft 2 in
Crew: 2
Weight Empty: 16,631 lbs
Power Plant: Two Rolls Royce Merlin liquid-cooled engines, at 1,635 hp each
Armament: Four 20mm cannons and four .303-caliber machine guns (VI); one 57mm cannon and four .303-caliber machine guns (XVIII)
Ordnance: 2,000 pounds (VI) / 1,000 pounds (XVIII) of bombs, or eight rockets
Top Speed: 425 mph
Range: 1,120 miles
Ceiling: 26,000 ft
Climb Rate: 1,870 ft/min
Maneuverability: Fair
Firepower: Excellent
Durability: Good

The Wooden Wonder: The Mosquito was one of the most versatile planes of the war. Courtesy National Air & Space Museum, Smithsonian Institution

Messerschmitt 109

Luftwaffe Fighter

Color illustration available

The Bf 109 was the standard Luftwaffe day fighter throughout most of 1944-45. It was inferior to the Fw 190 in many ways, particularly in terms of its armament. Although the plane had a very limited ground attack capability, it was pressed into that role in France on occasion. The Bf 109 was a nimble, fragile aircraft that was outclassed by the P-51D in most areas. The Mustang, in particular, could turn inside the Bf 109, and outrun the G model. The Bf 109K proved to be a little faster than the more rugged Mustang. The 109 stayed in service long past its prime simply because no replacement was available for the Luftwaffe Jagdgeschwader.

As a bomber interceptor, the Bf 109 was a failure. Its light armament made it difficult to shoot B-17s down, especially in a head-on pass. The Bf 109s fragile construction also made it vulnerable to the massed firepower of the American bomber formations. Still, with little else to rely on, the Germans pressed their Bf 109 groups into action against Allied bombers. To beef-up their firepower, 109s occasionally carried external gun packs, usually 20mm or 30mm cannon, in wing gondolas. These extra guns helped considerably against bombers, but degraded the performance of the plane so seriously that they were easy prey for escorting Allied Mustangs and Thunderbolts. Turn radius, speed, and roll rate were all impacted severely by the underwing packs. Bf 109s also carried the Gr. 21 rocket mortar, but again the tubes carried under the wings decreased performance.

Specifications for the Bf 109G-6, Bf 109K-4

Type: Fighter
Nickname: Gustav (G)
Introduced: Spring 1942 (G), Winter 1944 (K)
Length: 29 ft 5 in
Wingspan: 32 ft 6 in
Crew: 1
Weight Empty: 5,893 lbs
Weight Loaded: 6,940 lbs
Power Plant: Daimler-Benz 12-cylinder liquid-cooled engine, at 1,475 hp (G) and 2,000 hp (K)
Armament: One 30mm cannon and two 13mm machine guns (G); One 30mm cannon and two 15mm machine guns (K)
Ordnance: 250 kgs of bombs (G), 500 kgs of bombs (K), or two Gr. 21 rocket mortars
Top Speed: 386 mph (G), 452 mph (K)
Range: 350 miles
With drop tanks: 620 miles
Ceiling: 35,105 ft (G), 41,000 ft (K)
Climb Rate: 3,393 ft/min (G), 4,880 ft/min (K)
Maneuverability: Good
Firepower: Average
Durability: Average

A mechanic refuels a Messerschmitt 109. Courtesy National Air & Space Museum, Smithsonian Institution

Messerschmitt 262 Schwalbe

Luftwaffe Fighter Bomber

Color illustration available

The world's first operational jet fighter, the Messerschmitt 262 was deployed in the summer of 1944. It was a good, capable aircraft, but its effectiveness was dampened by a myriad of troubles, most of which were never solved. Its first combat role consisted of high and medium level bombing sorties over the Allied beachhead at Normandy. Without a bombsight, however, these attacks were wasted effort, as the bombs never hit their intended targets. As glide-bombing tactics were later developed, the plane became a more effective ground attack platform. The 262 began use as a fighter in Autumn of 1944 and proved to be a superb weapon. because of its incredible speed, it could avoid Allied fighters and devastate bomber formations. Despite its speed advantage, however, it initially achieved only moderate success in air combat, which was due, in part, to the slow rate of fire of its cannons.

The Messerschmitt 262 was a fairly maneuverable plane for a twin-engined fighter, but could not turn inside any Allied fighter, relying instead on hit and run tactics. When going after American heavy bombers, 262s almost never used head-on passes, since the closure rate often touched 700 mph. Instead, they approached from behind and above the formation, diving down to the bombers altitude, then closing in, flying level and directly behind the formation. When in range, they would fire their rockets and finish their pass with cannon fire. If the opportunity availed itself, they would make another run then dive for home.

The 262 could have been an outstanding fighter had it not been for its unreliable Junkers Jumo turbojet engines. The pilot had to be very careful, lest he cause one to flame out, or catch fire and explode. Any heavy-handedness, such as shoving the throttles too quickly open or closed, could destroy the engines. Thus, the 262 was a fast aircraft, but took a very long time to throttle up to its top speed and proved especially sluggish at speeds under 300 mph. Above that speed, its acceleration was a little better.

Specifications for the Messerschmitt 262
Type: Fighter Bomber
Nickname: Turbo, Spook, Bogey, Blowtorch
Introduced: Summer 1944
Length: 34 ft 9 in
Wingspan: 40 ft 11 in
Crew: 1
Weight Empty: 8,378 lbs
Weight Loaded: 9,742 lbs
Power Plant: Two Junkers Jumo 004B Turbojets, at 1,980 lbs of thrust each
Armament: Four 30mm cannons
Ordnance: 500 kg of bombs or 24 R4M rockets
Top Speed: 540 mph
Range: 652 miles
Ceiling: 32,810 ft
Climb Rate: 3,937 ft/min
Maneuverability: Good
Firepower: Excellent
Durability: Average

Courtesy National Air & Space Museum, Smithsonian Institution

Focke-Wulf 190

Luftwaffe Fighter

Color illustration available

The Fw 190 entered service in the summer of 1941 with a squadron in JG-26. It quickly established an excellent reputation among its pilots for being an easy plane to fly. RAF and later USAAF aviators grew to fear the snub-nosed fighter, as it carried a heavy cannon and machine gun armament that could devastate even the most durable Allied bomber. Fast, maneuverable, and incredibly responsive, the Fw 190 became the best fighter deployed in numbers by the Luftwaffe during the war. In the front lines, it proved to be a very flexible aircraft, as its airframe could be modified for different combat duties. The 190F model, for instance, was a dedicated ground attack and bomber interceptor version that carried extra armor plating to protect the pilot and the engine. The 190D, the last major model of the 190 series, was pure air superiority fighter, one of the best of the war. Its roll rate and quick acceleration made it a formidable opponent, even for the vaunted Spitfire.

Specifications for the Fw 190 A-8, D-9, F-8
Type: Fighter (A-8, D-9), Ground attack fighter (F-8)
Nickname: Dora Nine (D-9)
Introduced: Mid 1941 (A-8), Mid 1944 (D-9), Mid 1943 (F-8)
Length: 29 ft 4 in (A-8, F-8), 33 ft 5 in (D-9)
Wingspan: 34 ft 5 in
Crew: 1
Weight Empty: 7,652 lbs (A-8), 7,694 lbs (D-9), 7,328 lbs. (F-8)
Weight Loaded: 9,660 lbs (A-8), 9,480 lbs (D-9), 9,700 lbs (F-8)
Power Plant: BMW 801D-2 14-cylinder radial, at 1,700 hp (A-8, F-8); one Junkers Jumo 213A-1 12-cylinder liquid-cooled engine at 1,776 hp, with MW50 injection up to 2,240 hp (D-9)
Armament: Four 20mm cannons and two

The ultimate version of the Focke-Wulf 190, the Dora-Nine. Courtesy National Air & Space Museum, Smithsonian Institution

13mm machine guns (A-8); two 20mm cannons and two 13mm machine guns (D-9, F-8)
Ordnance: 700 kg of bombs or two Gr. 21 rocket mortars
Top Speed: 408 mph (A-8), 426 mph (D-9), 394 mph (F-8)
Range: 500 miles (A-8, F-8), 520 miles (D-9)
With drop tanks: 942 miles (A-8, F-8), 800 miles (D-9)
Ceiling: 33,800 ft (A-8, F-8), 32,800 ft
Climb Rate: 2,350 ft/min (A-8), 3,123 ft/min (D-9), 2,110 ft/min (F-8)
Maneuverability: Excellent
Firepower: Excellent (A-8), Good (D-9, F-8)
Durability: Excellent

Arado 234B Blitz

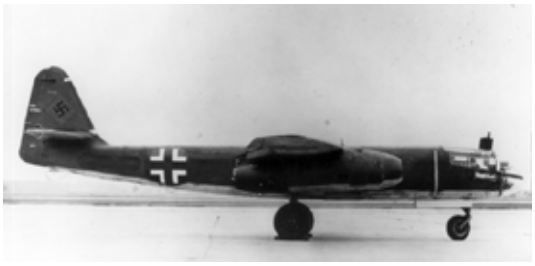
Color illustration available

Luftwaffe Light Bomber/Reconnaissance Aircraft

The Arado 234B was the first jet bomber ever produced for combat. Its revolutionary turbojet engines gave it remarkable speed, enabling it to escape from any Allied piston-engined fighter it faced. It was a relatively easy plane to fly, with docile handling characteristics. Problems with the rudder, however, made its directional stability rather poor. The Arado 234 would spin in most stalls, but usually for only one or two revolutions. Stall speed with flaps fully down averaged about 110 mph. Without flaps, the stall speed increased to a little over 150.

The Arado was initially deployed to reconnaissance units in the summer of 1944. Toward the end of the year, KG-76 received the B model and began flying pinpoint bomb raids with the new craft. The 234 saw service at the Battle of the Bulge, throughout the early months of 1945, and finally at the Remagen bridge. Escorted by Messerschmitt 262s, the Arados from KG-76 repeatedly tried to destroy the vital bridge over the Rhine, but to no avail. After March, conditions within Germany became so bad that few missions could be flown. Today, only one Arado 234 survives. It is on display at the Paul E. Garber Facility in Suitland, Maryland.

Specifications for the Ar 234 B
Type: Light Bomber/ Reconnaissance
Introduced: Winter 1944
Length: 41 ft 5 in
Wingspan: 46 ft 3 in
Crew: 1
Weight Empty: 11,464 lbs
Weight Loaded: 18,541 lbs
Power Plant: Two Junkers Jumo 004B Turbojets, at 1,980 lbs of thrust each
Armament: None
Ordnance: 1,800 kg of bombs
Top Speed: 460 mph
Range: 1,013 miles
Ceiling: 32,810 ft
Climb Rate: 3,350 ft/min
Maneuverability: Fair
Firepower: None
Durability: Poor



The Arado 234. Note the periscope on top of the canopy. It was a modified tank periscope used by the pilots to check their tails and drop their bombs. Courtesy National Air & Space Museum, Smithsonian Institution

Junkers 88

Luftwaffe Bomber

Color illustration available

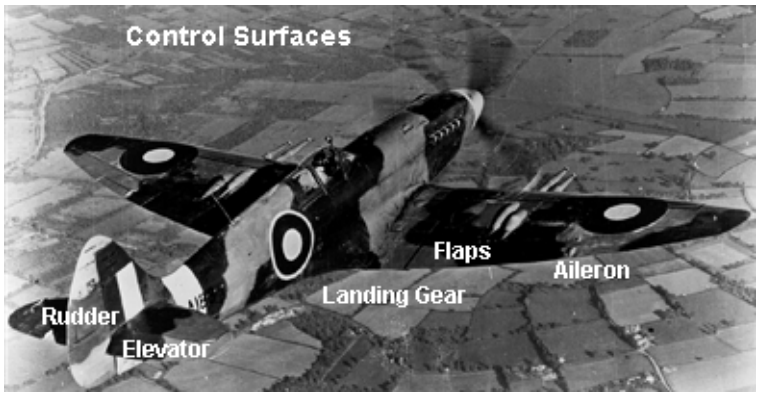
The Ju 88S was one of the final bomber versions constructed in Germany during the war. Shortly after production commenced, the Luftwaffe decided to concentrate its efforts on building fighters, and most bomber factories were converted. The Ju 88S was a lightly armed and armored bomber with speed as its greatest asset. With a nitrous oxide injection, the plane could reach nearly 400 mph. Such speeds made it extremely difficult to intercept.

Specifications for the Ju 88S

Type: Fast Light Bomber
Introduced: Early 1944
Length: 48 ft 9 in
Wingspan: 65 ft 7 in
Crew: 3
Weight Empty: 18,250 lbs
Power Plant: Two BMW 801G-2 14-cylinder radials, at 1,730 hp each
Armament: One rear-firing 13mm machine gun
Ordnance: 1,000 kg of bombs
Top Speed: 379 mph
Range: 1,400 miles
Ceiling: 34,000 ft
Climb Rate: 1,600 ft/min
Maneuverability: Fair
Firepower: Poor
Durability: Average

A Junkers 88 on a snowy runway. Courtesy Robert L. Lawson Photography

Flight



Control Surfaces and Movements

The pilot uses his airplane's control surfaces to guide it through the air. When an airplane is in flight, air is flowing quickly over its control surfaces. When a control surface is moved, it causes a pressure difference in the air flow. This difference will change the direction of the airplane.

The primary control surfaces are the ailerons, the elevators, and the rudder. With these, the pilot can perform three basic movements: bank, pitch, and yaw. Bank is the rolling motion of the airplane to the left or right. Pitch is the rotation up and down. Yaw is rotation in the flat horizontal plane to the left or right.

The ailerons, located on the wings, control the bank of the airplane. When the left aileron is raised, the right wing aileron will be lowered, and vice-versa. The ailerons are controlled by the stick. To bank to the left, move the stick to the left; to bank to the right, move the stick to the right.

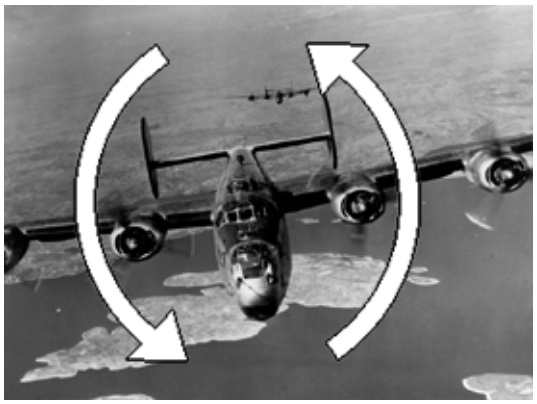
The elevators, located on the tail assembly, control the aircraft's pitch. When the elevators move down, the nose will pitch down, and vice-versa. The pilot controls the elevators with the stick. To nose the aircraft down, push forward on the stick. Pulling back on the stick will pull the nose of the aircraft up.

The rudder is located on the tail assembly. It controls the aircraft's yaw. When you move the rudder left or right, your aircraft's nose will yaw in the corresponding direction.

The flaps are located on the wings, inside from the ailerons. When the flaps are lowered, the shape of the wing is changed. The new shape increases the angle of attack of the wing. This will generate more lift. It will also increase the amount of drag on the airplane. Pilots use flaps to assist them in taking off and landing.

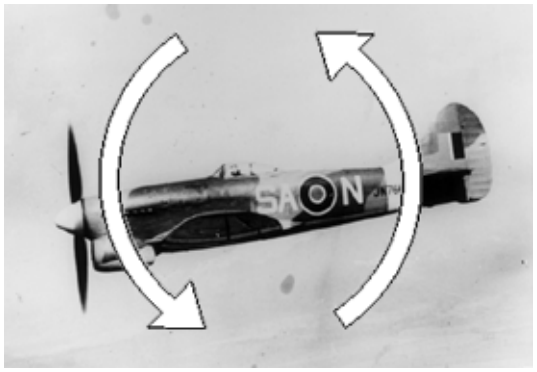
Most WWII aircraft had retractable landing gear. Once airborne, the pilot raises the landing gear to reduce the amount of drag.

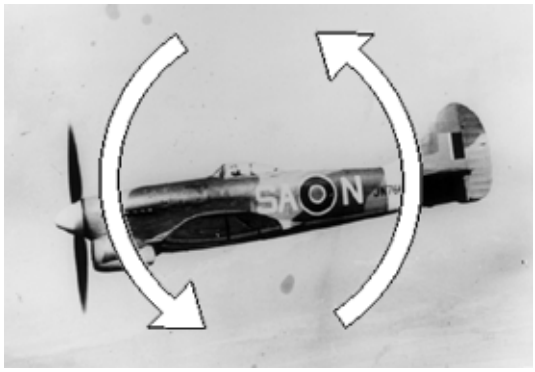
Bank



The ailerons control the airplane's bank. Move the stick to the right to bank to the right.

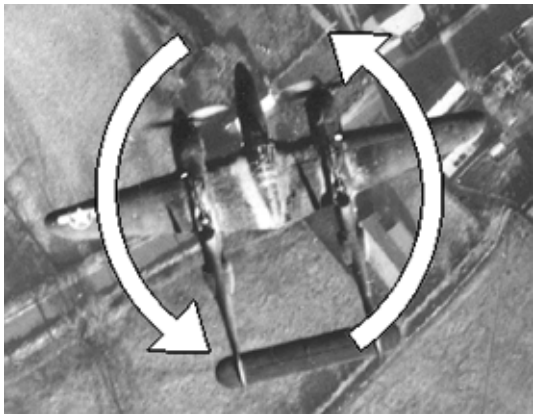
Pitch





The elevators control the pitch. To pitch down, push the stick forward.

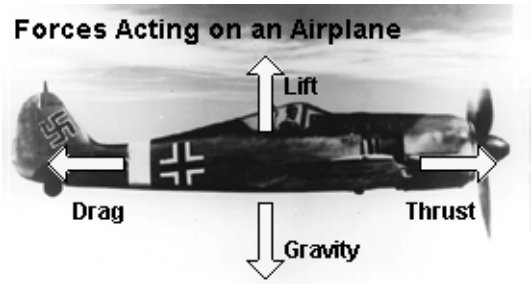
Yaw

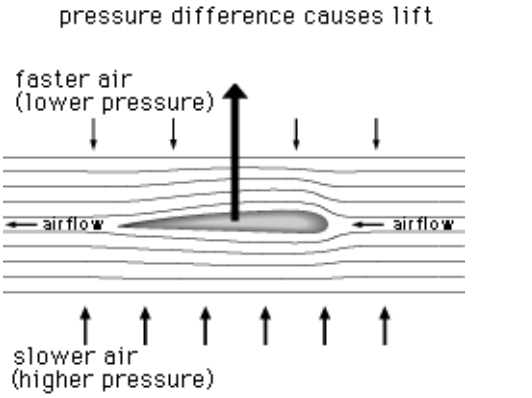


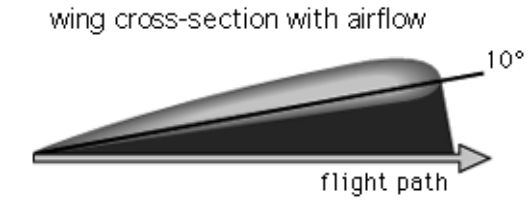
Yaw is controlled by the rudder. To yaw to the left, move the rudder to the left.

Physics of Flight

Four basic forces act upon an aircraft in flight: lift, thrust, gravity, and drag. While gravity is a constant that the pilot cannot control or alter, the pilot can affect the other three forces.







Lift
Lift is achieved through the design of the wing. As an aircraft moves, air flows over the surfaces of the wing. Wings have a special shape that forces the air to move faster over the top of the wing than the bottom. This creates a low pressure region above the wing. The pressure difference pushes up on the bottom of the wing, and lift is generated.

The angle at which the wing meets the airflow also affects the amount of lift generated. As this angle (known as the angle of attack) increases, more lift is created. However, if the angle of attack is too great, the air flowing above the wing will be disrupted, causing a sudden decrease in lift. This condition, known as a stall, occurs when the aircraft is either flying too slowly or flying at too steep an angle. When an aircraft stalls, the sudden loss of lift will force it into a dive. This is especially dangerous if the aircraft is at a low altitude.

The aircraft will recover from a stall when it has regained sufficient airspeed. Increasing airspeed increases lift. The more airspeed, the greater the difference between the air pressure above and below the wing, creating more lift.

Thrust
Thrust is generated by the rotation of the propeller. Propeller blades are shaped in a manner similar to the wings. However, instead of *lift* being generated (a movement upward), *thrust* (a movement forward) is created. To create more thrust, increase your throttle. Generally more throttle will increase your airspeed.

Drag
Drag is the friction caused by the aircraft's surfaces moving through the air. The more streamlined an aircraft, the less drag produced. Obviously, extended landing gear and lowered flaps will increase the amount of drag. Consequently, to achieve more efficient flight, a pilot will raise the landing gear and flaps after take-off.

When an aircraft is in level flight at a constant airspeed, all four forces (lift, thrust, gravity, and drag) are in balance.

Altitude
As a plane climbs to higher altitudes, the air thins out. This will affect the top speed the airplane can achieve. In the thinner air, the propellers cannot generate as much thrust. Also, the thinner air is lower in oxygen, and this will reduce the power output of the engine. These two factors decrease the overall thrust that the plane can generate. However, the thinner air has one benefit -- it will reduce the amount of drag on the airplane.

These effects combine in such a way that each airplane will have an altitude at which it can attain its best top speed. Below this altitude, the airplane is slower because of the increased drag. Above

this altitude, the airplane is slower because of the reduced thrust generated by the engine and propeller.

At some altitude, the thrust generated is not sufficient to generate any additional lift. This altitude is known as the ceiling of the airplane. The airplane is simply not capable of sustaining flight above its ceiling.

Some airplanes are equipped with a supercharger. It injects additional oxygen into the carburetor, allowing the engine to perform well at high altitudes. The P-38 Lightning was known for its superb high-altitude performance, thanks to its superchargers.

The thin air at high altitude also decreased the effectiveness of an airplane's control surfaces. Some airplanes were affected more than others, and became very sluggish and unmaneuverable.

G Force
G stands for the force of gravity. One G is the force experienced by a person standing on the Earth. When an airplane changes its orientation rapidly (as in a tight turn, loop, or other violent maneuver), it will experience additional G forces.

Positive Gs are generated when the airplane turns quickly or pulls up rapidly (as at the start of a loop). WWII aircraft were capable of generating 7 Gs or more. This is a force equal to seven times the force of gravity. These G forces have a physical effect on the pilot. In a high G maneuver, less blood is pumped to the pilot's brain, possibly resulting in a blackout. Occasionally in extended high G maneuvers, WWII pilots did black out.

Negative Gs occur when the airplane quickly noses down, as, for example, when it first enters a dive. Excessive negative Gs can cause a pilot to lose consciousness because of too much blood in the brain. Known as a red-out, this effect was virtually non-existent in WWII air combat.

Compressibility
When approaching the speed of sound, some airplanes will undergo an effect known as compressibility. Depending on the airplane, this effect will occur somewhere between mach .7 and .9 (520 and 670 mph).

Compressibility is caused when the air flows over the wing at speeds greater than the speed of sound (the speed of air flowing over the top of the wing is greater than the speed of the airplane). This transonic airflow creates a shock wave that disrupts the flow of air over the control surfaces. The result is a loss of effectiveness in the control surfaces.

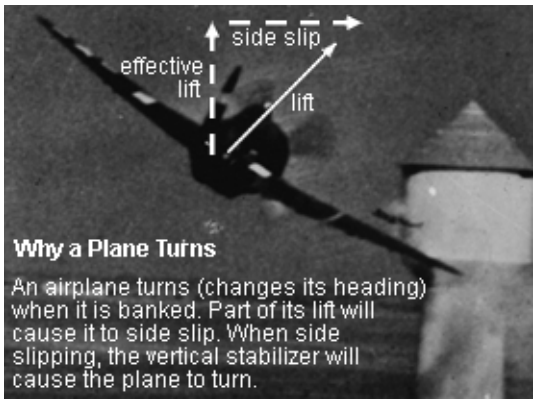
WWII airplanes would only experience compressibility in high speed dives. Compressibility was a very dangerous condition, making the ailerons and elevators virtually useless. The best course of action is to reduce throttle, and drop the flaps or even the landing gear to slow the airplane. Once it does slow, the pilot will regain control of the elevators to pull out of the dive.

Basic Flight Skills

Takeoff
To begin your takeoff, put your flaps halfway down and release the wheel brakes if they're on. Throttle up to about 90 percent of full. When the airplane has gathered enough speed, the tail will come up off the ground. When your speed reaches 95 mph, gently pull back on the stick. Your airplane will lift off the ground. Don't climb too steeply or your aircraft will stall, with no room for recovery. Once you've climbed to about 100 feet, retract your landing gear and raise your flaps.

Climbing
To start a climb, increase your throttle. You will begin gaining altitude gradually. To climb rapidly, increase the throttle and pull back on the stick to bring the nose of the aircraft up. The resulting increase in the angle of attack will generate more lift. Don't bring the nose up too far or your aircraft will stall. To achieve the best sustained climb rate, use full throttle with your aircraft's nose about 20 degrees above the horizon.

Descent and Diving
To descend without gaining speed, decrease the throttle. The reduced airspeed will generate less lift, and your airplane will gradually lose altitude. You can also descend rapidly by entering a dive. Push the stick forward to nose the airplane down into a dive. Your airplane will gather speed quickly and lose altitude rapidly. Be careful not to dive too steeply. The resulting high speed may cause compressibility or damage your airframe.



Turning
Bank your aircraft with the ailerons by moving the stick to the left or right. The more you bank, the greater the turn rate and the tighter the turn radius. You must also increase the throttle, as turning will bleed off speed. In tight turns, your airplane will lose more altitude, so you'll need to increase throttle more and keep the airplane's nose above the horizon. With the standard or expert flight model selected, you should also apply a little rudder and some back pressure (by pulling back on the stick) to maintain a well-coordinated turn.

Recovery from a Stall
Allow your aircraft to nose down. Don't fight the stall by pulling back on the stick. When the aircraft picks up enough speed, it will recover from the stall. Pull back on the stick gently to level out.


A battle-damaged Thunderbolt crash-lands on the Marsten Matting of an American airfield in France. Courtesy National Air & Space Museum, Smithsonian Institution

Recovery from a Spin
A spin is an aggravated stall that occurs when one wing stalls before the other. Normally this happens when the plane is maneuvering near the critical angle of attack and it stalls, as in a steeply banked turn. The stalled wing will lose lift and drop, while the lift and the drag of the other wing will induce the plane to rotate. The result is a corkscrew descent. To break the stall, the plane's rotation must first be stopped. The recommended recovery procedure is to:
1. Neutralize the ailerons by centering the stick.
2. Apply full rudder deflection opposite to the direction of the spin.
3. Push the stick forward to allow the plane to nose down.
4. Hold these control inputs until the plane stops rotating.
5. When rotation stops, center the rudder and gently

pull back on the stick to return to level flight.

Landing on an Airfield

First, line up with the runway. Position yourself about 3 miles out from the runway at an altitude of 500 feet. Reduce your throttle to about 70 percent of full. Lower your landing gear and drop your flaps all the way. With the flaps lowered your stall speed is reduced and you can approach at a lower speed and a steeper angle. Now, nose your airplane into a gentle descent. Reduce your throttle until you are flying at 10 mph greater than the stall speed. When you are over the runway and 25 feet up, cut your throttle and pull your nose up. If you've properly executed everything up to this point, you will gently settle down onto the runway. The best landing is a three-point landing, when the wing wheels and tail wheel all touch the ground simultaneously.

Flight Model Settings

In *Aces Over Europe*, you can set the level of flight realism to match your flight experience. So if you're a newcomer, you can jump right in to experience the thrill of WWII air combat. If you're a flight veteran, you can fly with a more challenging, realistic flight model. With the Realism Panel, you may set the flight realism to Novice, Standard, or Expert.

On the Novice setting, flying is easy. Turns are simplified so that you do not need to use the rudder or apply back pressure. When banked, the aircraft will turn without losing altitude or nosing down. Your landing gear will be automatically lowered when you touch down. Finally, your airplane will perform as if it were clean (carrying no bombs and additional fuel).

On the Standard setting, turning is modeled more realistically. You will lose altitude if you don't keep the nose above the horizon by applying back pressure (pulling back on the stick). Some rudder may be needed as well. Without rudder or back pressure, your turn may degenerate into a slow spiral dive. On Standard, the requirements for a safe landing are stricter than on Novice. High altitude will decrease the maneuverability of your airplane. On this setting, unlike the novice, bombs and additional fuel will decrease your plane's lift and climb rate. Your landing gear will not lower automatically when you touch down, so you'll have to remember to lower it.

The Expert setting will test your flying skill. In addition to the more realistic effects included on the Standard setting, the various quirks of certain aircraft are included. Some airplanes will experience compressibility in steep dives. High speeds may also damage your plane's airframe. Some airplanes are susceptible to spins (a very nasty kind of stall) as well. Safe landing requirements are even stricter, and turning is more difficult.

Combat Hints & Tips

FLIGHT MODEL AND COMBAT HINTS

Many changes have been made to the flight model since Aces of the acific. Some of these changes include: more severe stalls, spins, more accurate modeling of the effects of flaps, gear and flap damage at high speeds, "ground effect," more accurate top speeds and ceilings, more accurate stall speeds that vary by aircraft type, more accurate modeling of mass and drag from ordnance, and more realistic acceleration. Because of these changes, as well as the introduction of new weapons, mission types, and other features, we offer you the following hints on gameplay:

Some planes are almost impossible to spin. Others spin altogether too easily. A good pilot learns his plane's spin characteristics under safe conditions, rather than in the middle of a dogfight.

The first time you get in a spin you may have some difficulty recovering. To recover easily, center your joystick, apply rudder opposite to the direction of your spin, and then pull up gently once the stall light goes out. Spins near the ground are deadly -- don't ignore the stall buffet if you can't afford to spin.

Ordnance and drag -- Ordnance (bombs, rockets, drop tanks, or external guns) mounted on your plane will degrade your performance. Dogfighting with bombs under your wings puts you at an extreme disadvantage. External guns may give you incredible firepower, but the cost in performance can make living to use it very tough.

Scramble Missions -- Your planes are often loaded up with ordnance, ready to go out on a different mission, when enemy aircraft are sighted. If you are flying single missions, or are the flight leader in a career, you can change the ordnance in the preflight options screen. If you aren't the flight leader, be prepared to jettison the ordnance, or fight at a tough disadvantage.

Rockets -- The GR-21 rocket is actually a mortar round, and fires up, away from your aircraft. Learning to lob it into a bomber formation can be very tough. You may be given this rocket for ground attacks or anti-shipping attacks. A player who can hit tanks with the GR-21 has reason to be proud.

R4M rockets, on the other hand, are very powerful weapons. They fire all twenty-four rockets in a salvo, so pick your shots well. They also have an arming distance to prevent you from being caught in your own blast. If they aren't exploding, you may be too close.

Both rockets do blast damage, and you get credit for bombers destroyed in the blast, and both may force bombers to break formation, making them easier targets.

Medals and promotion -- Medals are awarded solely on the number of "kills" your pilot has. Promotions, on the other hand, are based on how well you pilot has been achieving his mission goals. Some pilots may be heavily decorated, yet not promoted, while others move quickly through the ranks without ever receiving a medal. It is entirely dependent on your playing style.

In any mission type there is a possibility that enemy fighters may be over or very near your base. This is especially true for the German pilots. Aircraft sometimes seem to come out of nowhere, so stay alert.

Remember, the Me-262 is not built for dogfighting. Your advantage is speed. Do hit-and-run tactics instead of getting into a turning war. This may take some practice to perfect.

Top speed varies by altitude. You may find yourself being outrun by a "slower" aircraft if his top speed happens to be at an altitude where your aircraft performs badly. For instance, the Spitfire has a rated top speed that is 31 mph faster than the Fw-190A, but at under 5,000 feet it is only 2 mph faster than the 190A, and at over 30,000 feet the Spit can be as much as 100 mph slower than the 190A.

More ground targets now have machine gun fire, and there are often flak tanks mixed in convoys. Be careful.

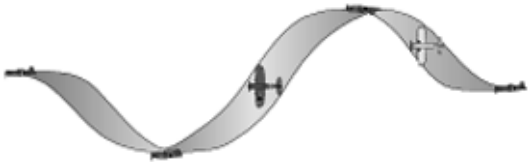
You can score far more points if, instead of merely autopiloting ome after achieving your mission, you patrol and attack ground targets that present themselves. This can be a great way to improve your score on an uneventful Escort Bombers mission. But be sure to watch your fuel, and conserve a little ammo in case there are enemies on your return path.

Flight Maneuvers

Break Turn

A break is a very tight turn at a high angle of bank, assisted by the elevators. Simply bank hard to one side by moving the stick to the right or left. Once the plane has rolled 45-70 degrees, pull back on the stick to sharpen the turn. If you should start to lose altitude, increasing back pressure on the stick or reducing your bank angle should raise your nose. A break is useful when you want to quickly change direction. It can be used when you see bandits that you wish to attack, or as an evasive maneuver.

Barrel Roll



When performing a barrel roll, your plane will cut a corkscrew path across the sky. To execute a barrel roll, bank sharply in one direction while pulling back slightly to maintain rotation about the roll axis. Maintain this bank as your plane inverts (at top of the roll) and continues along the roll until returning to level flight (at the bottom of the roll). A barrel roll can be used as a defensive maneuver when the enemy is on your tail. A perfect barrel roll can be performed without a loss of altitude, but it is very difficult. Most pilots will lose altitude in a barrel roll.

Immelmann

An Immelmann is a climbing half loop combined with a half roll. The result is reversed direction at a higher altitude. At the beginning of the maneuver, your plane should be flying level at a high speed. Begin by increasing your throttle and pulling back on the stick. As the plane reaches the top of the half loop, it will be inverted. Push the stick to the right or left so that the plane will roll to one side, and maintain the roll until your plane is right side up. Upon completion of an Immelmann, you plane should be at a higher altitude and travelling in the opposite direction from your initial compass heading. The Immelmann can be a useful pursuit maneuver when you pass beneath an enemy travelling in the opposite direction.

Loop

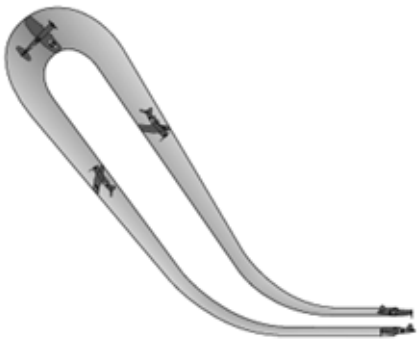
A loop is a full 360 degree rotation in pitch. Gain plenty of speed before beginning a loop (a loop is

plenty of speed before beginning a loop (a loop is often preceded by a dive). Increase the throttle to full and pull back on the stick to nose up. The plane should be upside down at the top of the loop. Maintain back pressure on the stick and complete the loop, flying level at the end of the maneuver. The plane should be travelling at its initial compass heading, but at a lower altitude.

Split-S

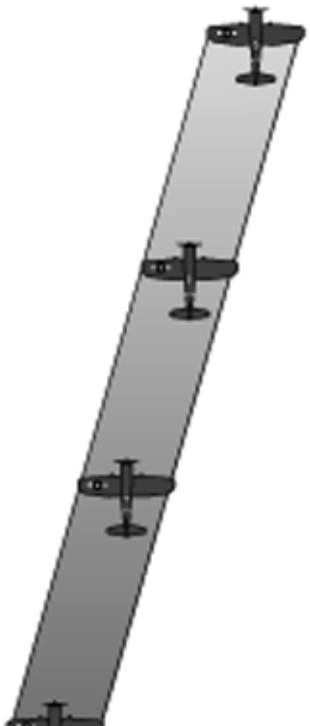
A split-S combines a half roll with back pressure on the stick to perform a half loop. First, roll the aircraft 180 degrees so that the plane is upside down. Then stop the roll and pull back on the stick to execute a half loop, returning the aircraft to level flight. This maneuver reverses the planes direction while losing altitude. Although it can be used to engage an enemy flying beneath you in the opposite direction, the Split-S will greatly increase your speed. This makes the maneuver ill-suited to planes that easily suffer from compressibility problems (most notably the P-38 Lightning).

Wing Over

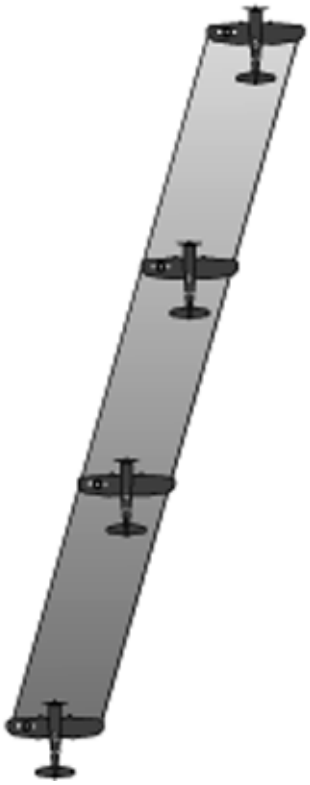


In a wing over, your plane behaves somewhat like a marble rolled up a ramp; gravity draws it back down to where it started. Rather than using ailerons to execute this 180 degree turn, pull back on the stick to begin a steep climb. As the plane nears a stall, use full rudder to yaw the plane over until its nose is pointing down in the opposite direction of the climb. This is a tricky maneuver, but it is useful after a diving attack, allowing a quick return for a second pass.

Skid

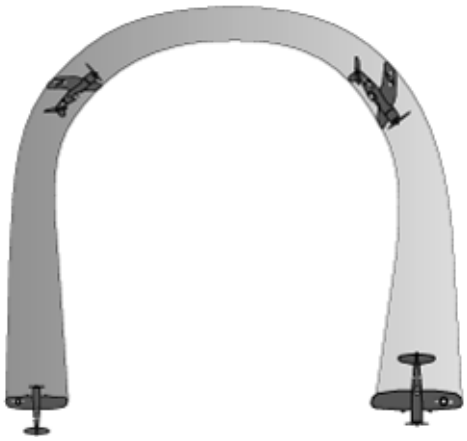


A skid appears as a lateral slide with a gradual loss of altitude. While dipping one wing, apply opposite



of altitude. While dipping one wing, apply opposite rudder to prevent yaw (your compass heading shouldn't change significantly). The plane will skid in the direction of the dipped wing as altitude is lost. A skid can be used to lose altitude without incurring a large increase in speed or a drastic change in heading. U.S. pilots would use an extreme form of skidding to throw off the aim of an attacker. When the American plane started to skid to one side, the attacker would turn (rather than skid) to pursue, causing his guns to drift off target.

Chandelle



A chandelle is a slow-climbing turn through 180 degrees. Beginning from level flight, move the stick to the right or left and gently pull back to increase elevation. Don't bank too steeply or you will perform a break turn (and lose altitude). Maintain this rising turn until you have turned 180 degrees. When you have completed this maneuver, you have reversed your direction and gained altitude.

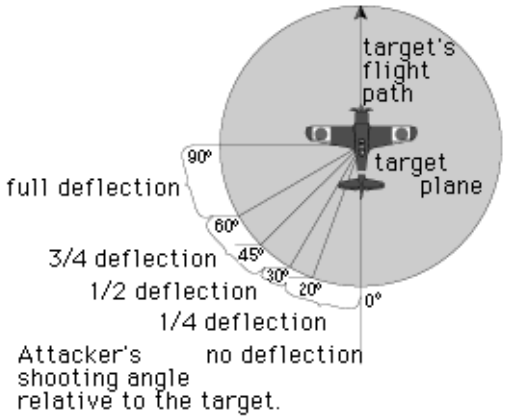
Air Combat Tactics

Test firing a Typhoon's guns at night. Courtesy National Air & Space Museum, Smithsonian Institution

Gunnery

The goal of air combat is to shoot down enemy aircraft as quickly as possible with minimum risk to yourself. To this end, your airplane becomes a weapon that must be pointed at the desired target, moved within range, and fired. A seemingly simple task, it is complicated by a target that is always in motion.

Deflection Shooting



If an enemy plane is moving directly toward (head-on) or away from you, you must close in to the distance necessary for your weapon to be effective, take aim, and fire. This situation is known as a direct, or **zero deflection** shot. It is the rare instance when the forward movement of the target does not affect where you aim. More often, you are forced to fire your shot from an angle, rather than from directly in front of or behind the enemy craft. In this instance you must take the enemy's forward movement into account, aiming at the point where he will be by the time your bullets reach his craft. "Leading" with your aim to place your bullets in a place that the enemy *will be* is known as **deflection shooting**.

During the war, few fighter pilots could hit anything when a high deflection shot was required. To remedy this, new gunsights arrived late in the war that calculated lead and deflection for the pilot. These were of limited use, however, and the better pilots often preferred the standard reflector sights. To minimize deflection, attacks were preferably made from head-on or dead-astern. The mark of an outstanding fighter pilot was the ability to hit targets in high deflection gunnery runs.

Gunnery Tactics

Like all combat maneuvers, finding the optimal shot requires that the pilot be acutely aware of the plane's capabilities, the surroundings, and the capabilities of the enemy.

A head-on pass sets you up for a no-deflection shot. However, you will have very little time to aim and will be flying directly into the enemy's line of fire. If the enemy has superior firepower, trading blows with him in this way is suicide and another tactic should be chosen. Against heavy bombers such as the B-17G, such attacks, while still very dangerous, can generally produce very good results.

A stern attack, like the head-on pass, also sets you up for a zero deflection shot. However, since the enemy is not closing on you (or moving away at an angle), you will have ample time to set up your shot. This is assuming that you can keep on the enemy's tail and that he doesn't have a rear turret. Stern attacks on aircraft equipped with rear defenses are extremely dangerous. You may have a near zero deflection shot on the enemy, but the enemy will have the same on you. The best way to dispose of an enemy aircraft is to surprise it from the rear. While he is recovering from his shock, you have a few precious seconds to pump him full of lead.

R.H. Harries Courtesy National Air & Space Museum, Smithsonian Institution

The range at which you open fire is vital. Firing at long range is a waste of ammunition, and may alert an unsuspecting enemy to your presence. A good pilot will hold back from firing until in close range. Veteran pilots of the war observed the following -- don't fire on an enemy plane until you are close enough for his plane to fill the view within your sight.

Fighter Combat

While there are no quick and easy steps to success in aerial combat, there are basic lessons from which to build a solid, and hopefully long-lived, combat career. The following rules have evolved from the first days of air combat in WWI to the years of training and battle experience that marked the end of the Second World War.

Detection
The first phase of combat engagement is known as **detection**, the instance when the enemy sees you or you see the enemy. As a combat pilot, it is this initial phase of an encounter that will determine whether you will be on the *offensive* or *defensive* . If you spot the enemy first, you will have the opportunity to secure advantages such as height and position before choosing if and when to engage the enemy.

Dick Turner. Courtesy National Air & Space Museum, Smithsonian Institution

While detection encompasses many factors -- AWARENESS is the most important. You must keep a constant and vigilant watch for the enemy -- ahead, to the left side, to the right side, above and behind. Known as rubber-necking, veteran pilots constantly scanned the sky for bandits (enemy fighters). Any pilot will tell you that to focus straight ahead is to invite disaster. Several factors should be foremost in the minds of all pilots.

The seat and fuselage on many aircraft create a blind spot behind the pilot. For this reason, it is easy for a flight to be surprised from behind by a bandit. Some aircraft have a bubble canopy, affording visibility to the rear. Even in these planes, however, the inconvenience of constantly rubber-necking and looking to the rear has caused more than one pilot to relax his guard, only to be bounced from behind and shot down by an unseen enemy. Consequently, it is an essential discipline for pilots to look back frequently -- also known as "clearing your tail" or "checking your six."

In formations of two or more planes, the role of keeping a watch behind -- checking the six of the section -- was assigned to the wingman. His primary role was defensive, preventing the flight from being surprised by a rear attack. The role of the wingman as watchdog for the vulnerable rear of the flight freed up the flight leader to concentrate on proper navigation to the target and to keep a vigilant watch for enemy aircraft ahead.

Visibility decreases as weather conditions worsen. Again, a seemingly obvious note but an important one. Clouds can conceal you (and the enemy), thus making detection much more difficult.

The glare of the sun can be a natural blind spot. A plane flying into, or out of, the sun can be virtually invisible. Again, the most deadly enemy is the one never seen, and flying out of the sun is a common combat tactic.

Once detection is made, the engagement enters the closing phase of combat.

A formation of P-47s. Courtesy National Air & Space Museum, Smithsonian Institution

Closing
If you've gained first sighting of the enemy, the next move of combat is in your hands. If you are undetected, you should secure all available advantages before engaging the enemy. These advantages are:

Height -- Gaining a vertical advantage on the enemy is a key tactic in air combat. With height comes the ability to control when a fight begins. Height also gives you the advantage of speed, as altitude can be converted into a fast diving attack on the enemy. The speed gained from this dive can then be converted back into altitude by pulling the plane into a climb.

Sun and Weather -- Use the elements of nature to your advantage. Position your attack so that you fly out of the sun, thus taking advantage of the sun's blinding effects. Utilize cloud cover to mask your approach on the enemy.

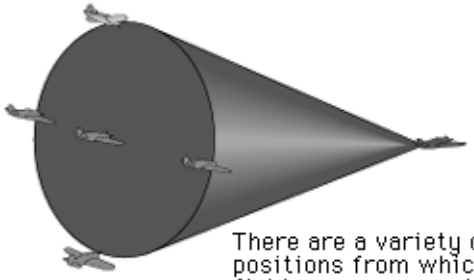
Use your position to your advantage. If you are above or behind the enemy when you gain first sighting, choose an approach that maintains your concealment for as long as possible.

Attack
When you have analyzed the situation and begin closing on the enemy, you must decide on the style of attack you will use.

Attacks Against Fighters
In WWII, there were two main schools of thought on air combat tactics: dogfighting versus hit and run attacks. The primary attacking decision a fighter pilot must make is which style of combat to employ. Dogfighting will favor the more maneuverable airplane with the tighter turning radius. Hit and run attacks require that your airplane can dive faster than the opponents. If you have no altitude advantage and it appears that your plane is outmatched in both speed and maneuvering, the best course of action may be to avoid combat and run. It's not something you'll brag about back at base, but it's the smart thing to do if you're outmatched and have the chance to get away.

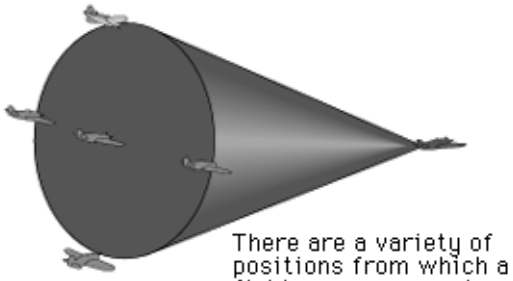
Attacks Against Bombers
Air combat against bombers differs from that against fighters because bombers are large and possess poor maneuvering abilities; they are incapable of the evasive tactics available to fighters. Countering the bomber's weaknesses in speed and maneuverability, they possess gun turrets for protection. This makes stern attacks on bombers extremely risky. A bomber's gunner can easily target a rear-attacking aircraft, having ample time to line up a shot at a craft that is moving straight into the line of fire. Your attack must take this heavy defensive capability into consideration. Five main tactics have evolved for attacks against bombers:

Stern Attack



There are a variety of positions from which a fighter can approach a bomber from astern.

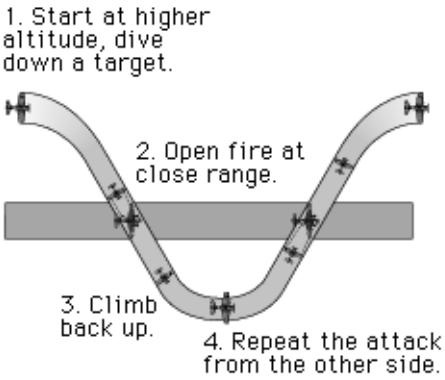
The simplest, and most dangerous tactic to use against a bomber, the stern attack, doesn't require



There are a variety of positions from which a fighter can approach a bomber from astern.

against a bomber, the stern attack, doesn't require great flying skill. The move has many variations, but is essentially an attack from behind that gives you a straight-on shot at the enemy with nearly unlimited firing time.

The High and Low Side Attacks



The side attack comes in two main variations, High and Low. Both variations use the same technique, but from different starting altitudes. Both require a high degree of skill at deflection shooting. The side attack begins from a position above the enemy, moving in the same direction yet slightly ahead and to one side. Turn toward the enemy then swing your plane around until you are facing him at about a 45 degree angle. Double back until you are directly beside the enemy, then reverse your turn until you are again heading in the same direction. This tactic quickly brings you into position for a full deflection shot at the side of an enemy plane. As you hold your course, the deflection lessens to the point where a full stern attack is possible. Usually, the attack is broken off before one quarter deflection is reached, the attacking pilot breaking away beneath the enemy.

The most effective of the side attacks is the High Side Pass, which is initiated from a position 1,200 - 1,500 feet above the target. The speed gained from a high side pass is sufficient to zoom-climb after the attack, therefore allowing the pilot to reposition for another run. The Low Side attack is not as effective for repositioning the attacker after the initial run, but requires only a 400-600 foot altitude advantage. Both forms of side attacks will place you into firing position without risking attack from the enemy's rear gunners. because of the angle and speed of attack, defensive gunners are faced with a rapidly changing rate of deflection and will find it difficult to pin you down.

Overhead Pass

The overhead pass is the most demanding of the anti-bomber tactics. It was not widely used by WWII pilots, because of its great difficulty. It requires an altitude advantage of at least 2,000 feet, a starting position well ahead of the enemy, and 2,000 feet of airspace *below* the enemy to allow for recovery and pull-up. It is an extremely difficult move, requiring a great deal of practice to perform smoothly. When properly executed it can be deadly, positioning you for blows on the enemy's engine and fuel tanks and baffling the opposing gunners with a quick moving target.

There are two variations of the overhead pass. Which one to use depends on whether you are heading in the same or opposite direction as the enemy. If you are heading the same direction, the move is executed by pulling a nose-high 180 degree turn toward the enemy plane. Because the turn is made from a position ahead of the enemy, you will find yourself pulling around to face your

target. The turn is completed when you have pulled yourself into the vertical plane of the enemy's craft and have flipped your plane into inverted flight (making it very easy to keep the enemy in sight). When you are directly over the target, drop your nose and dive down upon the enemy. The angle of attack should be near 60 degrees, positioning you for a high stern attack. The move is completed by cutting behind and below the target at a 45 degree angle. With the speed generated from your dive, you should easily be able to pull up to a higher altitude and set up for another attack.

To carry out an overhead from the opposite direction, position yourself above and directly in front of the enemy, keeping your craft in the enemy's vertical plane. Drop one wing to the side to keep the enemy in sight and, at the right moment, flip over into inverted flight and carry out the move. Performing the overhead approach from the opposite direction of the enemy is less complicated than from the same direction, but the closing speeds of the two craft make timing your moves more difficult. Great skill is required to execute the dive from inverted flight so that you are properly positioned behind the enemy.

Head-on Pass

By 1943, most German home defense squadrons discovered that the Achilles heel of the American bomber formations lay in the weak nose armament carried by the Forts and Liberators. To exploit this weakness, the Germans would fly above and ahead of a bomber formation, then execute a 180 degree turn and dive toward the approaching Fortresses. The Germans would spray the bombers with cannon fire, aiming for the engines and cockpit. They would then roll on their backs, dive through the formation, and split-S to make their escape. Such tactics proved highly successful if given the time to set up the attack runs properly.

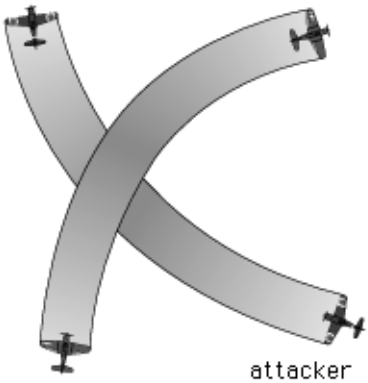
Defensive Tactics

The best defense is a good offense! This describes one of the fundamental rules of air combat -- detect the enemy first. There can be no substitute for a careful and vigilant watch that gives you first sight on the enemy. However, if first detection is lost, you'll find yourself on the receiving end of gunfire and must go on the defensive.

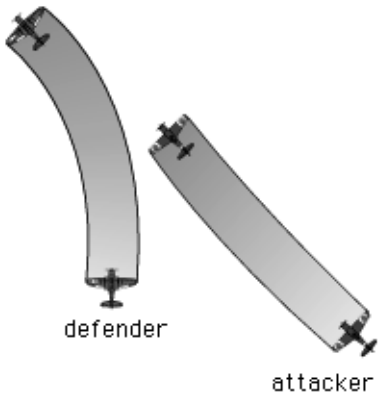
Evasive Tactics

If the wingman is too far away to offer assistance or if the attacker has already opened fire, evasive action is called for. The most common evasive tactic is to *break* -- perform a rapid, elevator assisted turn. This will increase the deflection angle for the attacker, making his shot on you more difficult.

In this situation the defender has correctly chosen to turn toward the attacker. Although he will pass through the line of fire of the attacker, it will only be for an instant. The attacker will not be able to follow the defender through his turn.



The defender has chosen to go with his natural instinct - to turn away from the attacker. The end result is that the attacker ends up on the tail of the defender with a relatively easy shot.



Always break toward the attacker! While breaking away may seem the logical move, it positions you as an easier target for the attacker (see illustration). Breaking is most effective when the enemy is attacking from the side.

Other evasive maneuvers include the split-S, Immelmann, loop and barrel roll. Climbing or diving out of combat can also be employed, depending upon the strengths of your airplane. In general, each plane type has maneuvers that are best suited to it. The P-47, with its great power and weight, could dive and gather speed like no other fighter in WWII. Hence, diving was a preferred evasive tactic by P-47 pilots.

In an instance when an attacker is extremely close, climbing, diving, or performing a break-turn will often leave you exposed to the enemy's guns for too long. In this situation, a high-speed skid is the best evasive tactic. Stomp on the rudder and apply reverse ailerons to throw your plane into a side-slip and throw off the aim of your attacker. When the high-speed skid is combined with a simultaneous dive, it is extremely difficult for the enemy to maintain his aim.

These tips can be useful but keep in mind that personal experience is the best teacher. Let this guide you in discovering which maneuvers you prefer to use with different aircraft.

The Wingman's Role and the Two-Plane Element

The role of wingman is vital in both Allied and Luftwaffe combat tactics. Operating with a flight leader, the wingman completes a mutually protective unit, with the wingman watching a flight's six so that the flight leader can concentrate on the skies ahead. The two planes also serve as protection for each other, a readily available defensive partner in the event the flight is jumped.

A B-26 crew poses in front of their plane. Courtesy National Air & Space Museum, Smithsonian Institution

As the rear watchdog for a flight, the wingman follows the lead from the wing leader at each and every turn. Playing a more offensive role, the wing leader selects the targets and determines the tactics of engagement. Once an attack has been launched, both the flight and wingman can engage the enemy. However, the primary responsibility of the wingman is to maintain a watch over the section's six and protect the wing leader. A wingman should NEVER leave the wing leader, even if targets present themselves as easy kills.

Special Tactics

Glide Bombing
In a glide-bombing run, the attack is made in a 20 degree dive. The move is much less accurate than dive-bombing, but easier to perform. It was a tactic widely used by inexperienced dive-bomber pilots and fighter-bombers.

Skip Bombing
This type of attack method was used on occasion in Europe to strike tanks and other ground targets. The Germans failed to develop an effective aerial anti-tank rocket before war's end, and the Luftwaffe Jabos found themselves forced to improvise. Some pilots preferred to dive down to absolute tree-top level, no higher than 20-30 feet, where they released a delayed-fused bomb as they perpendicularly approached an enemy tank. The bomb would strike the ground, then skip like a stone across a pond, right into the side of the tank. The delayed fuse ensured that the pilot would not be destroyed in the ensuing blast. Skip bombing also was used against shipping, though not nearly as frequently as in the Pacific Theater.

Strafing

A P-47 strafing an airstrip. Courtesy National Air & Space Museum, Smithsonian Institution

There are two basic techniques employed for strafing. In practice, frequent combinations of these two styles are employed. The first begins with a high altitude approach near 10,000 feet. When the target is spotted, you implement a steep dive with the enemy in your sights. When you are within weapons range, fire on the enemy and then pull up and around. The speed from the dive will allow you to climb back into position for another attack. The second technique relies upon the speed of your craft and the element of surprise. Closing upon the target from an extremely low altitude, begin firing on the enemy when you are within range. Walk the rudder (alternately depress the left and right rudder pedals) as you fire to spray your shots in an arc.

Rocket Attacks
A rocket attack against a ground target uses the same basic approach as the glide-bomb attack. From a target distance of 1,000 feet or less, fire the rocket with the target in your sights and quickly pull up. In the European Theater, rockets were used against ships, ground targets, and vehicles.

Against planes, the German GR. 21 rocket mortar was at best a mediocre weapon. It had to be launched from directly behind a bomber stream, approximately 1,000 yards away. The rockets would arch out over the formation, run out of fuel, then drop into the bombers and explode by either a time or proximity fuse. Needless to say, the weapon did not lend itself to accuracy. The late-war arrival of the R4M rocket gave the Germans a much better air-to-air rocket, but it was too late to affect the outcome of the war. These rockets proved accurate and were fired on a flat trajectory, making aiming much easier.

Weapons & Ordnance

Servicing the guns on a P-47 Thunderbolt. Courtesy National Air & Space Museum, Smithsonian Institution

Guns

USAAF

Hubert Zemke Courtesy National Air & Space Museum, Smithsonian Institution

.50-Caliber Machine Gun -- The primary American aircraft gun of World War II, the Browning .50-caliber saw widespread use in the wings, tunnels, turrets, and cowls of American aircraft. Possessing greater range and potency than the .30-caliber, the .50-caliber could deliver 800 rounds per minute with a muzzle velocity of 2,880 feet per second.

RAF

.303 Browning Machine Gun -- The standard RAF machine gun at the outbreak of the war, the .303 was a great disappointment in combat. Its rifle-sized bullets could not do great damage to enemy aircraft, and were useless against ground targets. While it remained in service until the end of the war, the 20mm cannon replaced it as the primary aircraft-mounted weapon used by the RAF.

20mm Cannon -- First employed in 1940 on Spitfires, this gun was a winner. With fierce hitting power and a fast rate of fire, the 20mm gave the British aviator a considerable edge over the Bf 109. Some fighters, notably the Typhoon and Tempest, carried four of these awesome weapons.

57mm Cannon -- The 57mm cannon was derived from an army anti-tank gun. Mounted on Mosquito XVIIIs, this huge weapon could wreak havoc with small coastal patrol vessels and submarines. The gun stretched from the Mosquito's nose right into the bomb bay, precluding the addition of a heavy bomb load on anti-ship missions. The Tse-Tse Mosquitos, as the cannon armed variant was called, served until late 1944 with RAF Coastal Command.

Luftwaffe

Loading ammo into a Bf 109. Courtesy National Air & Space Museum, Smithsonian Institution

7.9 mm Machine Gun -- Roughly equivalent to the British .303, the 7.9mm machine gun lacked range and hitting power. It was possible to spray a target thoroughly with this weapon without inflicting any critical damage. In time, most 7.9s in Luftwaffe aircraft were replaced with 13mm, or even 15mm guns.

13mm Machine Gun -- The 13mm gave the Germans parity with the American's deadly .50-caliber. The 13mm boasted a good rate of fire, long range and excellent hitting power.

15mm Machine Gun -- The 15mm entered service towards the end of the war. Only a few fighters, notably the Messerschmitt Bf 109K, came equipped with it. More dangerous than the .50-caliber, it was notably less effective than a 20mm cannon.

20mm Cannon -- The Germans used the 20mm cannon as the backbone of their aerial firepower. Most fighters mounted at least one, sometimes up to four, of these guns. Until the deployment of the 30mm cannon, the German 20mm was the only weapon capable of doing serious damage to the American B-17s and B-24s.

30mm Cannon -- This huge weapon entered widespread service in 1944. The Me 262 carried four of them as its standard armament. Some Bf 109G variants also carried one firing through the propeller hub. The 30mm could devastate even the most durable Allied aircraft with only a few hits. Its one drawback was its slow rate of fire.

Bombs

Bomb and shell craters dot the landscape around this former-French fort used by the Germans in the defense of Brest. Some French coastal towns remained in German hands until the end of the war. Courtesy National Air & Space Museum, Smithsonian Institution

Both sides used a variety of bombs throughout the war in Europe. For light attack duties, high explosive bombs ranging between 100-250 lbs were used most often. Against tanks or entrenched troops, aircraft would carry 500-1,000 lb bombs. Bombs in the 1,000-2,000 lb range were used to take out reinforced steel and concrete blockhouses or bunkers. Target profile generally dictated what size and type of bomb an aircraft would carry.

Rockets

Luftwaffe

GR. 21 -- The Gr. 21 was basically a Wehrmacht mortar adapted to aerial use by adding a small rocket engine to the projectile. It had a range of about 2,000 meters. Pilots fired it at an upward angle so the mortar bomb would drop into Allied bomber formations when it reached the apex of its arc and ran out of fuel. The weapon tended to be extremely inaccurate, and was roundly detested by pilots. However, if a rocket did happen to land in a bomber formation, considerable damage could be done. Often, two or three bombers would go down from one rocket burst. American pilots grew to fear these attacks and would sometimes break formation when facing interceptors equipped with the Gr. 21. This proved useful to the Germans, who began using the rockets to disrupt the integrity of the Allied bomber formations. With the bombers split up, they were easier to knock down. In Normandy, many fighter units used the Gr. 21 as an anti-tank weapon. Again, due to its inaccuracy, it was largely unsuccessful in this role.

R4M -- In the last months of the war, the Luftwaffe developed and deployed this air-to-air rocket. These pencil-thin projectiles were launched from wooden underwing rails mounted on Messerschmitt 262s in salvoes of up to 24 . They saw limited combat use, but impressed the pilots who used them with both their accuracy and their destructive power.

Allied

Bazooka rocket tubes employed by the USAAF, slung under the wing of a P-47. Courtesy National Air & Space Museum, Smithsonian Institution

5-Inch Rocket -- In the last years of WWII, the USAAF and the RAF began to rely increasingly on the 5-inch rocket for ground attack missions. This rocket saw action against shipping, tanks and armored pillboxes. With four to eight hard points or six bazooka tubes carrying the 69-inch long, 134-pound rockets; a plane could rival the firepower of a destroyer's salvo.

Vehicles

Weary GIs relax on a captured German staff car. Courtesy National Air & Space Museum, Smithsonian Institution

American Vehicles

M4A1 Sherman Tank
The Sherman saw service in both the U.S. and British armies during the war. From 1943 onward, it became the mainstay of Allied armor formations. Tough, dependable and fast, the Sherman was hamstrung by thin armor and an ineffective gun.

M3 Half-Track
Every American mechanized division counted on the M3 half-track for its mobility. Though incapable of stopping anything larger than a machine gun round, the half-track soldiered on until the end of the war. Like most American vehicles, it was solidly built, dependable and fast.

Duck
The Duck was a versatile amphibious truck that was used to haul troops and supplies ashore during the Normandy campaign. It had no armor, no weapons, and was highly vulnerable to air attack.

2.5 Ton Truck
The standard American supply and utility vehicle employed during the war.

British Vehicles

Churchill
The Churchill infantry tank was perhaps the best British tank to see wide-spread service during the war. Though slow, and lacking an adequate cannon, it was heavily armored and difficult to destroy.

Street fighting in Europe: a Sherman tank rumbles down a ruined city's street. Courtesy National Air & Space Museum, Smithsonian Institution

Street fighting in Europe: a Sherman tank rumbles down a ruined city's street. Courtesy National Air & Space Museum, Smithsonian Institution

German Vehicles

Tiger
The Tiger was one of the most dangerous tanks of the war. It carried a massive and deadly 88mm cannon, and was heavily armored. Its great weakness was its lack of mobility.

Panther
The Panther was considered the best medium tank of the war. It balanced speed, armor and firepower beautifully, making it a dangerous opponent.

The end of a German Panther, the best medium tank of its day. Courtesy National Air & Space Museum, Smithsonian Institution

Panzer IVH
The Panzer IV was a pre-war design the Germans were forced to modify and keep in production until 1945. Its low silhouette made it difficult to detect and destroy, nevertheless, it was an obsolete

design by 1944.

Jagdpanzer IV
The standard German tank destroyer used in Normandy, the Jagdpanzer IV was essentially a Panzer IV without a turret. With heavy armor and a decent gun, it was a match for any Allied tank.

Whirlwind
The Whirlwind was one of many flak tanks the Germans produced during the war. They were deployed with advancing panzer divisions to provide anti-aircraft support.

Tiger hunt! Two dreaded Tiger tanks lay shattered after an air attack. Courtesy National Air & Space Museum, Smithsonian Institution

SDK-251
This half-track saw service throughout the war in Wehrmacht panzer divisions. Fast and versatile, the 251 was modified repeatedly for different ground roles.

Truck
The Germans used trucks to carry supplies and troops behind the front lines. Unarmed and unarmored, they were easy targets for Allied fighter-bombers.

Ships

A Beaufighter launches a rocket attack on a freighter. Courtesy National Air & Space Museum, Smithsonian Institution

German

Z-Class Destroyers
Heavily armed with 5.9-inch guns, the Z-Class series proved formidable adversaries when pitted against Allied escort vessels. By 1944, most of the surviving ships in this class had been assigned to convoy duty between Scandinavia and the Continent.

E-Boat
E-Boats were German fast attack craft used in the English Channel to interdict Allied shipping lanes. They were extremely fast, but relatively defenseless against air attacks.

Allied

Pennsylvania Class Battleships
These obsolete American battleships were employed in Europe as bombardment vessels, pounding German positions around the Normandy beachhead throughout the summer of 1944.

Northhampton Class Cruiser
Cruisers were used during the Normandy operation as fire support vessels and anti-aircraft screen vessels.

Fletcher Class Destroyers
These ubiquitous Allied destroyers served as ASW ships, protecting the flanks of vital convoys. During D-Day, some destroyers were used as fire support ships off Omaha beach.

LST
One of the larger landing ships used by the Allies, the LST could carry tanks, men, supplies and vehicles right to the beach.

The end of the German Navy. Courtesy National Air & Space Museum, Smithsonian Institution

The end of the German Navy. Courtesy National Air & Space Museum, Smithsonian Institution

LCI
The Landing Craft Infantry was a troop-carrying amphibious warfare ship.

LCM
The Landing Craft Mechanized functioned as an inshore boat designed to haul one vehicle or up to 25 tons of supplies between the larger cargo ships and the beachhead.

Decorations & Medals

American

Army Congressional Medal of Honor

In 1782 George Washington established the first military decorations: the Badge for Military Merit and Honorary Badges of Distinction for soldiers. This quote from George Washington, referring to the Badge of Military Merit (Purple Heart), clearly describes the role of American military decorations. "The General, ever desirous to cherish a virtuous ambition in his soldiers, as well as to foster and encourage every species of military merit, directs that whenever any singularly meritorious action is performed, the author of it shall be permitted to wear on his facings, over his left breast, the figure of a heart in purple cloth, or silk, edged with narrow lace or binding. Not only instances of unusual gallantry, but also of extraordinary fidelity and essential service in any way shall meet with due reward."

British

Victoria Cross

The Victoria Cross was Britain's highest award for gallantry in combat, but was won by few aviators during the Second World War. More common awards included the Distinguished Flying Cross, which officers received for extraordinary service in air combat. Different medals existed for officers than for enlisted men; a reflection of the caste system prevalent in British society at the time.

German

Iron Cross

The Third Reich placed a heavy emphasis on military awards and ceremonies during World War II. Many of the medals given to combat veterans during the war were creations of the Nazi regime. Others, such as the Iron Cross First and Second Class, were more traditional awards that had been given out during World War I. The highest award a Luftwaffe aviator could win was the Knights Cross with oak leaves, swords and diamonds.

III. Game Play

Five Thunderbolt pilots tell tales of their last fight. Courtesy National Air & Space Museum, Smithsonian Institution

Quick Run-through

A quartet of P-47s buzzing an airfield. Courtesy National Air & Space Museum, Smithsonian Institution

> SPECIAL NOTE:
> The Game Play section explains the menus and controls used to play *Aces Over Europe*. For information on broader topics such as tactics, maneuvers, & historical background, refer to the "Contents" for the appropriate section.

If you want to acquaint yourself with Aces Over Europe without first reading the Game Play section, follow these instructions:

1. Follow the **Installation** instructions in the front of this manual to get *Aces Over Europe* installed and running.

2. Once the title sequence has begun, press the **Esc** key or **Spacebar** to view the Main Menu. Select **Fly A Single Mission**.

3. From the Fly Single Mission menu, select **Training**.

4. You will be asked what service you wish to fly for. Press **Accept** to fly this mission as a **USAAF** pilot.

5. The Training Mission screen will inform you that you'll be flying gunnery practice in a P-51 Mustang. Press the **Start** button to begin your mission. You will start the mission airborne in the cockpit of your Mustang.

You will have unlimited ammunition and plenty of drone aircraft to shoot at. To pause the action, press **P**. Scan the Quick Reference Card for keyboard functions, or refer to this chapter for more detailed game play information.

Main Menu

Choose from a variety of missions and set-up mission conditions.

Career Menu
Enlist as a pilot for the United States Army Air Force, the Royal Air Force, or the Luftwaffe.

View Vehicles
See close-ups and descriptions of the airplanes, ground vehicles, and ships of the war.

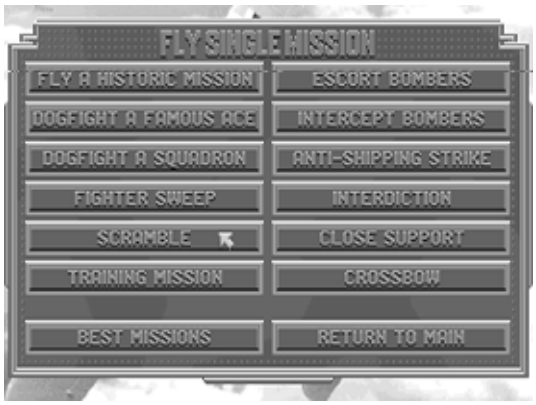
Other Options
Set preferences, Realism Panel, view credits and demos.

Mission Recorder
View and edit taped recordings of your missions.

Exit to DOS
Return to the MS-DOS® prompt.

Planning the next mission. Courtesy National Air & Space Museum, Smithsonian Institution

Fly Single Mission



Fly Single Mission is a fast, easy way to play *Aces Over Europe*. It also gives you complete control of the mission's setup. First you pick a mission type, then you determine the conditions of the mission. Once you've made these choices, you're ready to fly. Upon completion of your mission, your performance will be evaluated, and a score assigned. This score is based upon the difficulty level of the conditions you chose for the mission, how many targets were destroyed, and whether or not you achieved the mission's objective.

Mission Types

Training Mission
Learn flight basics with these Novice level missions. Choose the training mission type that teaches the skill you wish to improve. For tips, see the appropriate Reference Section.

Aerial Gunnery - Try to shoot drone aircraft as they fly a constant pattern. This is a good way to practice deflection shooting.

Antishipping - Attack a derelict ship convoy.

Intercept Bombers - Shoot down a drone bomber squadron. Beware of their defensive fire as you approach.

Ground Attack - Attack drone ground vehicles.

Landing - Land your aircraft at your airbase.

Fly a Historic Mission
To fly a Historic Mission, you must select a campaign and service. Press the Service button to choose the service you will fly for. Then press the Campaign button to view a different campaign's historic missions for your selected service. Choose a mission by using the up and down arrow buttons to move the highlight bar. Make your selection by pressing the Select button.

Walker Mahurin. Courtesy National Air & Space Museum, Smithsonian Institution

Dogfight a Famous Ace
Challenge one of the war's greatest pilots to head-to-head combat. Select the service of the ace you wish to fight against, then scroll through the menu of aces and select your opponent.

Dogfight a Squadron
Your flight struggles against an enemy flight in deadly combat.

Fighter Sweep
Clear the skies of all fighters over enemy territory.

Scramble
Get airborne and survive the enemy attack!

Escort Bombers
Protect your bombers as they complete their strike mission.

Intercept Bombers
Prevent enemy bombers from striking their target.

Anti-Shipping Strike
Try to sink enemy shipping.

Close Support
Assist ground forces by destroying enemy ground targets.

Interdiction
Disrupt enemy supply lines and communication by striking airfields, radar installations, trains, truck

convoys, and bridges.

Crossbow
Destroy V1 launch sites and radar installations.

Best Missions
Lists the highest recorded mission scores.

> **Note:** Some of these settings are interdependent. For example, the plane type can be affected by the type of training mission selected. If you make a choice that invalidates another setting, the invalid setting is changed.

Mission Conditions
Once a mission type has been selected, you will be asked to choose a service to fly for. Depending on the type of mission selected, you may also choose some or all of the following:

Number of Planes - Press the button labeled **Flight**, to specify the number of friendly aircraft. When dog fighting a squadron, you can specify the composition of the enemy flight as well.

Pilot Abilities - To adjust pilot ability, press the **Flight** button. You can choose the greenest novices or the greatest aces to fly with. When choosing enemy pilots, you can always select a novice, regular, veteran or expert pilot, but only on Dogfight an Ace or Dogfight a Squadron missions can the ability of an enemy Ace be specified.

Aircraft Type - Select the type of planes for your flight. You can select the type of planes flown by the enemy in Dogfight a Squadron or Dogfight a Famous Ace missions. On intercept bomber missions you can specify the bomber plane type as well.

Starting Altitude - Specify your flight's starting altitude from **Very Low** to **Very High**.

Surprise - When dogfighting an enemy squadron or ace, you can award the advantage of surprise to your flight, the enemy flight, or no one.

Cloud Cover - You can set the amount of cloud cover present during the mission from **Clear** to **Overcast.**

Preflight Instructions

Briefing
For most mission types, you will receive a mission briefing (the exceptions are Dogfight an Ace and Training missions). This briefing gives you the information you need to complete your assignment. For further mission information and options press the **Preflight Options** button.

Preflight Options

Hawker Tempest. Courtesy National Air & Space Museum, Smithsonian Institution

Configuration
Plane Type - Lists the plane you are flying on this mission.
Armament - Lists any guns or cannons your plane carries and the number of rounds in each. The armament listed is standard for each plane and may be supplemented by external guns through your ordnance selection.
Ordnance - As a flight leader you can determine your ordnance load. Your planes will be automatically armed with weapons suited to your mission. To choose a different weapon load, press the Ordnance button. Each ordnance load offers a different combination of bombs, rockets, external fuel tanks, and external guns available. Be aware that some long range missions require an external fuel tank (your default ordnance will include an external tank).

A typical USAAF bomber briefing. This one took place in Italy. Courtesy National Air & Space Museum,

A typical USAAF bomber briefing. This one took place in Italy. Courtesy National Air & Space Museum, Smithsonian Institution

Flight Roster
Position and Pilot - Lists the members of your flight and their skill level.
Formation - If you are leading the flight, pressing this button will show you the formations you can fly in. The numbers beside each plane correspond to their position in the flight.

Other Buttons:
Decline Mission - can be pressed if you do not wish to fly this mission.
Realism Panel - lets you adjust Realism settings before starting the mission.
Flight Map - Displays a map of the region and your flight path.
Begin Mission - puts you in the cockpit.

Postflight

[Esc] - End Mission
[Alt]+[X] - Exit to DOS
[Ctrl]+[Q] - Exit to DOS

> **Note:** If you exit to DOS, the status of the current mission and current settings on the Preferences and Realism panels will not be saved.

Ending the Mission
You may end a mission at any time by pressing the [Esc] key. You will receive more points for landing at your base at the end of your mission. A message will be displayed asking if you want to stop or continue flying. If you quit when your plane is severely damaged, it will result in a crash. If you stop before the mission is complete, you'll leave any friendly aircraft and ships at risk and your mission is considered a failure. Expect high losses if you choose to do so.

Other Possible Endings
Prison - If you land or crash (and survive) in enemy territory, you will end up in an enemy prisoner of war camp.
Crash - If you survive, it's likely you will be hospitalized until you recover from your injuries.
Killed in Action - If you take too many hits or crash too severely, you may be KIA.
Bail Out - Bail out of a damaged aircraft by pressing [Ctrl]+[B]. Be advised that bailing out is very dangerous; you'll be lucky to walk away from the experience.

Debriefing
When a mission is over, a debriefing recaps the mission's results.

Mission Objective Results
This text message describes success or failure of the mission.

Planes Shot Down/Targets Destroyed
Tallies the total number of enemy targets destroyed and the number personally destroyed. Targets are grouped into three categories:
Aircraft - Number of planes shot down.
Ships Hit - Number of bomb or rocket hits.
Ground Strikes - Number of ground targets destroyed.

Score
Scoring in *Aces Over Europe* is based upon a number of different factors:
Successful completion of your mission.
Shooting down enemy aircraft, destroying ships and ground targets.
Deducted points for aircraft in your flight that were shot down.
Bonus points for landing at your own base upon completion of your mission.

Your score is multiplied by the score factor, specified in the Realism panel.

> **Note:** AOE has no score "cap" so the top score you can achieve is limited only by your abilities. To prevent players using unlimited ammo from having a scoring advantage, only the original ordnance load will score points. For instance, if your aircraft is loaded with R4M rockets and you attack a bomber stream, you will be awarded points only for the bombers destroyed by the first volley of 24. Subsequent volleys, which are available only because ammo is unlimited, will not yield any increase in score. Targets and aircraft destroyed will always count toward victory conditions, however.

In any of the missions offered on the Fly Single Mission menu, your score will determine your standing in the Best Missions listing. In Career mode, your score will affect your promotion through the ranks.

Board of Inquiry
If you destroy any friendly forces during a career, you'll come before the Board of Inquiry. If you come before the Board three times, you'll be stripped of your wings and grounded permanently.

Mission Recorder

Use the Mission Recorder to record an entire mission, save it to disk and then replay it. The Mission Recorder even allows you to change the saved mission. You can alter the views, watch the action from nearly any angle (including from behind other planes) and enter the simulation again from any point in playback. The changes you make can then be saved, played back and modified even further. You essentially become actor, producer and director of your own WWII dogfights. To spread the news of your talent, transfer your recorded missions by modem, or on disk, to your friends who have *Aces Over Europe*. They can then load the files and admire your handiwork.

Lights, Camera, Action!
The first step in using the Mission Recorder is to save your mission to "tape" when it ends. Name the file and press **Save** to automatically save the mission in a sub-directory called TAPES. Press **Cancel** to cancel the save, erase the recorded mission and exit the simulation.

> **IMPORTANT**! The mission name that you choose can be no longer than eight characters long. The computer will cut off any additional characters. If disk space is too low to save the mission, you will receive an alert.

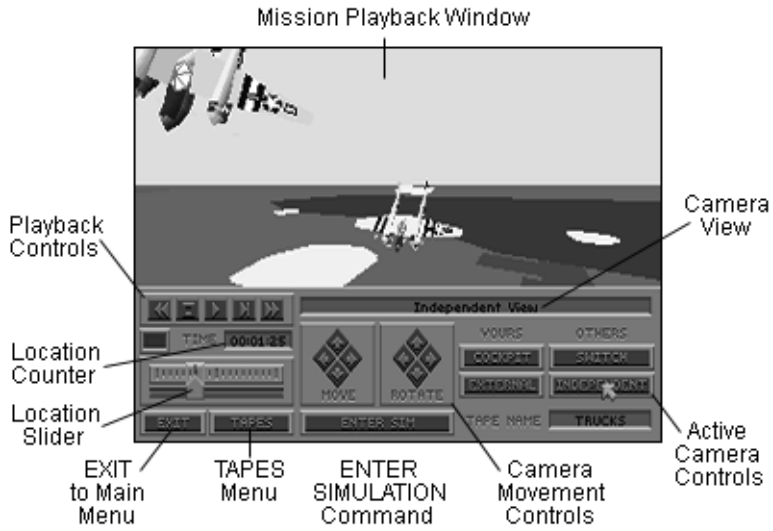
One more to go! A P-47 pilot sits in his cockpit, smiling for the camera. Courtesy National Air & Space Museum, Smithsonian Institution

Into the Editing Room
Once you have recorded and saved a mission, select **Mission Recorder** from the Main menu. This will activate the playback mode of *Aces Over Europe*. You will be shown a menu of all saved missions. Select the mission "tape" you wish to playback and press **Load**. The "tape" will load and the Mission Recorder's control panel will be displayed.

Filming a Bf 109 crew. Courtesy National Air & Space Museum, Smithsonian Institution

Mission Playback Window
The Mission Playback Window is where your loaded missions are displayed. Loaded missions will playback exactly as you originally played them. The Mission Playback Window has two modes of display, Edit and Full Screen.
Edit - displays the Mission Playback Window with the Mission Recorder's controls covering the bottom part of the screen. Use this mode to view and edit.
Full Screen - displays the Mission Playback Window without the Mission Record controls. You will see a full screen image of your mission as it plays. Use your joystick to change the view.

To switch between Edit and Full Screen modes, press the **[Esc]** key.



Playback Controls
The Playback Controls operate like everyday VCR controls. Playback Controls include: **Fast-Forward, Rewind, Stop, Play** and **Single Frame Advance. Note**: While **Fast-Forward** advances incrementally, **Rewind** will always rewind the tape to the beginning.

> **Note:** The mission recorder supports two new keys, "S" and keypad "+"**.** When in full screen view (after pressing ESC) "S" can be used to start and stop the progress of the tape, while the keypad "+" key can be used to advance one frame at a time. These keys make editing your vcr files much easier.

Location Counter
Operating just like a VCR counter, the Location Counter keeps a running mark of your playback position.

Location Slider
The Location Slider operates in two ways. First, it acts as a visual marker to display movement through the playing tape. Second, it acts as a visual fast-forward slider, allowing you to pick the location you wish to fast-forward to. To use the Location Slider to fast-forward, move the slider bar to the desired distance into the tape. When you release the slider bar, the Mission Recorder will display an on-screen countdown as it fast-forwards to the specified point.

Note: The slider cannot be moved backward. You must use the Rewind control.

Active Camera Controls
Active Camera Controls allow you to change the location of the playback camera.

In the *Yours* section, you can move the camera between your cockpit and your plane's external view. In the *Others* section, you can move the camera between other planes' external views and an independent world camera.

The options of **Switch** and **Independent** become active when you have switched your camera viewpoint to External. Continually pressing **Switch** will cycle you through all the external views of all enemy actors in the recorded mission. Pressing **Independent** will place the camera free from all aircraft movement to be completely controlled by the Movement Controls.

Camera Movement Controls
Once the Active Camera has been chosen, the viewpoint can be fine tuned by using the Camera Movement Controls. The two arrow pads operate slightly differently depending upon where your Active Camera is positioned.

Active Camera Inside Your Cockpit
Cockpit - allows you to look out the forward, left, right and back cockpit views.
External - allows you to switch to forward, left, right and back outside views of your plane.

Active Camera Outside Your Cockpit
Move - allows you to zoom the camera in/out. In Independent mode, it also shifts the camera left and right.
Rotate - allows you to rotate the camera over, under and around.

> **Note:** When in full screen view, use your joystick to move the camera.

Tapes
Pressing the **Tapes** button will bring up the Tapes control panel.
Load New Tape - Displays the tape menu for loading tapes.
Save Current Tape - Displays the menu for saving tapes.
Delete Tape(s) - Displays the menu, allowing you to delete recorded missions. Selecting a mission and pressing Delete will delete the mission from the TAPES subdirectory.
Done - Closes the Tapes control panel.

Enter Simulation
Pressing the **Enter Simulation** button at any point during playback will place you back into the simulation. You can replay the mission, making whatever changes you desire. When the mission is over, you will have the option to see a Mission Review based upon the changes made or to return to the Mission Recorder.

Preferences
The mission recorder has a preferences screen that can be accessed using F10. It will allow you to reset your preferences while replaying a vcr file. This can be very useful when replaying a file made on a slower or faster machine or to experiment with the effects of detail levels.

Exit
Quits the Mission Recorder, returning you to the Main menu. If you have made changes that haven't been saved, you will be asked to save or discard your modifications.

Editing Tips
When tape playback is stopped, you can fine tune the view. When you have the desired camera view, resume playback. Save this new version of the tape and view changes will be instantaneous upon playback.

[S] - Start/stop playback.
[+] - Frame advance.

If you wish to include a tape in the *Aces Over Europe* demo, name it in the form of **demo*.vcr**. From the Main menu's Options menu, select **Demo**. All demo tapes named **demo*.vcr** are shown.

Enlisting in a Career

Anxious USAAF officers watch a squadron of B-17s come home. This was probably a staged publicity photo. Courtesy National Air & Space Museum, Smithsonian Institution

When you elect to fly a career, you not only fly a pilot's missions, you live a pilot's life. Your career will be composed of a series of campaigns, during which you will fly for one of the actual squadrons that took part in that historic struggle. Each campaign has unique challenges and strategies, and includes pivotal battles that shaped the war's outcome.

You will fly a wide range of mission types, including escorts, intercepts, and sweeps. You will fly, and fly against, new aircraft as they are introduced. While some of the missions will be what you expected from your briefing, you must remain ever vigilant; the great aces of the war are prowling the skies.

When flying in Career mode, you can earn the right to command through promotion. You may choose to begin your career as an untested wingman, following your wing leader's instructions. With success in combat, you will be promoted and gain the responsibility of commanding your own wingman. Ultimately, you can be designated a Flight Leader, commanding several aircraft in combat.

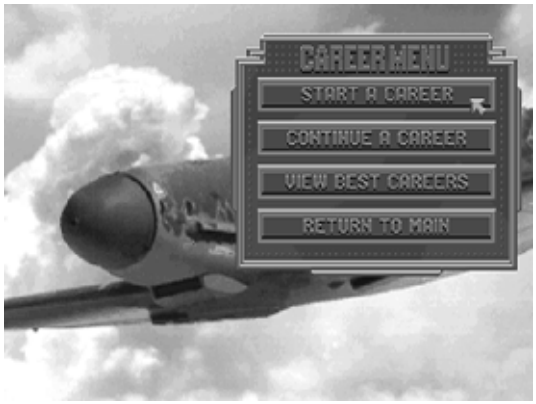
If you display exceptional gallantry, you will receive medals to recognize your greatest achievements. Gallant German pilots may be awarded the Iron Cross, R.A.F. pilots may receive the Victoria Cross, and American pilots can hope to earn the Congressional Medal of Honor if they perform "...above and beyond the call of duty..." Whenever you receive a medal, it will appear on your Pilot Record.

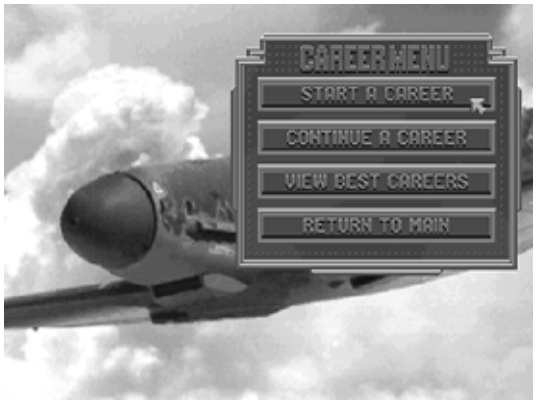
If your flying days last until the end of the war, your career will end in retirement. You will be shown your pilot record, as well as your pilot standing in comparison to your fellow aviators. If you are credited with more air victories than any friendly ace earned historically, you will be proclaimed "Ace of Aces."

Career Menu

Start a Career
You will be asked to select your service and to enter the name of your pilot. If the career roster is full, you will be asked to delete an existing pilot from the roster.

Once you've chosen your service and typed in your name, you'll be presented with a synopsis. You may also change your service, rank, or name. Press **Accept** to begin your career. Good luck!





Continue a Career
Select which pilot you wish to continue with. Pressing **View** will display the selected pilot's record.

View Best Careers
Displays the top ten career performances to date, ordered by number of victories. Pressing **View** will display the selected pilot's record.

Return to Main
Closes the Career menu, returns to the Main menu.

Campaigns

At the beginning of a career, you will be asked to select an historic campaign. Each campaign recreates a key conflict. The squadrons, warships, and maps are based on the actual historical conflict.

Campaign Select
Displays a campaign briefing sheet. Use the **Next** and **Previous** keys to scan other campaigns. Press Select to begin the displayed mission.

Squadron Select
Information on a squadron is displayed, including plane type flown, pilot quality and any aces of the squadron. If you have more than one squadron to choose from, pressing **Next** and **Previous** will let you review them. Press **Select** to join the squadron currently displayed. Once a squadron is selected, you can begin the campaign.

An airman kisses the ground after a rough flight. Courtesy National Air & Space Museum, Smithsonian Institution

Map of Europe
Displays a map of Europe so you can locate where your squadron is stationed. Using the cursor, press the arrow buttons on the screen to scroll the map. You can locate other places of interest by moving the cursor over the map. Click on any map icon and the name of each locale will appear. Press **Exit** to close the map.

Airbase Menu

Squadron Info
This screen displays the same information you reviewed while selecting your squadron: plane type flown, pilot quality, where you are stationed, and aces of the squadron.

View War Map
View a map of WWII Europe.

View Pilot Record
Review your current record including total victories by target type, pilot rank, plane flown, decorations and career score.

View aircraft
Inspect your aircraft. Use the arrow buttons to change your viewpoint.

Backup Career
If you are doing very well, you may want to backup your current status. After pressing **Backup Career**, enter comments which describe your career's current status. If the career roster is full, you will be prompted to delete another pilot or to cancel. This backup career may be restored from the **Continue A Career** option in the Career Menu.

Note: A pilot's most current career progress is automatically saved upon exiting the Airbase menu. **Backup Career** is used to save a separate version of the current career for later restoring. This is useful for undoing a mistake you've made in a mission. If you die or perform an act that damages your career, you always have the option of immediately replaying the mission. If, however, you wish to correct a career error after leaving the flight simulation, you still have the option of restoring the backup career and replaying the mission until you are satisfied with the outcome.

Return to Main
Pressing **Return to Main** will save your current pilot status and return you to the Main menu. You may later restore this career by pressing **Continue A Career** from the Career menu and selecting the pilot on the Career Roster.

Special Career Events

Throughout your career, you will witness and participate in major events that affect your career.

Squadron Movements
You will be notified if your squadron is relocated.

Forced Transfers
If your squadron is disbanded or rotated out, you will be notified of the reassignment.

Rumors
While waiting for your next mission, you may run into a squad mechanic with a juicy piece of gossip. Such rumors may pertain to enemy actions, useful tactics, or the latest from the home front. You may benefit from the words of your chatty friend, but remember: you cannot always believe everything you hear.

Communiqués from Headquarters
At times, your squadron may receive teletype messages from command. Communiqués often detail large military actions or major events. While these messages tend to be reliable, they may be slanted to protect morale.

Decorations & Medals

RAF	Luftwaffe	USAAF
Victoria Cross	Knight's Cross with oak leaves, swords, diamonds	Congressional Medal of Honor
Croix de Guerre (French)	Knight's Cross with oak leaves, swords	Distinguished Flying Cross
Distinguished Flying Cross	Knight's Cross	Legion of Merit
Distinguished Service Order	German Cross in gold	Silver Star
	Iron Cross, 1st class	Air Medal
	Iron Cross, 2nd class	Purple Heart

Promotions and Medals
If you perform your duty with distinction, you may receive a decoration to acknowledge your valor. Promotions are often given to the pilots who consistently complete mission objectives.

War Resolution

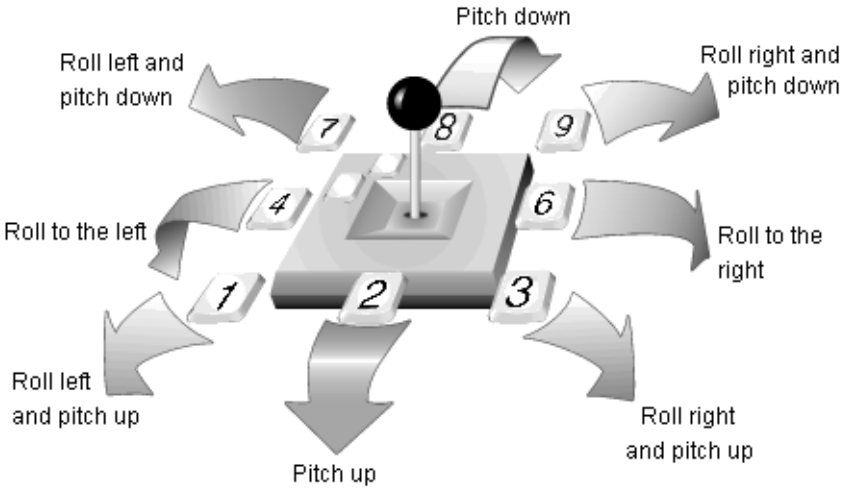
If you are fortunate and skilled enough to survive, you will see the war's end. At the close of your career, your final ace status will be ranked with all other pilots. If your performance places you among the ten best careers recorded, your name will be placed on the Best Careers screen.

Celebrating VE-Day in front of a P-61 Black Widow. Courtesy National Air & Space Museum, Smithsonian Institution

Flight Instructions

The Preferences panel lets you specify the method of control for three aspects of flight: **Flight Stick** control (moving ailerons and elevators), **Rudder** control and **Throttle** control. Pressing any of these three buttons produces a menu of controller options.

Flight Stick Control
You can use a variety of controllers to imitate the plane's flight stick.



Keyboard only - Use the keypad to control flight. See the graphic above for the function of each key.

Joystick 1 - Use a standard joystick in the first joystick port.

Flight Yoke -- If you wish to use the yoke's throttle slider, you should make the corresponding selection on the Throttle Control Menu.

ThrustMaster® FCS - Please refer to the ThrustMaster section

CH FlightStick Pro™ - Please refer to the CH FlightStick Pro section

Mouse - When using a mouse, remember that it is self-centering, and will re-center automatically after each movement.

Rudder Control
The rudder indicator found in the cockpit shows your rudder's orientation. If the tick mark is centered, then your rudder is centered.

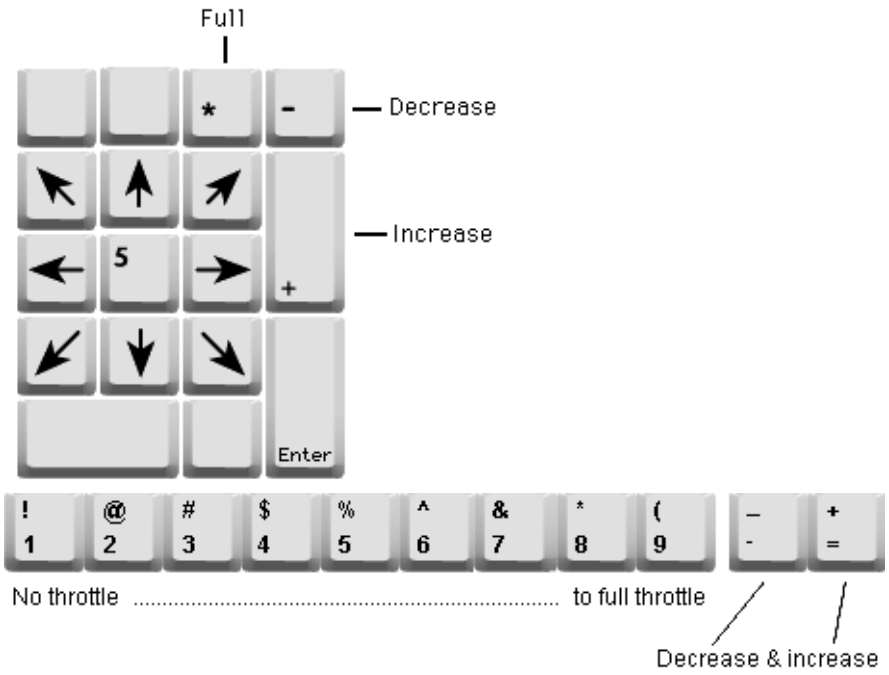
Keyboard only - Use the < and > keys to apply left and right rudder. Release the key to re-center the rudder.

Joystick 2 - If you have a second joystick, move the stick left or right to apply left or right rudder. If your stick is self-centering, releasing the stick will re-center the rudder.

Rudder Pedals - Press the left or right rudder pedal. Center the pedals to re-center the rudder.

Throttle Control

Keyboard only (from any view) - Use the numeric keys 1-9 to go from idle to safe maximum throttle. Pressing the + key increases the throttle and pressing the - key decreases the throttle. Pressing the * key provides full (100%) throttle (note: maintaining full throttle for an extended time will burn out the engine).



Joystick 2 -
If you use a second joystick, pushing it forward and back will increase and decrease the throttle. (note: maintaining full throttle will damage your engine).

Slider on Joystick 1 - If you have a joystick or yoke with a throttle slider, you can use it to control your engine speed.

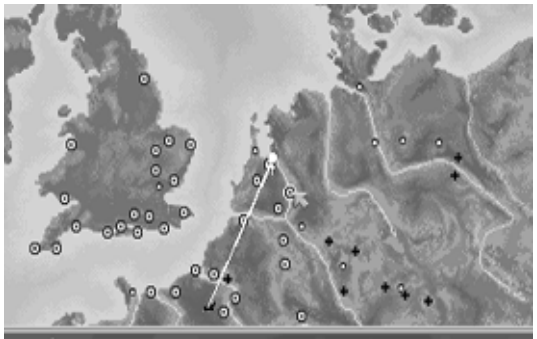
CH FlightStick Pro™ - Please see the CH FlightStick Pro section.

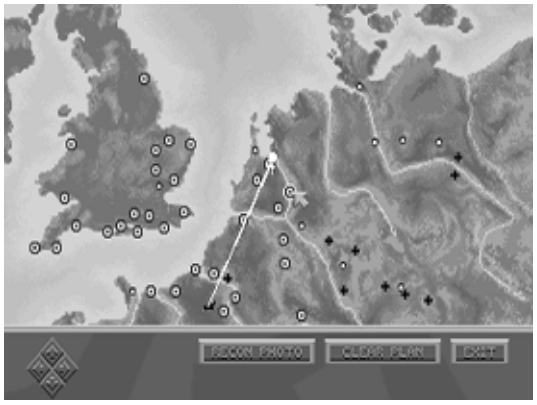
ThrustMaster® WCS - Please see the ThrustMaster Weapon Control System section.

Navigation and the Flight Map
With the map, you can review your mission orders, note primary and secondary targets and see any objects and places of importance.

View map during flight.

The map will automatically zoom in to show your current location. Use the arrow buttons on the menu bar to scroll the map view. With the cursor, you can also get information on each map feature, place the cursor over a map icon and you will see a highlight surround it. Click the left mouse button and you will receive additional information about that map feature.





Recon Photo
Any assigned targets on the flight map are denoted by a red outline around their icon. Pressing the **Recon Photo** button or clicking on the target's icon will show a reconnaissance photo of the assigned target. By pressing the **Target** button, a target overlay can be toggled on and off. This overlay marks any primary or secondary targets.

Flight Plan
Pressing the **Flight Plan** button produces a step-by-step description of your flight path. Pressing the Spacebar speeds the display of the Flight Plan. Once the **Flight Plan** has been drawn, the **Flight Plan** button switches to a **Clear Plan** button. Pressing the **Clear Plan** button removes the flight path from the map. Press [Esc] to remove a Flight Plan that is partially displayed.

Exit or Esc Closes your map.

You are to fly to the map points shown on your flight plan in the order they appear. During the simulation, if you wish to travel to a point other than the next point on your flight path, pressing the **D** key will select the current cursor location as your autopilot destination. Note that if you skip a point on your path, the Autopilot will bring you back to the point you skipped.

Autopilot

A Activate autopilot (compress time).

Engage the Autopilot to travel automatically to the next designated point on your flight plan (see above). Autopilot cuts the action until you reach your destination or need to be given an alert (enemies spotted, low on fuel, etc.).

Communication and the Radio

S Send a message.

Incoming messages from your wingman or flight will appear at the bottom of your screen. You can send radio messages by pressing S. A menu of possible messages will appear. You can choose from this list by pressing the function key that appears beside the message. The types of messages that you can send depend upon your status in the flight, the type of mission you are flying, and whether or not you are in combat.

Brakes, Landing Gear & Flaps

B Raises and lowers the dive brakes. Few aiplanes have dive brakes. They are used when dive-bombing.

W Applies the wheel brakes (only useful when you are on the ground).

L Raises or lowers the landing gear.

F Moves the flaps to the up, halfway or down positions.

Droptanks
On some aircraft, droptanks provide an additional fuel reserve to extend the plane's flight range. Carrying droptanks reduces maneuverability, so if you get into a dogfight, release them immediately.

D - Releases (drops) the external fuel tank

Weapon Selection and Firing
Weapon selection varies according to the type of aircraft.

Spacebar **or Controller button 1** Fire the selected guns.

G Change the selected guns (primary, secondary or all).

U Try to clear jammed guns by repeatedly pressing U (unjam).

Backspace Release bombs or torpedo.

R Fire a salvo of rockets.

Machine Guns - All fighter aircraft are equipped with at least one machine gun. (Note: the Arado is a light bomber and it doesn't carry a machine gun.) On the instrument panel, ammo counters display how much ammunition remains in the primary and (if present) secondary guns. A light is located beside each counter. If lit, the light indicates that the corresponding guns are selected. If your ordnance load includes external guns (see Preflight Menu), their ammunition is added to the secondary gun counter. When the simulation begins, your primary guns are selected. Remember to use your secondary guns when greater firepower is needed.

IV. Appendix

Throughout the war, women formed a major part of the American aviation industry's labor pool. Courtesy National Air & Space Museum, Smithsonian Institution

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As the civilian population suffered from the war, the Allied armies fed increasing numbers of refugees in 1944-45.

As the civilian population suffered from the war, the Allied armies fed increasing numbers of refugees in 1944-45. Courtesy National Air & Space Museum, Smithsonian Institution

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A Wac poses with an elderly woman. Courtesy National Air & Space Museum, Smithsonian Institution

Glossary

GIs and engineers having a meal on their airfield's Marsten Matting. Courtesy National Air & Space Museum, Smithsonian Institution

A

Abschuss: German equivalent of "Kill" or "Victory."
Abwehr: German intelligence service.
Ace: A pilot who has been credited with at least five aerial victories.
Ailerons: The movable surfaces on an aircraft's wings that control its bank.
Altitude: Another term for the pitch of an aircraft.
Ami: Luftwaffe slang for Americans.
Angels: The altitude of a particular group of aircraft. Angels 12 means 12,000 feet.

B

Bandit: An enemy fighter.
Bank: The rotation of an aircraft about its longitudinal axis (the axis running from the tail to the nose.)
Bogey: An unidentified aircraft.
Bounce: To surprise an enemy flight, usually from behind.
Break!: A term used to tell another fighter pilot that he is being attacked and should quickly take evasive action, as in: "Bandits on your six! Break left!" A break is also a fast, tight turn.

C

Check Six: To look behind your plane. The rear of any aircraft is known as the "Six O' clock Position," which is the most favorable place to attack. "Check your six" advises you to look behind your plane to ensure that no enemy fighters have crept up from behind.
Clobber College: When young pilots reported to their combat outfits, the old hands would tell them the best tactics to use in order to survive in combat. This period of indoctrination was known by some as Clobber College.

D

Deflection Angle: The angle a target is in relation to the aircraft shooting at it.
Dicke Autos: German slang for Allied heavy bombers. "Fat Cars" is the direct translation.
Dive-brakes: Air brakes equipped on dive bombers used to keep them from gathering too much speed in a steep dive during the attack run.
Division: Two sections - four planes. Also known as a Flight.

Dogfight: A twisting, turning engagement where moves are met by counter-moves as each pilot attempts to put his guns on the enemy. Indicative of the combat style used in WWI. Loosely used it means any air combat engagement.
Drag: The amount of air resistance a plane experiences. The less drag on a plane, the faster it can fly.

E

Elevators: The movable surfaces on an aircraft's tail assembly that control pitch.

F

Flak: Antiaircraft fire.
Flamed: Shot down a plane.
Flaps: Control surfaces on the inner part of the wings. They are used during take-off and landing to increase lift.
Flat-Hatting: Tree-top level, high speed flying. To be caught flat-hatting in the U.S. guaranteed serious punishment.
Flightleader: The term for the leader of a division.
Furniture Van: Luftwaffe slang for American heavy bombers.

G

Geschwader: German unit expression roughly translated to Wing. There can be fighter, bomber or ground attack wings.
G-Force: A measure of acceleration. One G is equal to the force of gravity. In steep turns, a plane and pilot will experience additional G's. The human body will lose consciousness between 8 and 10 G's.
Group: Several squadrons, usually 3-4.
Gruppe: German equivalent of Group.

H

Hawks: Enemy aircraft.
Holzauge: Luftwaffe term for Tail End Charlie. Literally means "Wooden Eye."
Horrido: Luftwaffe war cry of victory.

I

Indianer: Luftwaffe slang for Allied fighters. Means "Indian."

J

Jabo: Luftwaffe slang for fighter-bomber.
Jagdgeschwader: Luftwaffe equivalent of an American Fighter Wing. Usually the Geschwader would consist of 1-5 gruppen.
Jagdgruppe: Luftwaffe fighter group.
Joy: A term used to describe whether or not a flight saw combat. "No Joy" meant no air combat was encountered.

K

Kampfgeschwader: German bomber wing.
Kette: German term for Vic or Vee of 3 planes.
Kill: A downed aircraft credited to a pilot.

L

Lift: The amount of upward force generated by an aircraft's wings. It is lift that keeps the plane airborne.

M

Marsten Matting: The perforated steel planks laid down on nearly every American airbase constructed during the war in France and the Low Countries.

P

Pitch: The up and down rotation of an aircraft about its lateral axis (wing tip to wing tip). It is controlled by the elevators.

R

Roll: The rotation of an aircraft about the axis running from nose to tail. It is controlled by the ailerons.
Rotte: German term for two plane element.
Rudder: The control surface on the tail of an aircraft that controls its yaw.

S

Schwarm: German equivalent of a Finger Four.
Scramble: A quick take-off to intercept an enemy flight.
Section: Also known as an element or pair. A two-plane tactical unit, including a section leader and his wingman.
Squadron: Several divisions. Generally about 12-16 aircraft.
Staffel: German for squadron.
Stick: The control column in an aircraft's cockpit used to operate the ailerons and elevators.

T

Tail End Charlie: The last and most vulnerable aircraft in a formation.

V

Valhalla: Luftwaffe slang for a large formation of enemy aircraft.
V.S.I.: An acronym for the vertical speed indicator in a plane's cockpit.
Victory: The shooting down of an enemy aircraft.

W

Wehrmacht: German Army.
Wing: Several groups.

Y

Yaw: The rotation of the aircraft in the horizontal plane. It is controlled by the rudder.

WACs aboard a C-47. Courtesy National Air & Space Museum, Smithsonian Institution

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Camp life on the continent. Courtesy National Air & Space Museum, Smithsonian Institution