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Eagle Dynamics

DCS



DCS Fw 190 D-9 Dora Flight Manual

Dear User,

Thank you for your purchase of DCS: Fw 190 D-9, a simulation of the legendary German World War II fighter, and the fourth installment in the Digital Combat Simulator (DCS) series of PC combat simulations.

Like previous DCS titles, DCS: Fw 190 D-9 features a painstakingly reproduced model of the aircraft, including the external model and cockpit, as well as all of the mechanical systems and aerodynamic properties. Along the lines of our flagship P-51D Mustang title, DCS: Fw 190 D-9 places you behind the controls of a powerful, propeller-driven, piston-engine combat aircraft. Designed long before “fly-by-wire” technology was available to assist the pilot in flight control or smart bombs and beyond visual range missiles were developed to engage targets with precision from afar, the Dora is a personal and exhilarating challenge to master. Powerful and deadly, the aircraft nicknamed the Long-Nosed Dora provides an exhilarating combat experience to its drivers, and a worthy challenge to all fans of DCS: P-51D Mustang.

As operators of one of the largest collections of restored World War II aircraft, we at The Fighter Collection and the development team at Eagle Dynamics were fortunate to be able to take advantage of our intimate knowledge of WWII aviation to ensure the DCS model is one of the most accurate virtual reproductions of this aircraft ever made. Combined with volumes of outside research and documentation, the field trips to the TFC hangar and countless consultations and tests by TFC pilots were invaluable in the creation of this simulation.

The contents of this manual are based largely on actual vintage Fw 190 D-9 manuals of the aircraft’s service era.

With homage to the brave pilots of World War II, we hope you enjoy taking this true Flying Legend to the skies and into the fight!

Sincerely,

The DCS: Fw 190 D-9 Development Team

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INTRODUCTION



INTRODUCTION

The D for Dora variant of the famous Fw 190 fighter was nicknamed the Long-Nose by German pilots as well as the Allies. It was a departure from the radial-engine earlier variants and featured a more powerful inline engine, which gave the aircraft its characteristic long-nose shape compared to the iconic Fw 190 A. While experts may still argue about the Dora's looks, the performance gains were obvious. While the earlier variants excelled at lower altitudes but suffered higher up, at the most crucial altitudes where Allied bombers operated, the Long-Nosed 190 could easily match the best the Allies had to offer at all altitudes.

The Focke-Wulf Fw 190 is not just one of Germany's greatest fighter planes; it is perhaps one of the most famous aircraft of the entire Second World War. Featuring many advances and innovations, it broke new ground in terms of pilot comfort, ease of use, and versatility. First appearing in 1941, it was a rude awakening for the Allies, easily outclassing the best Allied fighter of the time, the British Spitfire Mk V. In the skies over France, it had no equal for many months as the British scrambled to produce its answer, the Spitfire Mk IX almost a year later.

An Allied pilot serving on Western and Eastern Fronts, or the Mediterranean, and flying at tree-top level or at the edge of its envelope would be likely to encounter a Fw 190. Nearly 40 variants of the versatile Focke-Wulf aircraft were produced ranging from high-altitude reconnaissance to ground attack aircraft and even night fighters. By late war, the Fw 190 was even used in one of the most eclectic operational aircraft of WWII, the Mistel composite aircraft, where a pilot in a Fw 190 was mounted above a modified twin-engine bomber loaded with explosives, which could later be detached to fly into its target.

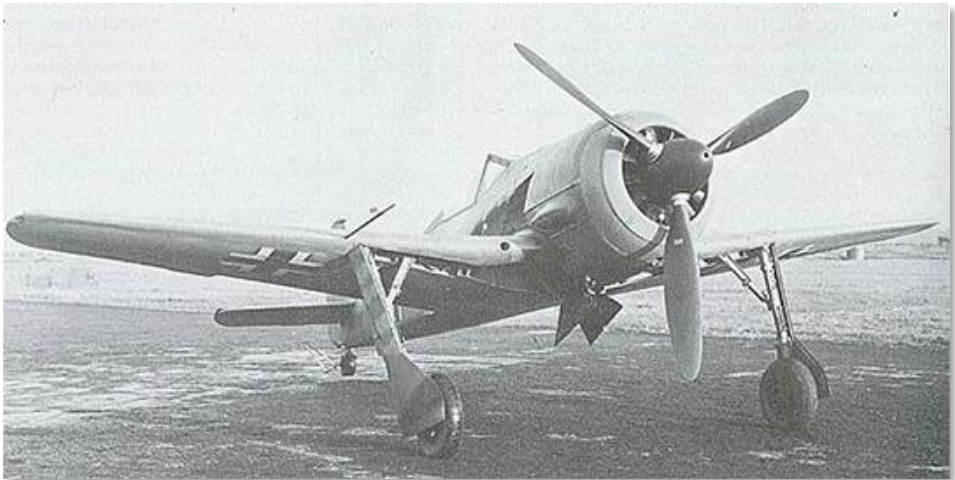


Figure 1: Fw 190 A prototype

The first and the most mass-produced Fw 190 variant was the A series powered by a radial engine. Serving as a pure air superiority fighter, fighter-bomber and ground-attack aircraft, the A series was loved by its pilots and feared by its enemies.

The design work started in 1939. The new aircraft proposed by Kurt Tank, the head of the technical department at Focke-Wulf, was, for its time, groundbreaking. It was a rare attempt to create a radial-engine fighter at a time when most designers preferred inline engines because of their supposed aerodynamic superiority. Unlike its main competitors, the Messerschmitt Bf 109 and the British Supermarine Spitfire, the 190 was not designed for speed but for durability. Its wide landing gear would make it easier to operate from primitive forward airfields, and its sturdy gear struts and shocks could withstand much harder landings. Sturdy airframe, ample armor, and appropriately designed internal systems made the 190 capable of returning home after taking more than a couple of hits. An innovative pushrod control system instead of the conventional cables and pulleys made the controls light and responsive. An industry-first ergonomic cockpit placed all controls at pilot's fingertips, and electrically powered equipment in place of hydraulics made simple push-button operations for gear, flaps, and weapons a reality. These simple cockpit controls and many automated systems made it easier to train new pilots on the Fw 190 in harsh war-time conditions.



Figure 2: Fw 190 A

The work on the D series began in 1942. As the new Junkers Jumo 213 engine offered clear improvements in performance, the decision was made to use it with the 190 airframe. While Kurt Tank, the Fw 190's lead designer, preferred the Daimler-Benz DB 600 series, the engines were already used in Messerschmitt fighters, while a surplus of the Jumo 213 bomber engines were readily available. The brand-new 213, an improvement on the earlier Jumo 211, offered 1,750 hp (1,287 kW) of take-off power that could be boosted up to an astonishing 2,100 hp (1,508 kW) of emergency power with MW-50 injection.

An Fw 190 A-8 airframe was used as a basis for the new D-series design. While the earlier radial engine was air-cooled, the liquid-cooled Jumo 213 required a radiator, which further added to airframe length and weight. Kurt Tank chose to go with a simple annular radiator design. The airframe was strengthened, and both the nose and the tail sections were increased in length by almost 1.52 meters.

The canopy design on the Dora series was changed during the production run. The first production examples used a flat-top canopy used on earlier A-series, the later Doras were upgraded to the advanced rounded-top canopy similar to Allied bubble canopies which offered improved all-around visibility. Other airframe improvements included a smaller streamlined center weapons rack.

While originally intended to serve as a bomber interceptor, changing realities of the war in the air meant that by the time the Dora entered production in August of 1944, it mostly saw combat against enemy fighters or in a ground attack role.

The earliest pre-production variants designated D-0 had the external wing guns removed; this was often reversed and future D variants were produced with the wing guns. Most D-9s intended for lighter anti-fighter role were still built without the outer wing guns, featuring a pair of 13 mm MG 131 machine guns and twin 20 mm MG 151/20E cannons.



Figure 3: Fw 190 D-9

The first production variants were designated D-9; there was no production of any interim designations between D-1 to D-8. The initial D-9 variants were rushed into service without the crucial MW-50 water injection. By December of 1944, all early variants were field-converted to spec. Later production D-9 variants built with the MW-50 at the factory had the tank that could be used for dual purposes, either for the methanol water injection or as an additional fuel tank.

Initial opinion of the upcoming Dora was not very high. Kurt Tank always stated that the D-9 was intended only as an interim stop-gap until a more perfect Ta-152 design could enter production. However, once Luftwaffe pilots got their hands on the stop-gap Long-Nosed Dora, they were pleasantly surprised. Performance and handling were good. When flown by capable pilots, the aircraft was more than a match to Allied fighters.

The Long-Nosed Dora is considered the best mass-produced late-war Luftwaffe fighter. In total, over 700 Doras were produced out of a total Fw 190 production run of over 20,000.

To this day, it remains one of the most recognizable shapes in the skies, and one of the most influential aircraft designs of the entire aviation era.

AIRCRAFT OVERVIEW



AIRCRAFT OVERVIEW

General Description

The Focke-Wulf Fw 190 D-9 fighter aircraft is a single-seat, low-wing monoplane powered by a 12-cylinder liquid-cooled inverted Vee inline Jumo 213 A-1 engine. The engine is equipped with a single stage, two-speed supercharger and an automatic manifold pressure regulator. The engine spins a three-blade constant-speed propeller.

The powerplant consists of a Jumo engine that delivers approximately 1,776 horsepower at 3,250 RPM. This can be further increased to 2,240 horsepower by the use of MW-50 water-methanol injection. Maximum emergency power in level flight is 1,600 horsepower at 3,250 RPM.

The fuselage is a semi-monocoque, all-metal structure. The forward section to the rear of the cockpit has four longerons and a horizontal partition dividing the cockpit from the fuel tank. The rear section of the fuselage is a conventional monocoque structure with light alloy frames. The entire structure is covered with light alloy stressed skin.

The wings comprise an all-metal structure with two main spars. Light alloy Frise-type ailerons with fabric covering are fitted. The split trailing-edge flaps operate electrically and depress 10 degrees for take-off and 60 degrees for landing.

The tail unit is an all-metal tailplane that continues through the fuselage and can be adjusted for incidence. The all-metal stressed skin tailplane is integral with the fuselage. The control surfaces are light alloy with fabric covering.

The armament consists of twin fixed synchronized 13 mm Rheinmetall-Borsig MG 131 machine guns with 475 rounds per gun mounted above the engine cowling, and twin fixed synchronized Mauser MG 151/20 cannons with 250 rounds per gun mounted in the wing roots.

Specifications for the Fw 190 D are:

- Wingspan – 10.5 m
- Overall length – 10.24 m
- Empty weight – 3490 kg
- Loaded weight – 4830 kg
- Wing area – 18.3 m²

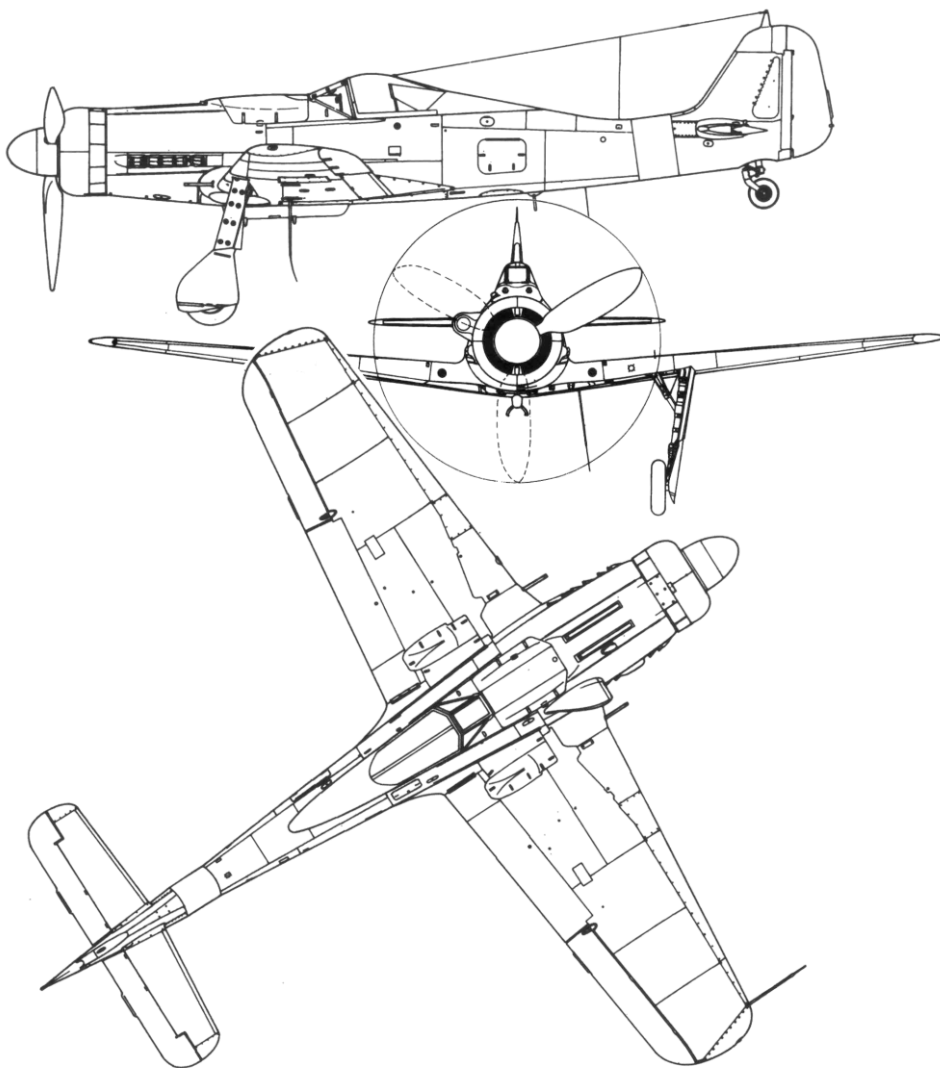


Figure 4: Fw 190 D-9 drawings

Fw 190 D-9 Major Assembly Parts

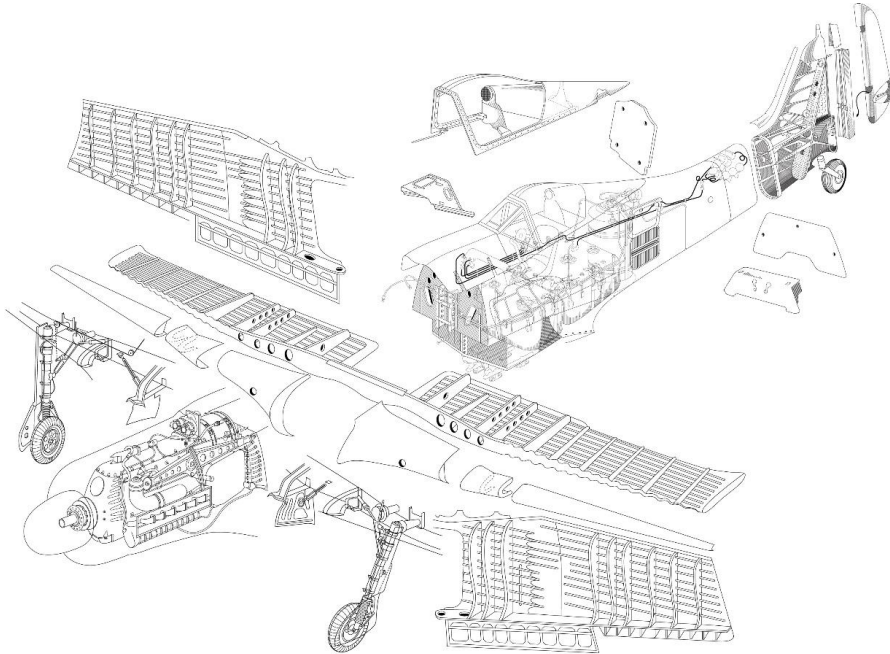


Figure 5: Fw 190 D-9 major assembly parts

Fuselage

The Fw 190 has an all-metal semi-monocoque fuselage. The fuselage is further divided by a partition behind the cockpit that separates the forward portion from the fuel tank. The forward cockpit section has four longerons between the front firewall and the rear bulkhead; the aft section, a conventional monocoque structure, contains shell segments that extend to the rear frame to which the tail section is attached. The entire fuselage is covered with light alloy.

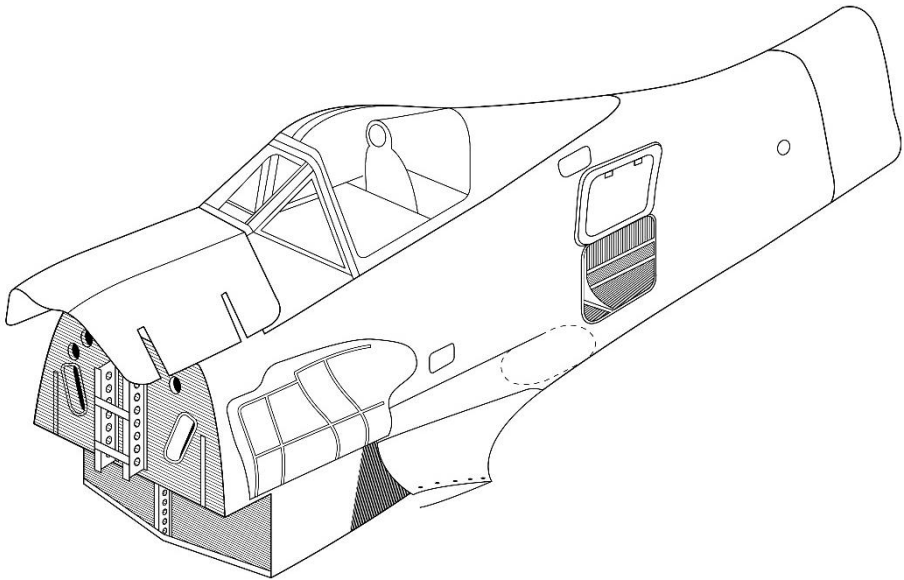


Figure 6: Fw 190 D-9 fuselage

Canopy

The Fw 190 features a bulged plexiglass canopy on ball-bearing rollers. The rollers move along the fuselage upper decking. The front windscreen has a metal frame. The canopy features a piece of head armor protecting the pilot from gunfire from the rear.

The canopy can be opened or closed via a conventional hand crank found on the right-hand side of the cockpit. The canopy can also be jettisoned in an emergency via a jettison lever.

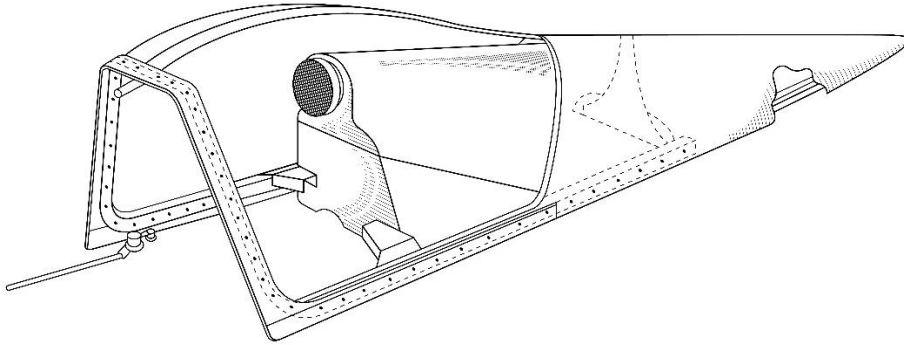


Figure 7: Fw 190 D-9 canopy

Many earlier aircraft designs featured canopies consisting of small glass or Perspex panes in a "greenhouse" framework. That greatly limited visibility to all sides, especially the rear, and created blind spots. Advances in thermoforming that allowed for sheets of plastic to be vacuum-formed into complex shapes however led to a breakthrough in canopy design. Self-supporting bubble-type canopies could now be created, offering greatly improved all-around visibility.

All Fw 190 versions offered such improved views. Initial prototypes and most A-series variants featured the pilot sitting higher up in the fuselage than in many other contemporary aircraft, with only a single metal frame blocking his view where the sliding canopy met the windscreen.

Further advances created an even better solution, first tried on the F-2 ground attack variant of the Fw 190 and quickly adapted to other variants such as the A-8 and F-8. This new canopy used outward bulges on the sides of the cockpit that allowed the pilot to see more of the battlefield to the front and sides. Most useful when attacking ground targets, this also offered clear advantages in air combat. Sometimes incorrectly called a bubble canopy, the new design had more in common with the Malcolm Hood used on later variants of the Supermarine Spitfire and the P-51B and C.

The new bulged canopy also included improved head armor within a reinforced bracing structure.

Both canopy types were used in the D-series of the Fw 190. First production examples shipped with the earlier flat-top canopy. Later production series used the improved bulged canopy design.

Wing

The Fw 190 D-9 has an all-metal monocoque wing with two spars. The main spar runs through the fuselage and connects the two wing panels. The rear spar consists of two sections, each attached to the fuselage.

Horizontally, each wing is divided into the upper and lower shells. The lower shell contains the main spar, while the upper shell contains the rear spar.

The interior of each wing contains the wing guns, the landing gear, aileron and flap controls and drive motors. The wings are further strengthened with wing ribs to which the shells are attached.

The main spar also holds the mounting points for the wing guns and the landing gear.

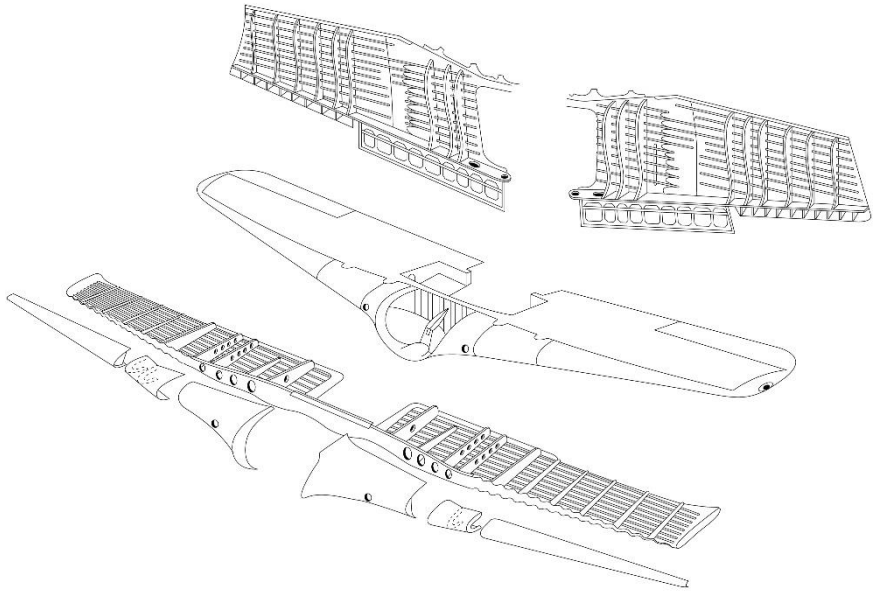


Figure 8: Fw 190 D-9 wings

Tail Section

The Fw 190 D-9 has an all-metal tail unit that contains both the tail unit and the vertical stabilizer. It is attached to the rear fuselage attachment bulkhead.

The main load-bearing section of the vertical stabilizer is a diagonal spar, to which the all-metal horizontal stabilizer and the tailwheel assembly are attached.

The fabric-covered rudder contains a metal frame with a spar and seven ribs. It has both aerodynamic horn balancing and mass balancing. There is also a trim tab; due to the aircraft being generally very stable in flight, the trim tab is only adjustable on the ground.

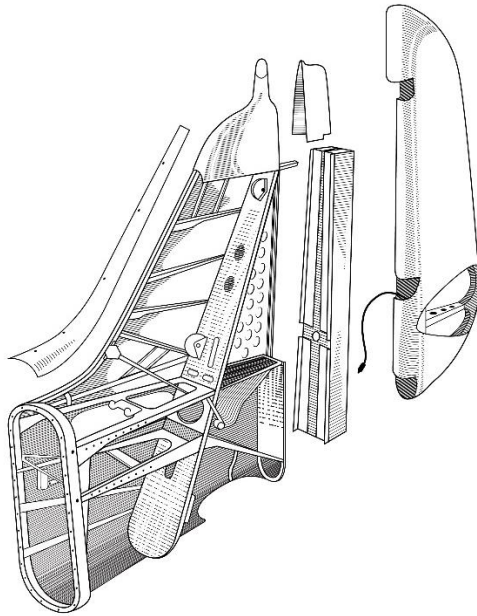


Figure 9: Fw 190 D-9 tail section

Flight Controls

The control unit assembly consists of the horizontal stabilizer and elevators, the vertical stabilizer and rudder, the ailerons, and the flaps.

The Fw 190 D-9 has a conventional control scheme with surfaces that include a vertical stabilizer, rudder, horizontal stabilizer, two elevators, two ailerons, and flaps.

As the Fw 190 D-9 is generally very stable in flight, only the horizontal stabilizer has trim adjustable in flight. Other control surfaces have trim tabs that can only be adjusted on the ground.

The control system for the aircraft is advanced for its age and uses a system of push rods and control cables. Compared to a conventional pulleys and cables system, the controls in the Fw 190 D-9 are lighter and more precise.

The control system uses differential bell cranks that transfer control movement near the center position into finer control surface movement, while control movement is magnified as the controls approach their limit.

The flight stick can be moved forwards and backwards in conventional fashion to control the elevator. It can be moved 20 degrees forward and 21 degrees rearward.

The flight stick can also be moved sideways to control the ailerons in conventional fashion. Aileron deflection is limited by mechanical stops in the control stick mounting base.

Flap position is controlled via pushbuttons on the left-hand side of the cockpit.

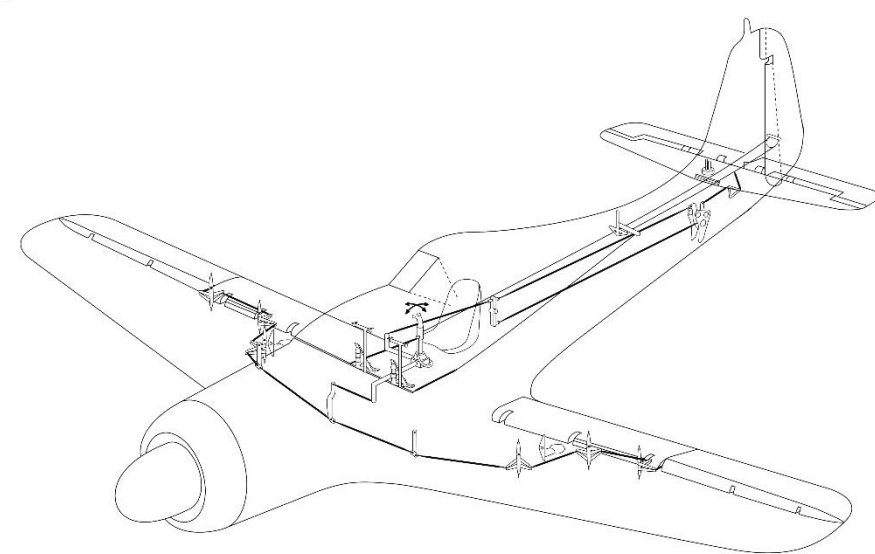


Figure 10: Fw 190 D-9 control cables

The horizontal stabilizer can be adjusted in flight to compensate for changes in aircraft trim. The operation is via an electric motor mounted within the vertical stabilizer.

The horizontal stabilizer trim switch is located on the left-hand side cockpit console. The motor is run as long as the switch is depressed, and until the limit position is reached. The actual position of the stabilizer is shown via the corresponding indicator.

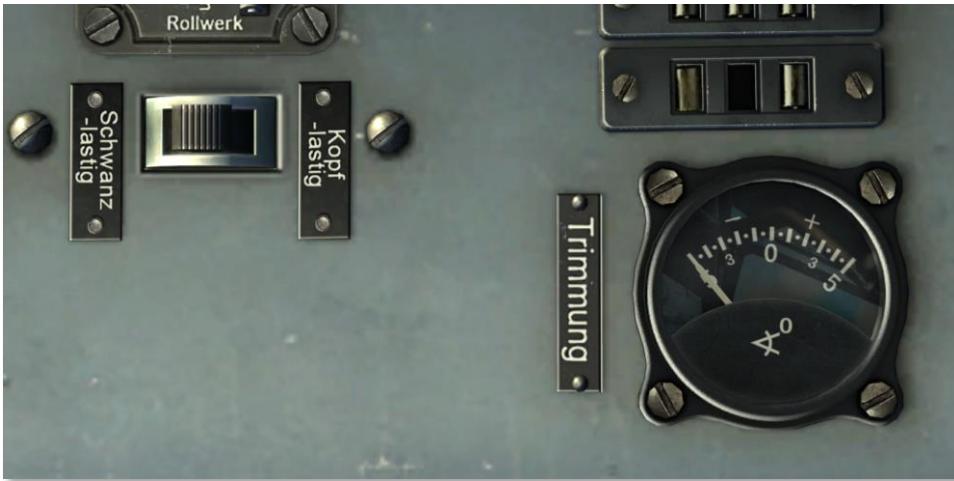


Figure 11: Horizontal stabilizer trim switch (left) and position indicator (right)

The trapezoidal elevator unit has a symmetrical airfoil.

The horizontal stabilizer is actuated by a spring-loaded switch located on the cockpit's left-hand side and can be moved between +2 and -3 degrees in flight.

The elevator comprises two identical half units, each attached to the stabilizer via pivot bearings. The elevator is aerodynamically balanced as well as mass balanced. The elevator has a trim tab that can only be adjusted on the ground.

The center-mounted fabric-covered rudder has aerodynamic horn balancing as well as mass balancing, and has a trim tab that can only be adjusted on the ground.

Frise-type ailerons made of light alloy with fabric covering are similar to the other control surfaces in construction. They also have mass balancing and a trim tab that can only be adjusted on the ground.

The landing flaps are of the split-type design and are identical, i.e. the right and left landing flap are interchangeable. They are operated electrically and can be set to three positions in flight: cruise, take-off, and landing. The standard take-off setting is 10 degrees of deflection; the landing setting is a full 60 degrees. There are no interim settings available to the pilot.

Landing Gear

The landing gear is of the inward retracting type, with the main wheels being housed ahead of the front spar when raised. The tailwheel is semi-retractable and is interconnected with the main wheels to synchronize retraction which is achieved by electrical means.

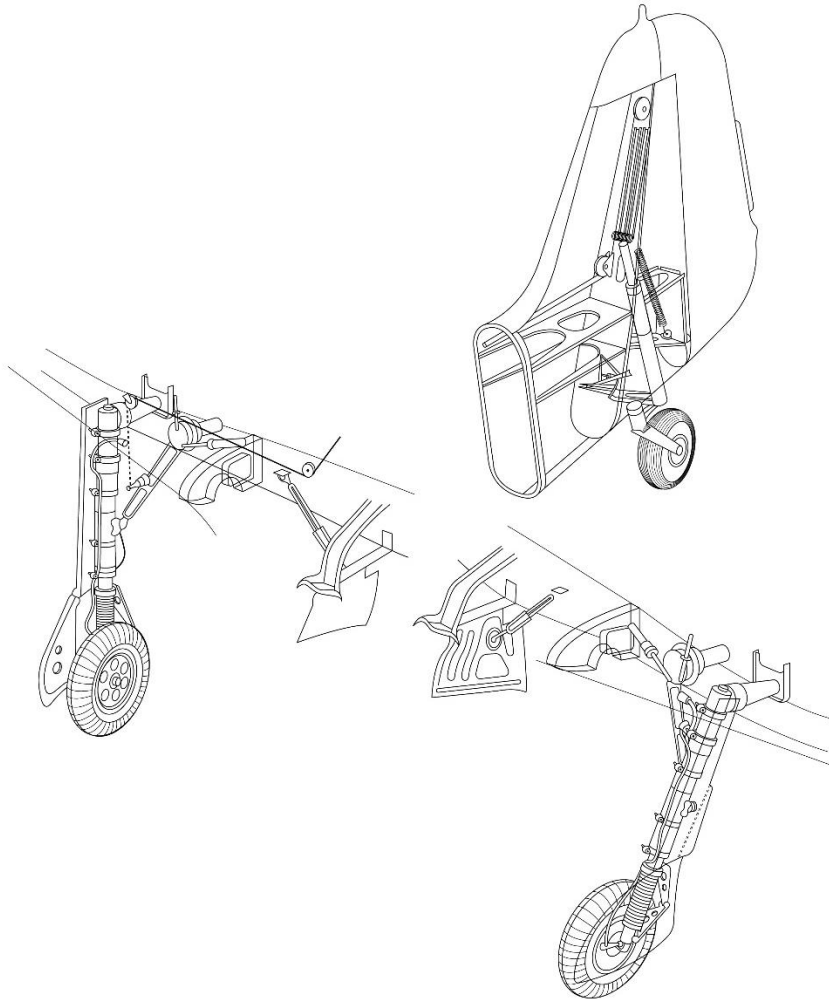


Figure 12: Fw 190 D-9 landing gear

The gear is extended and retracted electrically. A cable attached to the right main landing gear unit also retracts the tailwheel simultaneously with the main gear.

The main gear consists of two shock struts, with a scissors unit connecting the upper and lower shock strut members to absorb torque stresses.

Each main gear strut is operated individually by a drive unit powered by an electric motor mounted on the main spar.

A conventional tailwheel is also provided. It can be rotated 360 degrees and has a centering lock.

Both main gear members are secured in place by powerful locking hooks when retracted. The tailwheel is not locked in the up position, but is held in place by the tension of the retraction cable.

Undercarriage lowering is aided by a drive unit connected to a sealed air jack.

The undercarriage is controlled by simple pushbuttons located on the cockpit's left-hand side.

To raise the landing gear, simply depress the corresponding "Ein" (On/In) button and wait for the operation to complete. Once the gear is locked in position, red lights illuminate on the undercarriage indicator unit.

To lower the landing gear, depress the corresponding "Aus" (Off/Out) button and wait for the operation to complete. Once the gear is fully extended, green lights illuminate on the undercarriage indicator unit.

In case of electric motor failure, the main gear can also be lowered by pulling the emergency gear extension handle. This unlocks the shock struts which can then extend with the help of gravity and sealed air jacks.

The tailwheel is retracted simultaneously with the main gear.

When retracted, the lower half of the tailwheel remains exposed. In case of emergencies, it can be used as a tail skid.

Brake System

The Fw 190 D-9 has hydraulically operated brake shoes on each of the two main wheels. Each has its own hydraulic lines and can be braked individually.

The entire system is conventionally operated via rudder pedals.

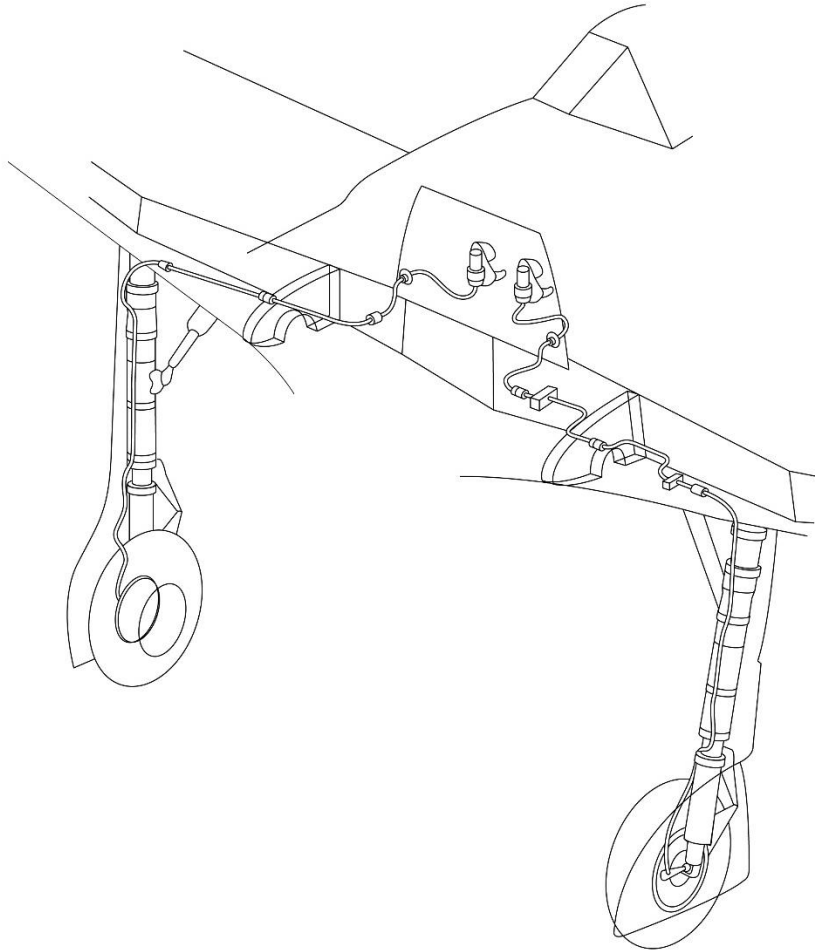


Figure 13: Fw 190 D-9 brake system

Engine

The Fw 190 D-9 is powered by a Junkers Jumo 213 A-1 engine, a 12-cylinder liquid-cooled inverted inline Vee. The Jumo 213 features a single stage, two-speed supercharger and an automatic manifold pressure regulator. The engine drives a three-blade constant-speed propeller.

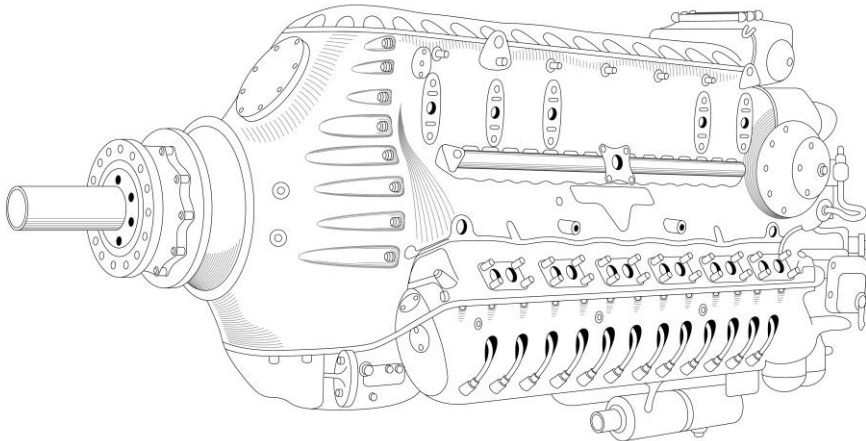


Figure 14: Junkers Jumo 213 A-1

Like most German aero engines, the Jumo 213 did not have a carburetor, but featured direct fuel injection.

Bediengerät Engine Control Unit

The Junkers Jumo 213 engine comes equipped with a "Bediengerät" (engine control unit), which is similar in function to the "Kommandogerät" (command device) used on BMW-801-powered earlier variants of the Fw 190.

The "Bediengerät" is a hydromechanical multifunction integrator that dramatically simplifies engine control. While in most other contemporary aircraft the pilot had to constantly operate a slew of levers to manage throttle level, propeller pitch, fuel mixture, and supercharger stages, the "Bediengerät" takes the majority of the workload away. The pilot simply has to move the throttle lever to set the desired manifold pressure. The "Bediengerät" takes care of the rest, setting all other parameters to allow the engine to properly operate at the desired manifold pressure, given the current flight conditions.

The gauge used to monitor desired supercharger pressure is the supercharger pressure gauge to the right of the front dashboard labeled "ATA" (for "Absolute Technische Atmosphäre", an obsolete unit of pressure).

Additional controls are also available that allow for some engine control unit parameters to be manually finetuned.

Supercharger

The Junkers Jumo 213 engine is equipped with a single stage, two-speed centrifugal supercharger with MW-50 water-methanol injection.

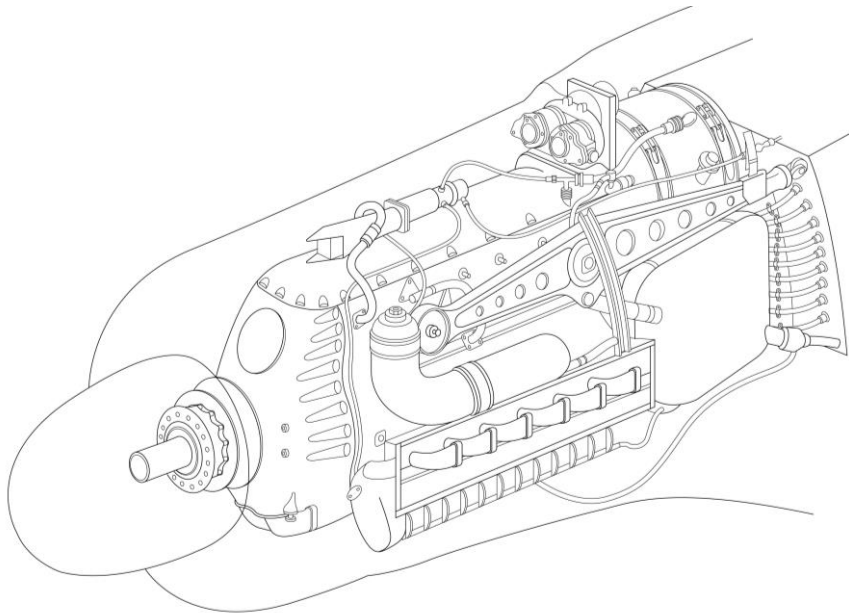


Figure 15: Junkers Jumo 213 A-1 assembly

Critical height is approx. 5500 meters.

MW-50 Water-Methanol Injection

MW-50 (Methanol-Wasser 50) is a 50-50 mixture of methanol and water sprayed into the Fw 190 D-9's supercharger, allowing the use of increased boost pressures.

The MW-50 tank has a capacity of 115 liters (85 kg). The fluid flow is about 160 liters/hour.

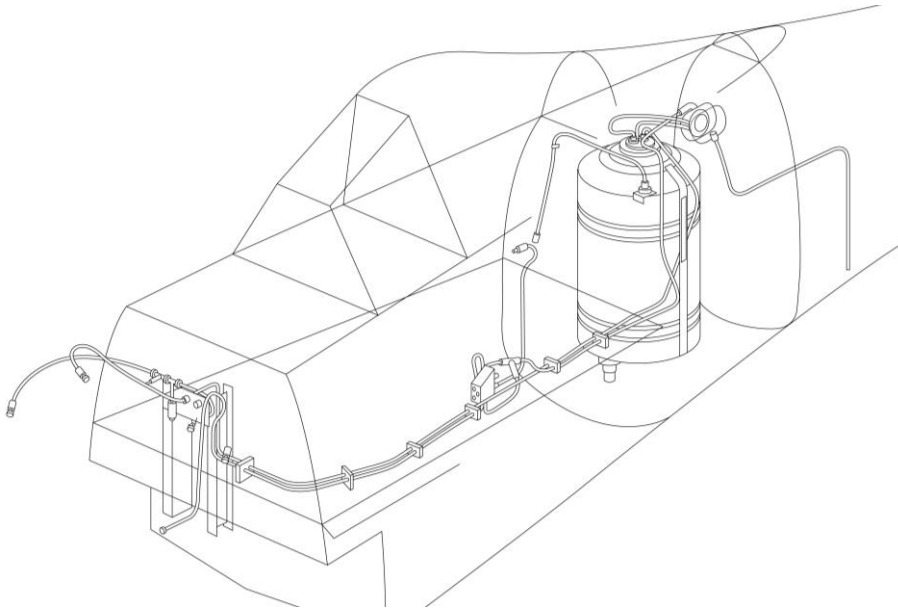


Figure 16: MW-50 system diagram

The primary effect of the MW-50 mixture spray is cooling of the air-fuel mixture.

The secondary effect of the MW-50 mixture spray is its anti-detonant effect, which is how the increase in boost pressure is achieved.

While the secondary boost-increasing effects deteriorate with altitude, the primary cooling effects are still noticeable. Therefore, the MW-50 system can be used to cool down the air-fuel mixture at all altitudes in the event of an emergency.

The boost provided by the MW-50 begins to decrease in power at altitudes above 6,000 meters.



Figure 17: MW-50 switch



Figure 18: Water/Methanol pressure gauge

The boost increase provided by MW-50 can be described with the word "incredible".

Turning the system on increases engine power by almost 100 HP due to the fact that a cooler mixture can pull in more air. At the same time it enables much higher supercharger boost levels. In optimal conditions, both effects combined increase engine power by a whopping 350...400 HP.

Please note that the MW-50 tank can also be used to store conventional aviation fuel, in essence providing extra range at the expense of available extra power.

The MW-B4 Selector on the left console is used to set the MW-50 tank status. Please note that incorrectly setting this switch can have catastrophic results, by either feeding the water-methanol mixture into the fuel lines, or spraying aviation fuel into the supercharger.

Propeller

The Junkers Jumo 213 A-1 engine drives a three-bladed VDM VS 111 constant-speed propeller with wood blades. Propeller diameter is 3.5 meters.

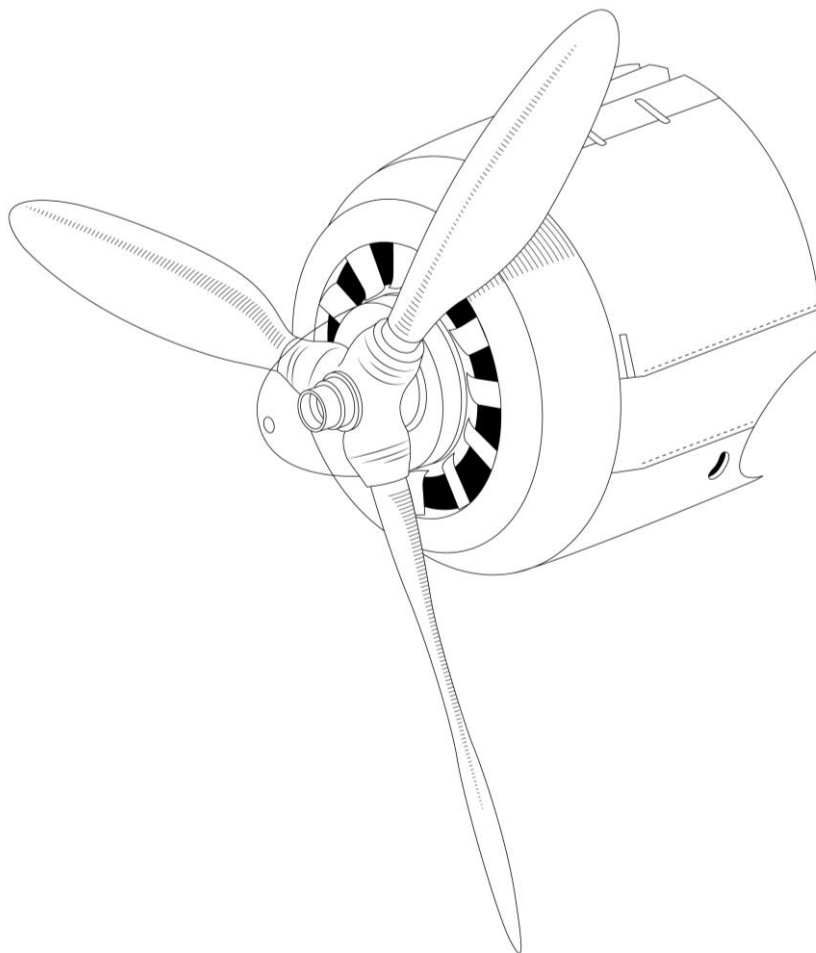


Figure 19: VDM VS 111 propeller

Fuel System

The Fw 190 D-9 has two main tanks, forward (Vorn) and rear (Hinten), both conveniently located below the cockpit floor underneath the pilot's seat. The fuel tanks are self-sealing. Engine-driven pumps feed the fuel into the engine at a normal pressure of 1 to 2 kg/cm². There is also an electrical booster pump in each of the two tanks that prevents vapor lock at altitude, provides improved fuel supply and can serve as a back-up in case of main pump failure.

The tanks have a capacity of 232 liters (172 kg) front (Vorn) and 292 liters (216 kg) rear (Hinten).
The MW-50 tank can be used as an additional fuel tank with a capacity of 115 liters.
The Fw 190 D-9 can also carry an external drop tank under the fuselage with the capacity of 300 liters.

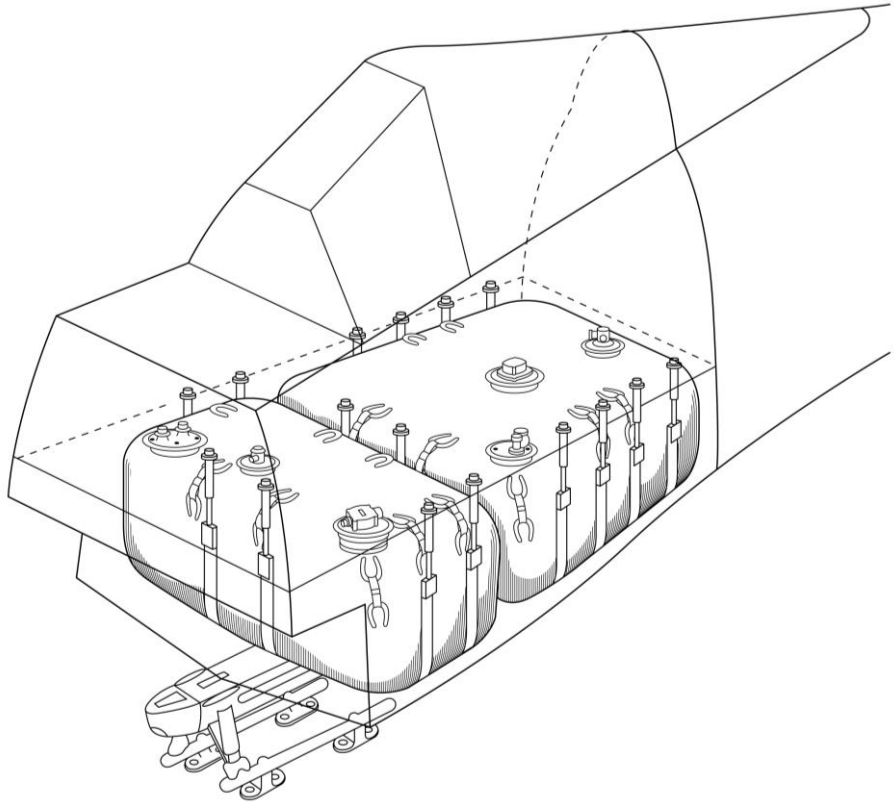


Figure 20: Front and aft fuel tanks

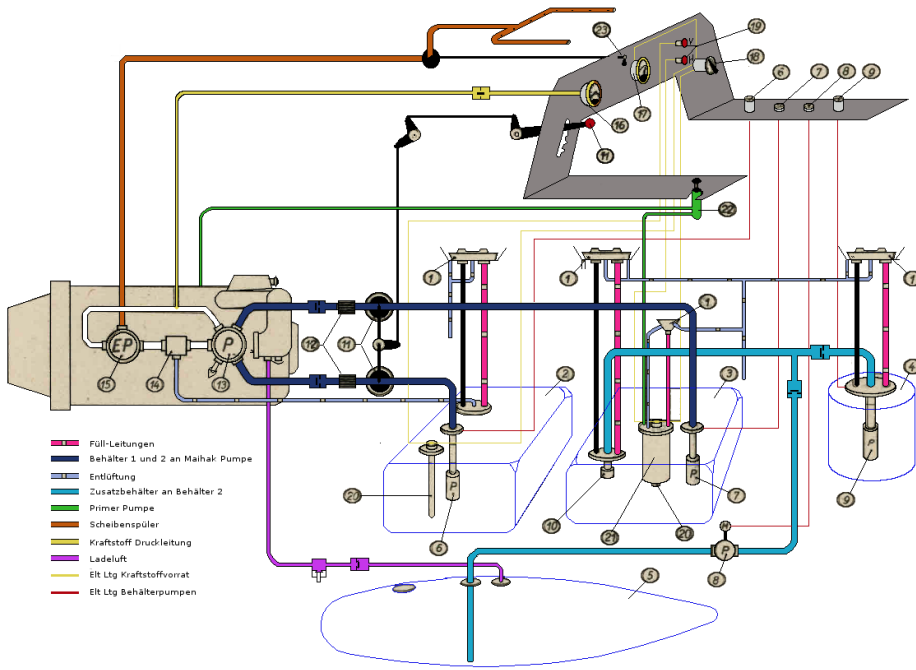


Figure 21: Fuel system diagram

- | | |
|--|--------------------------------|
| 1. Filling port | 13. Booster pump |
| 2. Forward tank (232 l) | 14. Vapor separator |
| 3. Aft tank (292 l) | 15. Fuel injection |
| 4. Auxiliary fuselage tank (115 l) | 16. Fuel pressure gauge |
| 5. Auxiliary jettisonable tank | 17. Fuel content gauge |
| 6. Forward tank feeder pump | 18. Fuel gauge selector switch |
| 7. Aft tank feeder pump | 19. Fuel warning lights |
| 8. Auxiliary jettisonable tank feeder pump | 20. Fuel level sender |
| 9. Auxiliary fuselage tank feeder pump | 21. Primer fuel canister (3 l) |
| 10. Shutter valve (shuts at 240 l) | 22. Primer pump |
| 11. Fuel selector | 23. Windscreen cleaner |
| 12. Fuel filter | |

The fuel system operates on a simple principle. The internal feeder pumps of the front [6] and rear [7] fuselage tanks feed into the engine's booster pump [13].

When the fuel selector (fuel cock) [11] is set to "Auf", both fuel lines from the forward and rear tanks are allowed to feed fuel to the booster pump. The booster pump draws more fuel than actually needed from both tanks and the surplus is routed back into the forward tank, thereby closing the valve for the forward tank. With this mechanism fuel effectively is drawn only from the rear tank as long as the engine gets enough fuel from it. When the engine pump starts to starve, the forward tank is "opened".

Additional tanks (auxiliary fuselage tank [4] and drop tank [5]) feed into the rear fuel tank. Fuel from the additional tanks flows through two feed lines to the rear tank. These feed lines are connected with a T-joint to the rear tank. Check valves are installed before the T-joint in each of the two lines that prevent the flow of fuel from one auxiliary tank to the other; or, when one of these two tanks isn't fitted, prevents loss of fuel through the unconnected feed line.

Note that the additional tanks won't start feeding the rear tank until the rear tank is at 240 from its 292 liters because of a fuel transfer limit switch ("Umpumpbegrenzer") [10] that regulates the flow of fuel from the auxiliary tanks to the rear tank.

When the rear tank is full, fuel is fed from the rear tank to the booster pump and the closed fuel transfer limit switch does not allow fuel from the additional tanks into the rear tank.

As soon as only 240 liters of fuel are remaining in the rear tank, the transfer limit switch opens and fuel is fed from the selected auxiliary tank to the rear tank.

The auxiliary tank will then continue feeding the rear tank and fuel will be drawn from the rear tank until the auxiliary tank becomes empty. The feeding from the auxiliary tanks to the rear tank will only stop when they are fully emptied. Since there is no gauge for monitoring auxiliary tank contents, the pilot can only notice them being empty when the rear tank fuel level falls below 240 liters.

When additional tanks are used, apply the following procedure:

- Set the fuel cock to „Auf“ (open).
- Set the fuel gauge selector switch to „Hinten“ (rear tank).
- Turn on the rear fuel tank pump by pressing the white E13 („Hinten“) circuit breaker
- When both additional tanks are fitted, the drop tank is emptied first, so that it can be discarded in an emergency.
- When a drop tank is equipped, turn the drop tank pump on by pressing the white E85 („Sonder“) circuit breaker. Fuel is forced from the drop tank to the rear fuel tank by air pressure drawn from the supercharger. This action is aided by the fuel pump which begins to run as soon as the circuit breaker is pressed. When the supercharger pressure is less than that of the surrounding air, the fuel pump alone feeds the fuel to the rear tank.
- When the drop tank becomes empty (rear tank gauge shows less than 240 l), turn off the drop tank feeder pump by pressing the red E85 („Sonder“) circuit breaker and jettison the depleted drop tank.
- When no drop tank is installed, the drop tank fuel pump can be left in the OFF position.
- When the auxiliary fuselage tank is used with B4 aviation fuel, the MW-50/B4 Selector on left side controls must be set to B4. Turning on the auxiliary tank fuel pump by pressing the white E96 („MW-Anlage“) circuit breaker is not necessarily needed, because fuel is fed by compressed air from the supercharger.

As soon as the (bottom) rear tank warning light turns on, there are 10 liters of fuel left in the rear tank and the following steps should be performed:

- Turn on the forward fuel tank feeder pump by pressing the white E14 („Vorn“) circuit breaker
- Set the fuel cock to „Hinterer Behälter zu“ (rear tank closed) to prevent suction of air into the booster pump
- Switch off the rear fuel tank feeder pump by pressing the red E13 („Hinten“) circuit breaker
- Set the fuel gauge selector switch to „Vorn“ (forward tank).

The (top) forward tank warning light indicates 80 liters of fuel remaining in the forward tank, sufficient for approximately 15 minutes flying time.

The engine consumes the fuel from a tank that is open according to the position of the fuel selector.

If drop tanks are used, their fuel pump, in turn, feeds the rear tank.

The pipe that feeds from the drop tank to the rear tank connects to a special limiting valve, mounted in the rear tank. If the plane carries a drop tank, that limiting valve will only open when the rear tank content drops below 240 liters.

At first, no fuel is consumed from the drop tank, because the limiting valve is closed. So, in the beginning, fuel will be consumed from the rear tank, until its level drops to 240 liters. Only then, the limiting valve will open and allow fuel from the drop tank to feed into the rear tank. When the drop tank is empty, the fuel level in the rear tank will drop below 240 liters – this is the indication that the drop tank is empty.

If drop tanks are used, set the fuel selector lever to „auf“, the fuel gauge selector switch to „Hinten“, switch on the rear tank fuel pump by activating the E13 „Hinten“ circuit breaker, and switch on the drop tank fuel pump by activating the E85 „Sonder“ circuit breaker. When the drop tank is empty (rear tank drops below 240 liters), switch off the drop tank fuel pump by deactivating the E85 „Sonder“ circuit breaker. The drop tank can now be jettisoned.

As soon as the rear tank empty warning light illuminates, the fuel level in the rear tank is approximately 10 liters. Switch on the forward tank fuel pump by activating the E14 „Vorn“ circuit breaker, and set the fuel selector lever to „hinterer Behälter zu“ to avoid sucking air in the pumps. Then switch the rear tank fuel pump off and set the fuel gauge selector switch to „Vorn“ so that the contents of the front tank are displayed on the fuel contents gauge.

The front tank empty warning light illuminates when the fuel level in the front tank reaches approximately 80 liters. This amount is sufficient for approximately 15 minutes of flight time.



Figure 22: Fuel selector lever

A single fuel contents gauge is also provided on the front dash. It can be switched to show the contents of the rear or the forward tank at any given time. The fuel gauge selector switch located to the right of the fuel contents gauge can be used to switch between the two modes.



Figure 23: Fuel contents gauge

There is also a fuel pressure gauge that monitors the fuel pressure as fed from the main fuel tank to the engine.

The following two fuel warning lights are provided to indicate low fuel in each of the tanks:

1. Return-to-base warning.

A fuel low level device fitted in the forward tank causes the top red (fuel low) warning light labeled "vorn" to illuminate when the contents of the forward tank fall to 80 liters.

2. Tank switch-over warning ("Umschaltwarnung").

A fuel low level device fitted in the rear tank causes the bottom white (rear tank switch-over) warning light labeled "hinten" to illuminate when the contents of the rear tank fall to 10 liters.



Figure 24: Fuel warning lights (left) and fuel gauge selector switch (right)

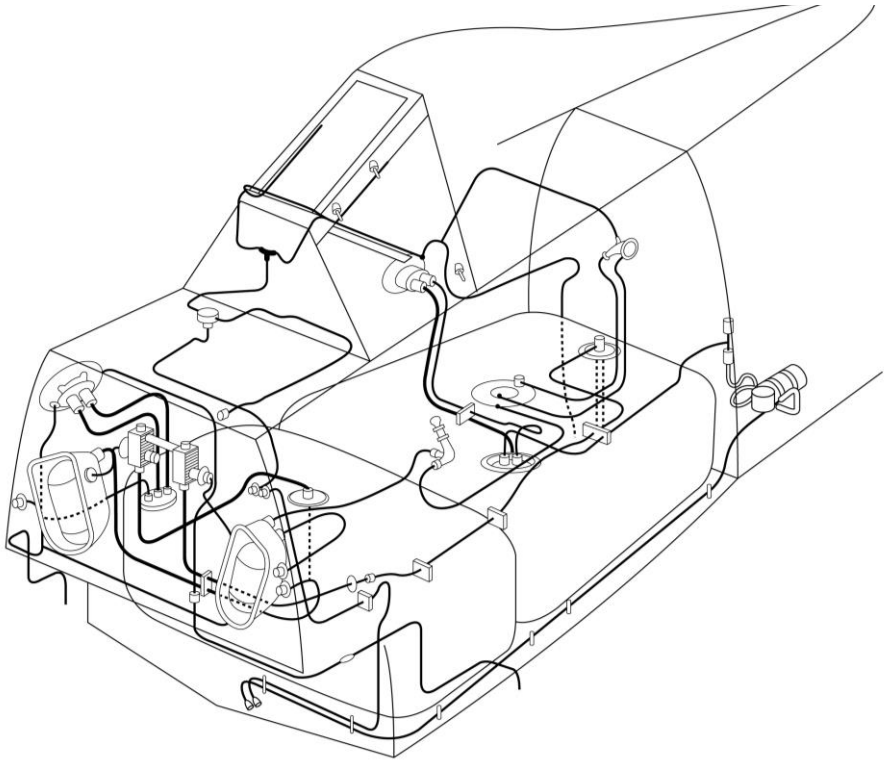


Figure 25: Fuel system

Oil System

A 55-liter oil tank is located in the left side of the engine. There is no air oil cooler - oil is cooled by engine coolant in the special heat exchanger.

Two cockpit gauges are provided, both located on the front dash. The oil temperature gauge monitors the system with the normal operating temperature range of 110...130 degrees Celsius (min. 40°C, max. 135°C). The right-hand side of the fuel and oil pressure gauge monitors the oil system with the normal operating pressure of 5 – 11 kg/cm².



Figure 26: Fuel and oil pressure, coolant temperature and oil temperature gauges

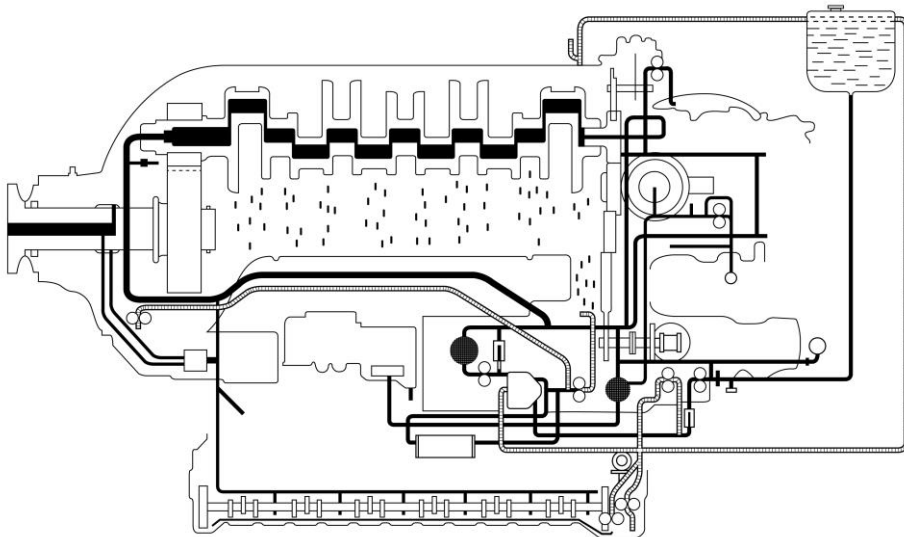


Figure 27: Oil system diagram

Coolant System

The D-series of the Fw 190 uses the AJA 180 annular radiator with a capacity of 115 liters. It is installed in front of the engine.

The Jumo 213 coolant system has both the main system, consisting of the coolant pump, engine, radiator, and the heat exchanger; as well as the secondary system with the secondary flow pump, coolant pump, and the coolant tank. The two systems only interact within the coolant pump.

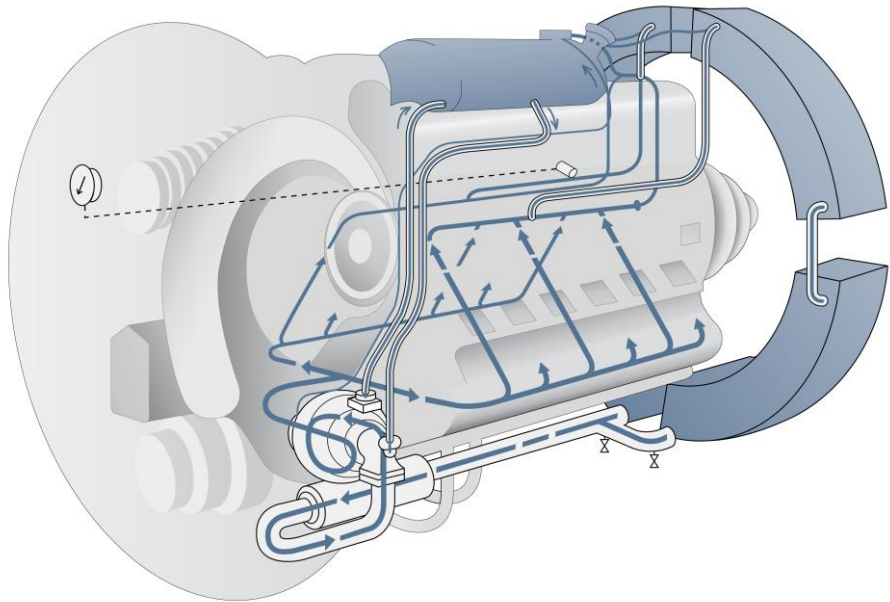


Figure 28: Coolant system diagram

The coolant system attempts to operate at a temperature of about 100 °C at all altitudes. A built-in electric temperature sensor between the engine and the radiator is used to control the temperature.

Proper pressure is required in the cooling system to prevent unwanted vapor formation. Any steam that may occur is separated in the vapor air separator of the coolant pump and then sent to the secondary system coolant tank where it is condensed.

However, if the boiling limit in the coolant tank is exceeded, the pressure begins to rise. Therefore, the pressure and temperature gauges should be watched at all times to avoid overheating and possible engine damage.

To avoid excessive pressure, the cooling system has a pressure-controlled pressure regulating valve which also performs the task of maintaining pressure at greater altitudes via the evaporation of the coolant in the coolant tank.

Electrical System

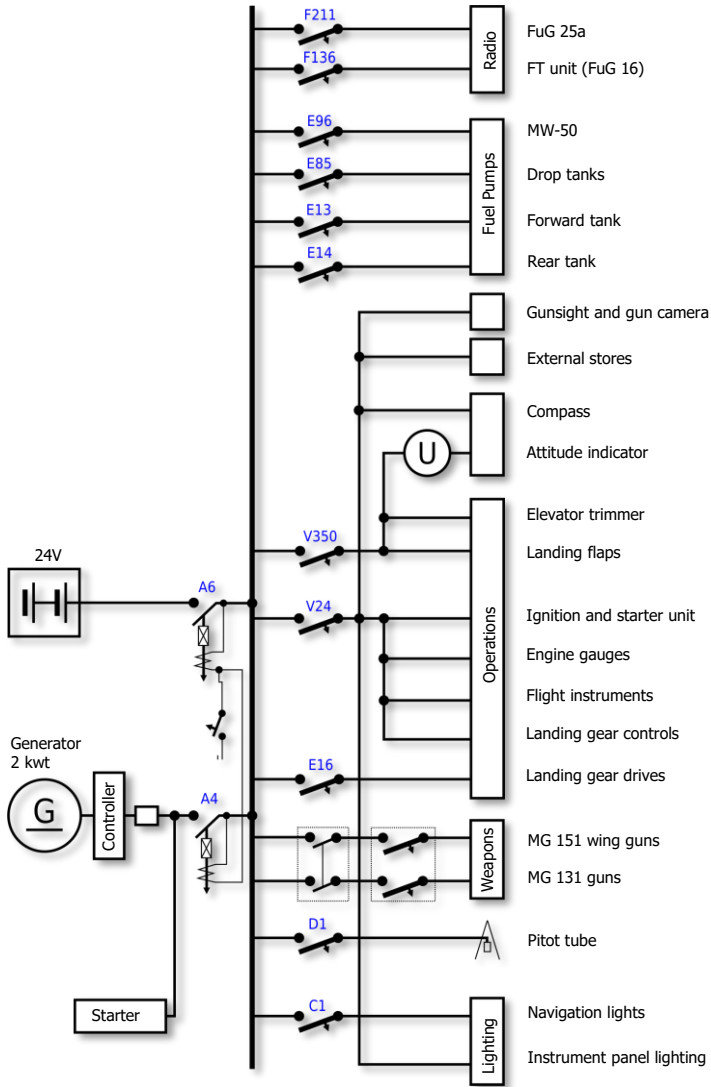


Figure 29: Electrical system diagram

Oxygen System

The oxygen system consists of a cockpit-mounted flow valve with the attached flow monitor, the regulator unit with oxygen hose, and high-pressure lines with pressure gauge, and a set of spherical bottles located in the aircraft tail that contain the oxygen. The bottles are split into separate systems as an additional safety measure.



Figure 30: Oxygen flow indicator and pressure gauge

Opening the flow valve starts the flow of oxygen. Oxygen flows to the regulator unit. The provided flow indicator and the pressure gauge located on the right-hand side of the front dash correspondingly indicate system status.

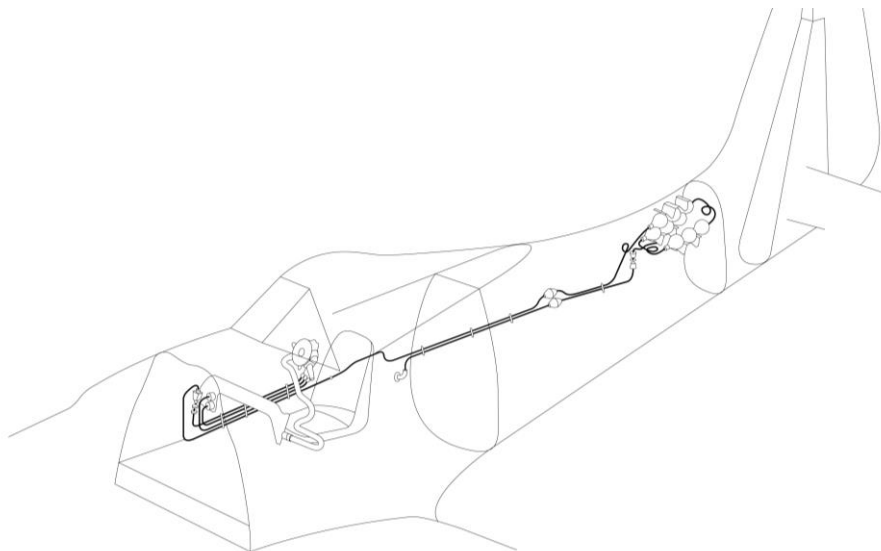


Figure 31: Oxygen system diagram

Radio Equipment

The aircraft is equipped with a FuG 16ZY radio, a specially-designed airborne VHF transceiver. The FuG 16 can be used for in-flight communication and DF homing. The set operates in the frequency range between 38.4 and 42.4 MHz.

The FuG 16ZY can also be set to "Leitjäger" or fighter formation leader mode that allows it to use a special "Y-Verfahren" (ground tracking and direction finding method) via the normal headphones.

The AFN-2 component of the radio set allows easy navigation to ground-based homing beacons, showing both direction and range on one simple dial.

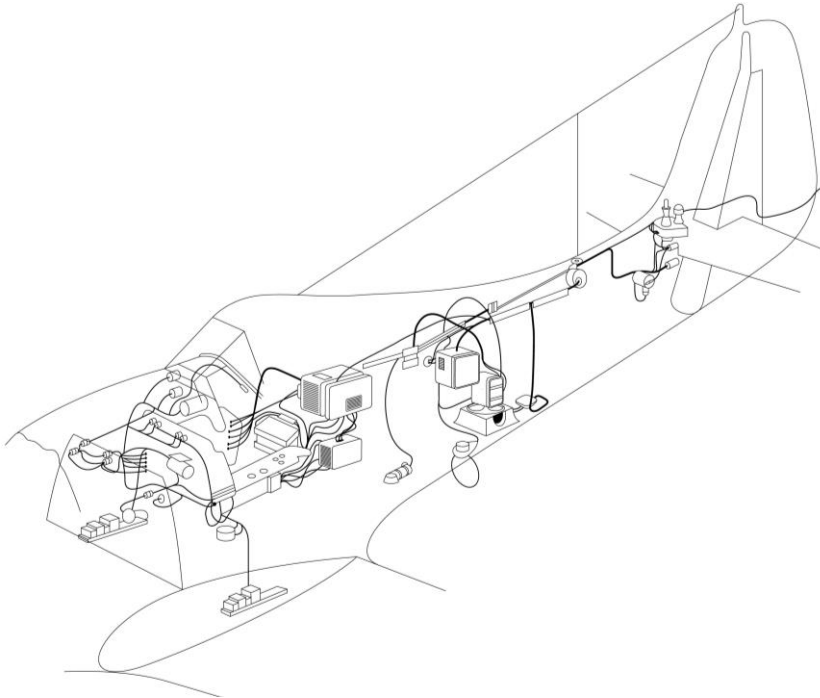


Figure 32: Radio equipment diagram

The FuG 25a "Erstling" (debut) component is one of the world's first Identification Friend or Foe (IFF) units that allows ground-based radar to identify the aircraft as friendly. The unit receives impulses from "Freya" or "Würzburg" radar stations. When enabled and properly set with the day's codeword, the FuG 25a replies with a pre-defined signal that the ground station can process to identify the unit as friendly. The FuG 25a operates in the frequency range of 125 +/-1.8 MHz, with the operating range of up to 100 km.



Figure 33: FuG 16ZY frequency selector, receiver fine tuning control, and volume control

Armor

The Fw 190 D-9 offers plentiful all-around pilot protection that includes an armored headrest, armored seat back, as well as a set of armor plating around cockpit walls.

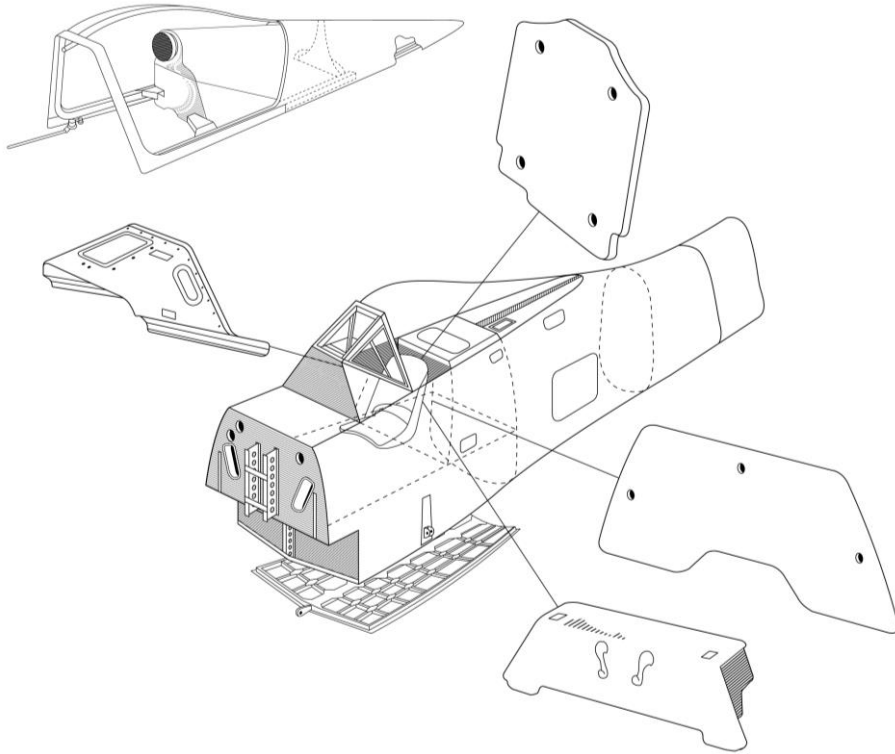


Figure 34: Fw 190 D-9 armor

Armament

The Fw 190 D-9 carries powerful fixed armament that consists of twin synchronized 13 mm Rheinmetall-Borsig MG 131 machine guns above the engine cowling with 475 rounds per gun, and twin synchronized Mauser MG 151/20 cannons in the wing roots with 250 rounds per gun.

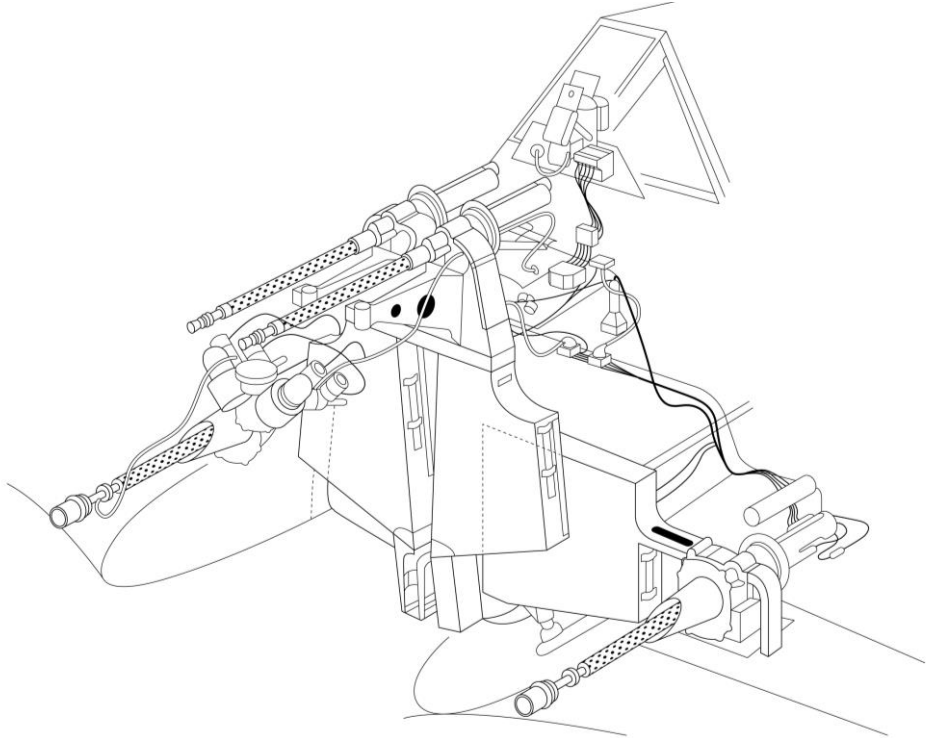


Figure 35: Fw 190 D-9 armament

Cockpit equipment for the armament includes the EZ 42 gunsight as well as the SZKK 4 ammunition counter.

The SZKK 4 ammunition counter is from the SZKK (Schalt-, Zähler- und Kontrollkasten) family of German indicators used on many Luftwaffe aircraft during WWII. While most pilots from other air forces had to estimate the amount of ammunition remaining in their weapons, German pilots had the luxury of seeing the actual amount of ammunition in their stores right in their cockpit.

The Fw 190 D-9 is also equipped with the pioneering EZ 42 gunsight that is roughly equivalent to the well-known K-14 gunsight used on the North American P-51D Mustang.

The design history of the EZ gunsight began before the war, but the Reich Air Ministry continued to focus on conventional reflector sights, installing the ubiquitous Revi (Reflexvisier) sight on most aircraft.

"Einheitszielvorrichtung" (target predictor unit) development remained low-priority until captured US aircraft showed that the Allies had predictor gunsights in operational use. Development took two long years, with first production EZ 42 units delivered in spring of 1944.

803 EZ 42 gunsights were produced in total until production ceased in March of 1945.



Figure 36: Flight stick, trigger, and bomb release button

A conventional flight stick is provided with a conventional trigger that allows the pilot to fire on-board armament as needed.

The stick also contains the bomb release button that can be used to drop the bomb load, or fire the underwing rockets.

COCKPIT

Russische Jäger	100	Moskito	16,5
Spitfire	11,2	Beaufighter	17,7
Mustang	11,3	Halifax	30,0
Hurricane	12,2	Lancaster	30,0
Thunderbolt	13,4	Boeing	31,6
Lightning	14,8	Liberator	33,5

Rumpf Rumpf Flügel

Gruppe

Schalter

10



Handzug für

Notsaug für Bedienung

Flügelast

Rumpflast

Achtung Kompaßeinstellung verstellen



COCKPIT

The cockpit in the Fw 190 D-9 was a revolutionary design that attempted to put all levers and instruments easily within reach. It was one of the first examples of ergonomic cockpit design, and can be seen as the early precursor of today's hands on throttle and stick (HOTAS) cockpits.

In stark contrast to its competitor, the Bf 109, the Fw 190 offered its pilot comfortable access to most important controls located easily within reach.



Figure 37: Fw 190 D-9 cockpit overview

The cockpit is divided into three main areas: the front dash that includes the instrument panel and the EZ 42 gunsight; the left-hand side that includes engine controls; and the right-hand side that includes canopy and oxygen controls, weapon controls, and electrical system breakers.

Front Dash Legend

The front dash includes the instrument panel and the EZ 42 gunsight.



Figure 38: Fw 190 D-9 front dash

1. EZ 42 gunsight
2. SZKK 4 with ammo indicators
3. Artificial horizon / turn & bank indicator
4. Airspeed indicator
5. Altimeter
6. FuG 25a IFF control unit (not implemented)
7. Stick
8. AFN-2 homing indicator
9. Vertical speed indicator
10. Repeater compass
11. Supercharger pressure gauge

12. Tachometer
13. Oxygen flow indicator
14. Oxygen pressure gauge
15. Oxygen flow valve
16. Pedals

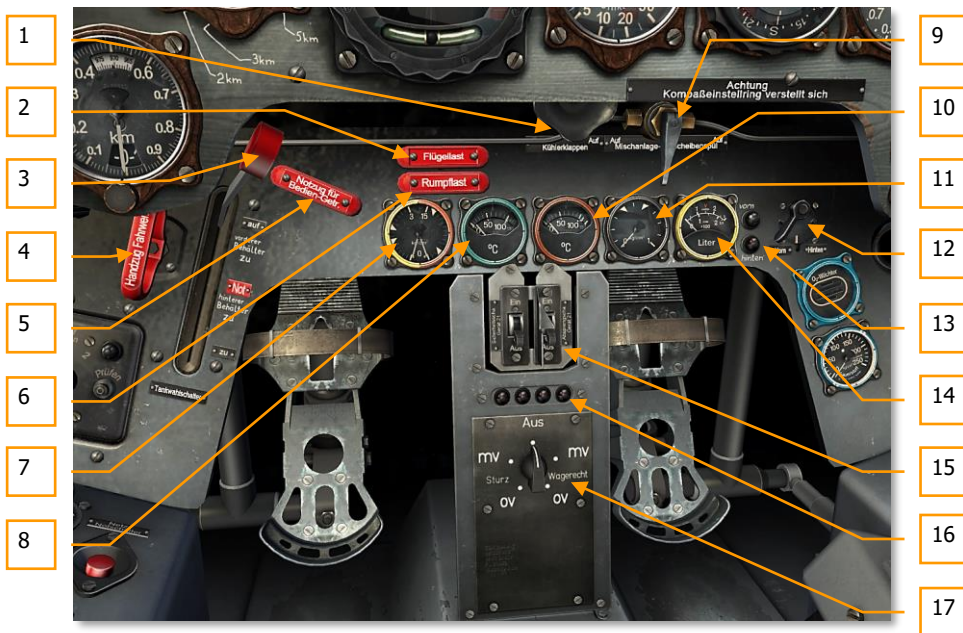


Figure 39: Fw 190 D-9 front dash lower part

1. Manual radiator flap control
2. Emergency wing load release
3. Fuel tank selector lever
4. Landing gear manual release
5. MBG emergency mode handle
6. Emergency fuselage load release
7. Fuel & oil pressure gauge
8. Coolant temperature gauge
9. Cold start and window rinsing (not implemented)

10. Oil temperature gauge
11. Water/Methanol pressure gauge
12. Fuel gauge selector switch
13. Fuel warning lights
14. Fuel contents gauge
15. 21-cm rocket control unit
16. Disposable load indicator lights
17. Bomb fusing selector unit

Left Side Legend

The left-hand side includes engine controls.

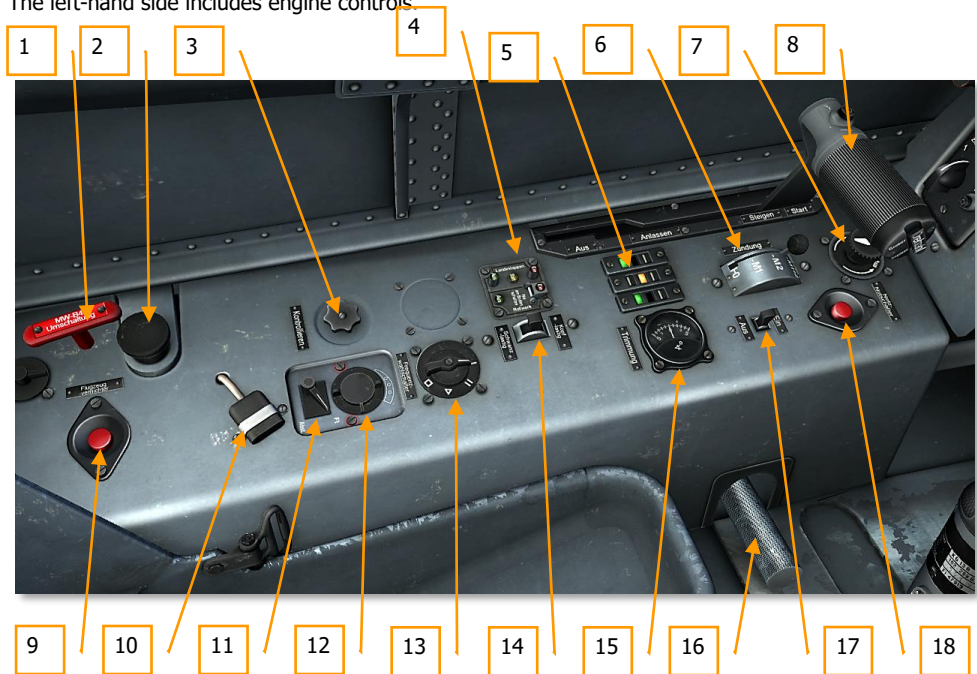


Figure 40: Fw 190 D-9 left side and legend

1. MW-50 tank contents (MW-50 / B4 aviation fuel) selector handle
2. Primer pump handle

3. FuG 16ZY fine tuning
4. Landing gear and flaps actuation buttons
5. Landing gear (left and right) and flaps (center) indicators
6. Ignition (magneto) selector switch
7. Instrument panel lighting dimmer control
8. Throttle lever
9. Radio self-destruction button (not implemented)
10. Heated suit connector (not implemented)
11. FuG 16ZY communications - homing switch
12. Headphone volume control
13. FuG 16ZY frequency selector
14. Horizontal stabilizer trim switch
15. Horizontal stabilizer trim indicator
16. Throttle friction knob
17. MW-50 power switch
18. Electric kill-switch

Right Side Legend

The right-hand side includes electrical system circuit breakers, canopy and weapon controls and a flight clock.

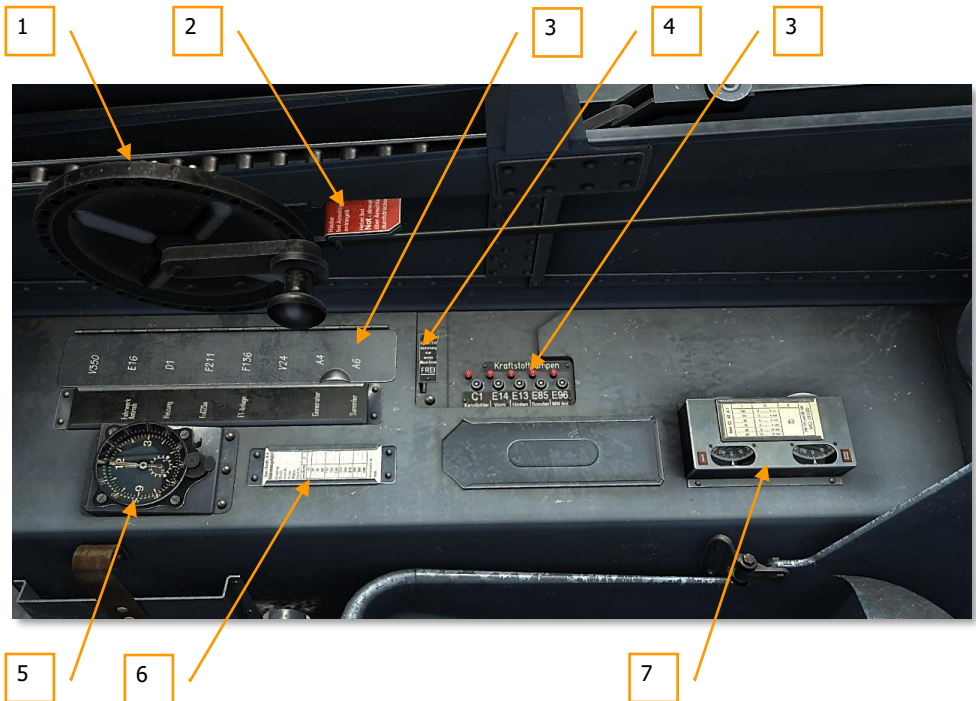


Figure 41: Fw 190 D-9 right side and legend

1. Canopy actuator drive
2. Canopy jettison lever
3. Circuit breaker panels
4. Starter switch
5. Flight clock
6. Compass deviation card
7. EZ 42 gunsight adjustment unit

Front Dash Indicators and Controls

This section will overview in detail all of the indicators and controls located on the front dash.

EZ 42 Gunsight



Figure 42: EZ 42 gunsight

An analog computer in the EZ 42 measures the aircraft angular velocity to automatically plot both bullet drop and target lead for on-board armament.

A target wingspan circle is used to aid in gauging distance to target, a crucial variable for accurate lead calculations. The floating aiming reticle is provided that plots estimated aiming point based on all input parameters.

A powered three-phase turn coordinator gyro provides the necessary computations. The gyro is mounted on the main base frame bracket. The movements of the gyro are transferred to the movements of the gunsight reticle.

A set of controls conveniently located in the cockpit allows the pilot to provide specific input to the gunsight relevant to specific target and flight conditions.

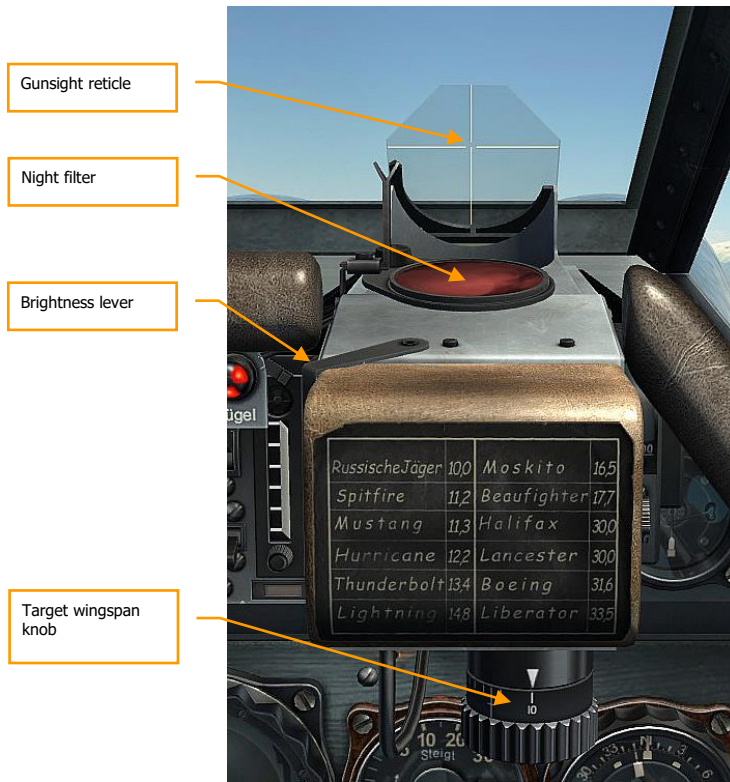


Figure 43: EZ 42 gunsight controls 1

The lower front of the sight panel includes a target wingspan knob, calibrated from 10 to 40 meters. The target wingspan is set to match the expected enemy aircraft wingspan prior to the start of an engagement.

The throttle lever incorporates a twist grip. The grip is attached to the sight by cable and pulleys, ending with a range pulley containing a scale calibrated from 0 to 1000 meters on the right side of the gunsight.

As the grip is turned, the range scale indicator moves to show the set target range.



Figure 44: Throttle lever with twist grip and cable

The EZ42 Justierkasten, a gunsight ballistics adjustment unit, mounted on the right side of the cockpit.

Depending on the current flight altitude, both rotaries I and II of the unit have to be set to the values given in the table located on the front of the unit.

For a given altitude band in column "H" (for "Höhe" - altitude), the columns I and II contain the recommended values for rotaries I and II.

Since in the specific model that is carried in the Fw 190 D-9, column II contains only a single fixed value ("63"), irrespective of altitude, rotary II is protected by a cover and cannot be adjusted by the pilot.

For example, at an altitude of 9 kilometers, rotary I has to be set to the value "68". Rotary II is fixed at "63".

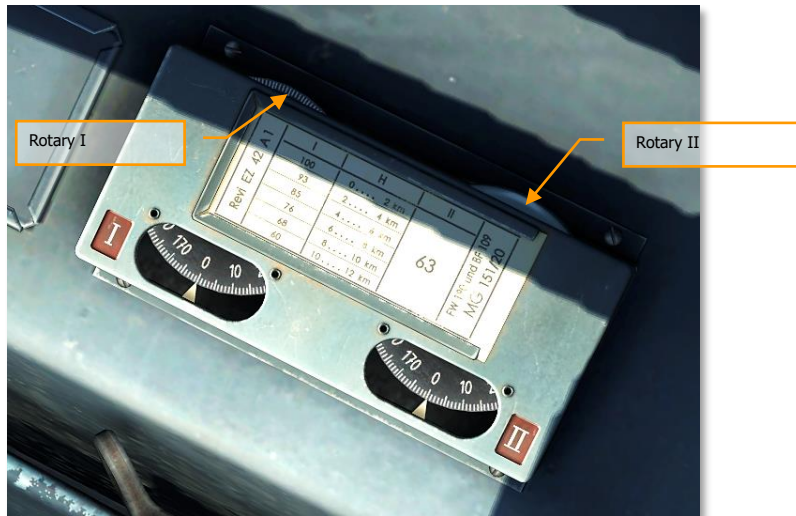


Figure 45: Gunsight ballistic adjustment unit

The throttle twist grip varies the range input into the sight. With the wingspan set, the throttle is used to frame the target with the gunsight reticle circle. This combination (wingspan set and target correctly framed) then produces the range that the sight uses in the calculation of the prediction angle. Added to this are own aircraft turn rates and corrections from the ballistics adjustment unit.

The EZ 42 has a backup iron sight ("Hilfvisier") that consists of both a rear and a front sight.

The rear sight ("Kimme") is a "Y"-shaped pin at the front left edge of the gunsight.

The front sight ("Korn") is the upwards pointing "A"- or arrow-shaped left end of the reflector glass holder.

To point the guns to the target, line up both sights so that the tip of the "A" aligns with the tips of the "Y".

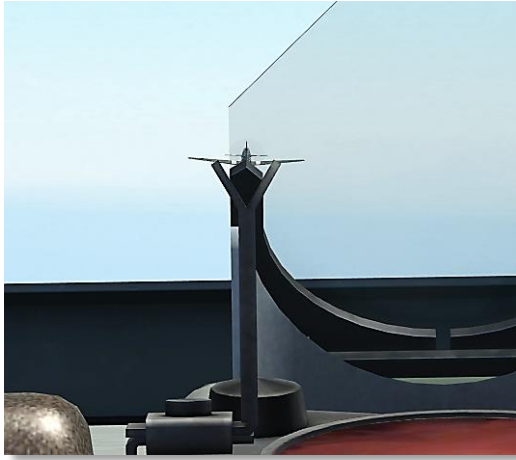


Figure 46: Pointing with the backup iron sight

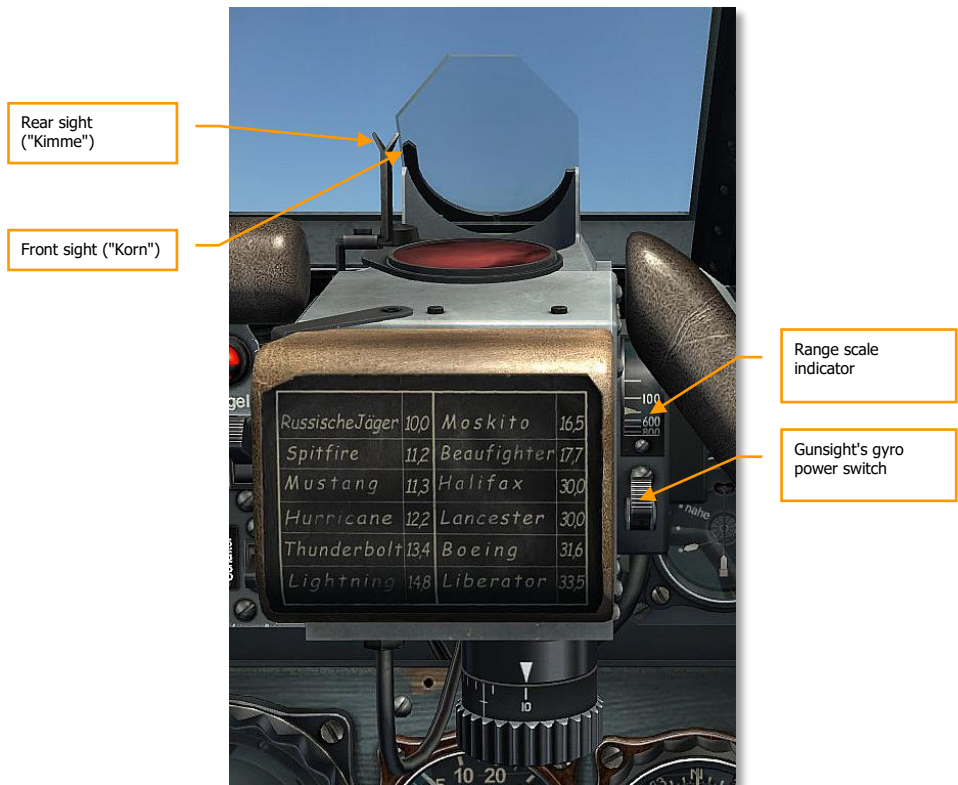


Figure 47: EZ 42 gunsight controls

Instrument Panel

Ammo Indicators

The SZKK 4 shows the ammo stores for each of the four guns. The four vertical banks in the SZKK show the state of, from left to right, the left MG 151, left MG 131, right MG 131, and the right MG 151. In other words, the outer indicators show the ammunition in the outer wing guns, while the inner two indicators show the ammunition in the fuselage guns.

The ammo counters are not directly linked to the ammo stores. Instead, they are reset to full (top) position when the guns are loaded on the ground, and then each mechanical indicator bar is lowered by one notch whenever a weapon is fired.

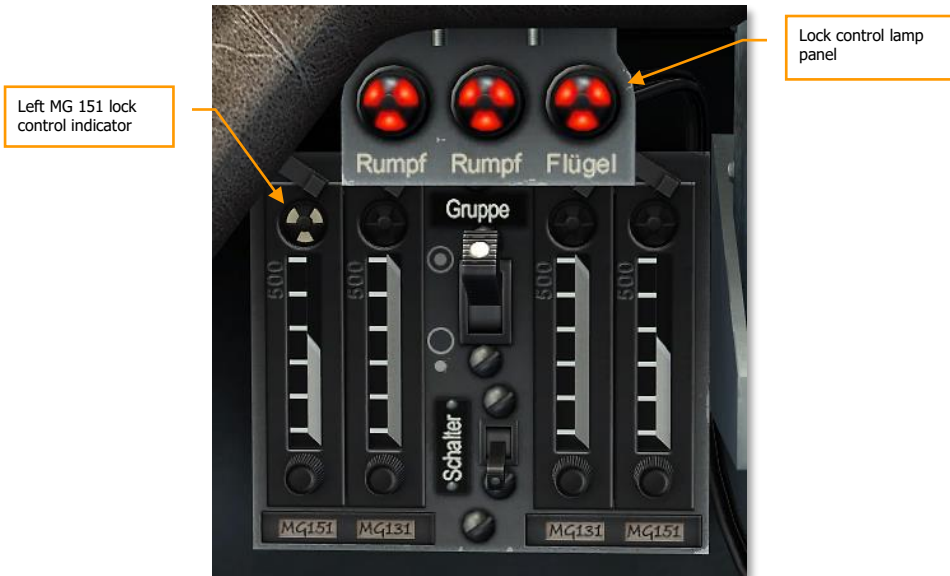


Figure 48: SZKK 4 with ammo indicators

Notches provided to the side of each indicator show the amount of rounds in the ammo store for each weapon.

White bar portion signifies ammunition in the stores; black bar portion signifies expended ammunition.

Each weapon's breechblock is directly linked to the corresponding indicator on the panel installed above the SZKK 4. Indication is provided by the red lock control lamps, which are labeled "Rumpf" (fuselage) and "Flügel" (wings):

- "Rumpf" for the left and right MG 131 guns
- "Flügel" for the right MG 151 gun.

Note that no electrical lock control lamp exists for the left MG 151 - its weapons status is indicated by the mechanical lock control indicator located on top of its ammunition counter. If the indicator is black, the breechblock is closed. If it is light, the breechblock is open. Flickering of the indicators whenever weapons are fired shows that the gun equipment operates properly. If the lock control lamp remains black or light when the trigger is pressed, a weapon malfunction has occurred.

AFN-2 Homing Indicator

This ubiquitous device was installed in most German aircraft of WWII. In the Fw 190 D-9, the AFN-2 indicator is a part of the FuG 16ZY equipment set.

The AFN-2 indicator allows for easy navigation to ground-based homing beacons, showing both direction and range on one simple dial.

The device has two moving bars that indicate homing beacon information. Each is similar to modern-day equipment, the VHF omnidirectional range – VOR – (vertical bar) and the distance measuring equipment – DME (horizontal bar).

The vertical bar indicates the general direction of the homing beacon in relation to the aircraft's nose.

The horizontal bar indicates the distance from the beacon.

The marker lamp in the center of the indicator will light when flying over aerodrome's near and far NDBs.

As the AFN-2 is a very sensitive instrument, special care to reduce vibrations is used when the indicator is installed in the Fw 190 D-9. It is installed into a separate aluminum sheet attached to the dashboard with rubber screws. This makes the device provide more reliable input; however strong vibrations can still disrupt its operation.

The frequency of the AFN-2 can be adjusted in the Mission Editor to any desired ILS beacon. By default it is set to 38 MHz.



Figure 49: AFN-2 homing indicator

Airspeed Indicator

A later model of a common Luftwaffe airspeed indicator, the gauge in the Fw 190 D-9 bears a km/h designation on the dial.



Figure 50: Airspeed indicator

The FI 22234 airspeed indicator displays Indicated Airspeed (IAS) and is graduated from 0 to 750 km/h on the main outside range, with the airspeed continuing past the 0 mark for up to 900 km/h. The scale is to 10 km/h from 100 to 750 km/h and to 50 km/h thereafter.

Please note that ranges between 0 to 180 km/h and 750 to 900 km/h overlap. No indication other than common sense is used to determine the airspeed within this overlap.

The handwritten altitude markings (2km, 3km, 5km, 7km, 9km) around the airspeed indicator and their corresponding line markings indicate the maximum allowed dive speed at those heights. Exceeding these limits can damage the aircraft.

Artificial Horizon / Turn & Bank Indicator

Another commonly used Luftwaffe indicator, this gauge manufactured by Askania in Berlin combines a turn/bank indicator and an artificial horizon into one.

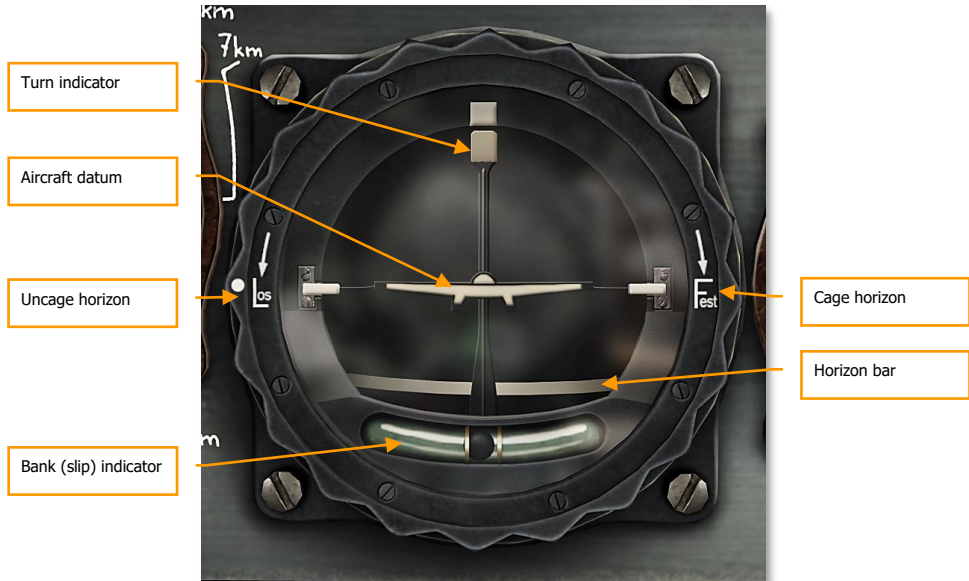


Figure 51: Artificial horizon

The turn-and-bank portion of the gauge is composed of a gyroscope-type turn indicator and a ball-type bank (slip) indicator. The bank indicator is a liquid-filled curved tube in which a free-rolling inclinometer ball changes position according to the direction of the force of gravity and centrifugal force. The bank indicator is used to minimize side-slip by keeping the ball centered between the center reference lines while turning. The limits of the bank indicator are $\pm 35^\circ$.

The horizon bar will indicate pitch up to 60° and bank up to 110° . The top needle of the instrument indicates the angle of bank.

Please note that the artificial horizon bar is locked during aerobatics!

The outer rotary ring is intended for caging/uncaging the artificial horizon. "Fest" is caged and "Los" is uncaged position.

Vertical Speed Indicator

The vertical speed indicator or variometer shows the rate of ascent or descent of the aircraft. The instrument is graduated from 0 to 30 m/s in both positive and negative directions and indicates vertical speed in meters per second. The face is scaled to 1 m/s between 0 and 5 m/s, and to 5 m/s thereafter.



Figure 52: Vertical speed indicator

The variometer is used to maintain a constant altitude when turning and to establish a definite and constant rate of climb or descent when flying on instruments.

Repeater Compass

The repeater compass consists of a rotary compass rose, a current magnetic heading pointer, and a desired heading reference stripe.



Figure 53: Repeater compass

The aircraft symbol with pointer rotates as the aircraft's heading changes. The compass rose can be rotated with the bezel to set the desired magnetic heading.

Supercharger Pressure Gauge

A standard instrument of R. Fuess in Berlin, as it was found in almost all piston engine aircraft. This device is used to monitor the charge pressure of the engine supercharger.

The gauge is graduated from 0.5 to 2.5 atmospheres absolute. The scale is to 0.02 and 0.1 ata throughout.



Figure 54: Supercharger pressure gauge

Altitude Indicator

The altitude indicator determines the altitude at which the aircraft is flying by measuring atmospheric pressure. The instrument consists of 3 parts; the needle indicates altitude in tens of meters, the lower window shows the kilometer disk, and the upper window shows barometric pressure in Millibar.

The gauge is graduated from fractions of 1 km from 0.0 to 0.99. The scale is 1/100 of a km, or 10 meters, throughout.

The kilometer disk shows even kilometers of altitude, rounded down. The disk can show numbers from 0 to 9, for a total limit from 0 to 9,999 meters.

The information shown by the meters needle and the kilometer disk should be added. For example, if the km disk shows 3 and the needle points at 0.4, the actual altitude is 3400 meters (3 + 0.4 km).

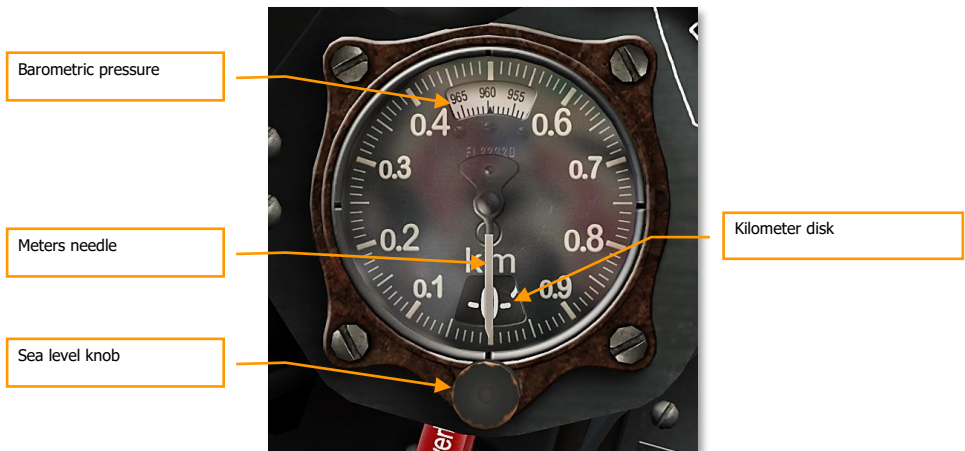


Figure 55: Altitude indicator

Tachometer

The tachometer provides remote indication of engine speed.

The actual speed of the motor is gauged with an electric sensor, and then transmitted to the speed indicator. The absolute maximum permissible speed of the Jumo 213 is 3.300 RPM.



Figure 56: Tachometer

The instrument is graduated from 0 to 3600 and indicates engine speed as Revolutions Per Minute (RPM, in German "Umdrehungen pro Minute" or short "U/min") in hundreds of RPM. The face is scaled to 100 RPM throughout. The normal operating RPM is 1600 - 2400. The maximum normal RPM is 3000.

Please note that, unlike in many Allied aircraft, the tachometer is used to set power in the Fw 190 D-9.

Manual Radiator Flap Control

The manual radiator flap control is used to control engine cowl flaps.

Please note that the control is obscured by the dashboard and is invisible from a pilot's normal point of view. It is located above and behind the corresponding plaque stating "Zu – Kühlerklappen – Auf" (Closed – Radiator Flap – Open).



Figure 57: Manual radiator flap control

The pilot reached behind the dashboard to operate the knob. Turning the knob clockwise, towards the "Auf" setting, mechanically opens the radiator flap. Turning the knob counterclockwise, towards the "Zu" setting, mechanically closes the radiator flap.

There is no radiator flap position indicator in cockpit.

Landing Gear Manual Release

When the main gear release buttons fail to work, a back-up manual system is provided. The emergency lever can be pulled, which unlocks the shock struts mechanically. This in turn allows the landing gear to extend under its own weight.

The aircraft should be in a generally wings-level attitude for the landing gear to drop.

Please note that the back-up system's spring will usually be sufficient to fully lock the landing gear in the down position. If it fails to do so, the standard gentle rocking aircraft wings for aircraft with hydraulic gear will not work for the Fw 190 D-9.



Figure 58: Landing gear manual release

Fuel Tank Selector Lever

The fuel tank selector lever is used to open or close the forward and rear fuel tanks depending on flight conditions.

The four possible settings are:

- "Auf" (Open) - Both fuel lines to the booster pump are open. Engine can draw fuel from both forward and rear tanks.
- "Vorderer Behälter zu" (Forward tank closed) - Engine can draw fuel from rear tank only.
- "Hinterer Behälter zu" (Rear tank closed) - Engine can draw fuel from forward tank only.
- "Zu" (Closed) - Both fuel lines to the booster pump are closed.

The Fw 190 D-9 can carry four fuel tanks:

1. Optional 300 liter external, jettisonable fuel tank (drop tank) – connected to the rear tank
2. 115 liter MW-50/B4 auxiliary fuselage tank – connected to the rear tank
3. Rear fuselage tank
4. Forward fuselage tank

The system is designed to reduce workload so that the pilot does not have to manage the different fuel tanks in flight - the aircraft takes care of it. When the Fuel Selector lever (fuel cock) is left in the "Auf" position and the necessary fuel pumps are switched on, the fuel system will automatically empty the drop tank, auxiliary fuselage tank, rear tank and the front tank in that order. Note that the corresponding fuel pumps still need to be switched off when a tank is empty to avoid them running dry. The corresponding fuel pumps are switched on/off with the following circuit breakers placed on the right console:

- E13 (Hinten - rear tank fuel pump)
- E14 (Vorn - forward tank fuel pump)
- E85 (Sonder - drop tank fuel pump)
- E96 (MW Anlage – auxiliary fuselage tank pump)



Figure 59: Fuel tank selector lever

If drop tanks are used, their fuel pump, in turn, feeds the rear tank.

When flying with drop tanks, drop tank fuel should be used first. This is achieved by setting the fuel tank selector lever to "vorderer Behälter zu" and switching on the external drop tank fuel pump with the E85 circuit breaker on the right console. Fuel is then drawn from the rear tank. As soon as the rear tank contents fall below 240 l, fuel is constantly being drawn from the drop tank.

When the fuel inside the drop tank is exhausted, the fuel tank selector lever is set to "Auf" and the external drop tank fuel pump should be turned off by popping out the E85 circuit breaker.

The drop tank can then be dropped by pulling the "Rumpflast" (fuselage store) handle.

MBG Emergency Mode Handle

This handle is connected via cable to the aircraft's "Motorbediengerät" (MBG). In normal position the MBG operates in automatic mode. In case of emergency, the handle can be pulled to allow the engine to operate at higher boost pressure than normal.

If at all possible, the handle should be pulled when the throttle is in Idle setting.

Speed control remains automatic.

Please take extra care to watch engine speed and boost. The engine must be loaded only as far as absolutely necessary in "Notzug" mode.

When flying in "Notzug" mode, boost pressure of 1.55 ATA should never be exceeded!

When flying in "Notzug" mode, engine speed of 2,700 RPM should never be exceeded!



Figure 60: MBG emergency mode handle

Emergency Fuselage and Wings Load Release

Pull the necessary handle to jettison any load attached to the fuselage or wing, such as drop tank or bombs.

- "Flügelast" – Jettison wings stores.
- "Rumpflast" – Jettison fuselage stores.



Figure 61: Emergency fuselage and wing load release

Fuel and Oil Pressure Gauge

Typical pneumatic double pressure gauge for fuel and oil, with two independently operating measuring stations and terminals. Manufacturer is the Maximal-Apparatus company, Paul Willmann / Berlin.



Figure 62: Fuel and oil pressure gauge

The gauge is divided into two sections. The left-hand side gauge and needle show fuel pressure in kg/cm^2 . The right-hand side gauge and needle show oil pressure in kg/cm^2 .

The fuel pressure gauge is graduated from 0 to 3 kg/cm^2 . The gauge is scaled to 0.2 kg/cm^2 throughout. Two indicator strips indicate normal operating pressure of 1 – 2 kg/cm^2 . The lower indicator strip shows minimum permissible pressure of 1.3 kg/cm^2 and the upper indicator strip the maximum permissible pressure of 1.7 kg/cm^2 .

The oil pressure gauge is graduated from 0 to 15 kg/cm^2 . The gauge is scaled to 1 kg/cm^2 throughout. Two indicator strips indicate normal operating pressure of 3 – 13 kg/cm^2 . The lower indicator strip shows minimum permissible pressure of 3 kg/cm^2 and the upper indicator strip the maximum permissible pressure of 13 kg/cm^2 .

Coolant Temperature Gauge

The FL 20342 electrical temperature indicator manufactured by Siemens shows the temperature of the coolant fluid. The gauge indicates temperature in degrees Celsius ($^{\circ}\text{C}$) and is graduated from 0° to 130°C . The face is scaled to 10°C . Normal operating temperature is $70\text{...}120^{\circ}\text{C}$.



Figure 63: Coolant temperature gauge

Oil Temperature Gauge

The FL 20342 electrical temperature indicator manufactured by Siemens shows the temperature of the oil. The gauge indicates temperature in degrees Celsius ($^{\circ}\text{C}$) and is graduated from 0° to 130°C . The face is scaled to 10°C . Two indicator strips indicate normal operating temperature of $110\text{...}130^{\circ}\text{C}$.



Figure 64: Oil temperature gauge

Water/Methanol Pressure Gauge

The FL 20504-1 MW-50 water/methanol pressure gauge indicates mixture pressure in the MW-50 system in kg/cm^2 .

The instrument is graduated from 0 to 1 kg/cm^2 . The gauge is scaled to 0.1 kg/cm^2 throughout. Two indicator strips indicate normal operating pressure of 0.4 – 0.6 kg/cm^2 . The lower indicator strip shows minimum permissible pressure of 0.4 kg/cm^2 and the upper indicator strip the maximum permissible pressure of 0.6 kg/cm^2 .



Figure 65: Water/Methanol pressure gauge

Fuel Contents Gauge

A single FL 20723 fuel gauge is provided for the two main fuselage tanks. The fuel gauge selector switch to the right of the fuel contents gauge can be used to display the contents of the forward or the aft fuel tank.

The instrument shows the contents of the selected fuel tank in hundreds of liters.

As both tanks are of unequal capacity, the instrument has two gauges. The upper gauge is to be used for the aft "Hinten" fuel tank (292 l). The lower gauge is to be used for the forward "Vorn" fuel tank (232 l).

Please note that there is no fuel content information for additional tanks (drop tank or auxiliary fuselage tank).

If additional tanks are used, their fuel pump, in turn, feeds the rear tank.

When drop tanks are used, the fuel selector switch should first be set to "Hinten". The fuel contents gauge will continue to display full for as long as the drop tanks continue to feed the rear tank. Once the drop tanks are emptied, the fuel quantity in the rear tank begins to decrease.



Figure 66: Fuel contents gauge with fuel warning lights

Fuel Warning Lights

While only one gauge is provided for both main fuel tanks, both are equipped with their own fuel warning lights.

The top red (fuel low) warning light labeled "vorn" illuminates when the contents of the forward tank fall to 80 liters.

The bottom white (rear tank switch-over) warning light labeled "hinten" illuminates when the contents of the rear tank fall to 10 liters.

Fuel Gauge Selector Switch

The fuel gauge selector switch is used to switch between the display of the contents of the forward or the aft fuel tank in the fuel contents gauge to the left.



Figure 67: Fuel gauge selector switch

Move the selector switch to "Vorn" to display the contents of the forward fuel tank.

Move the selector switch to "Hinten" to display the contents of the rear fuel tank.

If drop tanks are used, their fuel pump, in turn, feeds the rear tank. When the fuel gauge shows fuel consumption from the rear tank, the drop tank is empty and can be jettisoned.

Oxygen Flow Indicator

The oxygen flow indicator shows the flow of oxygen as it is inhaled and exhaled by the pilot. When the pilot inhales, the blinkers open as oxygen is moved through the system. As the pilot exhales and oxygen stops flowing, the blinkers close.



Figure 68: Oxygen flow indicator

Oxygen Pressure Gauge

The oxygen pressure gauge FL 30496 is located on the bottom right corner of the instrument panel and indicates pressure in the oxygen system. The gauge measures pressure in kilograms per square centimeter (kg/cm^2). The instrument is graduated from 0 to 250 kg/cm^2 and scaled to 10 kg/cm^2 . Normal full pressure of the system is 150 kg/cm^2 . In normal working conditions, oxygen pressure should decrease by no more than 10 kg/cm^2 after 20 minutes of operation.

Note that the oxygen pressure readings can drop as altitude increases due to the cooling of the oxygen tanks. Conversely, the pressure can increase as altitude decreases due to the warming of the tanks. A rapid decrease of oxygen pressure in level flight or during a descent is abnormal and may indicate an oxygen system leak or malfunction.



Figure 69: Oxygen pressure gauge

Oxygen Flow Valve

The oxygen flow valve is used to turn on the flow of oxygen to the pilot.

When the flow valve is opened, the oxygen is first sent to the oxygen regulator located on the right side of the cockpit, just behind the pilot seat. The oxygen regulator has a diaphragm which actuates a valve, permitting oxygen to flow through the regulator, where it mixes with free air in varying amount in accordance with barometric pressure.



Figure 70: Oxygen flow valve

Oxygen Emergency Knob

When increased breathing resistance during oxygen breathing is encountered, press the oxygen emergency knob several times with the right elbow for short durations.



Figure 71: Oxygen emergency knob

Weapons Console

The weapons console installed in the Fw 190 D-9 contains weapon controls and consists of three parts: the top rocket control unit containing two switches for operating underwing 21-cm rockets, four disposable load indicator lights placed below, and the bottom Zünderschaltkasten ZSK 244 bomb fusing selector unit that contains a dial used for fusing bombs. The ZSK 244 is a standard device used on many Luftwaffe aircraft.

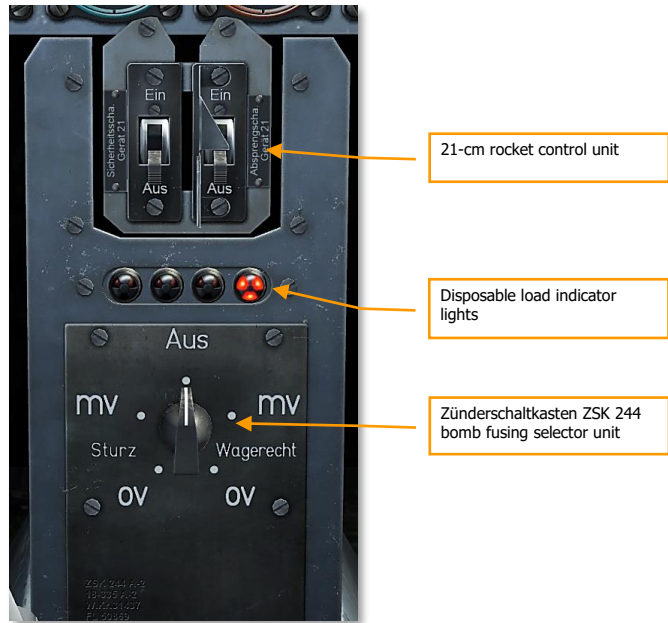


Figure 72: Weapons console

The rocket control panel contains two switches, both marked "Ein" (On) and "Aus" (Off).

The left-hand switch is safety. Set it to "Aus" to disarm the rocket warheads; set it to "Ein" to arm them.

The right-hand switch is jettison. "Aus" is the safe position. Set the switch to "Ein" to enable the blasting mechanism that detaches the rocket housing and their struts from the aircraft wing and restores clean configuration. The safety plate that protects against accidental use of the switch needs to be bent outside before the switch can be placed in the "Ein" position.

The B2 bomb release button located on the main control stick is used to launch both rockets simultaneously.

The ZSK 244 bomb fusing selector unit is very simple in operation. It controls the amount of electrical charge sent from the battery to the bomb fuse. Depending on the switch position, different fusing situations are ensured:

- Set it to "Aus" to disarm the bomb release.
- The two "Sturz" settings on the left-hand side are used for dive bombing.
- The two "Wagrecht" settings on the right-hand side are used for level bombing.
- The "OV" settings stand for "Ohne Verzögerung" (Without Delay), which means the bomb explodes immediately upon contact with the ground.
- The "MV" settings stand for "Mit Verzögerung" (With Delay), which means the bomb explodes after a short delay upon impact.

Therefore, the switch should be set in advance before the bombing run for a proper attack profile.

Left Side Controls

Throttle Lever

The Fw 190 is equipped with a revolutionary Bediengerät device, an early computer that greatly reduces pilot workload. Taking nothing but throttle and barometric conditions as input, the Bediengerät sets the optimal magneto timing, prop pitch, mixture, and engine RPM.

The throttle lever in the Fw 190 D-9 does not merely adjust the manifold pressure. Moving the lever influences nearly all engine and propeller parameters.



Figure 73: Throttle lever

The throttle gate is marked with four standard positions:

- "Aus" (Off)
- "Anlassen" (Engine start)
- "Steigen" (Climb)
- "Start" (Take off)

The throttle lever should be moved according to desired supercharger pressure (shown on the supercharger pressure gauge to the right of the front dashboard, the gauge labeled ATA).

The throttle lever can be fixed in place to maintain desired supercharger pressure by using the throttle lever friction knob located below the throttle lever by the cockpit floor.

The unmarked round button at the base of the throttle is the Push-to-Talk button for radio comms.

Ignition Selector Switch

The ignition selector switch controls the magnetos used to supply power to the engine ignition system and has four possible positions: "0" (Off), "M1" (right), "M2" (left), and "M1+2" (Both).

- "0". The magnetos are turned off.
- "M1". The right magneto is used to start the engine.
- "M2". The left magneto is used to start the engine.
- "M1+2". Both magnetos are used to start the engine.

Normally both magnetos are used to start the engine ("M1+2" setting).



Figure 74: Ignition selector switch

MW-50 Switch

The MW-50 switch toggles the MW-50 water/methanol injection that greatly increases engine power.

In order to use the MW-50 water/methanol injection, the MW-50 tank pump has to be activated first by pressing in the "E96 MW Anl." circuit breaker on the right console.

In addition to activating the tank pump, the system can be switched on or off with the MW-50 switch.

In the "Ein" position, the system is enabled. During correct operating conditions, the Bediengerät allows the addition of MW-50 into the supercharger and stops the injection when it is no longer necessary. In the "Aus" position, the MW-50 injection is disabled.

Apart from the switch setting, no On/Off indicator is provided; however, system status can be ascertained by watching the supercharger pressure gauge, the water/methanol pressure gauge, and simply by engine sound.

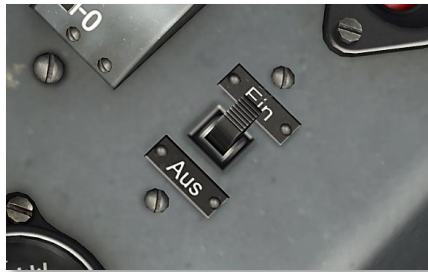


Figure 75: MW-50 switch

Landing Gear and Flaps Indicators

The indicator shows the position of each main gear leg (left and right) and flaps (center) between.

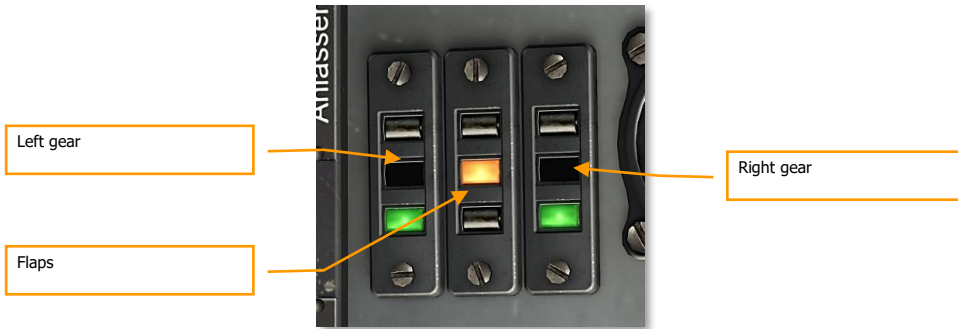


Figure 76: Landing gear and flaps indicators

Landing gear indication:

- When the main gear is up, both lights illuminate red.
- When the main gear is down, both lights illuminate green.

Flaps indication:

- Red – flaps up.
- Yellow – flaps in the intermediate, take-off position.
- Green – flaps down.

Mechanical indicators are installed in each wing to indicate landing gear and flap position. The position of each landing gear is indicated by a red pin that is raised when the respective gear is down and lowered when it is up. The position of each flap is indicated by a gauge which can be seen through a hole in the wing and shows actual angle of flap in degrees and movement of flap when actuated.



Figure 77: Landing gear and flaps mechanical indicators

Horizontal Stabilizer Trim Switch

The horizontal stabilizer trim switch is used to electrically set the rotation angle for the adjustable horizontal stabilizer based on changing trim conditions.

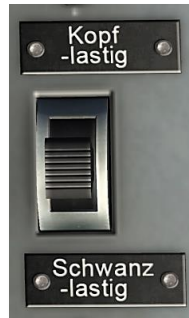


Figure 78: Horizontal stabilizer trim switch

The three-position switch is spring-loaded to the center position. Depress the switch to the up ("Kopflastig" – nose-heavy) or down ("Schwanzlastig" – tail-heavy) positions to change the horizontal stabilizer angle. The actuator motor continues to adjust the angle as long as the button is depressed until the limit is reached, at which time the motor is switched off.

Horizontal Stabilizer Trim Indicator

The indicator shows the current position of the adjustable horizontal stabilizer.



Figure 79: Horizontal stabilizer trim indicator

The gauge is graduated from -5 to +5 degrees, but the operating range is only -3 to +2 degrees of horizontal stabilizer inclination. The scale is to 0.5 degrees throughout.

The normal position is indicated by 0, which actually corresponds to +2 degrees of rotation on the horizontal stabilizer relative to the fuselage centerline.

Landing Gear and Flaps Controls

This set of pushbuttons allows the operation of both the landing gear and the flaps.



Figure 80: Landing gear and flaps controls

The "Rollwerk" set of buttons to the right is for controlling the landing gear. The two available positions are "Ein" (on, up position) and "Aus" (off, down position). Gear position can be monitored with both the electrical indicators and the mechanical indicators on the wings.

To raise the landing gear, retract the safety switch over the "Ein" (Up) button and press the button. The button remains pressed while the gear is in operation and pops up once the gear is raised and locked. The red "Ein" lights also illuminate on the landing gear position indicator. To eliminate the possibility of accidental operation on the ground, the safety switch should be reactivated after raising the landing gear.

To lower the landing gear, press the "Aus" (Down) button. The button remains pressed while the gear is in operation and pops up once the gear is down and locked. The green "Aus" lights also illuminate on the landing gear position indicator.

The "Landeklappen" set of buttons to the left is for controlling the flaps. The three available positions are "Ein" (Up, retracted), "Start" (Take-off, extended 10°) and "Aus" (Landing, extended 60°). Flap position can be monitored with both the electrical indicators and the gauge indicators inside the wings.

To raise the flaps, press the "Ein" (Up) button. The button remains pressed while the flaps are in operation, and pops up once the flaps are fully raised.

To set take-off flaps, press the "Start" (Take-off) button. The button remains pressed while the flaps are in operation, and pops up once the flaps are properly set to the take-off setting.

To fully lower the flaps, press the "Aus" (Landing) button. The button remains pressed while the flaps are in operation, and the flaps are fully lowered to the maximum angle.

FuG 16ZY Controls

The FuG 16ZY control panel has four controls:

- Frequency selector
- Headphone volume control (inside Anschlussdose AD18Y)
- Communications - homing switch (inside Anschlussdose AD18Y)
- Fine tuning knob (inside FBG 16)



Figure 81: FuG 16ZY controls

Frequency Selector

The frequency selector for the FuG 16ZY radio has four positions indicated by symbols. All four positions are locked to specific frequencies before flight. The pilot cannot manually set frequencies beyond the four presets. The presets, in the frequency range of 38.4 to 42.4 MHz, can be set on the ground (in DCS in the "RADIO PRESETS" tab of the mission editor).

The four frequencies are used for communication with different Luftwaffe units.

The "I" position is for the "Y-Führungsfrequenz", or management frequency, and is used for communication within the flight or squadron. It is also used for communication during ground tracking in "Y-Verfahren".

The "II" position is for the "Gruppenbefehlsfrequenz", or group order frequency, and is used to communicate between several flights from different squadrons participating in a single raid.

The "Δ" position is for the "Nah-Flugsicherungsfrequenz", or air traffic control frequency, and is used to communicate with the designated air traffic controller.

The "□" position is for the "Reichsjägerfrequenz", or Reich fighter defense frequency, and is used to coordinate country-wide air defense efforts in large scale raids.

Headphone Volume Control

The headphone volume control is used to adjust headphone volume. Turning the knob clockwise increases volume; turning the knob counterclockwise decreases it.

Communications - Homing Switch

The communications - homing switch can be set to one of two positions, "Ft" ("Funktelefonie" - radio telephony, without "E-Messton") or "Abst." ("Abstimmen" - frequency tuning, for tuning the receiver frequency to the "Y" ground station via "E-Messton").

This switch works in conjunction with the frequency selector. The settings of these two switches determine the operation mode of the FuG 16ZY radio set.

Please see the below table for details.

<i>Homing Switch</i>	<i>Frequency Selector</i>	<i>Push-to-Talk Open</i>	<i>Push-To-Talk Depressed</i>	<i>Transm</i>	<i>Recvr</i>
"Ft"	I	Listen	Talk	I	II
"Abst"	I	Homing Listen	Homing Listen+Talk	I	II
"Ft"	II, Δ or □	Listen	Talk	II, Δ or □	
"Abst"	II, Δ or □	Listen to loop antenna Targeting	Talk	II, Δ or □	

Because on the first frequency selector position (I) sending and receiving are conducted at different frequencies, it is not used in this simulation. For communication, use II, Δ or □ selector positions with "Ft" position of communications - homing switch.

The frequencies of all four positions can be assigned in the mission editor's "RADIO PRESETS" tab.

Fine Tuning Knob

The FBG 16 "Fernbedien(ungs)gerät" (remote control unit) is used for fine frequency adjustment within a selected preset.

Right Side Controls

Canopy Crank

The canopy crank can be used to open or close the canopy.

Rotate it clockwise to open the canopy and counterclockwise to close it.

Pulling out the crank handle releases the crank gear so that the canopy can be opened or closed by hand. This mode of operation is not simulated.

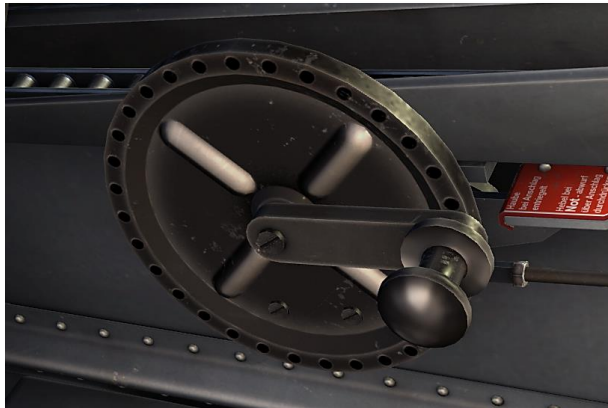


Figure 82: Canopy crank

Flight Clock

The "Junghans Borduhr Bo-UK1" was the standard instrument chronograph for all German aircraft in WWII. The clock is installed at the top of the right-hand console.

You can wind and adjust the clock with the round wind/set knob below.

With the start-stop button on the right you can stop (and restart) the whole clockwork, for example to set the time with the round wind/set knob.

The stopwatch mechanism is started and stopped by pressing the stopwatch button, located directly below the wind/set knob. First press to start, second press to arrest and third press to put it back. Each passing of the sweep second is recorded, up to 15 minutes, on the small register dial.



Figure 83: Flight clock

Adjust clock:

- Push down the start-stop button.
- Adjust desired time on wind/set knob with mouse wheel.
- Pull back the start-stop button.

Stopwatch:

- Start stopwatch with first press of stopwatch button.
- Arrest stopwatch with second press of stopwatch button.
- Put it back with third press of stopwatch button.

Circuit Breakers

Most electrical devices in the Fw 190 are operated with and protected by circuit breakers. Circuit breakers are used to manually open and close load circuits. When a short circuit or overload occurs, a circuit breaker automatically breaks the circuit. Thus, a circuit breaker acts both as a switch and an automatic fuse.

Each circuit breaker has two buttons: A larger black button with a white dot that closes the circuit and switches the corresponding device on - and a smaller red button that opens the circuit and switches the corresponding device off.



Figure 84: Circuit breaker cover down

The labels V350, E16, etc. on the cover designate the circuit that is protected by the circuit breaker (in accordance with the circuit diagrams of the Fw 190 D-9). The essential function of the circuit is printed on a plate adjacent to the circuit breaker cover.

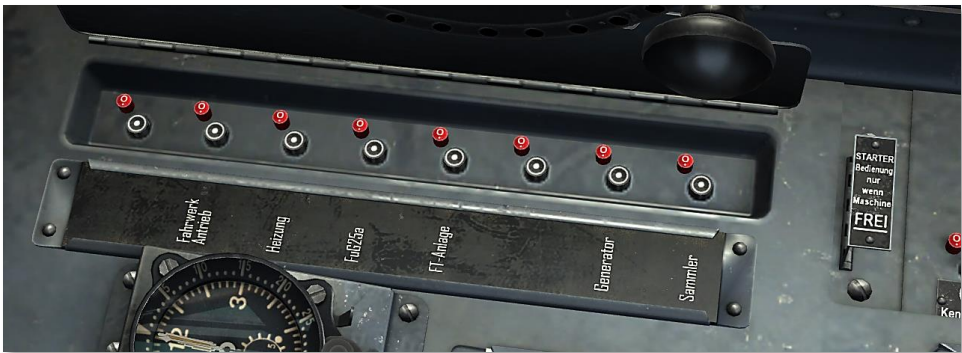


Figure 85: Circuit breaker cover up

An additional circuit breaker panel contains circuit breakers for navigation lights and fuel / MW-50 pumps.



Figure 86: Circuit breakers of additional panel

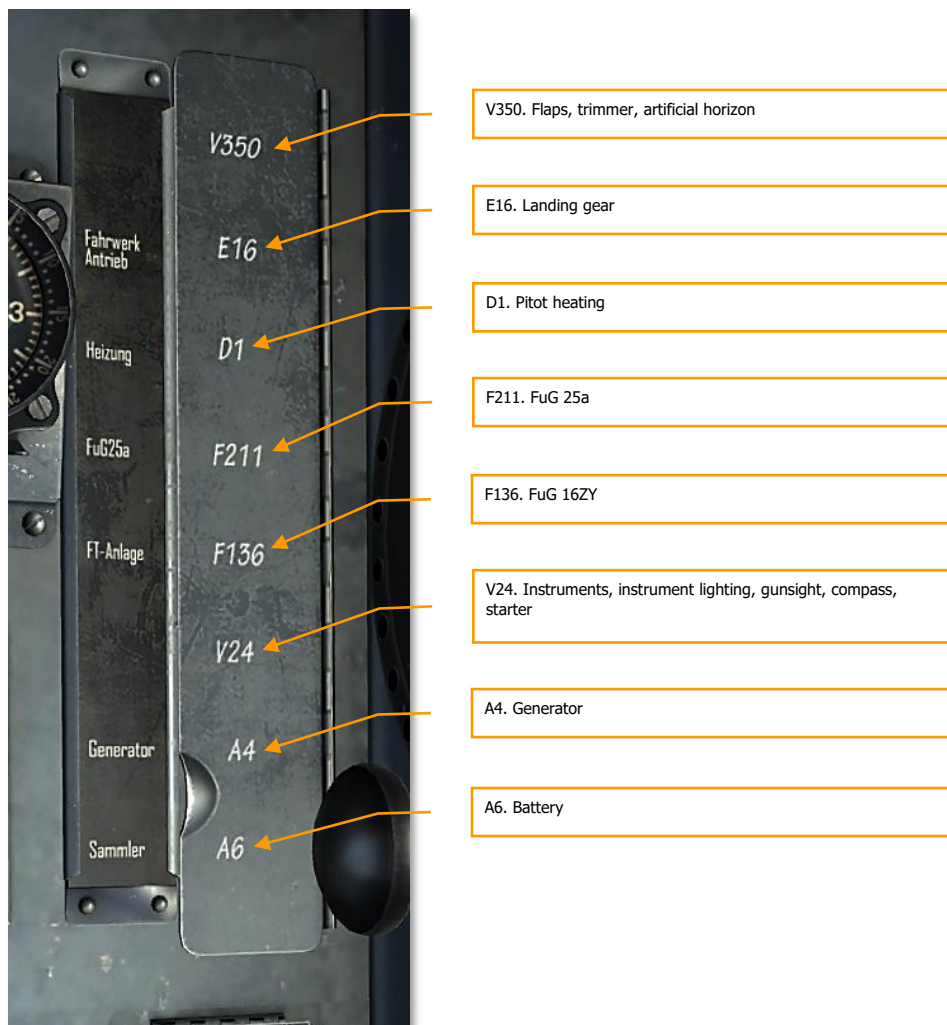


Figure 87: Circuit breaker legend of forward panel

Starter Switch

The starter switch is used to spin up the internal flywheel and to start the engine. The switch is spring-loaded and needs to be held in the down position to spin up a starting flywheel. When the flywheel has reached sufficient rotational speed, by pulling out the starter switch (up position), the spinning flywheel is connected to the crank shaft, which starts the engine.



Figure 88: Starter switch with cover

Kneboard Map

To aid with navigation, a kneboard map is included in the cockpit. The map can be opened at any time in the cockpit for a quick glance by pressing and holding the [K] command or toggled on and off with the [RShift + K] command. The map displays a plot of the flight plan and is initially centered on the starting waypoint. The [] (open bracket) and [] (close bracket) commands can be used to change the kneboard page, which cycles through the flight plan waypoints on the map view and aerodromes database.

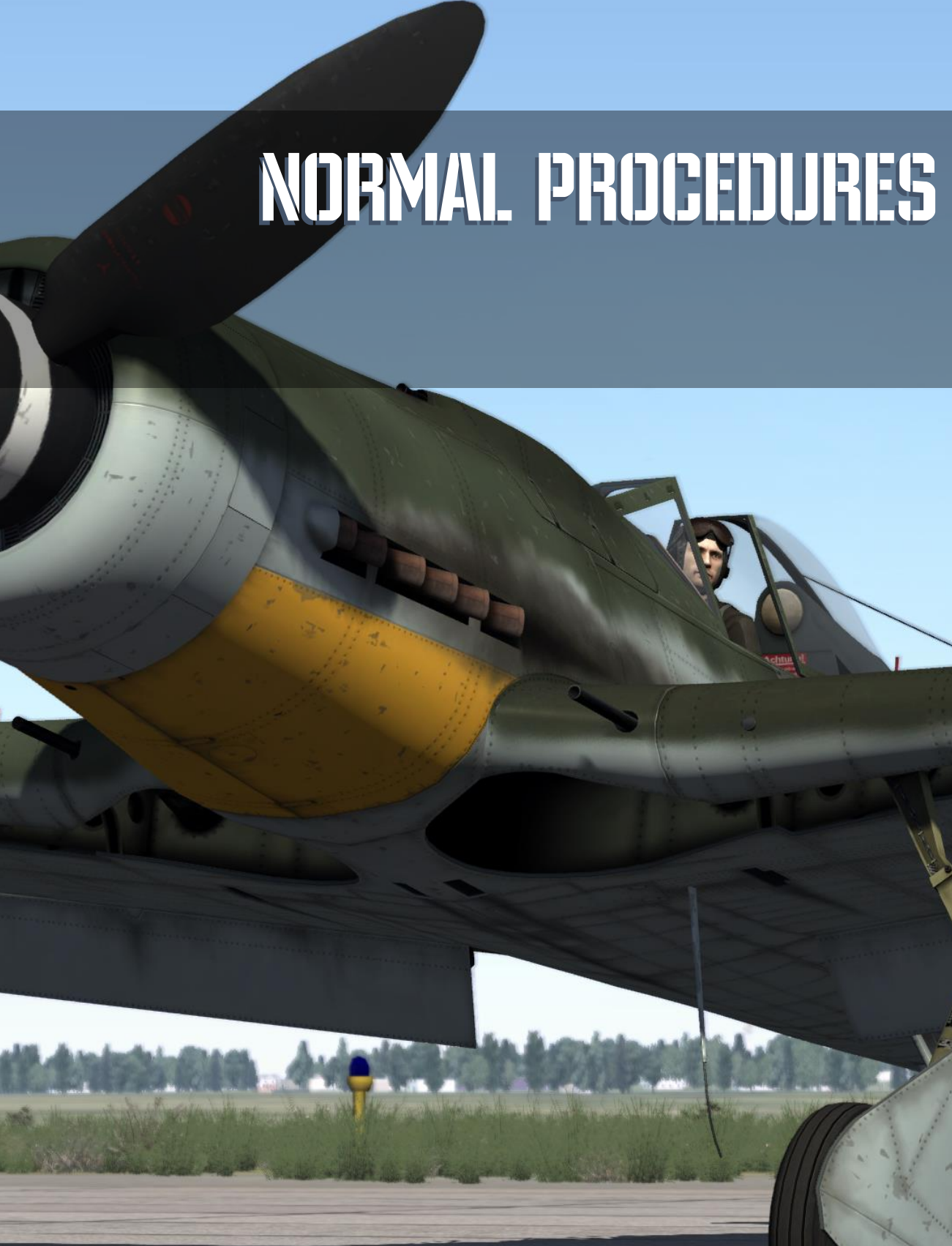
Additionally, the [RCtrl + K] command can be used to place a mark point on the map. A mark point indicates the location of the aircraft on the map in the current point in time (like a pencil mark on a paper map).

The kneboard can also be viewed on the pilot's left leg when the pilot is enabled in the cockpit [RShift + P].



Figure 89: Kneboard map

NORMAL PROCEDURES

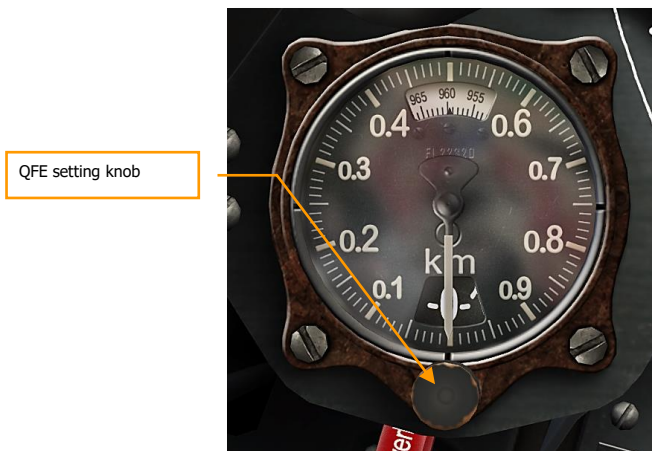


NORMAL PROCEDURES

Preflight Checks and Engine Start

As soon as you enter the cockpit:

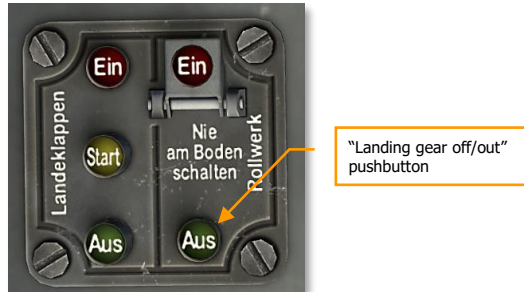
- Choose best seating position. This can be adjusted by using [RCtrl + RShift + Numpad8] and [RCtrl + RShift + Numpad2].
- Check if the rudder has full free and correct movement, and that the central rudder pedal position corresponds with the central rudder position.
- Set altimeter to QFE of the takeoff airfield.



- Turn on the oxygen system's side-way valve (on the right lower front panel).



- On the left side panel, the green "Rollwerk Aus" (landing gear off/out) pushbutton must be pressed, otherwise the landing gear will retract upon powering up of the aircraft's electrical system.



- Turn on all circuit breakers on the forward circuit breaker panel:
 - Flaps, trimmer, artificial horizon [LWin + 1]
 - Landing gear [LWin + 2]
 - Pitot heating [LWin + 3]
 - FuG 25a [LWin + 4]
 - FuG 16ZY [LWin + 5]
 - Instruments, instrument lighting, gunsight, compass, starter [LWin + 6]
 - Generator [LWin + 7]
 - Battery [LWin + 8]
- Check fuel in both tanks with fuel gauge selector switch. To right [RAIt + T], to left [RCtrl + T]



- Ignition (Magneto) selector switch to M1+2 position. To forward [End], to back [RShift + End].



- MBG emergency mode handle in automatic mode. Pushed in position (check). [RShift + M]



- Fuel tank selector lever in "auf" (open, full up) position. Up [T], down [RShift + T].



- Switch on fuel pumps with additional circuit breaker panel:
 - E14 Forward tank fuel pump [RWin + 2]
 - E13 Rear tank fuel pump [RWin + 3]
 - E85 External tank fuel pump if external tank is connected [RWin + 4]
 - E96 MW-50 if necessary [RWin + 5]



- Close canopy. Several times [LCtrl + C].
- Set throttle lever to "Anlassen" (Engine Start / Idle) position. [RAlt + Home]



- Press starter switch about 15...20 seconds to flywheel spin-up. Press and hold [Home].



- After flywheel spin-up pull up starter switch for engine start. Press and hold [\[RCtrl + Home\]](#).
- Set stabilizer trim to 0° (switch and indicator on left side panel).



Engine Warmup

1. With closed cooling flaps run engine at about 1000...1200 RPM until oil entry temperature reaches 40°C.
2. Slowly increase towards 1800 RPM, until coolant exit temperature has reached 60-70°C.

Stopping the Engine

At 1200 RPM let engine cool down, alternately switching M1 and M2. Keep coolant temperature below 100°C, otherwise danger of thermal evaporation.

In warm weather, open all cooler flaps already during landing flare, when in cold weather during taxiing off. When stationary, retard throttle lever and run engine at 1600-2000 RPM for some time in order to achieve uniform cooling. Stopping above coolant temperature above 120°C will generally lead to coolant fluid loss. Pull throttle lever beyond idle indent position with [\[RAlt + End\]](#) keys, switch off ignition, close fuel shutoff valve.

Taxiing

1. Taxi and take-off with fully opened cooling flaps only. The hand wheel for setting of cooling flaps position is located in the cockpit above the lower front panel. Hold [\[LAlt + A\]](#) for 20

seconds to fully open the cooling flaps. Refrain from unnecessarily operating the hand wheel, especially from stop to stop positions.

2. Avoid power settings below 1,000 RPM. Keep taxi times as short as possible in order to prevent coolant losses by vaporization.
3. When taxiing, first unlock the tailwheel, otherwise it will be impossible to make turns. In order to do so, push flight stick forward by approximately 3 cm.
4. Only after releasing the tailwheel, lock the brakes may be operated for testing purposes, left and right alternatively. Do not operate the brakes for too long.
5. In case the tailwheel does not unlock, it shall be tried to unlock by alternating brake application and simultaneous forward pushing of the flight stick.
6. On line up for takeoff, roll straight ahead for a short distance to ensure the tailwheel is in straight position.
7. The aircraft may have to be taxied below power settings of 1,000 RPM for a short while in order to avoid tire damage through braking heat. Taxiing has to be performed as to keep the usage of brakes down to a minimum; short braking impulses are better than continuous braking.

Preflight Check

Prior to takeoff, perform the following preflight check:

- Primary controls:
 - Controls – Check the stick and rudder controls to ensure they operate without binding. Watch the control surfaces for correct response.
 - Horizontal Stabilizer Trim Indicator – 0



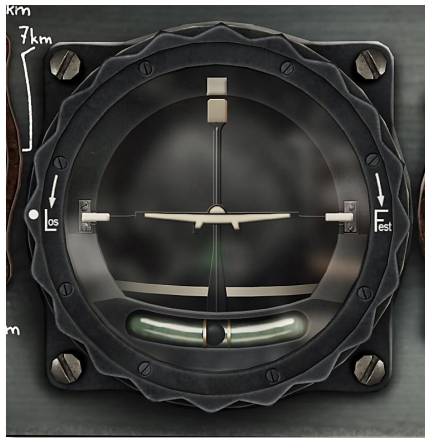
- Instruments and switches:
 - Altitude indicator set.



- Desired heading set.



- Artificial horizon uncaged.



- All instrument readings in desired ranges.
- All switches and controls at desired positions.
- Fuel system:
 - Fuel tank selector lever in Open (Auf) position (full up).
 - Fuel pump's circuit breakers ON.
- Flaps:
 - Flaps set for takeoff, pressed "Start" button.



Takeoff

Follow the below procedure to perform a normal takeoff:

1. In conditions of high humidity and temperatures below 0°, switch on pitot and windshield heating (respectively close circuit breakers for pitot heating, inner windshield heating and outer windshield heating).
2. Switch on both fuel pumps and switch the indicator to the rear tank.
3. In case flight is conducted with an auxiliary drop tank, initially only the rear tank fuel pump and the EP-1 E (drop tank pump) are to be switched on.
4. Set flaps to takeoff position. Push selector switch located on left side panel.
5. Verify take-off position by observing the mechanical indicator on the wing. The electrical indicator only shows full landing or up positions (green or red lights on the left side panel).
6. Pushing the stick forward unlocks the tailwheel, thereby making steering difficult. The best takeoff procedure is to hold the tail down by pulling the stick toward you until sufficient speed for rudder control is attained and then to allow the tail to rise slowly. Some rudder input may be necessary to maintain heading as the tail is lifted and stabilized in a takeoff attitude.
7. Swiftly advance throttle into take-off position. Hold flight stick back with only a light feel, but do not push forward.
8. Take-off distance on the runway without wind effect is approximately 350-400 m.
9. Take-off is at IAS = 170-180 km/h and performed on three points throughout take-off roll. Keep aircraft straight – the aircraft does not have a tendency to break out.
10. During takeoff, engine speed may reach a maximum of 3,300 RPM.
11. Engine power is set according to RPM indicator. Every throttle setting corresponds to a specific engine speed setting, maintained by the hydraulically operated governor.

Power Settings

The MBG emergency mode handle switches the MBG to manual operation by cutting off pressurised oil. In case of MBG malfunction, it allows to proceed flight using the manual throttle valve. Normally, this throttle fully opens at 40 degrees of the throttle giving room for further automatic control. In manual mode, its range is extended up to 90 degrees or full throttle lever range. Due to engine overstressing, the throttle must not be advanced beyond 2700 RPM or 60 degrees of its travel.

At the latest 3 min after takeoff, reduce to combat power and slightly push flight stick forward.

Throttle position can be fixed by turning the handgrip on the lower left.

Throttle Position	Power Output	RPM	Permissible Time	Fuel Consumption Liter/hour
90° command angle	Emergency power (increased take-off power)	3250	3 min	620 -20
90°	Take-off, combat and climb power	3250	30 min	590 +20/-40
75°	Continuous power	3000	constant	530
60°	Economy I	2700	constant	375
47°	Economy II	2400	constant	285
34°	Economy III	2100	constant	215
0°	Idle (in flight)	app. 1200	-	-
10°	Engine stop position	-	-	-

Retraction of Landing Gear

The landing gear must be retracted at or below IAS = 250 km/h. After takeoff, briefly and slightly apply brakes and retract landing gear.

Push the guarded red operating button on the left side panel to "On" position.

The landing gear has an electrical indicator on the left side panel, and mechanical ones on the upper wings. A colored marker pin retracts upon gear retraction.

Both main landing gears and the tailwheel are retracted when both red control lamps are illuminated. Check the marker pins on the wings.

Only after retraction of landing gear, retract flaps (red button for flaps "On").

Red control lamp illuminates. Also observe the mechanical indication on side of the upper wings (cutout with degrees scale).

Avoid sudden bursts of power during takeoff! Make it smooth and steady.

Climb

Perform the following steps once a safe takeoff is accomplished:

- Set throttle for climb power, 3,250 RPM.
- Best climb speed is 280 - 290 km/h indicated.
- **Attention!** Desired position for radiator split flaps can be set for 110°C.
- At an altitude of approximately 3,300 +/-200 m, automatic switching from low to high blower occurs noticeably. Avoid cruising or frequent change of altitude around blower switching altitude.
- Raise landing gear by retracting the safety switch over the "Ein" (Up) button and pressing the button. Ensure gear is properly raised and the red "Ein" light illuminates.
- Flaps up with "Ein" (Up) button.
- Check coolant and oil temperatures, and oil pressure.
- After reaching safety altitude, throttle back to 3000 RPM.
- Trim aircraft for climbing attitude as necessary.
- Check all instruments for proper function within normal parameters.

Cruise and Fuel Management

Set coolant temperature to 100°C (regulator setting).

Retard throttle so that resulting power setting is no more than max continuous power, 3000 RPM. Above 7500 m, max continuous power at 3250 RPM is certified.

Automatic rich/lean switching starts operating from 2800 to 2900 RPM.

In order to achieve longer ranges, and to save engine lifetime, choose power settings as possible.

Oil Entry Temperature at max continuous power is 110°C, minimum pressure is 4.5 atü. Maximum temperature (short duration) 130°C, however hereby the presence of oil dilution (cold start) has to be taken into account. Maximum pressure must not exceed 13 atü.

Upon exceedance of maximum temperature, engine power must be reduced.

Coolant Exit Temperature 100°C at all altitudes. Exceptions: During climb 110 (100)°C is permissible, and during takeoff and taxi 130 (120)°C permissible for brief periods of time.

These exceptional values are only valid in case an Erhard coolant regulator valve 2 atü (1.2 atü) is fitted.

Fuel Quantity Measuring. An electrical fuel quantity indicator is fitted to the lower front panel with a selection switch for the forward and rear fuel tanks. There is no fuel quantity indication for the drop tank or the additional fuel tank. Additional fuel is ducted into the rear tank. Recognition of additional

tanks having emptied is by fuel quantity indication dropping below 240 liters in the rear tank, with the fuel quantity indicator switched to the rear tank.

Switching Warning for the rear fuel tank occurs at approximately 10 liters remaining, white lamp illuminates.

Low Fuel Warning in the forward fuel tank occurs at 80 liters remaining, red lamp illuminates. Upon illumination of red lamp, fuel remaining for approximately 15 minutes at economy power setting.

Switching of Fuel Tanks

Without a drop tank, without additional tank, prior engine start:

- Fuel shutoff valve in position "Open"
- Both fuel tank pumps "On"
- Fuel quantity indicator switched to aft tank

In flight:

- Fuel shutoff valve "Open"
- Drawing of fuel is controlled by the switching "On" and "Off" of the fuel tank pumps.
- Monitoring of fuel quantity by observing the selectable fuel tank indicator.
- First empty the rear tank, with the rear fuel pump switched off (only when red lamp illuminates before the white lamp, isolate forward fuel tank with its fuel shutoff valve). Fuel quantity indicator on rear fuel tank.
- When white lamp illuminates, switch both fuel tank pumps to "On". Fuel shutoff valve remains in position "Open".
- Fuel quantity indicator to forward fuel tank.
- When red lamp illuminates, 80 liters remain in forward fuel tank, remaining available flight time approximately 10 to 15 minutes at economy power setting.

With drop tank under the fuselage:

- Fuel shutoff valve "Open"
- Drop tank fuel pump and rear fuel tank pump "On". Forward fuel tank pump "Off"
- At altitudes above 8000 m it may become necessary to additionally switch the forward fuel tank pump on.
- Fuel quantity indicator switched to rear fuel tank
- Once fuel indicator starts showing quantity less than 240 liters, the drop tank is empty.
- Drop tank fuel pump "Off".
- In order to jettison drop tank, pull emergency handle in cockpit.

With additional fuel tank in fuselage:

- Fuel shutoff valve in position "Open"
- Rear fuel tank pump "On". Forward fuel tank pump "Off"
- Additional fuel tank pump "On"
- Fuel quantity indicator on rear fuel tank
- Once fuel quantity in rear fuel tank drops below 240 liters, additional fuel tank is empty.
- Additional fuel tank pump "Off".

With drop tank and additional fuel tank:

- Fuel shutoff valve "Open".
- Drop tank fuel pump, additional fuel tank pump and rear fuel tank pump "On". Rear fuel tank pump "Off".
- Fuel quantity indicator switched to rear fuel tank.
- When fuel quantity indicator starts showing fuel less than 240 liters, drop tank and additional fuel tank are empty.
- Drop tank fuel pump and additional fuel tank pump "Off".
- **Attention!** When there is danger of incoming fire, the drop tank has to be jettisoned, and the drain of the the unprotected additional tank into the fuselage has to be pulled.

High Altitude Flight

During high altitude flight check oxygen flow in short intervals. Oxygen pressure gauge is located on the right side of the lower front panel next to the O2 guard. Start breathing oxygen at an altitude of 4000 m.

Night Flight

In case of too bright illumination of instruments and warning lamps are too bright, reduce brightness with obfuscator (on left side panel).

Prior take-off it is especially important to ensure proper stabilizer trim setting at 0°.

Special Flight Maneuvers

Glide

- Engine speed at idle 1200 +/-50 RPM.
- During longer periods of glide, advance throttle repeatedly to prevent spark plug fouling.
- Coolant exit temperature must not fall below 60 °C.
- Switching from high to low blower occurs automatically at 3300 +/-300 m.

Dive

- Dive speeds for fighters and fighter-bombers equipped with airspeed indicator FI 22234.
 - at 9 km altitude IAS = 500 km/h
 - at 7 km altitude IAS = 600 km/h
 - at 5 km altitude IAS = 700 km/h
 - at 3 km altitude IAS = 800 km/h
 - at 2-0 km altitude IAS = 850 km/h
- Engine speeds of 3300 RPM as short period maximum must not be exceeded.

Inverted Flight

No inverted flight, engine lubrication system is unsuitable. However, all aerobatic maneuvers may be performed, even if briefly leading through inverted flight.

Landing

- Reduce speed to approximately 300 km/h.
- Extend landing gear. Push button switch on left side panel or pull the landing gear pull lever (on left side of the lower front panel), until the landing gear is properly unlatched.
- Mechanical indicator pins appear upon extension. The landing gear is only completely extended when the white bar (red arrow pointing to it) is visible.
- Extend landing flaps between IAS = 300 and 220 km/h.
- Observe signal lamps. Do not exceed IAS = 300 km/h with extended flaps.
- Trim aircraft tail-heavy as necessary (push button for flaps respectively toggle switch for elevator trim on left side panel).
- Approach speed IAS = 220-220 km/h
- Touchdown at IAS = 170 km/h

- Pull back flight stick upon landing
- Retract flaps after rolling-out.
- Never hold the flight stick back when intending to make a turn so that tailwheel has free movement.

Engine Shutdown

Open cooling flaps fully, in warm outside conditions during approach, in cold weather during taxi, run engine at 1800 RPM for some time, hereby monitoring coolant temperature - must not be above 130°C, otherwise allow engine to run longer in order to cool down.

Retard throttle to stop position. Switch off ignition, fuel pumps, close fuel shutoff valve, and press the aircraft electrical power off switch.

Flight Emergencies

Go Around

- Go around with fully extended flaps.
- Retract landing gear.
- Only retract flaps to take-off position when at sufficient altitude and with sufficient airspeed. Note that the aircraft tends to fall slightly upon retraction of flaps.
- Operation as during normal departure.

Failure of the Landing Gear Drive

- Use emergency landing gear release in case of failure of the electrical drive. Operation as during normal operation.
- In case gear does not extend, push nose down and then recover sharply. Observe the mechanical indicator.
- In case gear does still not extend, proceed as follows:
 - Check if landing gear switch is set to "Off".
 - If yes, pull manual gear handle once again.
 - If this is not successful:
 - Open circuit breaker for landing gear drive (right side panel) and once again pull manual gear handle.
 - Make side slip maneuvers to extend landing gear.
 - Check that white marking on landing gear pins is visible.

- In case these procedures do not result in success, retract landing gear and carry out a belly landing.
- However, a single wheel landing is also possible, in this case touch down as for a normal landing but keep the aircraft level as long as possible with aileron input. Usually the propeller and wing tips will receive damage.

Power Plant Failure

- In case of a failure of engine regulator automatics, retard throttle towards idle as much as possible and pull emergency pull to the right of the fuel shutoff valve. Keep engine power to as to as little as possible in order to avoid engine stresses.
- When emergency pull is pulled, engine speeds higher than 2700 RPM are prohibited.
- In case of falling oil pressure indication, landing has to be carried out immediately, if possible.
- In case fuel vapors enter the cockpit, switch off fuel tank pumps, don oxygen mask and slightly open the canopy. Report leakage after landing.
- In case of a failed fuel pump, flight may continue to the next airfield at low RPM, using both fuel tank pumps.

Emergency Weapons Drop

Operate bomb emergency release handle on the lower front panel. The lever is returned to the original position by spring load forces upon release of the handle.

Emergency Landing in case of Engine Failure

- At low altitude, immediately pull up the airplane until IAS has reduced to approximately 300 km/h.
- Retard throttle to quick stop position
- Switch off ignition
- Set fuel shutoff valve to "Closed"
- Open canopy to the last cog. Latch cradle (canopy does not fly off in flight!)
- Extend landing gear at airfields only - otherwise danger of flipping over
- Fully extend flaps, trim aircraft tail-heavy
- Operate aircraft electric system off switch to "Off"

In unfavorable terrain, perform emergency landing with landing gear up.

Sliding distance on belly landings approximately 150-200 m. If there is sufficient space, do not extend flaps as this causes damage to the propeller. Perform the landing as in a glider.

The aircraft's behavior is completely harmless during belly landings.

Starting from high altitude it makes sense - in order to be able to cover a greater distance - to only extend the gear and flaps when it is assured that the chosen landing airfield can be reached.

Ditching

Ditching should be avoided as much as possible, since after 2-3 bounces the aircraft will sink over the nose immediately. Prior to ditching, the canopy has to be always jettisoned.

Landing without Flaps

- In case of a failure of the flap drive, it has to be noted that the aileron will become more sensitive on landing.
- The touchdown speed will increase by approximately 35 km/h. Since this differs greatly from airplane to airplane, it is recommended to establish the stall speed at high altitude with idle power setting (should result in speed of about 195 km/h), and add to this speed about 20 km/h to determine touchdown speed.
- The landing distance increases in this case from 600 m to about 850 m.

Parachuting

- As far as flight altitude is available and aircraft remains controllable, reduce speed as much as possible.
- If possible:
 - Operate electrical system "Off" switch
 - Switch off ignition
 - Close fuel shutoff valve
- Push the canopy emergency jettison lever at the punched disc. The canopy is jettisoned immediately by explosive cartridge. Prior to this, the canopy shall however be completely closed, or under no circumstances be open more than 300 mm (check marking!).
- Attention! Canopy emergency jettison is secured by securing wire!
- The canopy can also be manually opened (latch hand crank at the last cog position). This method is preferable when there is sufficient time and slow flight (below 300 km/h).
- Unfasten seat belt, strongly kick flight stick forward with foot, pilot is thrown clear of aircraft.

COMBAT EMPLOYMENT



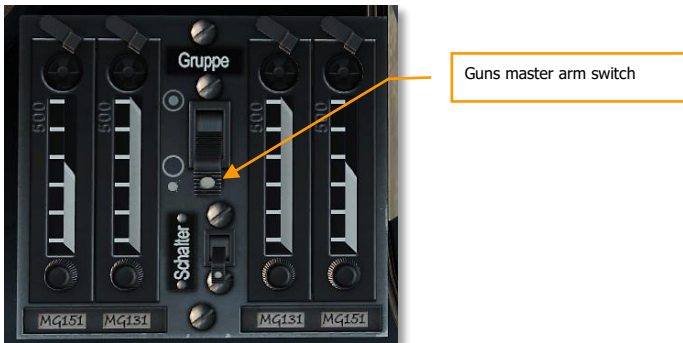
COMBAT EMPLOYMENT

In this section, we will overview weapons employment procedures for the Fw 190 D-9.

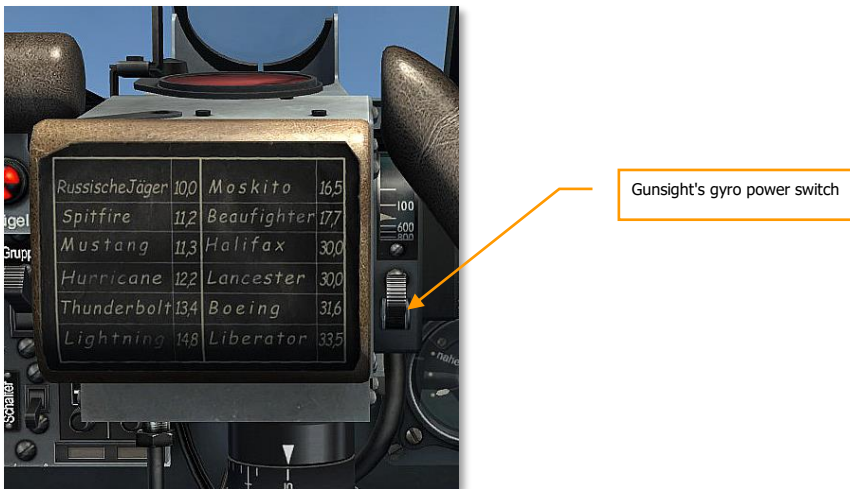
Guns

Use of the guns in dogfight and aiming a target with the EZ 42 gunsight.

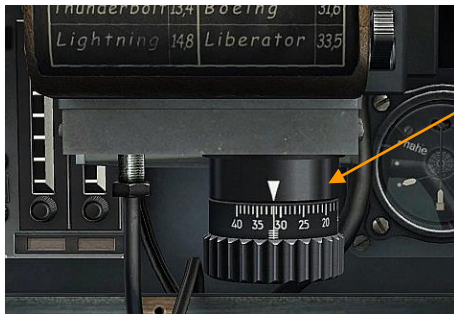
1. Turn on the guns master arm switch [C].



2. Turn on the gyroscope of the EZ 42 gunsight by pushing the gyro power switch upwards [M]. Note that the gyro needs an appropriate initial time of 1.5 minutes, otherwise the suitable derivative cannot be adjusted correctly.



- At the first sighting of an enemy plane, immediately adjust its wingspan with the target wingspan knob, increase [L], decrease [R]. Pay attention to adjust as precisely as possible.



Target wingspan knob

The following three wingspan values are indicated with special markings on the target wingspan knob:

- Average wingspan of single-engine fighter: 11.5 m.
 - Average wingspan of twin-engine aircraft: 16.5 m.
 - Average wingspan of four-engine bomber: 31.8 m.
- Set the range to target via twist grip on the throttle. Increase [L], decrease [R].



Twist grip

Fly the aircraft so that the target appears within the reticle circle and rotate the throttle twist grip until the diameter of the reticle circle corresponds to the target size.



Continue to frame the target with the reticle circle by rotating the twist grip as range changes. Track the target smoothly for one-two second(s); then fire.

Bombs

Releasing Bombs

The following is a standard procedure for releasing bombs:

1. Set the range to target to 0 with the twist grip on the throttle to fix gunsight reticule. Increase [;], decrease [']..



Twist grip for range selection

2. Set the bomb selector switch to the proper profile and delay position – to the left [LShift + B], to the right [LCtrl + B].



Bomb fusing selector unit

3. Press the bomb-rocket release button [RAlt + Space] on the control stick to release bombs.

Note. Bombs may be released when the aircraft is in any pitch attitude from a 30-degree climb to a vertical dive.

Do not release bombs when you are sideslipping more than 5 degrees in a vertical dive. Doing so may collide a bomb and the propeller.

Emergency Bomb and Drop Tank Release

The bombs may be jettisoned with the jettison fuselage stores handle, located below the main instrument panel.

"Rumpflast" - Jettison Fuselage Stores [LCtrl + R].



Rockets

Besides the bombs, the Fw 190 D-9 can also carry unguided rockets of two models: R4M and BR 21 (also called Werfer-Granate 21). Both rocket types are mounted under the aircraft's wings.

- The R4M is a 55-mm diameter anti-aircraft rocket. The rocket's warhead contains a 520 g charge of hexogen. The R4M is equipped with a contact fuse, so, maximal efficiency of R4M rocket launch is achieved by using the salvo mode. Fw 190 D-9 can carry 26 R4M rockets.



- BR 21 is a heavy 210-mm diameter anti-aircraft rocket weighing about 110 kg. It's fitted with a 40 kg warhead that contains a 10 kg charge. The BR 21 rocket is equipped with a time fuse designed to detonate the warhead at certain distance from the carrier. Fw 190 D-9 can carry two rockets of this type.



The R4M and BR 21 rockets can also be used against ground targets, however, originally they are not intended for such purposes.

Launching Rockets

Below is a standard procedure for launching rockets:

1. Set the range to target to 0 with the twist grip on the throttle to fix gunsight reticule. Increase [F], decrease [G].



Twist grip for range selection

2. Turn on the main rocket switch [Shift + O], located in the top of the weapon console.



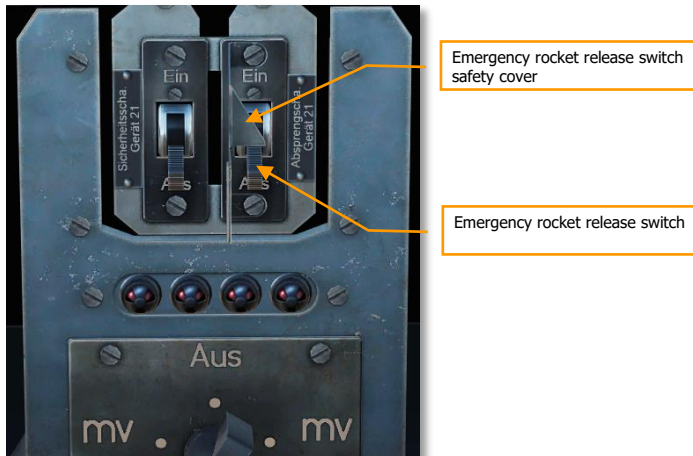
Main rocket switch

3. Press the bomb-rocket release button [RAIt + Space] on the control stick to launch rockets.
 - If firing R4M rockets, each press of the release button will launch one pair of rockets.
 - If firing BR 21 rockets, each press of the release button will launch one rocket.

Emergency Rocket Release

The rockets may be emergency jettisoned with the rocket emergency release switch, located to the right of the main rocket switch. The switch is guarded by the safety cover. To open the cover, press [LShift + K].

Emergency Rocket Release Switch [LShift + I].



RADIO COMMUNICATIONS



RADIO COMMUNICATIONS

There are two optional modes of using the radio that depend on the "EASY COMMUNICATION" OPTION under the GAMEPLAY tab. This setting also determines the key commands used to access the radio menu in-game.

Because the radio of the Fw 190 D-9 is limited to 4 channels, you will only be able to communicate with entities whose frequencies are loaded in your radio. Radio frequencies are loaded in the mission editor by the mission designer and should be made available as part of the mission briefing.

Easy Communication is enabled

The radio communications window is accessed by a press of the [\] backslash key (this is for US keyboards, other language keyboards may vary). After the command selection the radio or interphone will be selected (if required) and tuned (if required) automatically. Also [\] key will close radio command menu.

When the radio menu is displayed, recipients are color-coded as follows:

- Recipients on which at least one of the radios is tuned to are colored white.
- Recipients on which at least one of the radios can be tuned to but is not currently on the correct frequency are colored gray.
- Recipients that cannot be contacted due to range or terrain masking / earth curvature are colored black.

Each will also have their modulation / frequency listed. When you select a recipient, the appropriate radio will automatically be tuned to communicate with the selected recipient.

When Easy Communications mode is enabled, the following "quick" command shortcuts are also available:

[LWin + U] Request AWACS vector to home plate.

[LWin + G] Command flight to attack ground targets.

[LWin + D] Command flight to attack air defense targets.

[LWin + W] Command flight to cover me.

[LWin + E] Command flight to proceed with the mission and return to base.

[LWin + R] Command flight to proceed with the mission and rejoin.

[LWin + T] Command flight to open/close the formation.

[LWin + Y] Command flight to rejoin the formation.

Easy Communication is not enabled

When Easy Communications mode is OFF, the Push To Transmit (PTT) button [RAIt + \] is used to open the radio command panel. The PTT button opens and closes the radio communications window for the currently selected radio.

When recipients are displayed, there is no color-coding of availability and no listing of their modulation / frequency. This is the more realistic play mode and requires you to know the correct modulation / frequencies for each recipient and you must manually enter the frequencies on the correct radio.

Radio Communications Window

Top level recipient list:

If using "Easy Communications", recipients not present in the mission will not be listed.

F1. Wingman...

F2. Flight...

F3. Second Element...

F4. JTAC...

F5. ATCs...

F8. Ground Crew...

F10. Other...

F12. Exit

Hotkeys will also be available to directly issue any command in the structure. These can be found in Input Options.

To exit radio communications, you can also press the ESC key.

F1 Wingman

Upon selecting F1 Wingman from the main radio communications window, you have the option to select the basic type of message you wish to send to your number 2 wingman. These are:

F1. Navigation...

F2. Engage...

F3. Engage with...

F4. Maneuvers...

F5. Rejoin Formation

F11. Previous Menu

F12. Exit

F1 Navigation...

The Navigation options allow you to direct where your wingman will fly to.

F1 Anchor Here. Your wingman will orbit at its current location until you issue a Rejoin command.

F2 Return to base. Your wingman will return to and land at the airbase designated in the flight plan.

F11 Previous Menu

F12 Exit

F2 Engage...

The Engage options allow you to direct your wingman to attack a specific type of target. After issuing the order, the wingman will attempt to locate the specified target type and attack it.

F1 Engage Ground Targets. Wingman will attack any enemy ground unit it can locate.

F2 Engage Armor. Wingman will attack any tanks, infantry fighting vehicles, and armored personnel carriers it can locate.

F3 Engage Artillery. Wingman will attack any tube artillery or multiple rocket launchers that it can locate.

F4 Engage Air Defenses. Wingman will attack any enemy anti-aircraft artillery and surface to air missile units that it can locate.

F5 Engage Utility Vehicles. Wingman will attack all supply, transport, fuel, power generation, command and control, and engineering units it can locate.

F6 Engage Infantry. Wingman will attack hostile infantry units. Note that the infantry units are very difficult to detect unless they are moving or firing weapons.

F7 Engage Ships. Wingman will engage enemy surface combatants. Note that most surface combatants are heavily armed and that your aircraft is not well-suited to attacking such targets.

F8 Engage Bandits. Wingman will engage any enemy fixed-wing and rotary-wing aircraft it can locate.

F11 Previous Menu

F12 Exit

F3 Engage With...

Whereas the F2 Engage command allows you to give basic orders for your wingman to attack a target type, the F3 Engage With set of commands not only allows you to determine target type, but also the direction of attack and what weapon type to use. This is done in a tiered manner by first selecting target type, then weapon type, and finally the attack heading. The wingman will then attempt to locate targets of the specified type and attack them according to your specified weapon and attacking heading. While the F2 Engage options are fast to issue, the F3 Engage With options provide much greater control.

Target Type. These options mirror those of the F2 Engage orders and allow you to determine the type of ground target you want your wingman to engage.

F1 Engage Ground Targets. Wingman will attack any enemy ground unit it can locate.

F2 Engage Armor. Wingman will attack any tanks, infantry fighting vehicles, and armored personnel carriers it can locate.

F3 Engage Artillery. Wingman will attack any tube artillery or multiple rocket launchers that it can locate.

F4 Engage Air Defenses. Wingman will attack enemy anti-aircraft artillery and surface to air missile units that it can locate.

F5 Engage Utility Vehicles. Wingman will attack all supply, transport, fuel, power generation, command and control, and engineering units it can locate.

F6 Engage Infantry. Wingman will attack hostile infantry units. Note that the infantry units are very difficult to detect unless they are moving or firing weapons.

F7 Engage Ships. Wingman will engage enemy surface combatants. Note that most surface combatants are heavily armed and that your aircraft is not well-suited to attacking such targets.

Weapon Type. Once you have selected the target type, you will be given a list of weapon types that you want your wingman to engage the target with. These include:

F2 Unguided Bomb...

F4 Rocket...

F6 Gun...

F4 Maneuvers...

Although your wingman will generally do a good job of knowing when and how to maneuver, there may be times when you want to give him/her a very specific maneuvering order. This could be in response to a threat or to better set up an attack.

F1 Break Right. This command will order your wingman to make a maximum-G break to the right.

F2 Break Left. This command will order your wingman to make a maximum-G break to the left.

F3 Break High. This command will order your wingman to make a maximum-G break high.

F4 Break Low. This command will order your wingman to make a maximum-G break low.

F7 Clear Right. Your wingman will perform a 360-degree turn to the right of the current flight path while searching for targets.

F8 Clear Left. Your wingman will perform a 360-degree turn to the left of the current flight path while searching for targets.

F9 Pump. Your wingman will perform a 180-degree turn from its current heading and fly 10 nm. Once reached, it will turn 180-degrees back to the original heading.

F5 Rejoin Formation

Issuing this command will instruct your wingman to cease its current task and rejoin formation with you.

F2 Flight

Upon selecting F2 Flight from the main radio communications window, you have the option to select the basic type of message you wish to send. These are:

F1 Navigation...

F2 Engage...

F3 Engage with...

F4 Maneuvers...

F5 Formation

F6 Rejoin Formation

F11 Previous Menu

F12 Exit

F1 Navigation...

The Navigation options allow you to direct your flight where to fly to.

F1 Anchor Here

F2 Return to base

F11 Previous Menu

F12 Exit

These commands mirror those of the Wingman Navigation commands, but apply to all flight members.

F2 Engage...

The Engage options allow you to direct your flight to attack a specific type of target. After issuing the order, the flight will attempt to locate the specified target type and attack it.

F1 Engage Ground Target

F2 Engage Armor

F3 Engage Artillery

F4 Engage Air Defenses

F5 Engage Utility Vehicles

F6 Engage Infantry**F7 Engage Ships****F8 Engage Bandits****F11 Previous Menu****F12 Exit**

These commands mirror those of the Wingman Navigation commands, but apply to all flight members.

F3 Engage With...

These commands mirror those of the Wingman Engage With commands, but apply to all flight members. These commands work the same as the Wingman Engage With commands described above.

F4 Maneuvers...**F1 Break Right****F2 Break Left****F3 Break High****F4 Break Low****F7 Clear Right****F8 Clear Left****F9 Pump****F11 Previous Menu****F12 Exit**

These commands mirror those of the Wingman Maneuvers commands, but apply to all flight members.

F5 Formation

From the Formation menu, you can select the formation that the flight will fly in relation to you as the flight leader.

F1 Go Line Abreast**F2 Go Trail****F3 Go Wedge****F4 Go Echelon Right****F5 Go Echelon Left****F6 Go Finger Four****F7 Go Spread Four**

F8 Open Formation

F9 Close Formation

F11 Previous Menu

F12 Exit

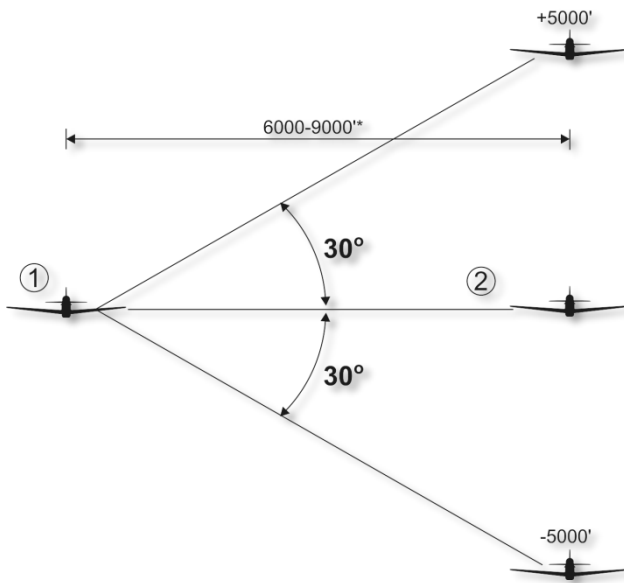
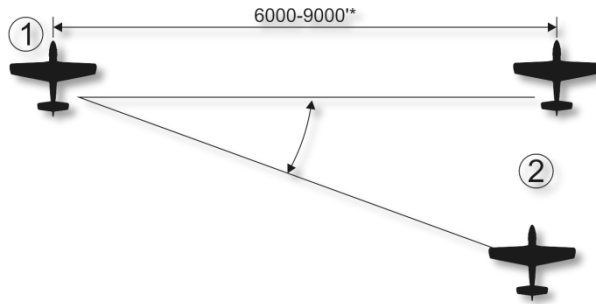


Figure 90: F1 Go Line Abreast

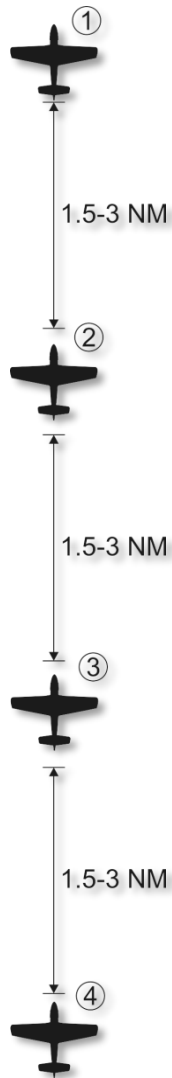


Figure 91: F2 Go Trail

Position may be modified within a 4000-12,000' envelope by flight lead.

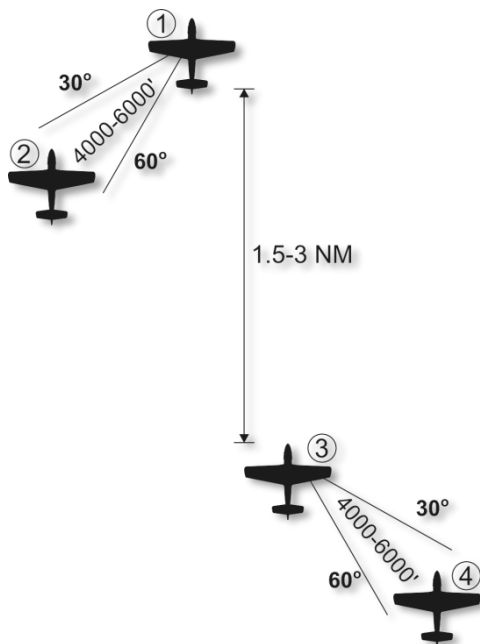


Figure 92: F3 Go Wedge

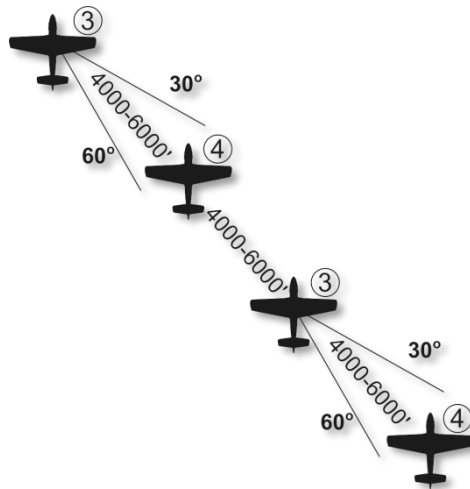


Figure 93: F4 Go Echelon Right

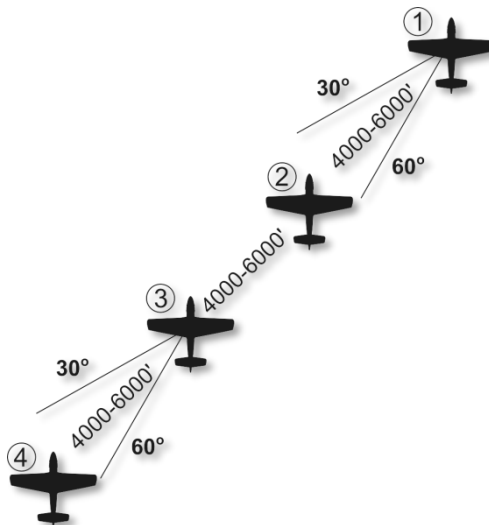


Figure 94: F5 Go Echelon Left

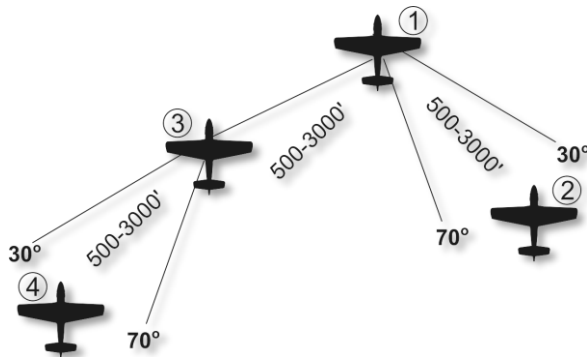


Figure 95: F6 Go Finger Four

Position may be modified within a 4000-12,000' envelope by flight lead.



Figure 96: F7 Go Spread Four

Position may be modified within a 4000-12,000' envelope by flight lead.

F8. Open Formation. Increase the distance between each aircraft in the current formation.

F9. Close Formation. Decrease the distance between each aircraft in the current formation.

F6 Rejoin Formation

Issuing this command will instruct your flight to cease their current task and rejoin formation with you.

Flight Member Responses

After sending a radio message to any of your flight members, you will have one of two responses:

Flight number of responder (2, 3, or 4). When a flight member will carry out the order, it will respond simply with its flight number.

(Flight member number) unable. When a flight member cannot carry out the order, it will respond with its flight number following by "unable". For example: "2, unable".

F5 ATC

The Air Traffic Control (ATC) system of this simulation is context sensitive to the location of your aircraft: on the parking ramp or runway/airborne.

Because the FuG 16 AM radio of the Fw 190 D-9 is limited to 4 channels, you will only be able to communicate with entities whose frequencies are loaded in your radio. Radio frequencies are loaded in the mission editor by the mission designer and should be made available as part of the mission briefing.

Each aerodrome's tower has several radios in different radio bands for radio communication with aircraft of different types.

ATC communication frequencies for Fw 190 D-9 radio band:

Anapa-Vityazevo: 38.40 MHz

Batumi: 40.40 MHz

Gelendzhik: 39.40 MHz

Gudauta: 40.20 MHz

Kobuleti: 40.80 MHz

Kutaisi (Kopitnari): 41.0 MHz

Krasnodar Center: 38.60 MHz

Krasnodar-Pashkovsky: 39.80 MHz

Krymsk: 39.0 MHz

Maykop-Khanskaya: 39.20 MHz

Mineralnye Vody: 41.20 MHz

Mozdok: 41.60 MHz

Nalchik: 41.40 MHz

Novorossiysk: 38.80 MHz

Senaki-Kolkhi: 40.60 MHz

Sochi-Adler: 39.60 MHz

Soganlug: 42.0 MHz

Sukhumi-Babushara: 40.0 MHz

Tbilisi-Lochini: 41.80 MHz

Vaziani: 42.20 MHz

Beslan: 42.40 MHz

Parking Ramp Start

Before you can communicate with ATC/Ground Control to get permission to start your engine, you first need to have your radio up and running.

With the radio now operating, press [↵] or [RAIt + ↵] to bring up the radio menu and then press [F1] "Request Engine Start".

If you have wingmen, they will also now start their engines.

After the aircraft has been started and configured, select [F1] "Request taxi to runway". Once you receive permission, you can taxi to the "hold short" area of the taxiway - the area on the taxiway just short of entering the runway.

If you have wingmen, they will also now taxi to the runway.

When at the hold short area, press [↵] or [RAIt + ↵] and [F1] "Request take off". When permission is granted, you can taxi on to the runway and take off.

Runway and Air Start

If you are not starting from the parking ramp, you can access ATC by pressing the [↵] or [RAIt + ↵] key. Upon doing so, you can select [F5] "ATCs".

If you are using "Easy Communications", a list of airfield ATCs are listed along with their contact frequencies. Select the airfield ATC you wish to contact. If not using Easy Communications, you will first need to push the channel button of the assigned ATC frequency you wish to land on the radio.

Once the airfield ATC is selected, you can either send them an "Inbound" message to indicate that you intend to land there, or an "I'm lost" message that will result in the ATC providing you guidance to reach the airfield.

When you select "Inbound", the ATC will respond with the following information:

- Heading to fly to reach landing initial point.
- Range to landing initial point.
- The QFE, or atmospheric pressure at the airfield elevation.
- Which runway to land on.

You can then radio:

- "Request landing" indicates your intent to land at the directed runway.
- "Abort landing" indicates that you will not be landing at the directed runway.
- "I'm lost" requests navigation assistance to reach the airfield.

If you've requested landing and are on final approach, radio request landing a second time and ATC tower control will provide permission if the runway is clear. It will also provide wind direction and speed.

After you have landed, proceed to the parking area and shut down the aircraft.

F8 Ground Crew

After landing at a friendly airfield and taxiing to a parking ramp, you can communicate with the ground crew for rearming and refueling by pressing the [\[F8\]](#) option to display the Ground Crew menu.

SUPPLEMENTS

Airbase Data

Airbase	Runway	TACAN, channel	ILS	Tower comm frequencies, MHz
UG23 Gudauta - Bambora (Abkhazia)	15-33, 2500m			209.00/130.0/40.20/4.20
UG24 Tbilisi - Soganlug (Georgia)	14-32, 2400m			218.0/139.0/42.0/4.65
UG27 Vaziani (Georgia)	14-32, 2500m	22X (VAS)	108.75	219.0/140.0/42.20/4.70
UG5X Kobuleti (Georgia)	07-25, 2400m	67X (KBL)	07 ILS - 111.5	212.0/133.0/40.80/4.35
UGKO Kutaisi - Kopitnari (Georgia)	08-26, 2500m	44X (KTS)	08 ILS - 109.75	213.0/134.0/41.0/4.40
UGKS Senaki - Kolkhi (Georgia)	09-27, 2400m	31X (TSK)	09 ILS - 108.9	211.0/132.0/40.60/4.30
UGSB Batumi (Georgia)	13-31, 2400m	16X (BTM)	13 ILS - 110.3	210.0/131.0/40.40/4.25
UGSS Sukhumi - Babushara (Abkhazia)	12-30, 2500m			208.0/129.0/40.0/4.15
UGTB Tbilisi - Lochini (Georgia)	13-31, 3000m		13 ILS - 110.3 31 ILS - 108.9	217.0/138.0/41.80/4.60
URKA Anapa - Vityazevo (Russia)	04-22, 2900m			200.0/121.0/38.40/3.75
URKG Gelendzhik (Russia)	04-22, 1800m			205.0/126.0/39.40/4.00
URKH Maykop - Khanskaya (Russia)	04-22, 3200m			204.0/125.0/39.20/3.95
URKI Krasnodar - Center (Russia)	09-27, 2500m			201.0/122.0/38.60/3.80
URKK Krasnodar - Pashkovsky (Russia)	05-23, 3100m			207.0/128.0/39.80/4.10

URKN Novorossiysk (Russia)	04-22, 1780m			202.0/123.0/38.80/3.85
URKW Krymsk (Russia)	04-22, 2600m			203.0/124.0/39.0/3.90
URMM Mineralnye Vody (Russia)	12-30, 3900m		12 ILS - 111.7 30 ILS - 109.3	214.0/135.0/41.20/4.45
URMN Nalchik (Russia)	06-24, 2300m		24 ILS - 110.5	215.0/136.0/41.40/4.50
URMO Beslan (Russia)	10-28, 3000m		10 ILS - 110.5	220.0/141.0/42.40/4.75
URSS Sochi - Adler (Russia)	06-24, 3100m		06 ILS - 111.1	206.0/127.0/39.60/4.05
XRMF Mozdok (Russia)	08-27, 3100m			216.0/137.0/41.60/4.55

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John A. Turner	Alex Huber	opps
Pascal Fritzenwanker	Willem Erasmus	nuclear
yendysl	Dmitry Schedrin	Tobais Hassels
Nestor Sanchez	Jordan Pelovitz	Lefteris Christopoulos
Joshua Miller	Philippe VINCENT	Dave Pettit
Ryan Pourroy	Josselin BEAU	Nikolaos Mamouzelos
Alexey Ershov	Nicholas Prosser	Karsten May
Tim Vleminckx	Manuel	DailyDozo
Trasric	Sebastian Baszak	snagov
Aaron Sotto	Marcus	anthony milner
Jeremy Louden	Fred de Jong	ALBERTO MARTIN SANTOS
Michael Barker	AndyJWest	Blarney DCS
Anjelus	Guillaume Couvez	

Kael Russell	Kornholio	Evgeniy
Collin Brady	Paolo Pomes	PhoenixPhart
Matthew Flanigan	Simulatu	Jonathan Marsh
Mátyás Martinecz	Mytzu	HellToupee
Tioga	Sebastian Hernandez	Tomas Lindahl
Ross David Hunter	ILYA GRYAZNOV	avner rev
SYN_Skydance	Blackmind	Theodoros Montesantos
Alex Sabino	Kyle Knotts	Jean-christian Ayena
Zaghloul Othmane	Tongp	Andrea Cavalli
Christian Kistler	Teapot	Alfonso Garcia Martinez
Jakub Komarek	Noah N. Noah	Alberto Minardi
Fraser Reid	Catseye	Chris West
Oskar Hansson	SATANA667	PHOENIX Interactive
Dimitrios Vassilopoulos	Jazz_35	Ross Goodman
James Franklin Lassiter	Neil Walker	MaP
Ilya Golovach	Leszek Markowicz	Miroslav Kure
Sean P. Burt	Christelle JESTIN	Vadrin
Grigori Rang	pierre burckle	hdbam
Jermin Hu	Rami Ahola	Peter Fischbach
PopoidAndroid	Sonia Holopainen	Carl Jamz Chivers
Richard	alfred demauro	Jouvet Laurent
Joshua Gross	Sylwester Zuzga	Frank Hellberg
Mitja Zadavec	Reinhard Seitz	gabsz84
Michiels Jorik	Jerzy Kasprzycki	benoit
Alexey Polovets	Christian Pintatis	Torsten Writh
Eric Fath-Kolmes	David	Gianluca Giorgi
TinfoilHate	Michael	Waldemar
Nicolas Piché	Vincent	Force_Majeure
Andrew Devine	Matt Crawford	Bob Radu
Jens Langanke	Sacha Ligthert	alon oded
Daryl	Bernhard Dieber	Christopher Phillips

lighthaze	Cristian Marentis	Richard Whatley
Christopher Mosley	Jochen Baur	Rick Keller
Ray Dolinger	Robert Dvorak	SolomonKane
Gordon McSephney	Sam "Mainstay" Valentine	Test
Rincevent	Marijn De Gusseme	Leonard Giesecker
Nicola	Vladimir Yelnikov	Paradox
Maxim	Bosko Djurisc	Torashuu
Davidov Vitaliy	Csaba Moharos	Jim Herring
Robert Morris	Useless	Colin Inman
Mikplayeur	James Smith	John Brantuk
Ian Taylor	Thomas Beuleke	Phoenix
Richy	Paganus	HR_colibri
Patrik Lindström	Darrell Swoap	Gregory Finley
jens bier	Roland Peters	Wiliam J. Bryan Sr.
Sakari Pesola	Stephen Barrett	Tim Julkowski
James Cleeter	Andrew Deng	Thomas Weiss
Christer Arkemyr	Ian caesar	David Terry
Richard Baas	matej renčelj	William Herron
Tomasz Karpiuk	Mikko Pulkkinen	Brendon
Kari Suominen	Paul R Kempton III	Gert Wijbrans
Norm Loewen	Federico Delfanti	rick andersen
Arjuna	Matt Parkinson	Andrew Fenn
tintifaxl	Bobby	David Stewart
Alejandro Montero	OhioYankee	gavin clunie
Connor	Rick Benua	Makoto Hakozaki
Paul Sims	Chris Ellis	Andrew Jennings
Ricardo Madeira	Keyser	Johannes Mueller-Roemer
Runar Aastad	Kirk Worley	Moritz Brehmer
Chawin	Gwyn Andrews	Shadow Stalker
Christian Taust	Nuno Silva	Nils Hansen
Mor Rotholtz	Uros Karamarkovic	Torbjorn Pettersson

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Andreas Macht	Lukas Erlacher	Jeremy Zeiber
Sputi	Jon webster	Jimbox
Agnar Dahl	Tomi Junnila	Alan Sharland
Antal Bokor	FF1	John Johnson
Jacob Røed	Torstein	Jacob Shaw
harinalex	Jared Winebarger	Keith Hitchings
Milan Šimundža	beikul	David Dunthorn
Christian Richter	Torsten Schuchort	Wyatt Moadus
Dave Webster	Caleb Keen	Eric Young
Alekseev Valentin	BOSCHET	Andrew Heimbuch
Sean Taylor	Mark	Bryce Whitlock
Balázs Lécz	Andrew Bartlett	Erik Schanssema
Rod Middleton	Neil Vennard	David Campbell
Karl Bertling	Pasi Yliuntinen	Wonderbread
Paul Mikhail	Declerieux	Kocso Janos
Alex Turnpenny	Jeremy Gates	Austin Mills
CiderPunk	Anonymous	Joseph Geraghty
Bryn Oliva-Knight	Eric Gross	Jukka Blomberg
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John Trimble	Guido Bartolucci	Gregory Choubana
Tòfol Jordà Chordà	Sam Yeshanov	Ken Cleary
Benjamin Roser	Sebastian Lindmark	chev255
ciaran coyle	Bob Denhaar	Stuart Walton
Sven R.	Scott Willtrout	James Jones

Jordan Cunningham	Markus Narweleit	blackjack04
Andrew Gibbons	Tomik	Andrew Dean
Erik	Lassi Miettunen	kongxinga
Pasbecq	Hagan Koopman	Warren Evans
Koop de Grass	James Goodwin	Roberto Mejia
Stephen Clark	L F Loxton	Jason Perry
Keith Ellis	David Irving	Ryan
Mike L	Jeff Petre	Paul Turner
John Boardman	Hugo Saint Martin	Alejandro
Ben Rosenblum	Guillaume Houdayer	hansentf
Hasanka Ranasinghe	Richard Orädd	John A. Edwards
Andrew Hickman	Emir Halilovic	Michael Turner
SonixLegend	HAYEZ JF	Simon József
Michael Anson	Thomas LaGoe	Christoph Gertzen
Jim Oxley	Tore Fagerheim	Javier Díaz Ariza
Thomas Nesse	Igor Kharlukov	Nico Heertjes
Philippe-Olivier Dubé	Peter Brooks	Chris Thain
Roland Reckel	Adam Navis	Jeff McCampbell
Mikael Harju	James dietz	UsF
Kevin Witt	siva	taratuta
Markus Berella	Andy McIntyre	Tommy Tomaszewski
Bodhi Stone	Jordi Haro	subject to change
Toni Wasama	Thomas Guiry (tf_t4trouble)	Vladimir Škorić
Bob Petrone	Kevin M. (tf_Stryker)	philux
Tim Hawkins	Larry Jones	Rune Hasvold
Martim Avelino Geller	Joonas (tf_Wraithweave)	MichaelB
RJ Stevens	Michael Olsen	Nacho
Uri Ben-Avraham	Mark Wallace	David Catley
Andrej Jesenik	Adam Chan	Gareth Morris
Andrew Wagner	Craig Martin	Andrii
f0uiz		Leon Grave

gkohl	Henrik Friberg	Andrew
Dale Jensen	Tom Shackell	Daniel O'Sullivan
Andrew Aldrich	Anthony Smith	rhinofilms
Denis P	Lorenzo Manzoni	Christopher Miner
Filip Kraus	Ant Paul	Richard McKeon
Henning	Tim Ireland	David Savina
Valeriy Nabatov	Mustisthecat	Jason Chang
ChenTing	Roberto Elena	Ian Hughes
John J Tasker	Ignacio Mastro Martinez	Barry Colegrove
Matthew Deans	vb12daduck	Oliver Hooton
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Alper Mat	Joen	Mark Sewell
Gunther Mueller	Luis Miguel Lopes	Patrick Pfeleiderer
Antvan	Graeme Hindshaw	David Stiller
Matthew Lindley	Dominik N.	Ammo Goettsch
Christian Koller	tessore	Ian Marriott
Matthew Morris	James Pyne	Francesco Kasta
Kevin Francis	Jacob Holmgren	Dale Winger
rami veiberman	yoel lavi	Claes Wiklund
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Karel Perutka	Jacob Babor	William Deal
Marc Heitler	Modulus	Rob Umpleby
Michael Fielding	Pieter Hofstra	Deadman
Jared Thomas	Andreas Monz	Simmy
John Mathews	Krueger	brian mandeville
Erdem Ucarkus	Paul Mulchek	Chris Wuest
Ed Curtis	Colin Coulter	Alex Hughes
Andy Cannell	Chui Yin Ho	michael waite
	Raj János	Yama

Robert Elliott	gordon vembu	Bryan Nogues
Adrian Putz	Erik Weeks	Eivind Tollerød Fosse
David Bray	John	Andrew Blinkin
Angel Francisco Vizcaino Hernandez	robin vincent	Bob Bent
Aleksander Yatsenko	Enrico Zschorn	Arvid Weimar
Stephen Ryan	Karsten	Aginor Chuain
Scott Hackney	Oscar Stewart	Christoffer Wårnbring
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Alex Hitrov	Vespero	Andre Schulze
Frank Townsend	Eric Anderson	Josse Aertssen
Boris Schulz	Lavi	Roger Buchser
Sam Lion	Robert	Daniel Beltran Gonzalez
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Vincent	Jon H	Patrick Naimo
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tony lafferty	Skorak	Benedict Hurkett
	Flying Colander	Victor Gil

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Christopher Hibberd	Amos Giesbrecht	Alex Cameron
John Small	Toby Rushton	Ian Jones
Robert Nigel Jamison	Joonwook Park	Alan Dougall
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Robin Senkel	Cecrops	Tim Rawlins
Joseph W Scupski	Brian Kiser	Space Monkey
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Peter Schmecker	Victor "Dream Traveller" Buttaro	Kurt Reimann
Drovek	Glen Reed	Luke Griffin
Joonas V	Steven Rushworth	Samuel Morrissey
Ville Vuorinen	Andrew Broadfoot	John Smalley
Nir	Olivier Kozlowski	Chris Weerts
Pavel Škoda	Matthew Hill	Mr John C Smith
Jeremy Lambert	Gestl Guenther	Hugh Man
Heillon	Thomas Hegman	Michael Parsons
Eli Havivi	Vit Prokop	Dimitri Apostola
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Helio Wakasugui	Evgeniy Troitskiy	Norbert Röhr
sterfield	Tom Humplik	Martyn Downs
Andy Davidoff	Steve Rizor	Hideki Mori
ALLAIN	Gerald Jarreau	Akin
Kristofer Crecco		javierlarrosa

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Eric Howe	Aku Kotkavuo	kyle sinclair
Alexey_K	Andrew Olson	JUERGEN
Tuomas Virtanen	Charles Burns	Jose Angel Gomez
Keith Bedford	Ken Peterson	PA_Hector
J.D. Cohen	colin scutt	Andrew Stotzer
Gavin Crosbie	steve lecount	Charles M. Wilsenach
bupbup	Tamir Katz	Kyle Hannah
Vieillefont Antoine	Timo Hiltunen	Anton Grasyuk
Goat Yoda	Istvan Takacs	Saxon66
Nicholas Bischof	michael tardio	Joseph Noe
David Schroeder	Chris H. Hansen	Ryan Peach
Jonathon Walter	Sebastian Schöder	Trevor Burns
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daisuke sato	Curtis	MTShelley
Juanfra Valero	Adrian Borodi	Juha Liukkonen
vella	Pekka	Conor Bradley
Anthony	Lenny Cutler	Orion Robillard
Taproot	Shimon Okun	John Burgess
HansHansen	Tarasyuk Yuriy	Tom Strand
Ivan	Brayden Materi	Jeremy Bartos
Derek Barnes	Marc Michault	lowellsil
peter winship	Alcaudon101	Johan Waldemarsson
DUPONT Philippe		Nigel Patrick Holmes

EagleTigerSix	Kenneth Bear	Peter James Taylor
Timothy Bauer	Jenei Béla	Theo
Zetexy	Ian Cockburn	Toni Uusitalo
Ha Za	Andreas Demlehner	Leandro Medina de Oliveira
Gabriel Venegas	OSCAR LUIS GALVEZ CORTES	MgFF
Shuyang leung	Peter Svensson	Caleb E. Farris
Jing Wang	Brillet Thomas	Chad David
Grant Marchant	Brad Hawthorne	Thelmos
Hen Shukrun	Kjetil Lavik	David Mann
ric	Ian Todd	Burgin Howdeshell
ian d	Leonas Kontrimavicius	Tomas Hridel
Peden Harley	Christian Bretz	Berno
DAVID CARLISLE	Koh Desmond	Mario Hartleb
Gabriel Glachant	Daniel	Gary Dills
Aries The Destroyer	Paul Thompson	Christopher Vance
Jan Kees Blom	Joshua	Rainer Schweers
Arto Rajajärvi	Tom Johnson	Stephen Lynn Flores
Alexandr Petak	Edward A. Dawrs	Stephen Higginbotham
MrBoBo	Gerald Gassenbauer	Tim
Roger Owen	RJW Scharroo	groovy
Tacno	Robin Norbistrath	Matt Berndt
Jack Beck	GUMAR	Colin Muir
Valentin Loginov	Neville Wakem	Andrew Thomson
Abc	Carsten Vogel	Christopher Lamb
Ivan Čavlek	Robert Ormes	CHO SUNG BAE
jensl	captncrunch240	Ivan Fedotov
Martin Eriya	Nico Henke	Sita
Enrique Alonso Benítez	Chaussette	Alistair Stuart
Kevin Beswick	Ivan_st	Dominik Schulz
Borek Fanc	Mazin Ibrahim	Simon Picken
mp		

Jan Jaap Schreur	Juan Carlos Morote Martin	Jarrold Ruchel
Christian Mundt	Alvio Costantini	Brian Carlton
Sven G.	Aaron Fess	Field Manar
Williame Laurent	Nicholas Wagner	Eric Turner
Matthew Johnson	Aleksey Vlasov	John Phelps
NoS	beda	Takku
Derek Hatfield	Jim Barrows	Matt Olney
LordLobo	Erik Dahlbäck	JetBane
Reece Heinlein	steve smith	Michael Grzybowski
Crimea_MULTI	Spencer Miller	Johan Lind
Barry Matthew James	Maik Baumert	Justin Smithson
Vincent Eysel	David Frees	Paul Cook
Asier García	Andrew McCann	Zach Brown
Allan Renwick	Celso Lopez	Kyle
Lukas Vok	Sebastian Grant	Brendan Clary
Amraam	David Gray Castiella	Brian Charles
Keith Mercer	Martin Thomas	Rick Miles
Tekray	Andrew Suhren	Admir Nevesinjac
Chris Benson	Waide Tristram	JanP
Joshua Smith	cliff clark	Gavin
Toni Talasma	Charles Conley	Zhou Lingshu
Stuart Andrews	Kim Johnstuen Rokling	Carl F Altrock
Robert Mahon	Lars Lie	Bieringa
James Faraca	Hans Liebherr	Konstantin Kharin
Jan Beissner	Ola Nykvist	Phil Barker
Stephan Gako	Karl "Light" Akkerman	chris birkett
Tony Buman	Andreas Schmidt	Shane Sigley
Mark Hickey	Julio Cesar Cardoso	Manuel Pace
Leonid Dreyer	Thomas Mitchell	Gregg Cleland
Martin Kubani	Tripp	Charles Hill
Veli-Matti Paasikivi	Robert Walters	Ofer Raz

Kotaro Asada	Stephan Kerkes	Florian Gehrke
Zlatko Birtic	Eric	Christian Kreuter
Andrew Smith	Alexey	Stefan Meier
juan jose vegas repiso	Radu Gabriel BOIAN	Michael Long
Henrik Stavshoj	Frederic GEDEON	Phil Hawes
Gustaf Engelbrektsen	David Moore	Sharin Vladislav
Yurii Nadeyin	Peter Pühringer	Dominic Wirth
Jukka Karppinen	Julian C Oates Jr	Nicolae Buburuzan
Eoghan Curtin	Rhandom	Vladimir Švajda
Pierrick GUIRAL	Josef Eberl	Jarosław Tomaszewski
Janus Sommer	Premysl Truksa	Duane Kennard
Juha Hayashi	Ivica Milovan	Nicolas Köhler
Rommelius	yanba109	Sami Luukkonen
Phil	Kieran Vella	Jan Baßfeld
Teppo	Glenn Lilley	Mod-World
Garry Goodwin	Imrahil09	Jürgen Klein
Ralf Pitzer	AtreidesNL	Mark Fisher
Magistr	David Pajnic	Brant Templeton
callsignalph	trashcutter	Viktor Friesen
Luke Campbell	Beot	Daniel Boontje
chedal-bornu sebastien	Mark Gordon Cochrane	Benjamin Böhm
Tim Huthsteiner	Joel Anthony Palaszewski	Fabian Wiesner
Ryan Heseltine	Rydén	Manuel Santiago Melon
emanuele garofalo	Mark David Cleminson	Guntin
Branton James Elleman	James Freer	Mark McCool Jr
Kim Ahlin	Jhusdhui	Tim Krieger
Chris Engel	steven connolly	Andreas Wagner
David Grundmann	Jonathan Rolfe	marco meyendriesch
Paul Grint	marly fabien	Karst van der Ploeg
Oliver Bennett	Stephen Wilson	Markus Bössinger
Gleb Ivanovsky	Sandra Walsh	Martin Durech

Michiel Erasmus	Robert Culshaw	James William Read
Marcus Holm	sydost	Jason Smith
jesus gonzalez	Kenneth P. Kaiser	Matthew Martin
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omar karmouh	Friedrich Plank	Derek Guiliano
Henning Leister	COUSSON	Paul Cookson
juan enrique jurado mateu	Andreas Tibud	Brett Stengel
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joe troiber	Anthony Echavarria	Olaf Binder
Mike Williams	Garrett	Raphael Willerding
Pedro	Andrew Webb	Nick Walsh
Roman	AaronAsh	Remon
Steve	Etienne Brien	Tomas Friberg
Henning Leister	Michael	Brian Phillip Colella
Sándor Balikó	Jarad Clement	

Sergey	Nikolay	Greg Bell
Adam Schneider	Ryan Doppke	George Succar
Christian	Roger Ringstead	Michael Langness
William Clark	Nick Yudin	Thomas Leitner
David Taylor	Allan Chunn	Sean G of the CoD
Gera	Giovanni Anthony Bryden Jr.	Sergey "ROSS_BerryMORE" Oliferuk
=DRACO=	graylobo	Timo Vestama
sfer314	kenneth	Matt Styles
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Rico Reyes	Aki Holopainen	David Rilstone
Jeff Zhou	Magnus Andersson	David Miles
Joseph Piasecki	Randy Erwin	Kim Fast
KS	ivdadrelbul	Martin Støyl
Michael Landshman	Sergey Mozheyko	Michael Walker
ROSS_Borman	Dalminar	Mattia Garuti
Jack Wilson	Michael Petrarca	Mark Shepheard
Craig	Matt Renfro	Trevor Tice
Thomas Lipscomb	Dan Antonescu	Martin Ponce
Wayne Dickinson	Andreas Pichler	Adrian Cretu
Jared Macon	Mick Alden	Giovanni Degani
Daryll Chupp	Ilia	Sean Tudor
James Nielsen	Brian Lanham	WhiskeyBravo
Tobias A	Denis Winters	Michael Lajeunesse
Alexander Vasilyev	jameson	Chris Madera
Jared Fast	David Gregory	Dmitry Khonin
The Shoveler	Antonio Manuel Ortiz Seguel	Franciscus Berben
Hrvoje Topličanec	Thomas Harkless	Bo Henriksen
k05	Jeff Dodson	Martin Moráček
Roland Schulpen	hangar16	wuffman
Azametric	Daniel Webb	Ian Bishop
TheKhann		

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Viacheslav	ROGIER	Deascii
Conrad Lawrence	ugo cozza	Michael Ditter
David Ordóñez	PH	shurke
Jim Allison	Alexander Orevkov	Bochkarev Leonid
kcstokes	Wienerschnitzel	James D Brown
Christopher Scarre	TerminalSaint	Aaron Pratt
Andrey ScorpyX	Derinahon	Tom Summers
Vadim Adel	Pablo M Derqui	Miguel Angel González Domingo
Hasse Karlsson	Steve Chatterton	Aapef
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Gary Edwards	Daniel Holst	Michael Miles
Josh lee	Jochen Hamann	Zinoviy Khutoryan
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Danny Vanvelthoven	Robin Harroun	Gabor Buzasi
Emilio Londono	Kev	Michiel Jongenelen
Angustimus	Sideris Fotis	Nicklas Sjöqvist
Jeffrey Gumbleton	Konstantin Dibrov	Kimmo Eklund
Bill	Peter Baltzer Hansen	Bertrand Heurtefeu
Troy Nakauchi	Alex	Brian Lee Faull
Jaron Taylor	Peter Wiklöf	Ilja Osovin
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Angus MacQueen	DAVID R COLEY	Robert Noke
Ramsay Beshir	Charles Jesch	Don Menary
MarkHawk	cv	Patman DM
Miguel Arias	Gary Lisney	Paul Dyer
Juan Soler Huete	Andy Toropkin	

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Felix Mueller	Siv	Broodwich
Christopher D. Chambers	Matjaž Mirt	Aleksandr Kochelaev
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Zachary Layne	Fredrik Sjöborg	Scott Eckrich
Terry Scott	Matthew Schneider	Vasco Charles Morais-Boulay
Tyler Krebs	Andrey Dvornik	Petter Lausund
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Jacob Williams	Daniil	william neil harding
Mark Linnemann	ALFA_49	Bill Poindexter
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James Stephen	Marc-David Fuchs	Capgun
Terry	Jose Manuel	Thomas Cofield
Aram		Alexey Ibragimov
Jefferson Santos		Blackwolf_927
RvGils		Daniel Vukmanich
Michael Sprauve		Nicholas Landolfi
Jan Ctrnacty	Rayvonn Core	Arrie
Gene Bivol	enrique colome	Mathew Crane
Julian Gaffney	TrailBlazer	Tom Tyrell
Charmande	pavlich	Evan Kosnik
Mehth	Lawry Playle	John Hannan
John Huff	Michael G Ribordy	Tim Chapman
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andrew norgrove	Lanzalaco Salvatore	Joe Dionisio
Tibor Kopca	Janusz	Warmoer
Mario von Thenen	Knut Hanssen	Johan Törnholt
Pedro Mellado	Ljas	Mark Siminowski
Andrew Payne	Thomas Falmbigl	James Sterrett
Graham Smart	Michael Heron	Michael C Ringle
Aviad Tobaly	Ville Ilkka	Ryan Denton
Tyler Moore	David O'Reilly	James F Miller
Allan Spears	Stephen Morrison	Dalton Miner
Jens Kadenbach	Royraiden	James Cook
Dave Kelly	Torsten Tramm	Mike O'Sullivan
Nick	Ken Biega	Andres Riaguas
Ian Seckington	Andrew Brown	Antonio Ruotolo
James Cross	David Levy	Joseph Krueger
Mikko Laukkanen	Karsten Borchers	Chris Payne
Fangqiu Zhu	Jerry Frost	Carl Lyles
Austin Moses	Michal BIZON	Korotky Vadim
Richard Harris	James Phelan	Kenneth Avner
Kevin Garrett	Kiefer Jones	Mason Flake
Gregory Foran	Sigurd Hansen	Ryan Yamada
Penpen	Jorin Sheaffer	oat03001
Prvt.SNAFU	Robert Ian Charles Fellows	g_nom21
Mark Watson	Måns Gotare	davisballen
DarKcyde	Ashley Ellis	ian leslie finlay
Keith Young	Wade Chafe	Kaijev
Scruffy	Jonathan Lim	PakoAry
Mark Delahay	Eduardo Gutiérrez García	Evert Van Limbergen
John Pengelly	Felix Berchtold	Jeff Kerian

Christoph Jaeger	Famin Viacheslav	Robert Conley III
Devin Ragsdale	Vit Zenisek	Sean Walsh
José Oltra Martínez	William Pellett	Trevor Tranchina
Steve Harmer	Victor Nakonechny	Thomas Fuchs
David McCallum	Nurbol	George Neil
Sebastien Clusiau	Tobias Kiedaisch	Kyle Colyer
Jordan Marliave	Sam Carlson	W. Duncan Fraser
Michael Riley	John Nespeco	Joe Veazey
Stefan V	DJB	San Mecit Erdonmez
JST	Jakob Boedenauer	tough boy
Bas Weijers	Glen Murphy	Ian Buckler
Jonathan Clarke	Tempered	Jamie Denton
Matti Lund	DDB	Marek Ratusznik
Roman Frozza	Jacob Eiting	gerard o'dwyer
sdpg_spad	Joshua Blanchard	Chris Osterhues
lmercier cedric	James L. Rumizen	Yukikaze
Arcady Chernavin	Mdep5809	Ishtmail
Duncan Hewitt	Dr. Stefan Petersen	Mark McRae
Jim Valentine	DanMe	Bruce Wilson
Ye91	Bruce Mackay	Axion
Wasserfall	Nick Iassogna	Alexandre Tellier Talbot
Marcelo Tocci Moreira	Tim Collins	MK
Youngmok Rhyim	Scott Heimmer	Chance
Hassel Krauss	Drew Pedrick	Alain Becam
Matthew Walker	Christopher Nee	Roman Kolesnikov
Aleksey Kopysov	Viktor Baksai	Jake O'Mahony
ivan decker	Brad Ernst	Oliver Sommer
Juliano Simoes Haas	Glenn Pechacek	Forest Faltus-Clark
Daniel Agorander	Stephen M Zarvis	War4U
Nick Mowbray	John Vargas	Angel Morata
ApeOfTheYear	Paul Cucinotta	Fredrik Petersson

Totoaero	Lunovus	Martin Scholz
garengarch	Steve Gentile	Micha Tanny - a.k.a IAF_Phantom
Jeroen Gommans	Robert Cannon	Bjarne Stig Jensen
paul green	Colin	Colin Rowland
Shannon Craig	Jeffrey A Bannister	Craig Gillies
Sergey Ravicovich	Jeffrey Walsh	Jez Brown
chardon	Brett Bodi	Massimiliano bonin
Tim Mitchell	Bearcat	Runefox
Bjoern Wiederhold	Jason Brown	Ian Keenan
Adrian Havard	Stephen Hulme	Dan Randall
Christoph N	Sheldon cannon	Michael Illas
Stefan Jansen	Daniel Dillman	Otto Conde de Resende
sdo	Nicolas Belanger	Robert Holleman
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Aaron Zmarzlinski	Mike Todd	Ori Pugatzky
Remco	ryan brantly	michael
Nick Vamis	Vit Premyslovsky	Benjamin Frost
Frerk Schmidt	Scott Beardmore	Crimson Machete
David Weaver	Ray West	Hansang Bae
Sergey Velikanov	Iran Fernandes de Oliveira	Eric Staton
Sherif Hosny	David Craig	Wang Feng
Nils Thiel	Jason Reynolds	Rob Brindley
Tim Wopereis	Anthony Chant	Thomas Ruck
Torsten Tramm	Jinder Greewal	Brian Scott Pagel
Jeroen Wedda	Conrad Smith	Insy
Adam Murray	Andrew Fudge	kevman
Arto Santasalo	Ross White	

Reinhard Eichler	Mark Gaffney	Matthew Enloe
Leif Lind	jeremy	Sega Dreamcast
ATAG_Old_Canuck	Cian Quigley	Jean-Pierre Weber
Robert Bähr	Paul Adcock	Peter Scaminaci
Iker ulloa	Greg Huffman	Yaniv Harel
RF	Tom Bies	Eric Keith Robinson
Peter Bartlam	Tim Morgan	David Horkoff
Jasper Hallis	Igor K.	Craig Brierley
Jordan Forrest	kurnz	Kenneth Sapp Jr.
fedja	Benjamin de Rohan	Jack Gurley
Jonathon Kinnin	Sébastien Vincent	Titus Ou
Rey	Roy Woodworth	Ron Cassinelli
Berkes Attila	Nick Maurette	Kestutis Zilyš
hansen	Michael Benton	Gary N. Peden
Scott Gorring	Qi Huo	Joe Troiber
Sebastian Riebl	jamie	Brian Kanen
Axel Haake	Blake Cetnar	Ron Brewster
Martin Winter	Drum_Tastic	Alexey Slavutskiy
greco bernardi	Douglas Watson	Michael Smith
Elfin	Zappatime	Hammed Malik
Martin Gronwald	Matt Engelhart	Eric Koepp
oldracocon	Edward Kiervin	Timothy J. Burton
William Skinner	dennis worley	Dennis Camosy
Johan Soderholm	Michael Rishel	John Lynn
Khaydanov Yuriy	Scott Fligum	Tien Brian
Boomerang	Mark A. Kirkeby	Colin McGinley
Alex "Razorblade"	Tom McGurk	Gerald Gong
Alexander Casanova	Paul Hughes	Ryan Thomas Jaeger
Jared Sorensen	Charlie Orchard	Jason Deming
Adam	Edward Winsa	William S. Ball
Patrick O'Reilly	AKuser99	Eponsky_bot

Ronald Hunt	Kent-Ruben Elvestrand	Jiong Zhang
Michael Jochim	brimen	Gary
Arthur Changry	Heinz-Joerg Puhlmann	Allan Taylor
Jamees Hancock	jcenzano	Bennett Ring
Richard Stinchcomb	roman	Bastiaan Jansen
Charles Savas	Jason Montleon	Libor Stejskal
Chris H	Falco	David Maclean
Wayne Berge	Marco Landgraf	Sokolov Andrey
Wes Murks	tkmr	Chris Schultz
Russ Beye	Brandt Ryan	Zaxth - Weresheep of Sin
Juris L Purins	Andrew Spanke	desert eagle540
mike richgruber	Matt Lind	Paul Walker
kurt Weidner	Bryan Baldigowski	Mitchell Sahl
Karfai Michael Yau	Chris Cantrell	Cornay Sinac
Geoffery Jensen	Daniel Marsh	Markus Sohlenkamp
Thomas Dye	Benjamin Freidin	Stanislav Sereda
Robert Schroeder	Chris C	Paul Elton
Leon Higley	SimFreak	Hans-Joachim Marseille
Tobalt	Manuel Ramsaier	Rae
Braden Johel	Olivier Anstett	Nyary Laszlo-Carlo
Seeker37	Tor Stokka	Conny NÄslund
Polar	Kirk Lange	Kevin Clarke
Alex Pekarovsky	Timo Wallenius	Vaz
airdoc	Christoph Jungmann	Erich Kreiner
Barry Maunsell	David Penney	Axel Miedlig
Peter Reinhard	alfonso cordoba aguiera	JÖrgen Toll
Maler	Flagrum	Euan Arthur Emblin
Todd Bergquist	Edin Kulelija	Jose Luis Navarro Reus
James Schlichting	Iván Pérez de Anta	Graham Wilson
Peter Krause	Col Shaw	Ian Kaiser
Daniel Eremeyer	Rick Zhang	Peter Stephenson

Christian Gomolka	Eldur
Michael Umland	Feldmann
Lawrence Lester	Matthew Horrigan
Dave Farr	Doug Elliott
Hannu Heino	Espen Hundvin
Neil Merrett	Mark Clark
Christopher Ludgate	Einar Oftebro
Markus	Danny Stevenson
Mark Thorp	pedro
Darrell Herbert	Cory Avery
Alfredo Croci	Shaun Cameron
Tyler Gladman	Iffn
Julian Urquizu	Ante Turkovic
John Regan	Ashley Bennett
Joel Opdendries	George Bonner
Stewart Forgie	Greg Appleyard
Vendigo	Anton Quiring
Sean Buchanan	Mhondo
Snowhand	Sandalio
Frenzy	Kristian V Meyer
Wayne Adams	Andres
Jukka Rouhiainen	Julian
Sam Wise	David Challis
Keith Bumford	Brad Rushworth
Sonid Salissav	Alon Tall
Bradford Julihn	TRESPASSER
Kirin	Matt Miller-Fewer
Emil Philip	MARCELO TAKASE
Joel Docker	James Roy
Tino Costa	Boris G
Jon Isaacs	Dave Reichard

Gold Backers

Phantom88
 Or Yaron
 Måns Serneke
 Polaris Penguin
 Marius Backer
 Peter Fritz
 Joan Sabater
 Jim Van Hoogevest
 Sergey Ipolitov
 Joseph Anthony Elliott
 Tony Webber
 LP
 Akshay Tumber
 Celtik
 J.J. Wezenberg
 JiriDvorsky
 Oliver Scharmann
 Jostein Kolaas
 Karl Asseily
 Hans Heerkens
 kevin Hürlimann
 Reinhard Zeller
 Brad Stewart
 AJD van der Valk
 Erik Nielsen
 Thomas Bakker
 Harry vandeputte

Martin Janik	Zamaraev Anton	Robert Shaw
Luís Ferreira	Vladislavovich	Gregory Daskos
Carl Johnson	Max dahmer	Salvador
bouder	auo74	Jason Story
Sven Bolin	Torian	Scott
Michael Gaskell	Arno Hasnaes	Secret Squirrel
Nezu	Murray Thomas	Pier Giorgio Ometto
Kevin Vogel	Ron Harisch	William Forbes
Laivynas	Dean Gardiner	Griffith Wheatley
JANIN Elie	Stanislav	Donald Burnette
Mikko Räsänen	Christian Noetzli	Duncan Holland
Maxim Lysak	HoperKH	Karl Miller
klem	Johannes Wex	Fabian Kraus
Ian Linley	G W Aldous	Miquel Tomàs Homs
Jaws2002	Steve Butler	Ulrik Svane
Martin Heel	Sergey Goretsky	Christopher Ruse
desruels jean	Nathan	Goanna1
Tom Lewis	Daniel Clewett	Dean Christopher
Michal Slechta	Drew Swenson	Fortomaris
Joakim Söderman	DragonShadow	Stephen Turner
Matt Skinner	Andreas Bombe	charger-33
Mattias Svensson	Mario Binder	Roy Enger
Frank Zygor	Greg Pugliese	Ian Grayden
Mysticpuma	Richard Williams	Buster Dee
Andrey	Phil Rademacher	Antonio Salva Pareja
Steven Mullard	Gershon Portnoy	Robert Staats
Kaiser	Alexander Vincent	John McNally
Michael Leslie	Nicholas Sylvain-Obsidian	Håkan Jarnvall
Stewart Sayer	Tormentor	
Carlos Henrique Arantes	Zoltann	
Theodoro	Pizzicato	
	Christopher Foote	

Platinum Backers

Kevin Gruber	CAHUC Fabien	Luke Scalfati (tf_neuro)
Ilkka Prusi	Andrew Gluck	Chivas
Ryan Power	Zinj Guo	Charles Ouellet
David Vigilante	Stephen Ptaszek	Harald Güttes
Adam Del Giacco	MACADEMIC	Chekanschik
Patrick	Ariel Morillo	Kodoss
Richard Boesen	Michael Vrieze	Brad Edwards
Mike Williams	Aaron Kirsch	dgagnon99
Robert Cattaneo	Hen	Sam Higton
Alvin Pines	Shawn Godin	=tito=
JOSHUA C SNIPES	G W Aldous	Rémy "Skuz974" STIEGLITZ
Ole Jørgen Hegdal Lie	Michael Brett	Andreas Gruber
Ethan Peterson	Tom Lucky Klassen	William Denholm
Jim Magness	KDN	322Sqn_Dusty
AirHog71	Brian Thrun	theoretic
Ralph Mahlmeister	Martin Jaspers	AndK
Les Hillis	John Guidi	Mike Abbott
Dieter	Tom Galloway	Aníbal Hernán Miranda
Sean Trestrail	Ian	Trond Bergsagel
Johanen	Dimitrios Syrogiannopoulos	Geoff Stagg
Atle Fjell	Ryohei Yoshizawa	Alexander Osaki
Eric W Halvorson	TC1589	Nirvi
DavidRed	Federico Franceschi	M. Carter
Grant MacDonald	mike parsell	David Block
Richard Ashurst	HolyGrail FxFactory	Alexis Musgrave
David Stubbs	Chad Owens	Necroscope
Stefano Dosso	Bobby Moretti	Mike Bell
KLEPA	Melanie Henry	Richard Skinner
	Christoffer Ringdal	Palmer T Olson
	Ilya Shevchenko	Caulis Brier
	Soeren Dalsgaard	

michael addabbo
Krupi
Christian Knörndel

**Diamond
Backers**

Robert Sogomonian
Etienne Boucher

Ronald L Havens
Dave
John Bliss
Pers
graham cobban
John Wren
Pitti
Simon Shaw
Don Glaser
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