



Fw190A-8 **ANTON**



DCS Fw 190 A-8
Flight Manual

Dear User,

We thank you for your purchase of DCS: Fw 190 A-8, a simulation of the legendary German World War II fighter.

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 A-8 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 Fw 190 A-8 is a personal and exhilarating challenge to master. This powerful and deadly craft should prove to be both an exhilarating combat experience to its drivers, and a worthy challenge to all fans of the DCS: P-51D Mustang and Spitfire LF Mk. IX.

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 service era Fw 190 A-8 manuals that we were able to acquire.

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 A-8 Development Team

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INTRODUCTION

The Focke-Wulf FW 190 is one of the most famous aircraft of World War II, widely considered to be one of the most successful aircraft of German origin. There were many innovations in its design, which significantly lightened the pilot's workload and expanded the aircraft's operational range. The Fw 190's combat debut on the Western Front of 1941 proved to be quite the unpleasant surprise for the Allies: it demonstrated markedly superior performance compared to the British Spitfire Mk.V. It continued to dominate the skies over France unopposed until the Spitfire Mk. IX joined the fight, almost a year after the FW 190 A-8.

Almost 40 variants were created for the aircraft, from high-altitude reconnaissance to ground attack and night fighter roles. At the end of the war, the FW 190 saw use in one its most unusual roles as an upper component of the Mistel composite aircraft strike package. The Mistel "flying bomb" configuration had the FW 190 installed above a specially converted twin-engine bomber loaded with explosives, which the pilot of the FW 190 would aim at a target and release, detaching their fighter from the larger payload craft.

The first version of the aircraft to enter mass production was the FW 190 A, equipped with a BMW-made radial engine. It was an air-superiority fighter, fighter-bomber, and attack aircraft all in one package - beloved by its pilots and hated by its rivals.

AIRCRAFT HISTORY



AIRCRAFT HISTORY

The Focke-Wulf 190 project began in the summer of 1938. The head of the aircraft design team, Kurt Tank, put forward two proposals: one variant of the aircraft outfitted with a Daimler-Benz DB 601 liquid cooled engine, and a second outfitted with the new air-cooled BMW 139 radial engine.



Figure 1: Kurt Tank, creator of the Focke-Wulf 190

The FW 190 V-1 prototype was a cantilevered low-wing aircraft with a stressed-skin wing. Its maiden flight took place on July 1, 1939. The second prototype, the Fw 190 V-2, took off in October 1939. This variant was armed with two 13-mm (0.51 inch) MG 131 machine guns and two MG 17 7.92 mm (0.31 inch) machine guns.

Both aircraft were equipped with large propeller domes which would later on be replaced with NACA propeller domes.

Before the second prototype made its first flight, the decision was made to replace the BMW 139 engine with the more powerful, but longer and heavier BMW 801 engine.



Figure 2: Fw 190 V1

This required a large number of major changes to the design: the airframe needed additional structural reinforcement, while the cockpit would have to be moved closer to the tail section of the fuselage. Distancing the cockpit from the engine also solved the aircraft's issues with its center-of-gravity while simultaneously eliminating crew discomfort caused by the engine's noise and heat generation. The third and fourth prototypes were not completed, and the Fw 190 V5, equipped with the new engine, was built in early 1940. At the end of 1940, the aircraft received a new wing design, with a wingspan increased by 1 m (3 feet 3.5 inches). Although the speed of the Fw 190 V5g was lower by 10 km / h (6 mph), it came with improved maneuverability, outperforming the prototype with the shorter wing (designated as Fw 190 V5k.)



Figure 3: Fw 190 A Prototype

The first seven units of the pre-production batch of Fw 190 A-0 were outfitted with the original wing, while the rest had the longer wing design. The first combat unit was equipped with these aircraft in August 1941.

Fw 190 A-1: The first Fw 190 A-1 fighters left the assembly line of the Marienburg Focke-Wulf plant in June 1941. In August, the monthly production reached 30 units. In the same month, the Arado aircraft manufacturing company in Warnemünde began producing the aircraft under license, while AOG in Oschersleben began production in October. The Luftwaffe received 82 units by the end of September, and the rest of the contract, a total 102 units, was fulfilled before the end of October. One of the first units to be produced, designated FW 190 A-1/U1, was outfitted with the BMW 801D-2 engine as an experiment. Some of the A-1 series aircraft received a FuG 25 IFF device alongside the FUG 7a onboard radio station. All units had the cabin, fuel and oil tanks reinforced with armor. The aircraft's armament consisted of four 7.92 mm (0.31 inches) MG 17 machine guns.

One of the aircraft's main issues as noted in the reports of technical officers was engine overheating, which led to frequent fires.

An order was made for 100 additional units equipped with a 1238 kW (1660 hp) BMW 801C-1 radial engine, longer wings, and a FuG 7a radio.

The Fw 190 A-2 series was equipped with the BMW 801C-2 engine. Only then was it possible to eliminate the overheating of the rear star of the engine with the help of air vents that ran along the side of the fuselage behind the engine. The same air vents were also fitted on all A-1 series aircraft that remained in service. New synchronizers were also developed, making it possible to reinforce the aircraft's armament by installing the 20-mm Mauser MG-151/20E cannon at the base of the wing instead of the MG-17 machine guns. The mass of the aircraft increased to 3850 kg. The ReviC/12C gunsights were replaced with the newer ReviC/12D. Significant improvements were also made to the electromechanical undercarriage drives.

Fw 190 A-3: Production of the BMW 801D-2 reheated engine began in the spring of 1942. The aircraft outfitted with this engine were designated Fw 190 A-3. The new engine saw an increase in power up to 1,730 hp, made possible thanks to an increased compression ratio in the cylinders and an increased speed of both gears of supercharging. The newer engine also consumed the higher (96) octane C3 fuel instead of the 87-octane B4 fuel used by the older engine.

The armament of the standard A-3 remained the same, but some aircraft saw regular changes in their weapons loadout. The goal was not only to expand the operational capabilities of the FW 190 as a fighter, but also to adapt it to fulfill new requirements. Some modifications were not systematized and are known only from photographic evidence. The most well-known variant is the FW 190 A-3 which was equipped with an ETC 501 bomb rack, capable of carrying up to a 500 kg payload of bombs (1x500 kg, 2x250 kg or 4x50 kg via an ER 4 adapter) or a 300-liter drop tank. Some aircraft had their wing-mounted armaments removed, but this variant did not receive any special designation. In addition, 72 Fw 190 Aa-3 (auslaendisch - "international") were produced and sent to Turkey from October 1942 to March 1943. Majority of the export-version FW 190 were equipped with weapons loadouts similar to the A-1's: 4xMG 17 + 2xMGFF.

Delivery of the Fw 190A-4 variant began in the summer of 1942. This variant was outfitted with a FuG 16Z radio station and a radio antenna fixed on the keel. The A-4 series was equipped with a BMW 801D-2 engine adapted to the MW-50 water-methanol mixture injection system for a short-term increase in power up to 1,566 kW (2,100 hp), which gave an increase in speed up to 670 km / h (416 mph) at an altitude of 6,400 m (21,000 ft). The Fw 190A-4/Trop variant was equipped with filters that allowed for operation in the Mediterranean. It was also capable of carrying a 250 kg (551 lb.) bomb under the fuselage. The FW 190 A-4/R6 variant had no MW-50 mixture injector. This variant of the aircraft could carry two WGr.21 210-mm (8.27-inch) rocket launchers under the wings. The FW 190A-4 / U8 had the capability of carrying a 300-liter drop tank under each wing and a 500-kg bomb (1102 pounds) under the fuselage, but this came at the cost of having only two MG 151 guns outfitted.

The Fw 190 A-5 went into production in early 1943; It was equipped with a new engine mount, which allowed designers to move the engine about 15 cm (6 inches) forward. Variants for the Fw 190 A-5 included the Fw 190 A-5/U2 night fighter that came with exhaust flame dampers, two MG 151/20 autocannons, an ETC 501 bomb rack, and two 300-liter drop tanks. The Fw 190 A-5/U3 version was similar to the U2 and could carry a 500-kg (1102 lb.) bomb under the fuselage and two 115-kg (254 lb.) bombs under the wings. A recon fighter variant, the Fw 190 A-5 / U4, was equipped with two RB 12 cameras for reconnaissance operations. The Fw 190 A-5/U6 and the Fw 190 A-5/U8 long-range model were the fighter-bomber variants; the Fw 190 A-5/U11 was specialized for close air support missions and came equipped with a 30-mm MK 103 cannon under each wing; The Fw 190 A-5/U12 aircraft had a fixed loadout of two MG 151/20 cannons and two MG 17 machine guns, as well as two WB 151A gun pods each carrying a MG 151/20 cannon. The torpedo bomber variants were capable of carrying the LTF5b or LT 950 torpedoes and were designated as the Fw 190 A-5 / U14 and Fw 190 A-5 / U15 respectively. The MK 108 30-mm autocannon in the wing consoles was adopted as standard armament for the Fw 190 A-5 / U16 model.

The Fw 190 A-6, based off of the experimental Fw 190 A-5 / U10, was built in June 1943. This variant was unique in the fact that the aircraft carried MG 151/20E 20mm caliber autocannons instead of the standard MG FF. For this, the wings had to be modified in order to accommodate the heavier guns and larger ammunition containers. The wing structure was specially modified for the installation of 20 mm and 30 mm guns along with their ammunition. In addition, the A-6 aircraft also came equipped with a standard FuG 16ZE radio station (which was also present in some A-5 units) with an additional circular antenna for the radio compass. Mass production of the A-6 series aircraft began in July 1943 and lasted until November of the same year. The standard armament of the Fw 190 A-6 was two MG 14 machine guns and four MG 151/20E autocannons. Some units came with the ETC 501 bomb rack, which was typically used for carrying 300-liter drop tanks. Modifications made to A-6 series aircraft were marked with the code "Ruestsatz". A total 569 units were produced.

Production of the Fw 190 A-7 began in November 1943; the A-7 was a mass production version of the A-5/U9, which came equipped with two 13-mm MG 131 machine guns mounted under the engine cowlings, replacing the smaller caliber MG 17s. Due to this change, the upper part of the aircraft's engine cowling had characteristic bulges due to the larger size of the heavy machine guns. The ReviC/13D gunsight was also replaced with the newer Revi 16B, and the aircraft's undercarriage was fitted with reinforced wheel rims, which previously had been used only on F series aircraft.

The aircraft commonly came equipped with an ETC 501 bomb rack, allowing them to carry either bombs or a 300-liter drop tank. A small number of aircraft came with only a light holder for the drop tank, instead of the bomb rack. Some aircraft had their armament reduced to two MG 131 and two MG 151/20E; these aircraft were designed to conduct maneuvering dogfights with enemy fighters. Ruestsatz kits (R1, R2, R6) were provided for the standard configuration.

One A-7 aircraft (W.Nr. 380394) was used as a testbed for the new pair Doppelreiter drop tanks which had improved aerodynamics and a capacity of 270 liters. They were designed to be suspended to the upper side of the wing, which would reduce aerodynamic drag and only slightly reduce the speed of the aircraft. The aircraft's armament consisted of only two MG 151/20E autocannons. Work on the new tanks was carried out at the FGZ (ForschungsanstaltGrafZeppelin) research center and although the test results were favorable, the new tanks would not go into mass production, as this would have led to a temporary decline in production.

In January 1944, after the production of only 80 units of the Fw 190 A-7, further production was halted in favor of the new A-8 series.

The modification of the Fw 190 A-8 differed from the previous one primarily in terms of its configuration. The aircraft's airframe was adapted for the installation of the GM-1 engine boost system and an 85-liter fuel tank was mounted in the rear fuselage. If necessary, this tank could also be replaced with a larger 115-liter tank. The fuel tank shifted the aircraft's center of gravity to the tail and to compensate for this deficiency, the ETC 501 bomb rack was shifted 20 cm forward. Starting with the A-8 series aircraft, the bomb rack would become a standard component installed on all units. The FuG 16ZY radio station was installed on all units, and so in addition to the ring-shaped antenna of the radio compass, a Moran-type antenna appeared under the left wing. One particularly characteristic detail of the aircraft that distinguishes the A-8 from the A-7 is the pitot tube, which was transferred to the right wingtip from the middle part of the right wing's front edge. The Fw 190 A-8's armaments consisted of two MG 131 heavy machine guns and four MG 151 autocannons.



Figure 4: Fw 190 A-8

A total of 20,000 Focke-Wulf 190A were constructed.

AIRCRAFT

OVERVIEW



AIRCRAFT OVERVIEW

General Description

The Focke-Wulf FW 190 A-8 fighter aircraft is a single-seat, low-wing monoplane powered by a 2-row, 14-cylinder BMW 801D-2 engine with a two-speed supercharger, a reduction gear, and a 12-blade cooling fan. The aircraft boasts high speed and good maneuverability and can be utilized as a fighter-bomber equipped with aerial bombs or as a long-range fighter carrying a ventral fuel tank.

The powerplant consists of a BMW 801D-2 that delivers approximately 1,500 horsepower at 2,400 RPM. Maximum emergency power at level flight is 1,705 horsepower at 2,700 RPM.

The aircraft is equipped with a three-blade constant speed propeller with a diameter of 3.3 meters.

The Kommandogerät control unit monitors and automatically adjusts the propeller speed, boost, fuel mixture status, ignition delay and supercharger mode.

The fuselage consists of a Dural plating covering the monocoque frame. Located between the front and rear sections of the cabin are four spars and a horizontal partition that separates the cabin from the fuel tanks. The rear section of the fuselage is a conventional monocoque structure with light alloy frames.

The aircraft's radio equipment consists of the FuG 25a IFF (Identification Friend or Foe) system and the FuG 16ZY VHF communications and guidance system.

The wings comprise an all-metal construction: the main spar is a solid piece while the rear spar is divided by the fuselage.

The horizontal and vertical tail pieces are placed symmetrically on the tail section, and the ailerons are mounted on the outer consoles of the rear part of the wing. The landing flaps are located between the ailerons on the rear bottom surface of the wings.

The aircraft's elevator and ailerons are manipulated by the aircraft's control stick; the rudder - by foot pedals. The horizontal stabilizer and flaps operate electrically. The synchronous movement of the leading motors for the flaps is achieved by synchronic switches.

The armament consists of twin fixed synchronized 13 mm Rheinmetall-Borsig MG 131 machine guns, twin fixed synchronized Mauser MG 151/20E cannons mounted in the wing roots, and twin fixed Mauser MG 151/20E cannons mounted in the outer wing panels.

Specifications for the FW 190 A-8 are:

- Wingspan – 10.5 m.
- Wing surface area – 18.3 m².
- Overall length – 8.95 m.
- Aircraft height – 3.95 m.
- Empty weight - 3490 kg.
- Take-off weight - 4909 kg.

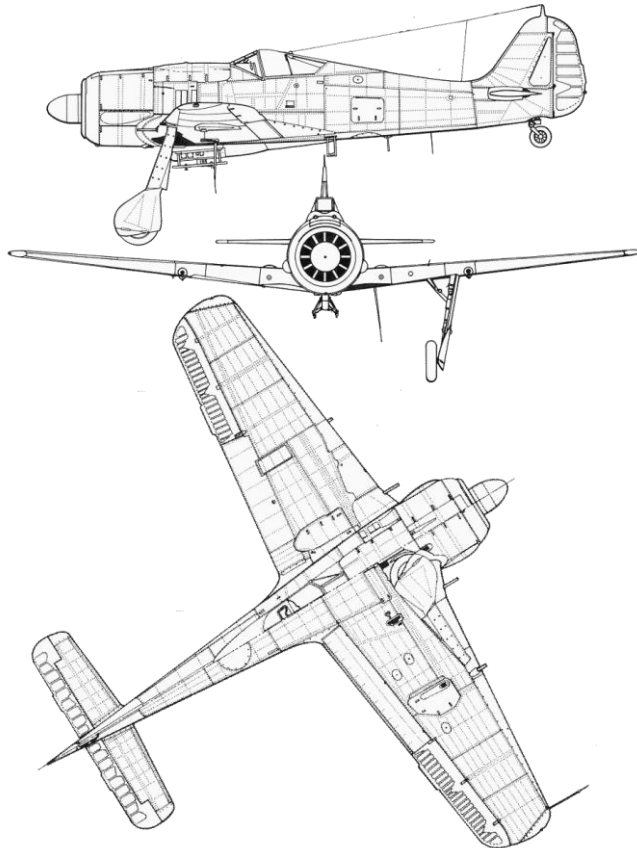


Figure 5: Fw 190 A-8 Three-View

Fw 190 A-8 Major Assembly Parts

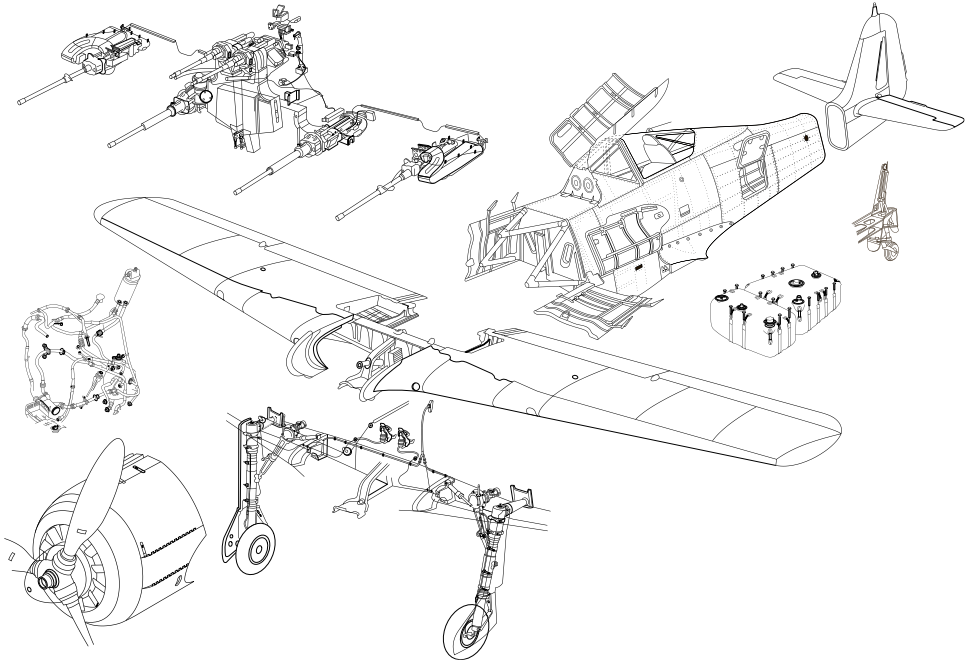


Figure 6: Fw 190 A-8 major assembly parts

Fuselage

The FW 190 A-8 has a monocoque fuselage with an all-metal Dural lining. The engine mount is located in the frontal section of the fuselage and follows the contours of the engine; the rear section of the fuselage ends in an oval bulkhead to which the tail assembly is attached. Structurally, the fuselage is divided into two main parts - the front, which runs from the fireproof frame to the eighth frame, and the rear, which runs from the eighth to the fourteenth frame.

The engine mount is fixed to the fireproof frame. The cockpit and main fuel tanks are located in the frontal section of the fuselage.

An equipment compartment is located in the rear section of the fuselage, which also houses a fabric partition that prevents engine exhaust gases from entering the pilot's cockpit.

The front part of the cabin has four spars located between the nose's fireproof partition and the rear frame. The rear part of the cockpit has a horizontal bulkhead separating it from the fuel tanks. The rear section of the fuselage is a monocoque construction which ends at the frame to which the tail section is attached.

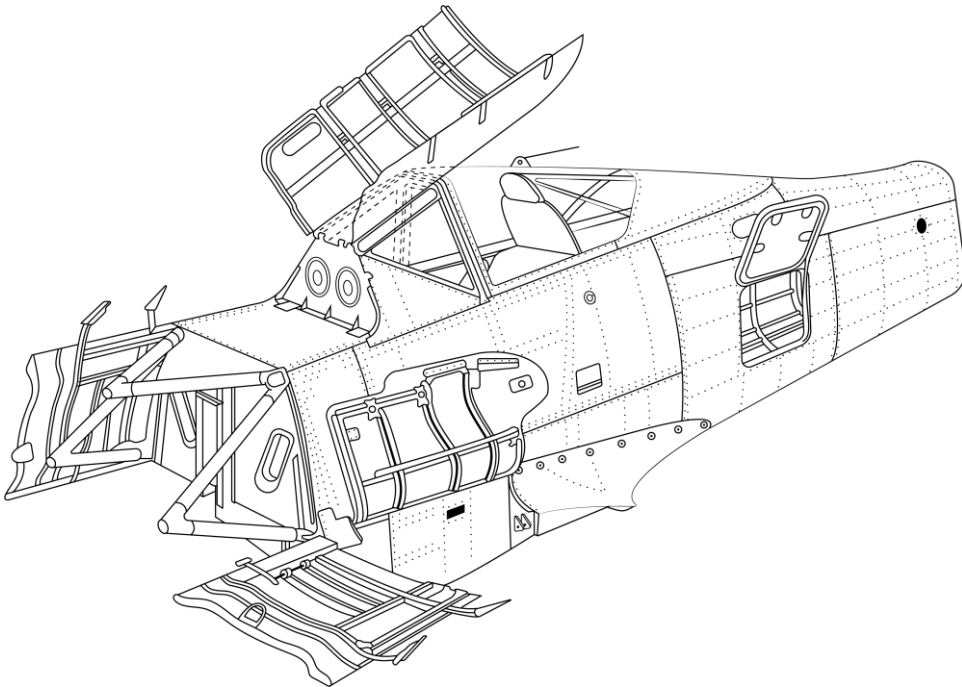


Figure 7: Fw 190 A-8 fuselage

Canopy

The Fw 190 A-8 cab has a longitudinally sliding plexiglass canopy on mounted on ball-bearing rollers. The frontal windshield unit consists of three separate bulletproof glass panels. The canopy framing also serves as a fixture point for the armament, gunsight, and instruments, and is also an attachment hatch for the fuselage-mounted armament. The aircraft's windshield is mounted in 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.

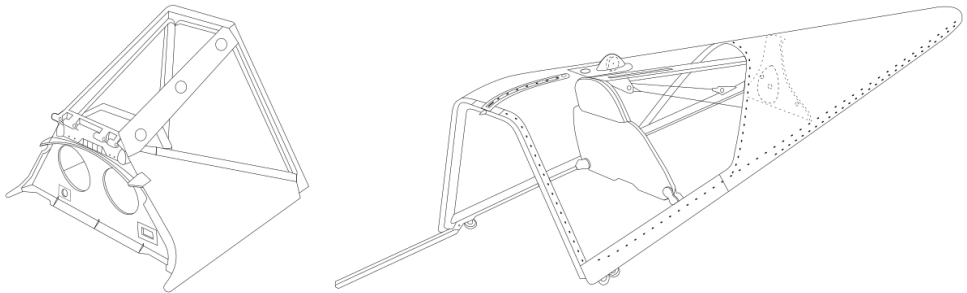


Figure 8: Fw 190 A-8 canopy

Many earlier aircraft designs featured canopies consisting of small glass or Perspex planes 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.

Both canopy types were used on the aircraft over the course of its service life. First production units shipped with the earlier flat-top canopy, while later production series used the improved bulged canopy design.

Armor

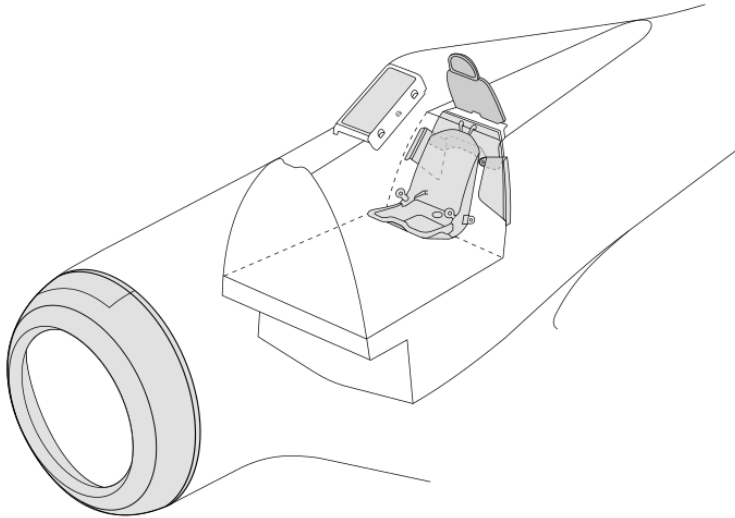


Figure 9: Fw 190 A-8 armored elements

The aircraft's armor protects the pilot from gunfire coming from all sides. Armored components include the seat headrest, seat back, as well as a set of armor plating around the cockpit walls.

An armored ring protects both the front part of the engine cowling and the oil tank together with the oil cooler assembly.

Wings

The Fw 190 A-8 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 main spar also holds the mounting points for the wing-mounted guns and the landing gear.

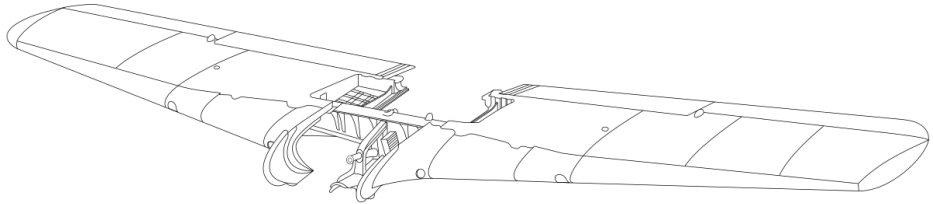


Figure 10: Fw 190 A-8 wings

Landing Gear

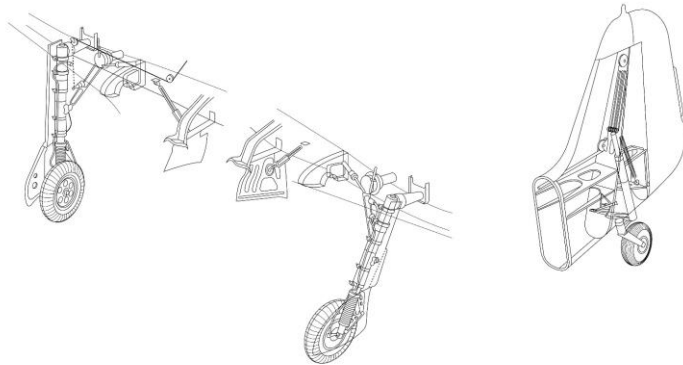


Figure 11: Fw 190 A-8 landing gear

The undercarriage consists of two shock struts with a scissors unit connecting the upper and lower shock strut members to absorb torque stresses. The main undercarriage struts are attached directly to the main spar.

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

The undercarriage folds into the wing when retracted. Both the struts and the wheels are kept in place in a compartment located in front of the main spar inside the wing.

Both main gear members are secured in place by powerful locking hooks when retracted.

The tail wheel is partially retractable. It can rotate 360 degrees or be fixed in place by pulling back on the control stick.

The right landing gear has a cable connection to the tail wheel, which causes the tail wheel to retract in sync with the main struts.

When retracting the undercarriage, the tail wheel is fixed in the upper position by a cable connected to the right main strut. When retracted, the lower half of the tailwheel remains exposed. In case of emergencies, it can be used as a tail skid.

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 position of the main landing gear is monitored both by instrument (located inside the cockpit) and visually, with the help of a pin indicator.

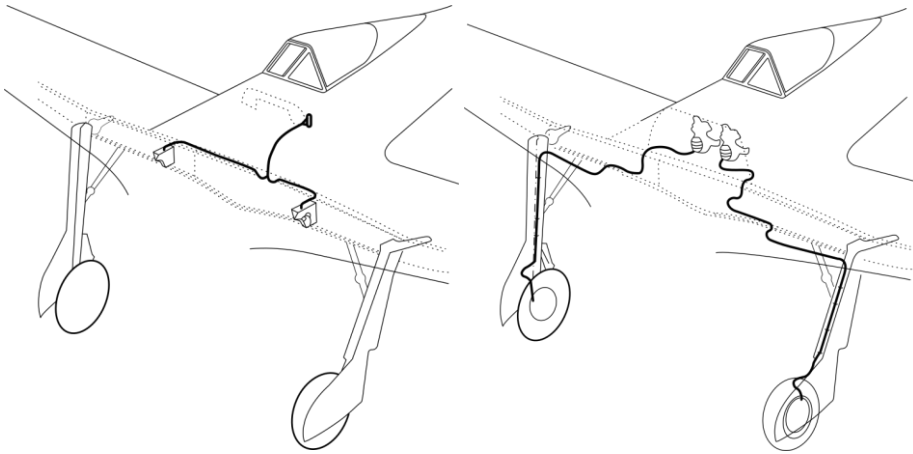


Figure 12: Fw 190 A-8 brake system

Hydraulic brake systems, each with their own hydraulic pump and brake line, are installed on each main strut wheel of the aircraft's undercarriage. Brake pressure can be applied individually to each wheel.

The hydraulic fluid tank for the control unit has a capacity of 5.6 liters.

The system is conventionally operated via the rudder pedals.

Flight Controls

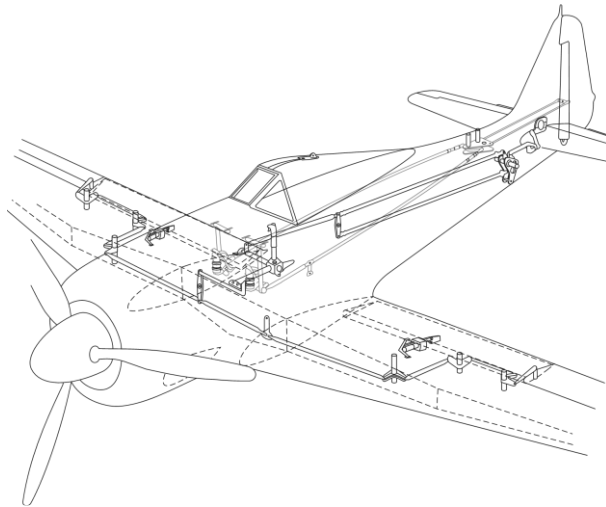


Figure 13: Fw 190 A-8 flight control system

The Fw 190 A-8 has a conventional control scheme with surfaces that include a vertical stabilizer, rudder, horizontal stabilizer, two elevators, two ailerons, and flaps.

As the aircraft 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 surfaces are light-alloyed with a fabric lining and, with the exception of the leading edges, are designed to provide aerodynamic and weight compensation.

The metallic load-bearing skin of the tail unit is integrated into the fuselage design.

The vertical tail fin consists of the fin itself and the rudder mechanism.

The vertical stabilizer is of an all-metal construction and is attached to the tail section of the fuselage. Located inside it is a diagonal spar to which the horizontal stabilizer and the tail wheel unit are attached.

The horizontal tailfin is of a symmetrical, trapezoidal shape, with rounded tips.

The horizontal stabilizer can be adjusted in flight to compensate for aircraft deviation. Adjustments are made by means of an electric motor placed inside the vertical stabilizer. It can be set to deflect within a range of $+4 \text{ } ^\circ$ to $-1 \text{ } ^\circ$ while in-flight.

The elevator consists of interchangeable halves attached to the stabilizer on the hinges and has aerodynamic and weight compensation.

The rudder has a similar construction to the elevator and is attached to the vertical stabilizer at three points.

The rudder has a metal frame with a spar and seven ribs and a fabric covering. Owing to the good longitudinal stability of the aircraft in flight, it can only be trimmed 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.

The control system uses differential bell cranks that transfer control movement near the center position into finer control surface movement.

The flight stick can be moved forwards and backwards in conventional fashion to control the elevator. It can be moved 20.5 degrees forward and 21.5 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.

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 stabilizer can be set to deflect at an angle of +4 to -1 degrees. The actual position of the stabilizer is shown via the corresponding indicator.

Engine

The Fw 190 A-8 is equipped with a 14-cylinder two-row radial BMW 801D-2 engine with a two-speed supercharger, a gearbox and a 12-blade cooling fan. The engine drives a three-bladed constant speed propeller.

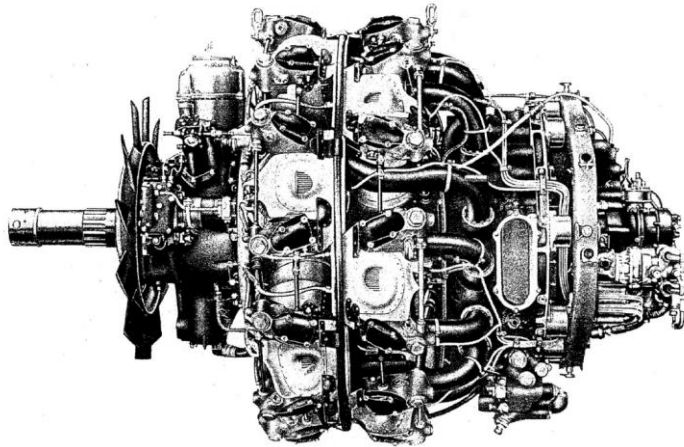


Figure 14: BMW 801D-2 engine

Like most other aircraft engines of German make, the BMD 810D-2 was equipped with a direct fuel injection system.

Ignition System

The inertia starter used to start the engine can be switched on manually or electrically.

The starter shaft is located in the equipment compartment on the left side of the engine. The electric starter switch is located on the cockpit right-side panel.

During manual startup the starter brushes are removed by using the handle located on the bottom left of the dashboard.

A Bosch dual magneto system mounted in the nose of the engine compartment is responsible for ignition.

Both electrical circuits are isolated from each other; one circuit is responsible for the spark plugs located near the intake, while the other is for the spark plugs located near the exhaust valves.

Each spark plug operates individually. The ignition delays are monitored by a control instrument in the cockpit.

Engine Supercharger

The BMW 801D-2 engine is equipped with a single-stage two-speed supercharger.

A fan located in front of the engine supplies the air which enters the filtered air intakes through two channels on both sides of the fuselage fairing.

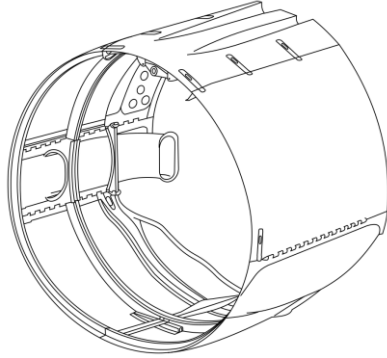


Figure 15: Engine cowling with internal air intake channels

Kommandogerät Engine Control Unit

The Kommandogerät 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 Kommandogerät takes the majority of the workload away. The pilot simply has to move the throttle lever to set the desired manifold pressure. The Kommandogerät 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".

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

Propeller

The FW 190 A-8 is equipped with a VDM 9-12153 B three-blade constant speed propeller with metal blades. The diameter of the propeller is 3,300 mm. (10'10").

The Kommandogerät system automatically adjusts the propeller blade angle while in flight but can also be adjusted manually in case of system failure or whenever the need arises.

The control device used to set the propeller blade angle is located in the front left section of the engine.

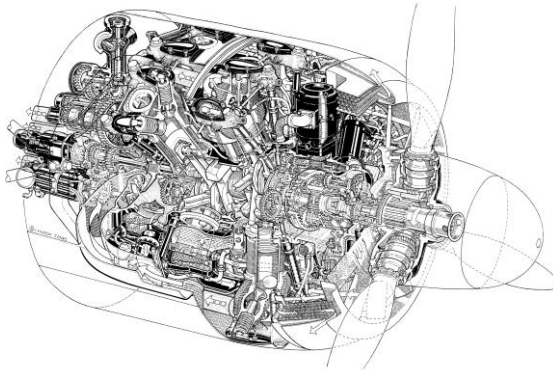


Figure 16: BMW 801D-2 powerplant assembly

Fuel System

The Fw 190 A-8 has two main fuel tanks: front (Vorn) and rear (Hinten), both conveniently located below the cockpit floor underneath the pilot's seat.

The fuel tanks are self-sealing, with a total capacity of 524 liters (388 kg): 232 liters (172 kg) for the front tank and 292 liters (216 kg) for the rear tank.

A 3-liter tank for the primer pump is built into the rear fuel tank.

A drop tank with a capacity of 300 liters can be installed under the fuselage on the ETC 501 rack.

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.

A fuel tank with a capacity of 115 liters or an 85-liter tank containing the GM-1 mixture may also be installed behind the eighth bulkhead.

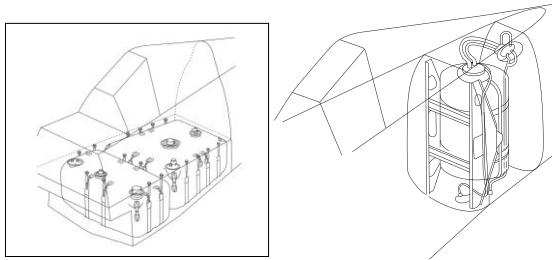


Figure 17: Front and rear fuel tanks

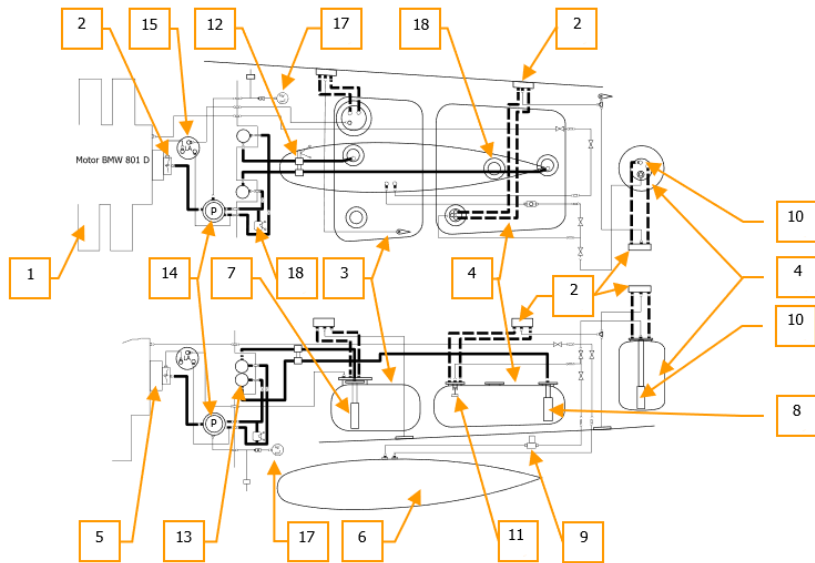


Figure 18: Fuel system diagram

1. BMW 801D-2 engine
2. Filler necks
3. Forward tank (232 l)
4. Aft tank (292 l)
5. Auxiliary fuselage tank (115 l)
6. Auxiliary jettisonable tank
7. Forward tank feeder pump
8. Aft tank feeder pump
9. Auxiliary jettisonable tank feeder pump
10. Auxiliary fuselage tank feeder pump
11. Shutter valve (shuts at 240 l)
12. Fuel selector
13. Fuel filter
14. Booster pump
15. Vapor separator
16. Fuel pressure gauge
17. Fuel line shutoff valve
18. Primer fuel canister (3 l)

Engine Pre-fill System

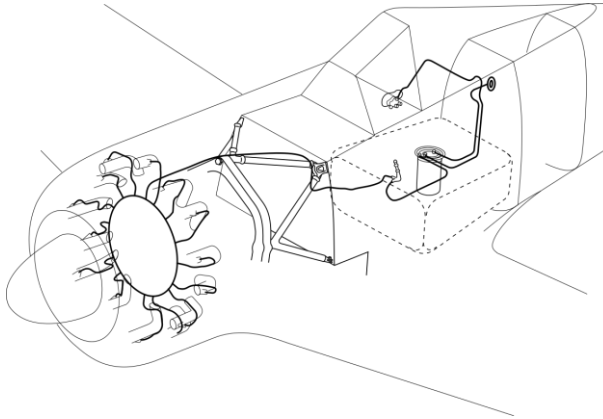


Figure 19: Pre-fill system

The pre-fill system is designed to prepare the engine for startup by means of spraying fuel into all 14 cylinders of the engine through the supercharger tubes, and subsequently igniting this fuel.

The system is comprised of the AP 20 SUM pump and a 3-liter tank.

Oil System

The lubrication system is integrated with the engine and is not included in the airframe design, with the exception of the pressure and oil temperature indicators. The radiator and the 58-liter oil tank (effective capacity - 55 liters) are ring-shaped and are located in the front of the engine under the armored casing.

All elements are connected to the oil filter through a pipe system. The oil system allows for the filling of hot oil or gasoline-diluted oil, which facilitates cold engine starting. The forced oil circulation is facilitated by the oil pump, while the oil temperature is automatically controlled by a thermostat.

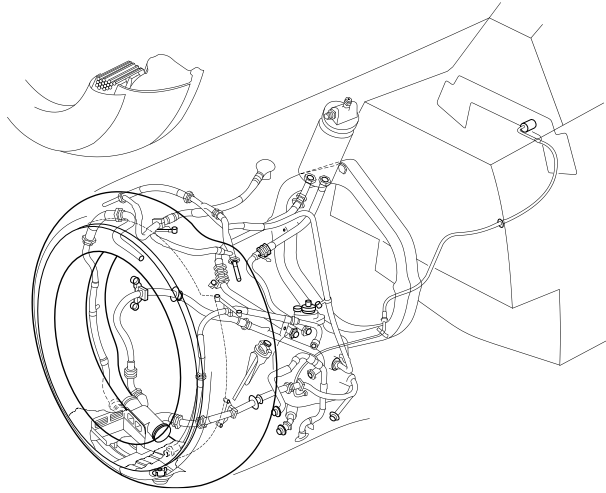


Figure 20: Fw 190 A-8 oil system

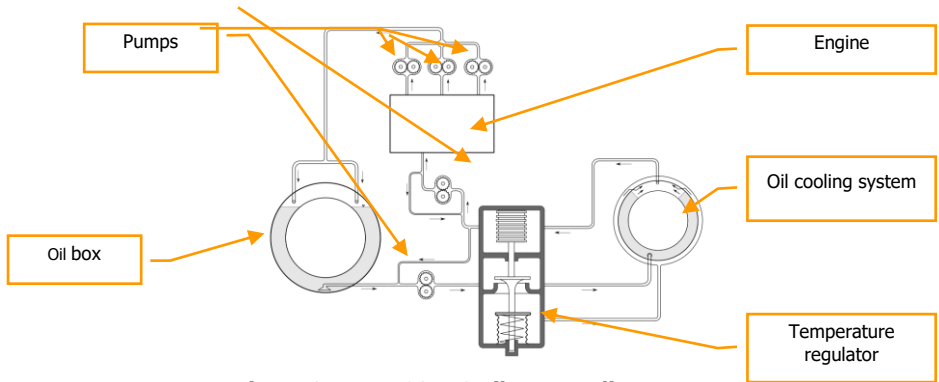


Figure 21: Fw 190 A-8 oil system diagram

Electrical System

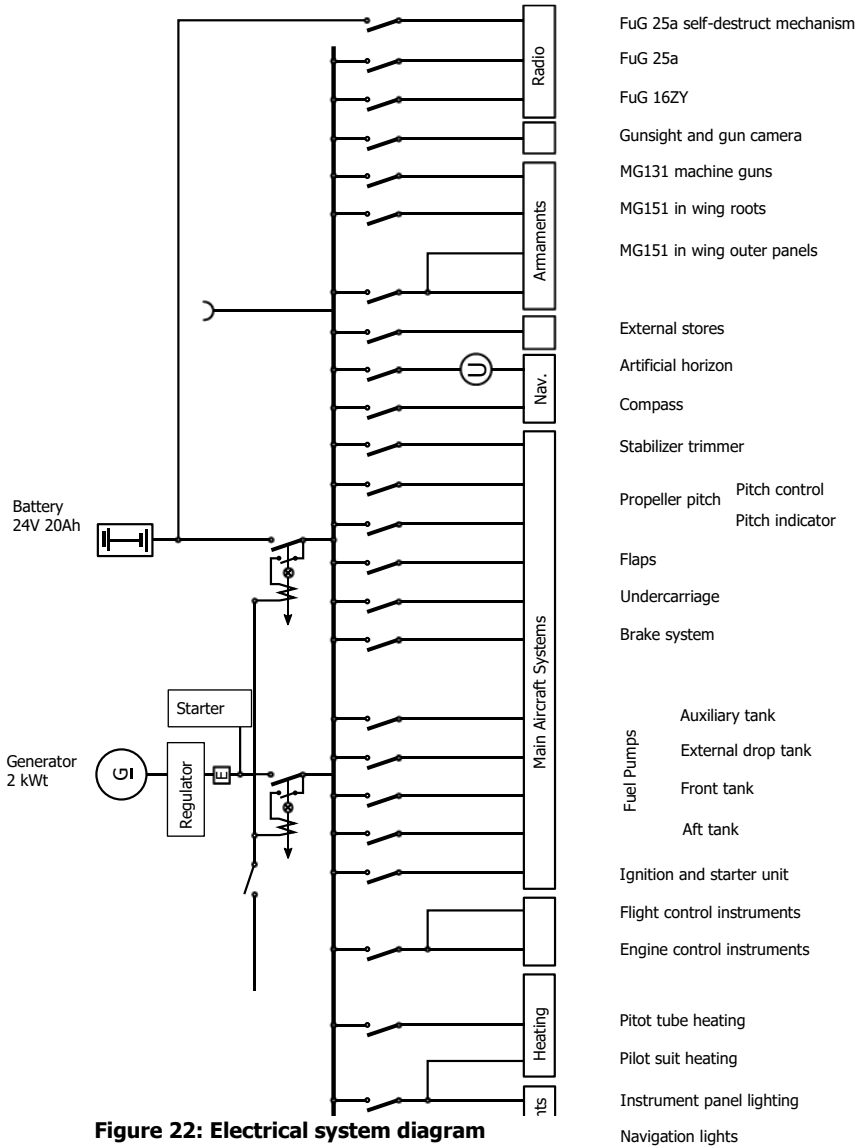


Figure 22: Electrical system diagram

Oxygen System

The oxygen supply system consists of 9 two-liter spherical oxygen tanks located in the tail of the aircraft; high-pressure lines with a pressure gauge; a flow valve with an oxygen supply indicator; and a regulator with a hose and a mask. The bottles are split into three separate systems as an additional safety measure.

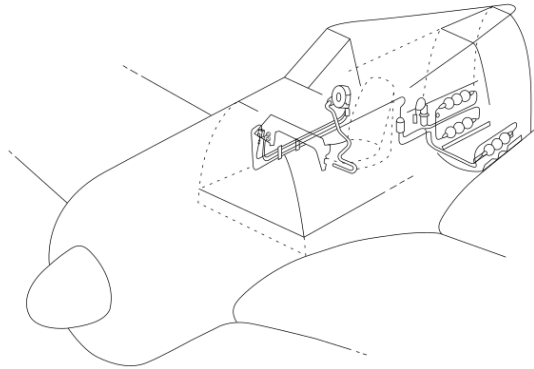


Figure 23: Oxygen system diagram

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.

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, IFF (in conjunction with the FuG 25a), and DF homing. The set operates in the frequency range between 38.5 and 42.5 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 located in the cockpit.

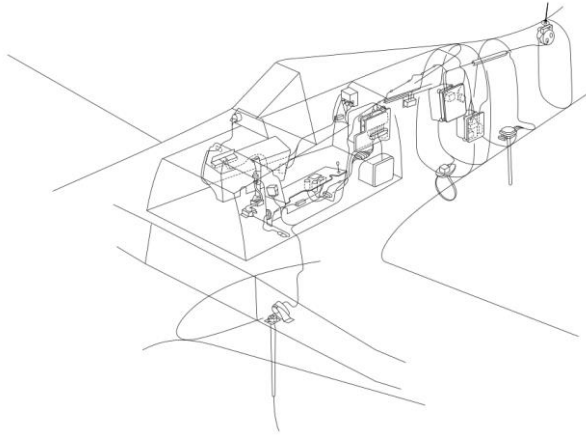


Figure 24: Radio equipment diagram

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.

Armament

The Fw 190 A-8's basic weapon loadout consists of two Rheinmetall-Borsig 13mm MG 131 machine guns installed under the engine cowling with 475 rounds per gun, two synchronized Mauser MG 151/20E autocannons installed in the wing roots with 250 rounds per gun, and an additional two Mauser MG 151/20E installed in the wing outer panels with 125 rounds per gun.

The weapons located above the engine and in the wing roots are synchronized in order to fire through the propeller blades without causing the aircraft any damage. The MG 151/20Es located in the wing outer panels are not outfitted with any sort of synchronization mechanism.

The machineguns by default were synced in parallel; the inner and outer cannons were set to converge at a distance of 600m and 400m, respectively.

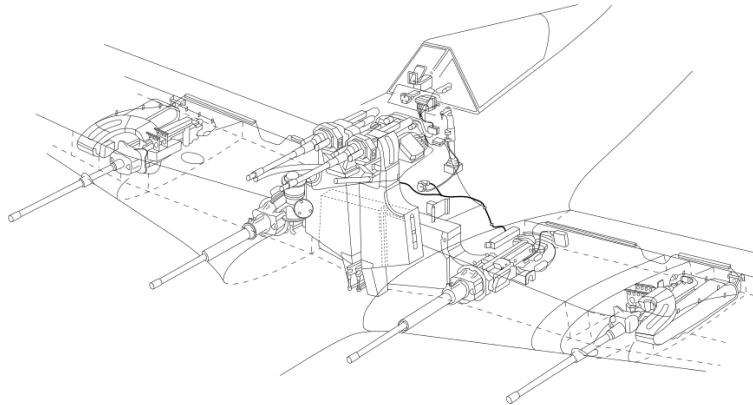


Figure 25: Fw 190 A-8 machine gun and cannon armaments

In addition to the above, the Fw 190 A-8 also came with the ETC 501 belly-mounted bomb rack that allowed it to carry a SC500 500kg bomb, or WR 21 unguided rockets on wing-mounted racks.

Gunsight

For weapons targeting, the Fw 190 A-8 came equipped with the standard Revi 16B gunsight that was installed on the vast majority of Luftwaffe combat aircraft.

The Revi 16B is a sight designed for use with both synchronized and unsynchronized aircraft weaponry and is equipped with both a built-in dimming rheostat for adjusting the crosshair brightness and a night filter.

Reflector sights work by projecting an image of the targeting reticle onto the reflector glass such that the reticle appears at infinity, providing a fixed aiming point relative to the weapon's line of fire.

When using the Revi 16B in combat, the pilot must independently make corrections for the target lead and distance, G-loads, and other parameters necessary for accurate fire.

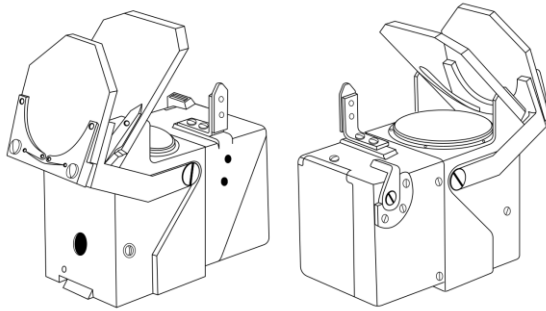


Figure 26: Revi 16B gunsight

Photographic Equipment

Focke-Wulf fighters are equipped with a BSK 16 (Ballistische Schußmeßkammer) aerial gun camera. The equipment is mounted on an adjustable platform in the front edge of the left wing panel and connected to the aircraft electrical circuit. The camera lens is located at the front edge of the wing and is covered with a glass window fairing. The transparent glass panel can be replaced with a color photo filter.

The BSK 16 is a 16 mm film camera. The length of the tape is 15 meters, and the tape is driven by an electric motor inside the camera. The motor is equipped with a switch that limits the movement of the belt to 3.75-mm sections, which allows the pilot to make 4 fragments from 43 to 57 seconds each. The camera is activated by pulling the trigger on the aircraft's control stick, as well as by pressing a button on the throttle, allowing for video recording without having to open fire.

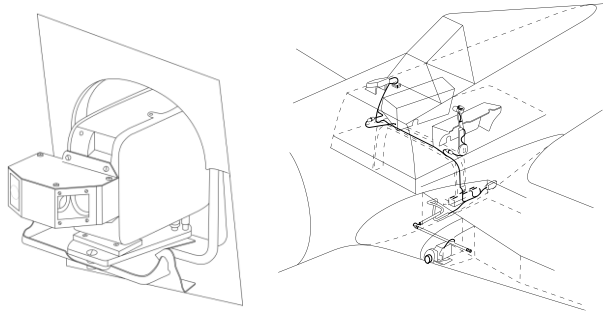


Figure 27: BSK 16 aerial gun camera

COCKPIT



COCKPIT

The cockpit in the Fw 190 A-8 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 28: Fw 190 A-8 cockpit overview

The cockpit is divided into three main areas: the front dash that includes the instrument panel, fuel tank controls, radiator ventilation flaps, and the Revi 16B gunsight; the left-hand side that includes engine, undercarriage, and radio equipment controls; and the right-hand side that includes canopy and oxygen controls, weapon controls, and electrical system breakers.

FRONT DASHBOARD

The aircraft's front dashboard includes the instrument panel and the Revi 16B gunsight.



Figure 29: Fw 190 A-8 upper front dash

1. Revi 16B gunsight
2. SZKK 4 with ammo indicators
3. MG 131 armed lights
4. Artificial horizon
5. Airspeed indicator
6. Altimeter
7. Control stick
8. AFN-2 homing indicator
9. Rate of climb/descent indicator
10. Repeater compass
11. Supercharger pressure gauge
12. Tachometer
13. Oxygen pressure gauge
14. Oxygen flow indicator
15. Oxygen flow valve

16. Engine ventilation flap positioning lever

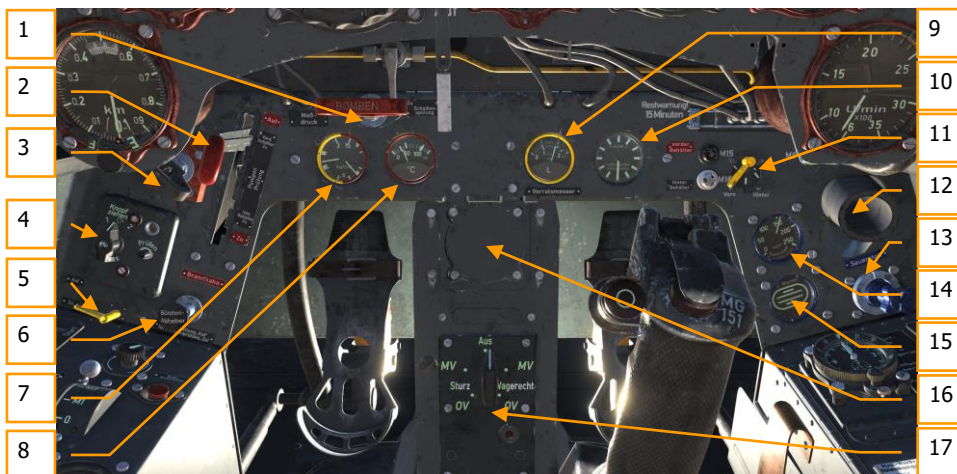


Figure 30: Fw 190 A-8 lower front dash

1. Manual jettison handle for under fuselage stores
2. Fuel tank selector lever
3. Undercarriage manual extension handle
4. IFF control unit (FuG 25a)
5. Fuel shut-off valve
6. Engine starter brushes withdrawal button
7. Fuel and oil pressure gauge
8. Oil temperature gauge
9. Fuel contents gauge
10. Propeller pitch indicator
11. Fuel gauge selector switch
12. Flare pistol holder
13. Oxygen flow valve
14. Oxygen pressure gauge
15. Oxygen flow indicator
16. 21 cm rocket control unit (not implemented)
17. Bomb fusing selector unit

FRONT DASH: INSTRUMENTS AND CONTROL DEVICES

This chapter will provide a detailed overview of the instruments and control units located on the front dash of the aircraft.

Revi 16B gunsight



Figure 31: Revi 16B gunsight

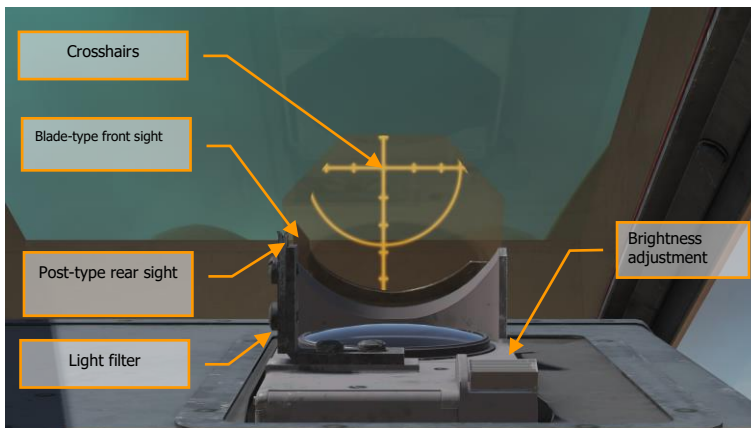


Figure 32: Revi 16B components

Instrument panel

Ammunition Indicators

The SZKK 4 shows the ammo stores for each of the four guns. The four vertical banks in the SZKK 4 show the state of the MG 151s in the following order: outer-left, inner-left, inner-right, outer-right.

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.

Notches provided to the side of each indicator show the amount of rounds in the ammo store for each weapon. The white bar portion signifies ammunition remaining; black bar portion signifies expended ammunition.

Just above the SZKK 4 ammunition indicators are signal lights directly connected to the breechblock of each individual MG 151, starting with the outer-left gun and ending with the outer-right gun. The signal lights to the left of the SZKK 4 (shown below) are connected to the MG 131 breechblocks.

If the indicator is black, the breechblock is closed. If it is lit up, 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.

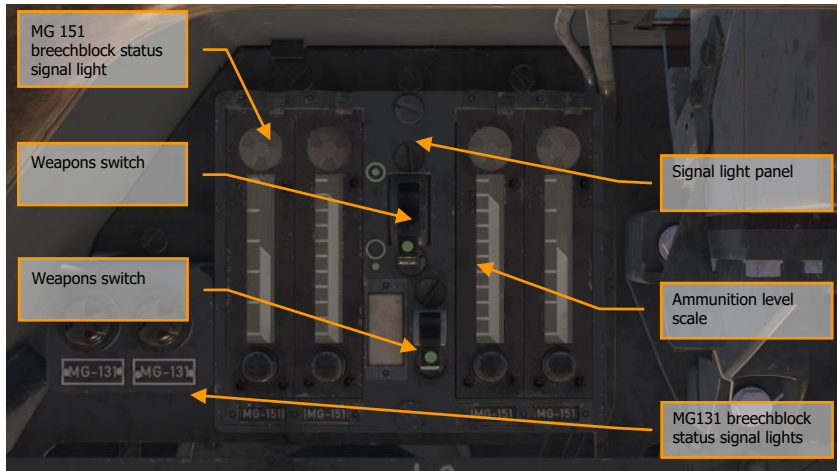


Figure 33: SZKK 4 with four separate ammunition indicators

AFN-2 Homing Indicator

The AFN-2 radio navigator is part of the aircraft's FuG 16ZY radio equipment set.



Figure 34: AFN-2 homing indicator

This ubiquitous device was installed in most German aircraft of WWII. 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.

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 A-8. 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.

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 35: Attitude indicator

Airspeed Indicator

The Indicated Airspeed (IAS) gauge is graduated from 0 to 700 km/h and has additional markers for airspeeds up to 900 km/h.



Figure 36: Airspeed indicator

The aircraft's 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.

Artificial Horizon / Turn and 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.

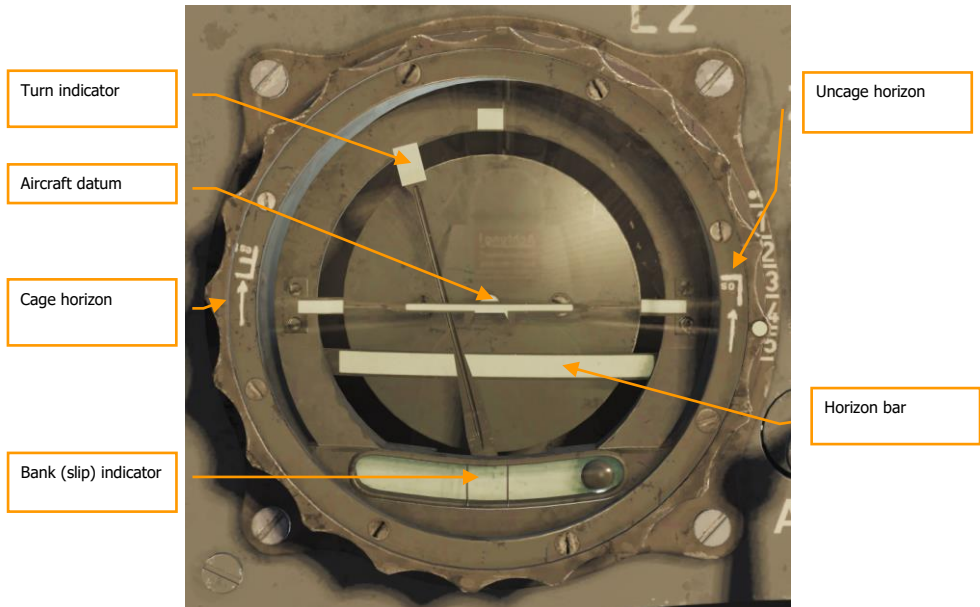


Figure 37: Artificial horizon

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 sideslip 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 38: 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.

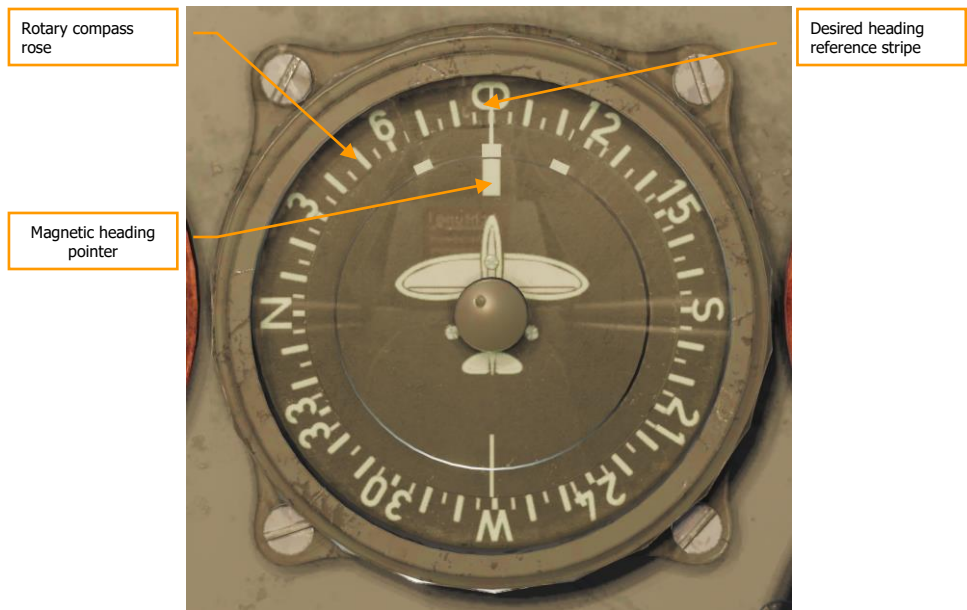


Figure 39: Repeater compass

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

This instrument monitors the pressure in the engine supercharger.

The gauge is graduated from 0.6 to 1.8 atmospheres absolute. The scale is 0.1 ata per large notch throughout.



Figure 40: Supercharger pressure gauge

This instrument is one of the most fundamental instruments monitoring engine operation.

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.

Tachometer

The tachometer provides remote indication of engine speed.

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.



Figure 41: Tachometer

Engine Ventilation Flap Manual Control Lever

The engine ventilation flap manual control lever is used to control the engine cowl flaps.

The lever is located on the dashboard between the artificial horizon and the vertical speed indicator and is equipped with a flap position indicator.

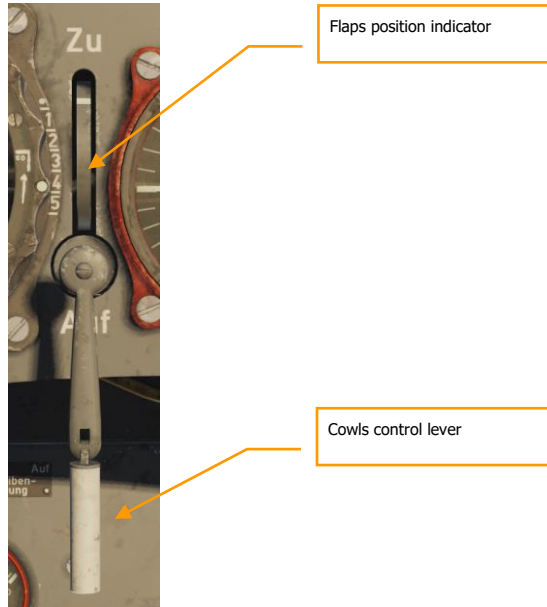


Figure 42: Engine ventilation flap manual control lever

Putting this lever into the "Auf" position, will manually open the cooling cowls of the engine. Putting this lever into the "Zu" position, will close the cooling cowls.

IFF (Identification Friend or Foe) Transponder

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.

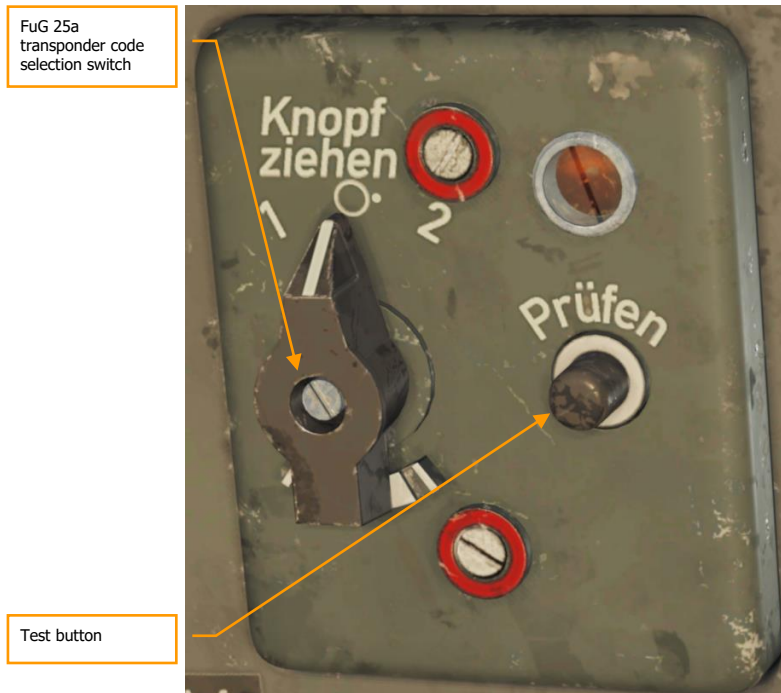


Figure 43: FuG 25a IFF transponder

Stop Cock Control Lever

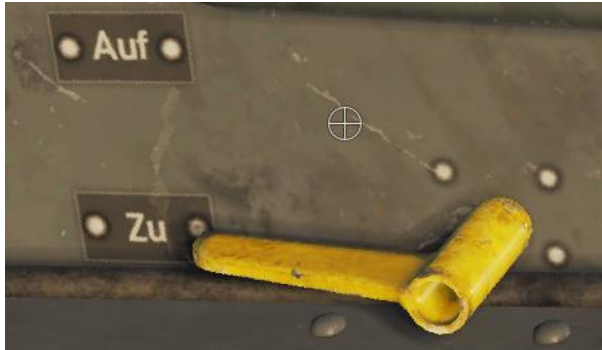


Figure 44: Stop cock control lever

For normal operation select "Auf". For test pumping select "Zu".

The lever is spring-loaded in the open position. When checking the pumps, the lever should be held in the test pumping position.

Engine Starter Brushes Withdrawal Button

This device is used during manual engine startup without the use of electrical starters.



Figure 45: Engine starter brushes withdrawal button

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.

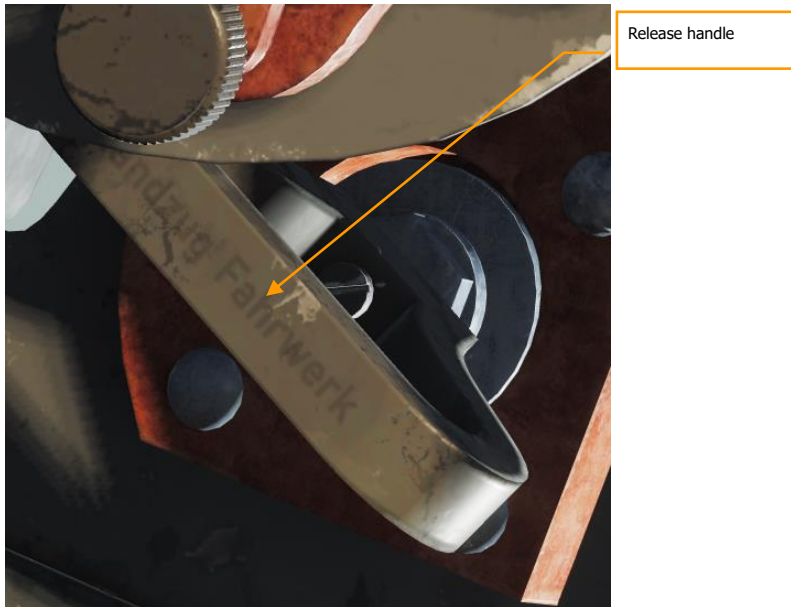


Figure 46: Landing gear lever manual release handle

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. Has four possible settings:

- "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.

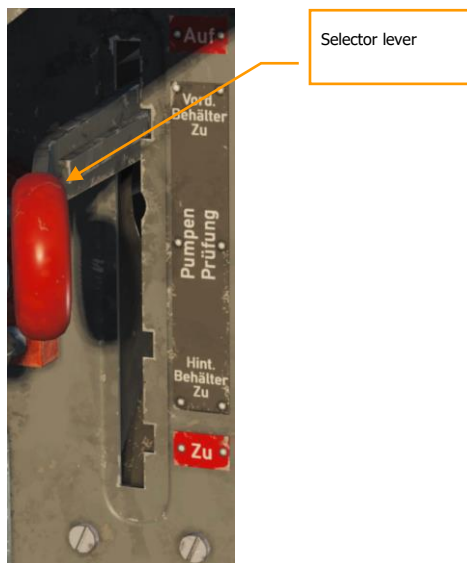


Figure 47: Fuel tank selector lever

Setting the fuel selector to the "Auf" position, opens up the shut-off valves of the main lines of both fuselage tanks. This ensures fuel flow to the engine pump. The engine pump pumps more fuel than is required for normal operation. The excess fuel is returned to the front tank via the drain line, thus ensuring fuel consumption only from the aft tank until it is fully depleted. When the pump begins to receive insufficient fuel, the front tank valve opens.

If there are additional fuel tanks (auxiliary fuselage and/or external drop tank), the fuel from them enters the rear fuel tank via two lines. The lines of the additional tanks are combined into an auxiliary fuel line through a T-shaped connection or T-joint. In front of the T-joint, non-return valves are installed to prevent fuel from flowing from one additional tank to another. Also, in the absence of fuel in additional tanks, these valves prevent the leakage of fuel from the main tanks.

Fuel transfer from the additional tanks is carried out only when the remaining fuel in the aft tank is 240 liters. The auxiliary line restrictor valve is connected with the fuel level sensor in the aft tank.

When the amount of fuel remaining in the aft tank is greater than 240 liters, fuel from the aft tank is fed to the engine pump. At the same time, the restrictor valve of the auxiliary line prevents the flow of fuel from the additional tanks.

When the fuel level in the aft tank reaches exactly 240 liters, the restrictor valve opens up the auxiliary line. The additional tanks continue to feed the aft tank until they are fully depleted. The additional tanks are not equipped with any fuel gauge sensors, and so the only way to tell that they have been fully depleted is when the aft tank's fuel level begins to drop below 240 liters.

When flying with drop tanks, drop tank fuel should be used first. 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.

Emergency Fuselage and Wings Load Release

Pulling this handle will immediately jettison any load (drop tanks or bombs) attached to the underside of the fuselage.



Figure 48: Emergency fuselage and wing load release handle

Engine Cold Start Lever / Windscreen Washer (not implemented)



Figure 49: Engine cold start lever / windscreen washer

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 50: 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 triangle-shaped markers indicate normal operating range for pressure.

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 .

Oil Temperature Gauge

This instrument 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 $110 - 130^{\circ}\text{C}$.



Figure 51: Oil temperature gauge

Fuel Contents Gauge

The fuel contents gauge displays the contents of the forward or the aft fuel tank depending on the position of the selector switch to the right of it.



Figure 52: Fuel remaining gauge

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. The lower gauge is to be used for the forward "Vorn" fuel tank.

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.

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.



Figure 53: Fuel warning lights (left) and fuel gauge selector switch (right)

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.

When using a drop tank, this selector switch must be set to "Hinten".

When the fuel gauge shows fuel consumption from the rear tank, the drop tank is empty and can be jettisoned.

Propeller Pitch Indicator

This instrument displays the position of the propeller blades. The hands of the device are like the hands of a clock: the 6:00 position corresponds to 100% (fine) pitch, and 12:30 - 0% (coarse) pitch.

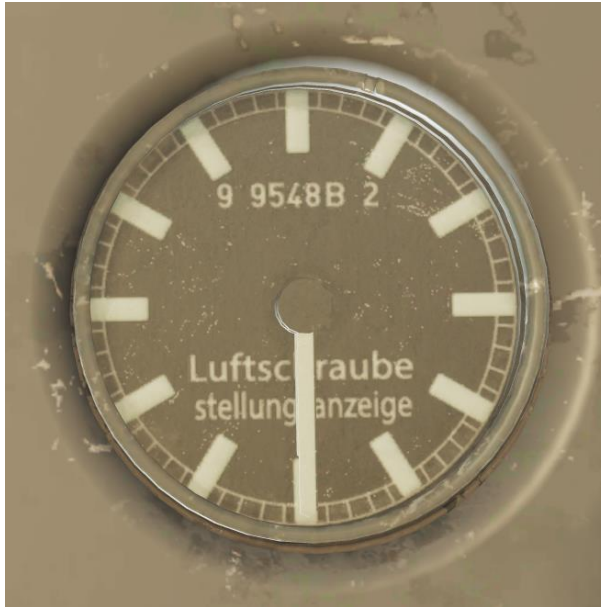


Figure 54: Propeller pitch indicator

The instrument readings and their corresponding level of propeller pitch are shown in the table below:

| Indicator | Pitch | Indicator | Pitch | Indicator | Pitch |
|-----------|-------------|-----------|------------|-----------|------------|
| 6:00 | 100% | 6:19 | 95% | 6:39 | 90% |
| 6:58 | 85% | 7:18 | 80% | 7:37 | 75% |
| 7:57 | 70% | 8:16 | 65% | 8:36 | 60% |
| 8:55 | 55% | 9:15 | 50% | 9:34 | 45% |
| 9:54 | 40% | 10:13 | 35% | 10:33 | 30% |
| 10:52 | 25% | 11:12 | 20% | 11:31 | 15% |
| 11:51 | 10% | 12:10 | 5% | 12:30 | 0% |

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 55: Oxygen flow indicator

Oxygen Pressure Gauge

The oxygen pressure gauge is located on the bottom right corner of the instrument panel and indicates pressure in the oxygen system.



Figure 56: Oxygen pressure gauge

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.

Oxygen Flow Valve

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



Figure 57: Oxygen flow valve

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.

Emergency Oxygen System Button

Under certain flight conditions, especially at altitudes of 4,000 meters upward, oxygen deprivation may occur unnoticed.

It is recommended to immediately switch on the emergency oxygen system at the first signs of breathing difficulty. To do this, press the oxygen emergency knob several times with the right elbow for short durations.



Figure 58: Emergency oxygen button

Weapons Console

The Zünderschaltkasten 244 weapons console found on the Fw 190 A-8 is a standard-issue device used in many Luftwaffe combat aircraft.

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 **"Wagerecht"** 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.

The switch should be set to the proper attack profile in advance before the bombing run.



Figure 59: Weapons console

Left Side Panel

The control devices for the engine and aircraft main systems are concentrated on the left-side control panel.

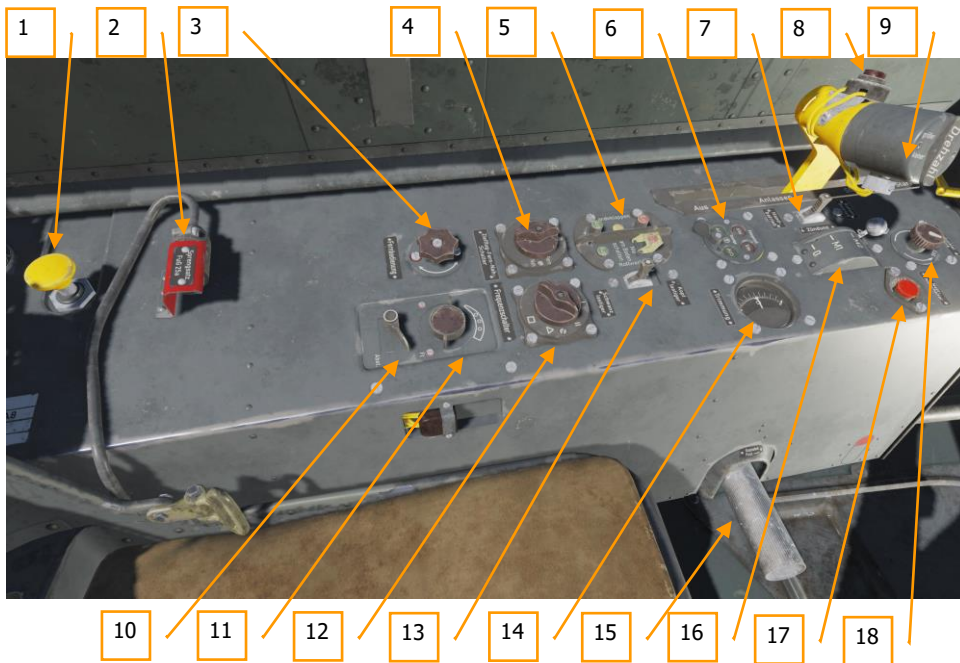


Figure 60: Fw 190 A-8 left side control panel

1. Primer fuel pump handle
2. Headset cord attachment point
3. FuG 16ZY receiver fine tuning
4. FuG 16ZY homing range switch
5. Undercarriage and landing flap actuation buttons
6. Undercarriage position indicators
7. Kommandogerät Auto / Manual mode switch
8. Push-to-talk button
9. Throttle lever with thumb-actuated propeller pitch control

10. FuG 16ZY FT (communications) and ABST (homing) switch
11. Headset volume control
12. FuG 16ZY frequency selector
13. Horizontal stabilizer trim switch
14. Horizontal stabilizer trim indicator
15. Throttle friction knob
16. Ignition (magneto) selector switch
17. Electric system kill-switch
18. Instrument panel lighting control

Throttle Lever

The Fw 190 A-8 is equipped with a revolutionary Kommandogerät device, an early computer that greatly reduces pilot workload. Taking nothing but throttle and barometric conditions as input, the Kommandogerät sets the optimal magneto timing, prop pitch, mixture, and engine RPM.

The throttle lever in the Fw 190 A-8 does not merely adjust the manifold pressure. Moving the lever influences nearly all engine and propeller parameters.

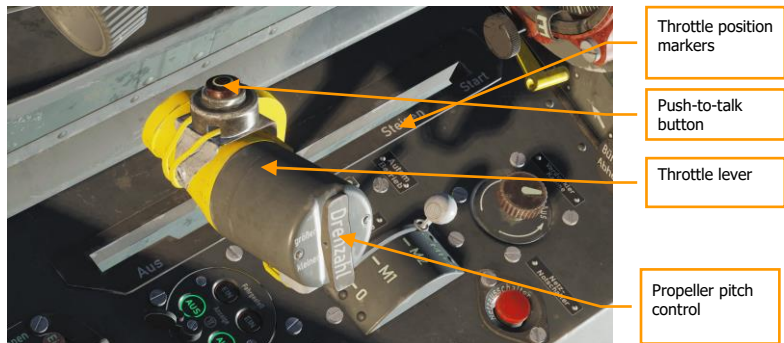


Figure 61: Throttle lever

The throttle 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 the engine settings 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.

The control crank on the flat end of the throttle lever controls propeller pitch. "Größer" increases pitch, "Kleiner" decreases it.

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).

Magneto selector switch

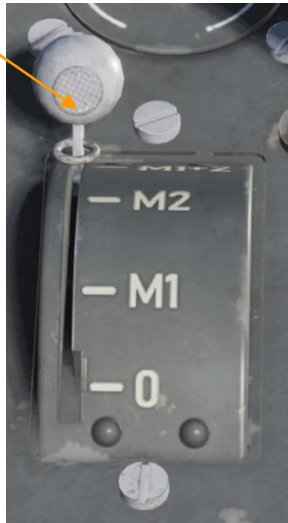


Figure 62: Magneto selector switch

Kommandogerät Mode Selector Switch

The switch puts the Kommandogerät engine control device in the pilot's desired mode. The upper position sets it to automatic control, the lower position to manual.



Figure 63: Kommandogerät mode selector switch

Landing Gear Indicators

This indicator displays the status of the main gear legs (left and right) in either the deployed or retracted states.



Figure 64: Landing gear indicator

- Red lights mean the undercarriage is retracted.
- Green lights mean the undercarriage is deployed.

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.

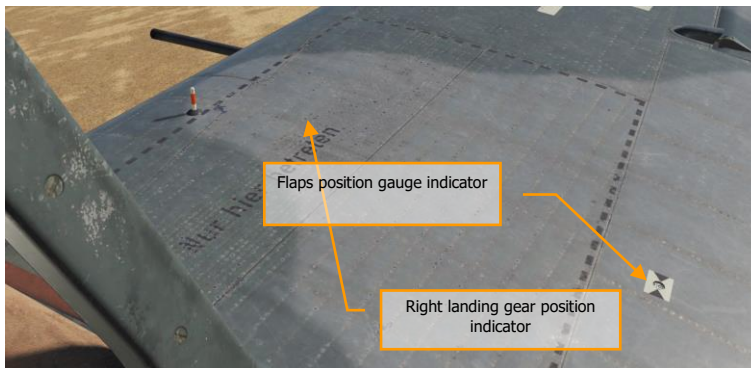


Figure 65: Landing gear and flaps mechanical indicators

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 66: 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 67: 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.

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.

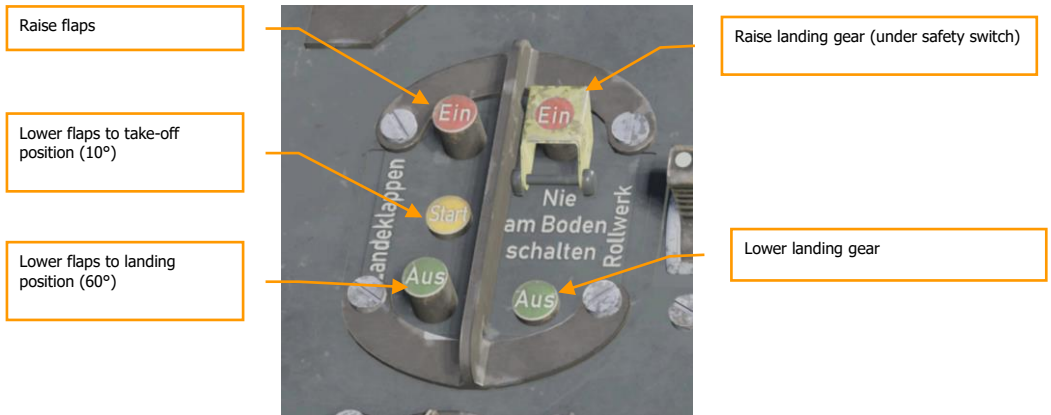


Figure 68: Landing gear and flaps controls

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 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°).

To raise the flaps, press the "Ein" (Up) button.

To set take-off flaps, press the "Start" (Take-off) button. The flaps will be set to deflect at an angle of 10°.

To fully lower the flaps, press the "Aus" (Landing) button. The flaps will be set to fully deflect at an angle of 60°.

FuG 16ZY Radio Station Controls

The FuG 16ZY control panel has four controls:

- Frequency range selector (not working)
- Frequency selector (not working)
- Headphone volume knob
- Communications-Homing switch
- Fine tuning knob

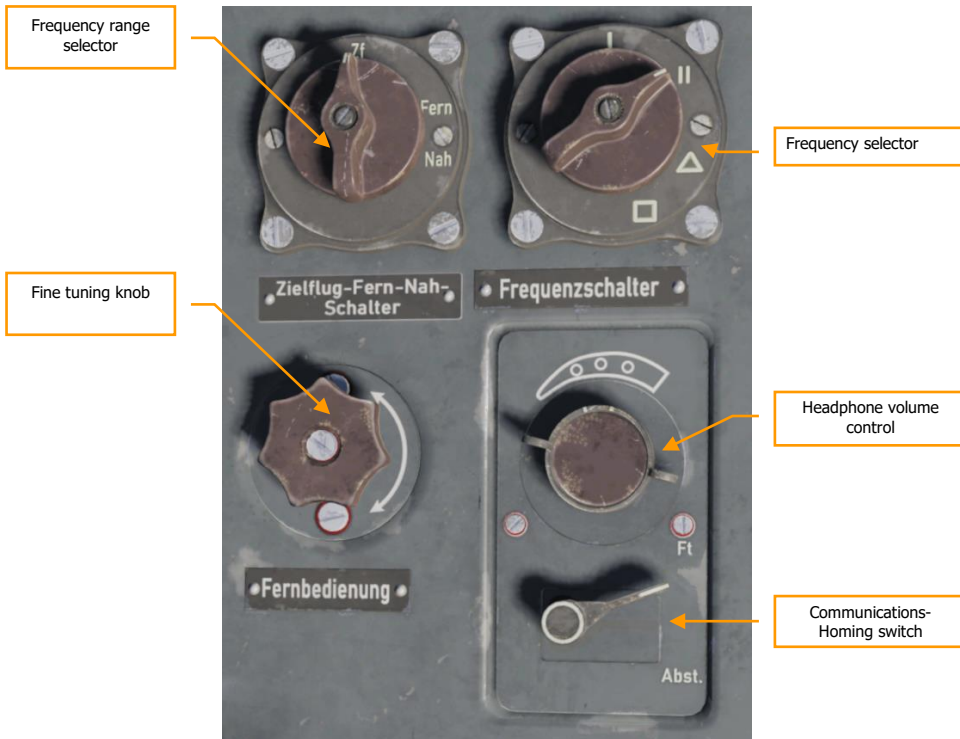


Figure 69: FuG 16ZY controls

Frequency Selector

The frequency selector for the FuG 16ZY radio has four positions indicated by the symbols I, II, Δ and □. 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). These 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.

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.

| Homing Switch | Frequency Selector | Push-To-Talk Open | Push-To-Talk Depressed | Transm | Recvr |
|---------------|--------------------|--|------------------------|------------|-------|
| "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 "Fernbediengerät" (remote control unit) is used for fine frequency adjustment within a selected preset.

Electric System Emergency Kill-Switch



Figure 70: Electrical system killswitch

Used for shutting down the Fw 190 A-8's electrical system in emergency situations.

Right Side Panel

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

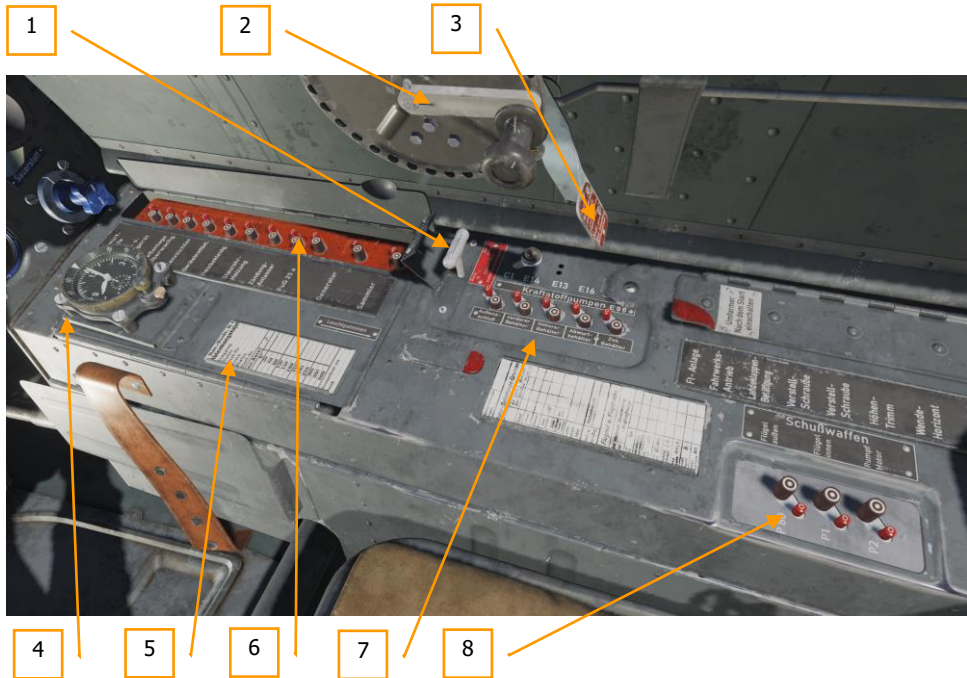


Figure 71: Fw 190 A-8 right side panel

1. Starter switch (with raised cover)
2. Canopy crank
3. Canopy jettison lever
4. Flight clock
5. Compass deviation card
6. Circuit breaker panels
7. Fuel pump circuit breaker panels
8. Armament circuit breaker panels

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.

Behind the canopy crank is a lever for jettisoning the canopy by means of a propellant charge.

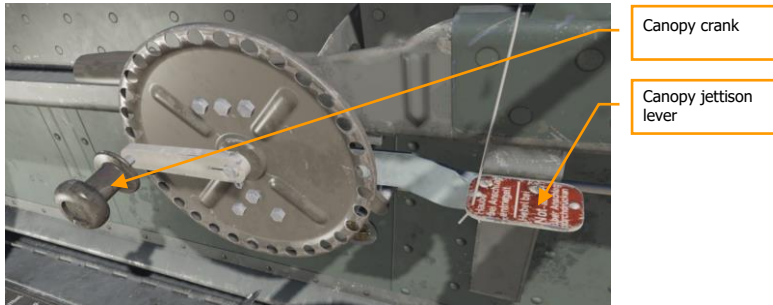


Figure 72: Canopy crank and jettison lever

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.

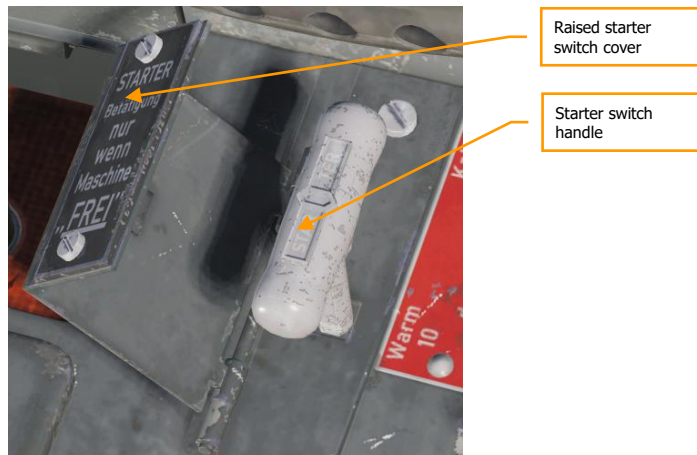


Figure 73: Starter switch with cover raised

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.

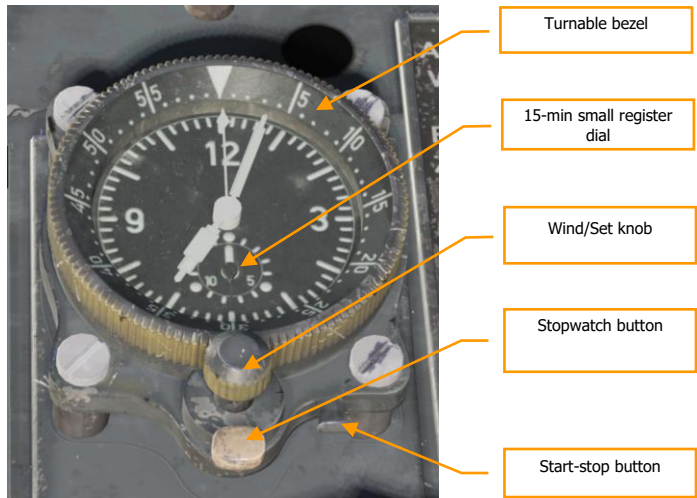


Figure 74: Flight clock

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. Each circuit breaker has two buttons: A black button with a that closes the circuit - and a red button that opens the circuit.

Four circuit breaker panels are located on the right-side panel of the Fw 190 A-8's cockpit.

The main and rear circuit breaker panels each have 11 circuit breaker buttons and are covered by flap lids.

The circuit breaker panels governing the armament and fuel systems have 3 and 5 buttons respectively.

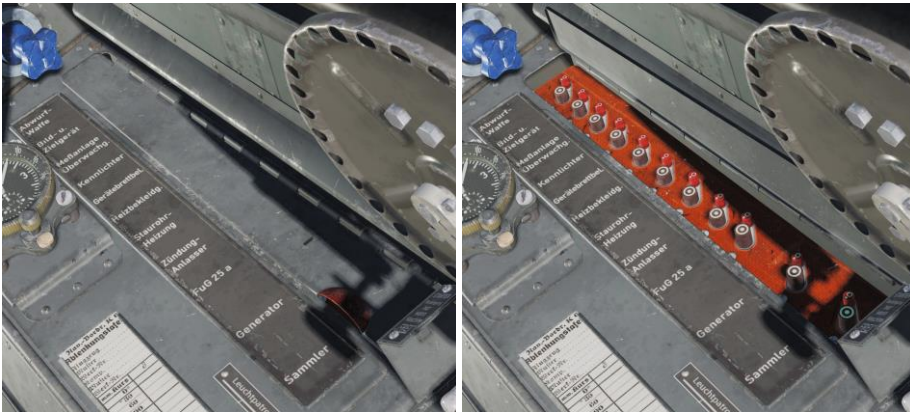


Figure 75: Circuit breaker panels, cover down (left) and cover up (right)

The switch names and codes of their corresponding devices are printed on the adjacent panel.



Drop Ordnance & Optional Armament

Gunsight and Gun camera

Instruments

Navigation lights

Cabin illumination

Clothes heating

Pitot heating

Ignition

FuG 25a IFF

Generator

Battery

Figure 76: Instrument panel circuit breaker



Figure 77: Fuel system circuit breaker

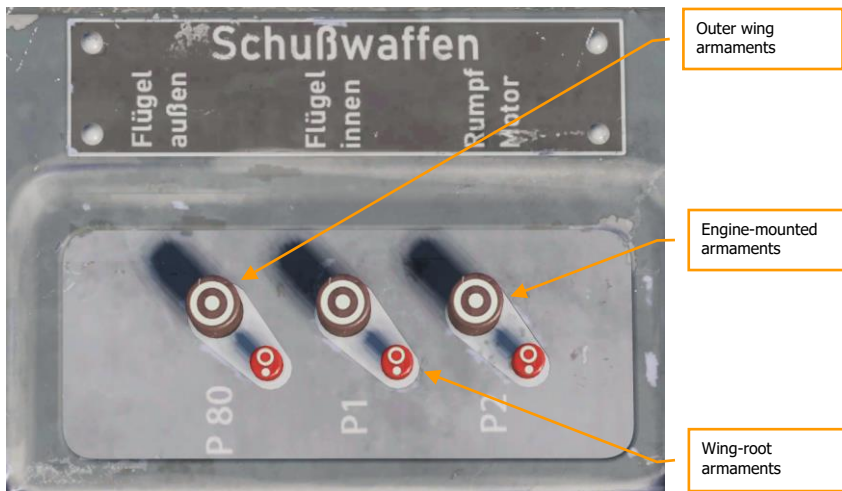


Figure 78: Weapon system circuit breaker

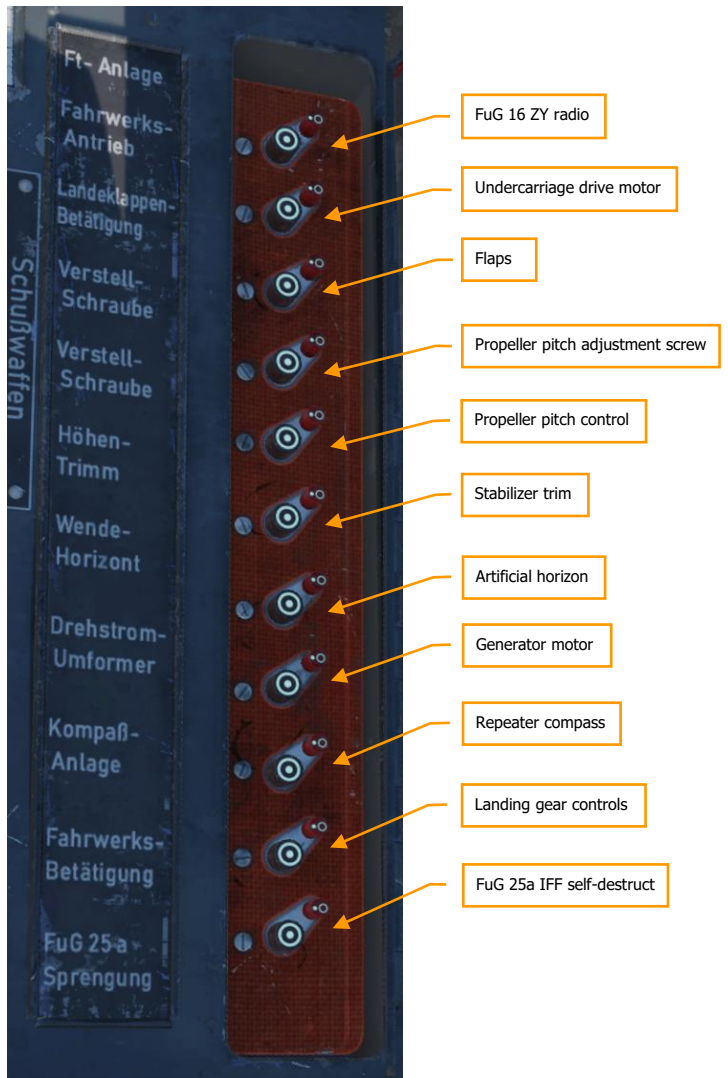


Figure 79: Rear panel circuit breaker

Control Column

The control column is used to steer the aircraft in roll and pitch.

Moving the control column backwards deflects the elevators upwards, causing the airplane to climb. Moving the control column forwards deflects the elevators downwards, causing the airplane to descend.

Moving the control column left or right deflects the ailerons, causing a roll to the direction of control column movement.

Sudden stick movements can have catastrophic consequences!

The control column also houses the firing triggers for the gun, gun camera, and bomb release.

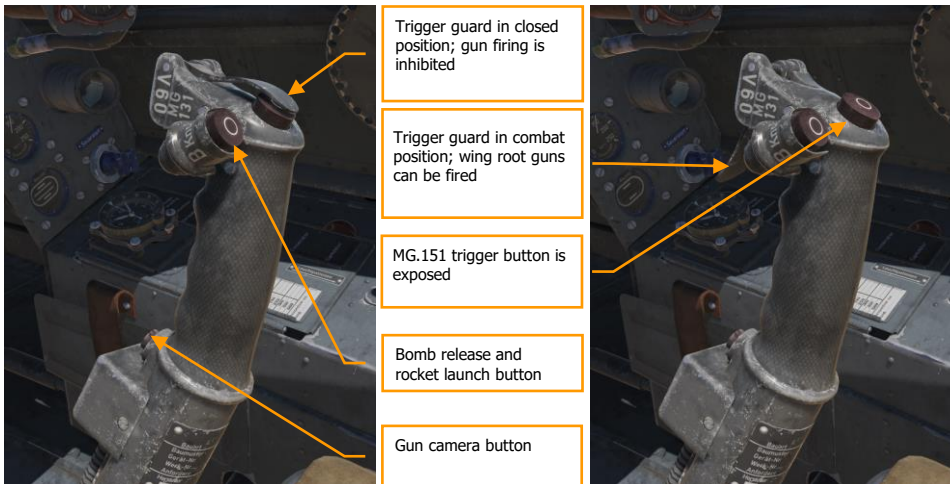


Figure 80. Control column and buttons with trigger guard closed (left) and open (right).

Kneeboard Map

To aid with navigation, a kneeboard 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 kneeboard 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 kneeboard can also be viewed on the pilot's left leg when the pilot is enabled in the cockpit [RShift + P].



Figure 81: Kneeboard map

NORMAL PROCEDURES



NORMAL PROCEDURES

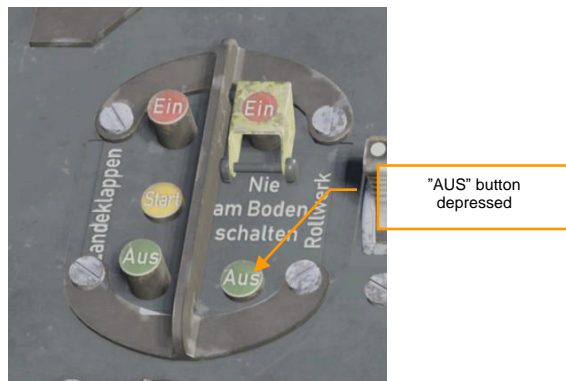
Preflight Checks and Engine Start

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.
- 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.



Engine Startup

Usage of the electric starter is permitted only when connected to an external power supply!
Use the on-board battery only in emergency situations!

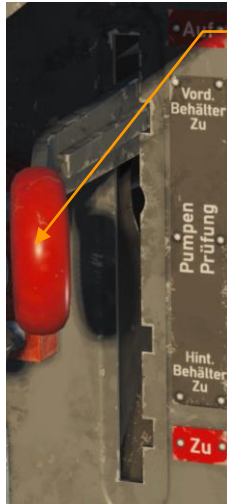
- Set the magneto to 0.
- Give the signal for the ground personnel to connect the aircraft to the airfield power supply.
- Switch on the circuit breakers for the following: Airfield power, propeller pitch control, ignition, starter, generator. DO NOT switch on the circuit breaker for the on-board battery.
- - Airfield power [LWin + 1]
 - Propeller pitch setting automator [LWin + 2]
 - Ignition [LWin + 5]
 - Starter [LWin + 6]
 - Generator [LWin + 7]
- Set the propeller pitch control to manual. Set the knob on the throttle handle to the 12:00 position.



Increase
propeller pitch

Reduce
propeller pitch

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



Fuel selector in the "AUF" position

- Ensure the proper operation of the fuel tank pumps; on the fuel system circuit breaker panel, switch on one circuit breaker for every pump and monitor the fuel pressure (0.3-0.4 atü) on the gauge. Switch off the pumps.
- Switch on the following pumps.
 - C1 (External connection) – [RWin + 1]
 - E14 Front tank pump [RWin + 2]
 - E13 Aft tank pump [RWin + 3]
 - E16 Drop tank pump, if applicable [RWin + 4]
 - E96 Auxiliary tank pump, if required [RWin + 5]

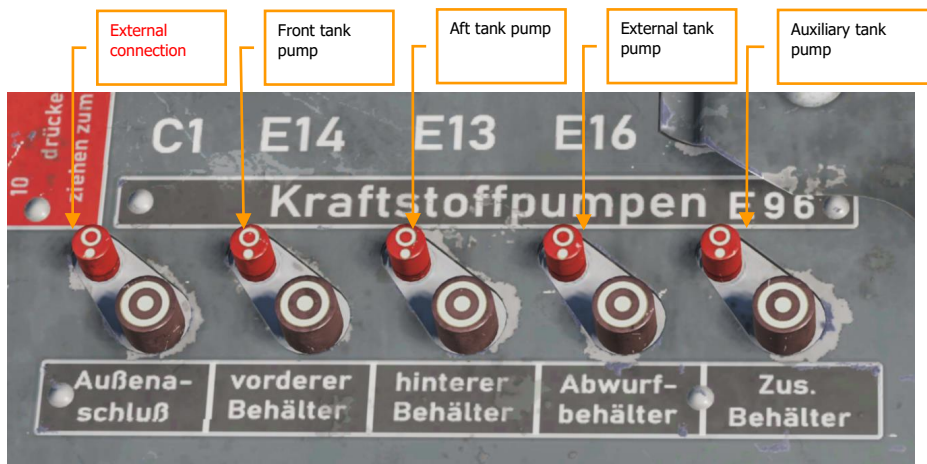


Figure 82: Fuel circuit breaker legend

- Set the throttle lever to "Anlassen" (Engine start / idle). **[RALT + Home]**



- Close the canopy by pressing and holding **[LCtrl + C]**.
- Pump fuel using the primer pump: short but energetic movements on the handle located on the left panel. Press **[LAlt + P]** 1 to 15 times depending on the outside air temperature.



- Press the starter handle and hold for 10 seconds (20 seconds in cold weather) until the flywheel spins up. Press and hold **[Home]**.
- Set the ignition (magneto) selector switch to M1+2 position. **[End]** to push the switch forward, **[RShift + End]** to pull the switch backward.



Ignition (magneto)
selector handle

- After flywheel spin-up, pull up on the starter switch for engine start. Press and hold **[RCtrl -+ Home]**.



- If the engine runs harshly, pump fuel again using priming pump while increasing RPM, if necessary.
- After engine startup, keep the engine running at a setting of 500-600 RPM until the oil pressure indicator starts moving, then immediately increase the speed to 1200 rpm. If the arrow of the oil pressure indicator does not move within 15 seconds, stop the engine and call the personnel for repair. If there is a malfunction of the onboard power supply network, the engine will not start.
- Give the signal for the ground personnel to disconnect the aircraft from the airfield power source.

In case of emergency or when it is not possible to use an external power supply, the pilot may perform engine startup using the onboard battery.

To do this, switch on the on-board battery circuit breaker instead of the airfield power circuit breaker and perform the engine startup process.

Engine Warmup

- Turn on the propeller pitch control unit. Warming up the engine with the with an activate pitch control unit has been observed to help with the correct distribution of oil in the system, thus preventing problems during flight operations.
- Increase RPM to 1200 immediately once the oil pressure readings begin to change and warm up the engine to at least + 25 ° C (as indicated by the gauge). Engine operation at an RPM of 600-1100 must be avoided at all costs as this can cause vibration damage to the engine impeller.
- Increasing RPM beyond 1200 may be done only after warming up the oil to 30 ° C. Continue engine warmup at 1400-1500 RPM.
- Monitor the oil pressure carefully! When the oil temperature is in the range of 40 - 45 ° C, oil pressure can be up to 15 atü. At temperatures above 40 - 45 ° C, the pressure is automatically reduced by the temperature regulator to 8-9 atü.
- Check the fuel pumps:



Set and hold the fuel line shut-off lever to the "Zu" position - this lever is spring-loaded and when released it automatically returns to the "Auf" position. Switch the fuel selector valve from the front tank to the aft tank and observe the fuel pressure gauge.

When the engine is running at 1200 RPM, keep the levers in the selected position for at least 1 minute. There should be no noticeable drop in fuel pressure.

Afterwards return all the levers to the "Auf" position.

Avoid extended engine operation at RPM settings from 600-1000 RPM.

- Switch on the following circuit breakers for the main instrument 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 [\[LWin + 6\]](#)

Taxiing

1. Taxi and take-off with fully opened cooling flaps only. The cooling flaps position lever is located in the cockpit above the lower front panel. Hold **[LeftAlt + A]** to fully open the cooling flaps. Refrain from unnecessarily operating this lever, especially when nearing the limits.
2. Avoid power settings below 1,200 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 the flight stick forward by approximately 3 cm.
4. After releasing the tailwheel, test the individual wheel brakes. Do not operate the brakes for too long.
5. If the tailwheel fails to unlock, push forward on the flight stick while depressing and releasing the wheel brakes.
6. When lined 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 1,200 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 bursts of brake pressure are better than continuous braking.

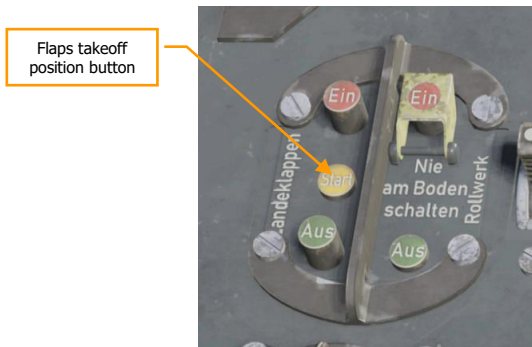
Preflight Check

Perform the following checks before taking off:

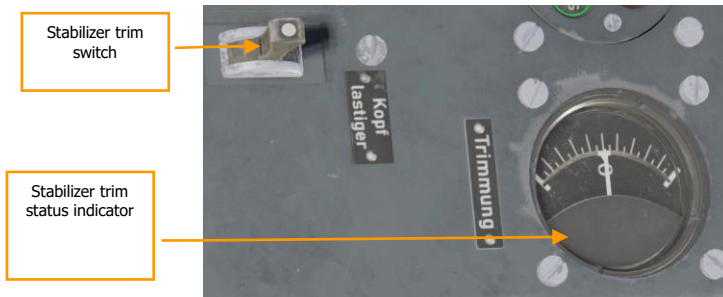
1. Primary controls:
 - 1.1. Controls – Check the stick and rudder controls to ensure they operate without binding. Watch the control surfaces for the correct response.
2. Fuel system:
 - 2.1. Fuel tank selector lever set to Open/"Auf" (fully up).
 - 2.2. Fuel tank circuit breakers ON.
 - 2.3. Check fuel in both tanks with fuel gauge selector switch. **[RAIt + T]** to move the switch to the right, **[RCtrl + T]** to move the switch to the left.



3. Flaps:
 - 3.1. Flaps set to takeoff position. The yellow "Start" button must be depressed.

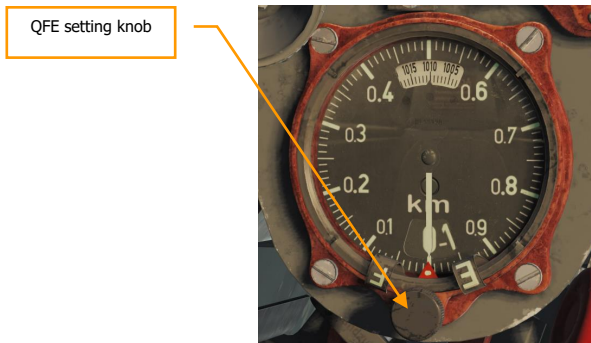


4. Ensure that the horizontal stabilizer trim indicator shows 0°.



5. Instruments and switches:

- 5.1. Set the altimeter to zero.

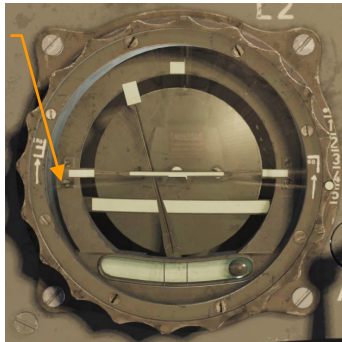


- 5.2. Set the desired heading on the compass.



5.3. Uncage the artificial horizon.

Artificial horizon
uncage



5.4. Ensure that all instrument readings are in their desired ranges.

5.5. Ensure that all the switches and controls are at their desired positions.

Takeoff

Follow the procedure outlined below to perform a normal takeoff:

1. In weather conditions of high humidity and temperatures below 0°, switch on pitot and windshield heating (press the circuit breaker buttons for pitot heating, inner windshield heating and outer windshield heating respectively).
2. Switch on both fuel pumps and switch the indicator to the rear tank.
3. When taking off with an auxiliary drop tank, only the aft tank fuel pump and the EP-1 E (drop tank pump) are to be switched on initially.
4. Set flaps to takeoff position by using the selector switch located on the left side panel.
5. Verify that the flaps are in the 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 the flight stick back with only a light tug, but do not push down.
8. Take-off distance on the runway without wind effect is approximately 650-1300 m depending on the take-off weight.
9. Take-off is at IAS = 170-180 km/h and performed on three points throughout take-off roll. Keep the aircraft straight – it does not have a tendency to break out.
10. Maximum allowable RPM during takeoff is at 2700 RPM.
11. Engine power is set according to the RPM indicator. Every throttle setting corresponds to a specific engine speed setting, maintained by the hydraulically operated regulator.
12. Within 3 minutes after take-off, reduce the power to combat power and push back a little on the control stick. Throttle position can be fixed in place by using the throttle friction knob on the bottom left of the cockpit.

Throttle position can be fixed in place using the throttle friction knob located in the lower part of the cockpit.

Power Settings

Supercharging and engine RPM depending on throttle position:

| Throttle | Pressure boost | Revolutions |
|----------|----------------|-------------|
| Percent | ata | RPM |
| 22 | 0.8 | 1500 |
| 26 | 0.85 | 1600 |
| 31 | 0.9 | 1700 |
| 36 | 0.95 | 1800 |
| 42 | 1 | 1900 |
| 48 | 1.05 | 2000 |
| 54 | 1.1A | 2100 |
| 60 | 1.1R | 2200 |
| 64 | 1.15 | 2260 |
| 66 | 1.2 | 2300 |
| 68 | 1.25 | 2330 |
| 71 | 1.3 | 2375 |
| 76 | 1.35 | 2460 |
| 79 | 1.37 | 2530 |
| 84-90 | 1.42 | 2700 |

Engine power settings – supercharger first stage:

| Mode | Permissible time (min) | Altitude | | Output (H.P.) | RPM | Pressure | |
|----------------------|------------------------|----------|------|---------------|------|----------|------|
| | | M | ft | | | ata | psi |
| Take-off / Emergency | 3 | 600 | 1790 | 1705 | 2700 | 1.4 | 20.2 |
| Combat, Climb | 30 | 700 | 2300 | 1500 | 2400 | 1.3 | 18.7 |
| Max continuous power | Constant | 1200 | 3940 | 1350 | 2300 | 1.2 | 17 |
| Max economy | Constant | 1800 | 5900 | 1045 | 2100 | 1.1 | 15.6 |

Engine power settings – supercharger second stage:

| Mode | Permissible time (min) | Altitude | | Output (H.P.) | RPM | Pressure | |
|----------------------|------------------------|----------|-------|---------------|------|----------|-------|
| | | M | ft | | | ata | psi |
| Take-off / Emergency | 3 | 5700 | 18700 | 1420 | 2700 | 1.4 | 20.20 |
| Combat, Climb | 30 | 5300 | 17400 | 1300 | 2400 | 1.3 | 18.70 |
| Max continuous power | Constant | 5500 | 18000 | 1165 | 2300 | 1.2 | 17.00 |
| Max economy | Constant | 5400 | 17700 | 970 | 2100 | 1.1 | 15.60 |

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

Retraction of Flaps and 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 the "Ein" (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 the flaps (red "Ein" (On) button for flaps).

The red control lamp should illuminate. Also observe the mechanical indication on side of the upper wings (cutout with degrees scale).

Climb

Perform the following steps following a safe takeoff:

- Set throttle for climb power - 2700 RPM.
- The optimal climb speed is 280 - 290 km/h indicated.
- Raise the landing gear by raising the safety switch over the "Ein" (Up) button and pressing the button. Ensure that the landing gear is properly raised, and the red "Ein" light is illuminated.
- Raise the flaps by pushing the "Ein" (Up) button. Ensure that the flaps are properly raised, and the red "Ein" light is illuminated.
- Check oil temperature and pressure.
- After reaching the safe altitude, throttle back to 2400 RPM. Trim the aircraft for climbing.
- Check all instruments for proper function within normal parameters.

Attention! It is recommended to open the radiator cooling flaps at a temperature of 110°C.

At an altitude of approximately 3300 +/- 200 meters, the supercharger automatically switches supercharger speed from low to high. Try not to fly or frequently change your altitude within this threshold.

Cruise and Fuel Management

Perform the following procedures when flying with auxiliary and/or external fuel tanks:

- Set the fuel selector to "Auf" (open).
- Set the fuel gauge sensor switch to "Hinten" (aft tank).
- Start the aft tank booster pump by pressing the white E13 circuit breaker button ("Hinten").
- When equipped with a drop tank, activate the drop tank booster pump by turning on the E85 circuit breaker ("Sonder"). The fuel from the drop tank is squeezed out by the air taken from the engine supercharger, which, together with the work of the boost pump, creates a high pressure of fuel in the drop tank main line. If the air pressure from the supercharger is less than the atmospheric pressure, the booster pump is sufficient for normal fuel transfer to the aft tank.
- The fuel from the drop tank is consumed first, since this tank can be jettisoned.
- After completely depleting the drop tank (when the fuel gauge needle begins to drop below 240 l.), turn off the drop tank booster pump by pressing the red E85 circuit breaker button ("Sonder"), then jettison the tank by pulling on the corresponding handle.
- In the absence of a drop tank, the E85 circuit breaker ("Sonder") should be in the "off" position.
- If there is fuel in the auxiliary fuselage tank, turn on the tank booster pump. However, since the fuel from the auxiliary fuselage tank is also squeezed out by air from the supercharger, this action is not mandatory.

When the bingo fuel signal lamp for the aft tank illuminates, perform the following procedures:

- Turn on the front tank booster pump by pressing the white E14 ("Vorn") circuit breaker button.
- Set the fuel selector to "Hinterer Behälter zu" (aft tank shut off) to prevent air from being sucked from the tank by the engine pump.
- Turn off the aft tank booster pump by pressing the red E13 circuit breaker button ("Hinten").
- Move the fuel gauge sensor switch to the "Vorn" position (front tank).

The warning lamp for bingo fuel status in the front tank lights up when the fuel balance reaches approximately 90 liters, which corresponds to approximately 25 minutes of flight.

Adjust the throttle position so that the engine power does not exceed 2300 RPM. At altitudes above 7,500 m, a constant power of 2,300 rpm is permissible.

To achieve greater flight range and save engine life, set the engine to economic modes below 2100 RPM.

If the engine temperature exceeds the maximum permissible temperature, reduce engine power.

Fuel Quantity Measuring. An electrical fuel quantity indicator is fitted to the lower front panel with a selection switch for the forward and aft fuel tanks. There is no fuel quantity indication for the drop

tank or the additional fuel tank. Additional fuel is ducted into the aft tank. Recognition of additional tanks having emptied is by fuel quantity indication dropping below 240 liters in the aft tank, with the fuel quantity indicator switched to the aft tank.

Switching Warning for the aft fuel tank occurs at approximately 10 liters remaining. A white lamp will illuminate when this occurs.

Low Fuel Warning in the forward fuel tank occurs at 90-100 liters remaining. A red lamp will illuminate to signal that the aircraft has enough fuel for approximately 25 minutes at economy power setting.

Switching of Fuel Tanks

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

- Fuel shutoff valve: "Open"
- Both fuel tank pumps: "On"
- Fuel quantity indicator: Aft tank

In flight:

- Fuel shutoff valve: "Open"
- Fuel draw is controlled by switching fuel tank pumps to "Off" or "On".
- Monitor fuel reserves by observing the selectable fuel tank indicator.
- First empty the rear tank, with the rear fuel pump switched off. If the red light activates before the white one, switch off the front tank on the fuel tank selector panel and set the fuel gauge to monitor the aft tank.
- When the white light activates, switch both fuel tank pumps to "On". Fuel shutoff valve remains in the "Open" position.
- Set the fuel quantity indicator to the front fuel tank.
- The red signal light indicates that 25 minutes of fuel remain at engine max economy settings.

With a drop tank:

- Fuel shutoff valve: "Open"
- Drop tank fuel pump and aft 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: switch to aft fuel tank
- Once the fuel indicator drops below 240 liters, the drop tank is empty.
- Drop tank fuel pump: "Off".
- Pull the emergency jettison handle in the cockpit to jettison the drop tank.

With an auxiliary fuel tank in the fuselage:

- With an auxiliary fuel tank in the fuselage:
- Fuel shutoff valve: "Open"
- Aft fuel tank pump: "On".
- Forward fuel tank pump: "Off"
- Auxiliary fuel tank pump: "On"
- Fuel quantity indicator set to aft fuel tank
- Once the fuel indicator for the aft tank drops below 240 liters, the auxiliary fuel tank is empty.

- Auxiliary fuel tank pump: "Off".

With drop tank and auxiliary fuel tank:

- Fuel shutoff valve: "Open".
- Drop tank fuel pump, auxiliary fuel tank pump and aft fuel tank pump: "On".
- Front fuel tank pump: "Off".
- Fuel quantity indicator: switch to aft fuel tank.
- When the fuel quantity indicator drops below 240 liters, both the drop tank and auxiliary fuel tank are empty.
- Drop tank fuel pump and auxiliary fuel tank pump: "Off".

Attention! When there is danger of incoming fire, the drop tank has to be jettisoned, and the drain of the unprotected additional tank into the fuselage has to be pulled.

High Altitude Flight

During high altitude flight check oxygen flow in short intervals. The 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

Regulate instrument lighting using the illumination controls located on the left side panel.

Prior to take-off it is especially important to ensure that the stabilizer trim setting is 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.

Dive

Dive speeds for fighters and fighter-bombers:

- 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

Do not exceed the maximum allowable RPM of 2500.

Inverted Flight

Continuous flight while in an inverted position is ill-advised as the aircraft's lubrication may experience malfunctions. However, maneuvers may still be performed safely, including those that require the aircraft to take an inverted position.

Landing

- Reduce speed to approximately 300 km/h.
- Extend landing gear. Push the button on the left side panel or pull the landing gear pull lever (on left side of the lower front panel), until the landing gear is properly deployed.
- 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 as tail-heavy as necessary (the toggle switch for elevator trim is located next to the undercarriage and flap control panel, on left side instrument panel).
- Approach speed is IAS = 220-220 km/h
- Touchdown at IAS = 160-180 km/h, depending on aircraft weight
- Pull back on the flight stick upon touchdown
- Retract flaps after rolling out.
- Never hold the flight stick back when intending to make a turn so that the tailwheel has free movement.

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.
- Perform standard landing procedure.

Note that the aircraft tends to fall slightly upon retraction of flaps.

Engine Shutdown

Let the engine cool down by running it at 1200 RPM for 2 minutes.

Open cooling flaps fully: during approach if in warm weather, during taxi if in cold weather.

Retard throttle to stop position. **[RALT - End]**

Switch off ignition, fuel pumps, close fuel shutoff valve, and press the aircraft electrical power off switch.

Shutting down an insufficiently cooled engine can cause thermal damage, breakdowns, and the engine may refuse to start again.

Reference Data

Distances and speeds of takeoff and landing roll depending on aircraft weight and runway surface type:

| Weight, kg | Takeoff roll, m | | Rate of climb after takeoff, m/s (flaps at 10°) | Landing roll, m | | Roll time, seconds | |
|------------|-----------------|-------|---|-----------------|-------|--------------------|-------|
| | Concrete | Grass | | Concrete | Grass | Concrete | Grass |
| 4000 | 640 | 660 | 11 | 380 | 400 | 14,5 | 15,5 |
| 4500 | 780 | 820 | 9 | 520 | 560 | 18 | 19,5 |
| 5000 | 960 | 1110 | 7 | 680 | 730 | 22 | 24 |
| 5500 | 1200 | 1280 | 5 | 880 | 960 | 26,5 | 29,5 |

Landing speed, depending on aircraft weight:

| Weight | Speed | Weight | Speed |
|--------|-------|--------|-------|
| Kg | Kph | Lbs. | Mph |
| 3500 | 159 | 7600 | 98 |
| 3600 | 161 | 7800 | 100 |
| 3700 | 163 | 8000 | 101 |
| 3800 | 165 | 8200 | 102 |
| 3900 | 167 | 8400 | 103 |
| 4000 | 169 | 8600 | 105 |
| 4100 | 171 | 8800 | 106 |
| 4200 | 173 | 9000 | 107 |
| 4300 | 175 | 9200 | 108 |
| 4400 | 177 | 9400 | 109 |
| 4500 | 179 | 9600 | 111 |
| 5000 | 180 | 9800 | 112 |

Flight parameters without bomb load, measurements and calculations under the conditions:

Takeoff weight: 4365 kg (9625 lbs.)

Fuel quantity: 640L (141 gallons)

Armament 2 MG 131 (475 shells), 2 MG 151 (250 shells), 2 MG 151 (140 rounds)

Fuel 500 kg (1102 lbs)

| Altitude | | RPM | Supercharger pressure | | Fuel consumption | | Average speed | | Flight time | Flight distance | |
|----------|-------|------|-----------------------|------|------------------|------|---------------|-----|-------------|-----------------|-------|
| km | ft | rpm | ata | psi | kg/h | lb/h | km/h | mph | hours | km | miles |
| 0.3 | 984 | 2300 | 1.20 | 17.0 | 360 | 795 | 515 | 320 | 1.2 | 615 | 382 |
| | | 2100 | 1.10 | 15.6 | 225 | 496 | 465 | 289 | 1.91 | 885 | 550 |
| | | 2000 | 1.05 | 14.9 | 205 | 452 | 440 | 273 | 2.10 | 920 | 572 |
| 2.0 | 6562 | 2300 | 1.20 | 17.0 | 370 | 816 | 550 | 342 | 1.28 | 635 | 394 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 505 | 314 | 1.82 | 890 | 554 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 480 | 298 | 2.01 | 945 | 587 |
| 3.0 | 9843 | 2300 | 1.20 | 17.0 | 350 | 772 | 540 | 335 | 1.30 | 665 | 413 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 505 | 314 | 1.82 | 885 | 575 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 490 | 304 | 2.01 | 955 | 612 |
| 5.0 | 16405 | 2300 | 1.20 | 17.0 | 360 | 795 | 575 | 357 | 1.32 | 695 | 431 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 535 | 332 | 1.84 | 925 | 575 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 510 | 317 | 2.02 | 985 | 612 |
| 7.0 | 22967 | 2300 | 1.20 | 17.0 | 325 | 716 | 580 | 360 | 1.48 | 775 | 481 |
| | | 2100 | 1.10 | 15.6 | 220 | 485 | 530 | 329 | 1.98 | 990 | 616 |
| | | 2000 | 1.05 | 14.9 | 195 | 430 | 495 | 308 | 2.18 | 1035 | 644 |

Flight parameters with external drop tank, measurements and calculations under the conditions:

Takeoff weight: 4682 kg (10326 lbs.)

Carrier rack: ETC 501

Load: Drop tank, 300L (66.2 gallons)

Fuel quantity: 940L (207 gallons)

Armament 2 MG 131 (475 shells), 2 MG 151 (250 shells), 2 MG 151 (140 rounds)

Fuel 734 kg (1618 lbs)

| Altitude | | RPM | Supercharger pressure | | Fuel consumption | | Average speed | | Flight time | Flight distance | |
|----------|-------|------|-----------------------|------|------------------|------|---------------|-----|-------------|-----------------|-----|
| km | ft | rpm | ata | psi | kg/h | lb/h | km | ft | rpm | ata | psi |
| 0.3 | 984 | 2300 | 1.20 | 17.0 | 360 | 795 | 490 | 304 | 1.85 | 915 | 569 |
| | | 2100 | 1.10 | 15.6 | 225 | 496 | 440 | 273 | 2.95 | 1310 | 816 |
| | | 2000 | 1.05 | 14.9 | 205 | 452 | 415 | 258 | 3.24 | 1370 | 852 |
| 2.0 | 6562 | 2300 | 1.20 | 17.0 | 370 | 816 | 520 | 323 | 1.86 | 950 | 590 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 475 | 295 | 2.79 | 1325 | 825 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 455 | 282 | 3.10 | 1415 | 880 |
| 3.0 | 9843 | 2300 | 1.20 | 17.0 | 350 | 772 | 515 | 320 | 1.98 | 990 | 616 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 480 | 298 | 2.80 | 1325 | 825 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 460 | 286 | 3.10 | 1420 | 884 |
| 5.0 | 16405 | 2300 | 1.20 | 17.0 | 360 | 795 | 545 | 338 | 1.97 | 630 | 637 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 505 | 314 | 2.79 | 830 | 856 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 485 | 301 | 3.10 | 875 | 915 |

Flight parameters with bomb load, measurements and calculations under the conditions:

Takeoff weight: 4923 kg (10855 lbs)

Carrier rack: ETC 501

Bomb load: SC500

Fuel quantity: 640L (141 gallons)

Armament 2 MG 131 (475 shells), 2 MG 151 (250 shells), 2 MG 151 (140 rounds)

Fuel 500 kg (1102 lbs)

| Altitude | | RPM | Supercharger pressure | | Fuel consumption | | Average speed | | Flight time | Flight distance | |
|----------|-------|------|-----------------------|------|------------------|------|---------------|-----|-------------|-----------------|-----|
| km | ft | rpm | ata | psi | kg/h | lb/h | km | ft | rpm | ata | psi |
| 0.3 | 984 | 2300 | 1.20 | 17.0 | 360 | 795 | 485 | 301 | 1.2 | 575 | 357 |
| | | 2100 | 1.10 | 15.6 | 225 | 496 | 430 | 267 | 1.91 | 825 | 513 |
| | | 2000 | 1.05 | 14.9 | 205 | 452 | 410 | 255 | 2.10 | 860 | 535 |
| 2.0 | 6562 | 2300 | 1.20 | 17.0 | 370 | 816 | 515 | 320 | 1.21 | 590 | 366 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 470 | 292 | 1.79 | 815 | 506 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 450 | 280 | 2.00 | 870 | 546 |
| 3.0 | 9843 | 2300 | 1.20 | 17.0 | 350 | 772 | 510 | 317 | 1.28 | 610 | 379 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 470 | 292 | 1.78 | 805 | 500 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 455 | 282 | 1.96 | 860 | 535 |
| 5.0 | 16405 | 2300 | 1.20 | 17.0 | 360 | 795 | 540 | 335 | 1.29 | 630 | 391 |
| | | 2100 | 1.10 | 15.6 | 240 | 529 | 500 | 311 | 1.77 | 830 | 516 |
| | | 2000 | 1.05 | 14.9 | 215 | 474 | 475 | 295 | 1.94 | 875 | 544 |

EMERGENCY PROCEDURES



EMERGENCY PROCEDURES

Emergency situations are described as situations in which, as a result of system failure or combat damage, it becomes impossible for the pilot to maintain the required airspeed for horizontal flight. In case of an emergency situation, the pilot may decide to parachute from the aircraft, or to perform an emergency landing.

Below are some possible emergency situations.

Engine Overheat

Engine overheating can be recognized by the oil temperature exceeding the maximum allowable.

Probable causes of engine overheat while in flight:

- Climbing at high engine power but insufficient speed. To solve this problem, maneuver the plane back to level flight, then reduce power and increase speed.
- Oil leak. Determined by oil pressure gauge readings. The engine will continue to overheat even with fully opened radiator flaps. As it is impossible to eliminate oil leakage in flight, maintain minimum speed and engine power and try to make an emergency landing as soon as possible, or, if worse comes to worst, parachute from the aircraft.
- Exceeding the maximum permissible engine operating conditions or sustaining combat damage. This problem cannot be solved in flight. Immediately make an emergency landing or parachute from the aircraft.

Engine Failure

Engine failures are divided into two main categories: those that occur suddenly and those that are preceded by characteristic signs.

Sudden failures are quite rare and are usually the result of combat damage, failure of the ignition system, or exhaustion of fuel supply.

Most engine failures occur gradually and allow the pilot to determine the failure in advance by characteristic signs. Signs of possible engine failure are engine disruptions, drops in oil pressure, drops in boost pressure, and unstable RPM.

When these symptoms appear in flight, immediately make an emergency landing.

In-Air Engine Startup

To perform an in-air engine startup (not tested):

- Set throttle to idle
- Apply the starter according to the engine startup procedure.

Engine Failure during Takeoff

The probability of engine failures during take-off can be significantly reduced by following proper engine startup procedures, as well as by carefully checking engine operation before take-off. In case of engine failure during the takeoff run, when the plane has not yet achieved liftoff, follow these steps:

- Throttle down completely.
- Apply brake pressure to stop the aircraft, taking care not to nose over.
- If you are unable to stop while on the runway, then turn the magneto / ignition switch to the "0" position and put the fuel lever to the "Zu" position.
- If there is a risk of rolling past the runway colliding with terrain, discard all wing and fuselage-mounted equipment and retract the undercarriage by opening the protective cover on the control panel and pressing the "Ein" button (raise).
- Jettison or manually open the canopy.
- After the aircraft has come to a stop, leave the cockpit as soon as possible and immediately get to a safe distance from the aircraft.

Engine Failure after Liftoff

If an engine failure occurred shortly after separation from the runway, you must quickly assess your situation and make an emergency landing before losing speed. Perform the following:

- Maintain a gliding speed of 260-270 km / h by using pitch. Monitor and control your flight altitude.
- Turn off the propeller pitch breaker.
- Set the propeller to a low RPM using the manual "Drehzahl" pitch regulator on the throttle.
- Jettison all external load.
- Jettison the canopy by pulling on the emergency jettison lever.
- If your chances of a successful landing are low, retract the landing gear and perform a belly landing.
- If you have enough time, fully release the flaps.
- Turn the ignition switch to the "0" position (off).
- Set the fuel lever to the "Zu" position (closed).
- Tighten your seat belts, in this case figuratively.
- Try to land directly on the aircraft's current course.
- After landing, exit the cockpit and immediately get to a safe distance.

Engine Failure in Flight

Upon detecting signs of engine failure while in flight, the pilot may either perform an emergency landing or, if doubting the chances for a successful emergency landing and with sufficient altitude, parachute from it.

Follow this procedure if intending to perform an emergency landing:

- Immediately lower the nose of the aircraft to prevent the aircraft from bleeding too much speed and entering a stall. Maintain instrument speeds above stall speed.
- Jettison all external load, ideally over sparsely populated areas.
- Set the fuel lever to the "Zu" position (closed).

- Choose a landing site. If there is an airfield nearby, contact its ATC and report the landing. Carefully make your approach and try to land against the wind. Bend your head and jettison the canopy by pulling the emergency reset handle.
- If landing on a sufficiently long runway and with sufficient time and altitude to perform a proper approach, then deploy landing gears. Under any other landing conditions, do not deploy landing gears.
- Lower the flaps by 20 °. When the plane establishes a glide path, lower the flaps completely.
- After landing, immediately exit the aircraft and get to a safe distance.

Fire

Do not open the canopy in case of fire, otherwise the cabin will quickly fill with smoke. Do not release the undercarriage as the flames can penetrate the inside of the plane through the open niches, making a bad situation worse. When the engine catches fire, perform the following procedure to try and contain it:

- Shut off the fuel valve by moving its lever to the "Zu" position.
- Throttle down completely.
- Turn the ignition selector switch to the "0" position.

During a fire, cover all exposed areas of the body, including the eyes. If the fire forces you to parachute from the craft, open the canopy just before leaving the plane. Do not jettison the canopy until the seat belts are unbuttoned, the plane is balanced, and you are ready to jump. Then pull the emergency canopy jettison handle and exit the craft over the starboard side. If the canopy jettison mechanism fails, push the canopy open using your head and shoulders.

System Failure

If performing an extended emergency return flight, the pilot may set the engine to exceed 2400 RPM.

If oil pressure drops, land immediately if possible.

If gasoline vapor penetrates into the cab, turn off the fuel pumps, wear the oxygen mask and open the canopy slightly.

In the event of failure of one of the fuel pumps, the pilot may fly to the nearest airfield at a low RPM while using both tank pumps simultaneously.

In the event of a Kommandogerät failure, including loss of oil pressure, the pilot can adjust the boost using the mechanical connection of the throttle to the shutter, and the RPM can be controlled manually using the manual RPM control knob.

Pneumatic System Malfunction

If one of the tires is poorly inflated or deflated, then land on three points and do not use the brakes unnecessarily. If such a need arises, use the opposite pedal and brake to level the plane.

If the right tire is deflated, land on the left side of the runway; if the left tire is deflated - land on the right.

If the tires are missing, do not attempt to land on the metal wheel rim, instead land on the fuselage.

Landing on one wheel is possible - you land as usual but keep the aircraft from banking for as long as possible. When performing such a landing, the propeller and wing tips usually sustain damage.

Undercarriage Drive Failure

Use the emergency landing gear release in case of failure of the electrical drive. Operation is the same as during normal operation.

In case the landing gear does not deploy, push down on the nose and then sharply recover. Observe the mechanical indicator.

If the gear does not deploy, check if the "Aus" button on the landing gear control panel is pressed. If it is pressed, pull on the emergency gear release handle once more.

In case the gear still does not deploy, proceed as follows:

- Disconnect the undercarriage drive electrical switch and pull the emergency release handle again.
- Perform side slips to release the undercarriage,
- Check if the white marking on the landing gear pins is visible.

If the above procedure fails, retract the undercarriage and perform a belly landing.

Electrical System Failure

The onboard electrical system of the aircraft is controlled by a group of circuit breakers installed in a separate panel on the starboard side.

In case of overload or short circuit of one of the sections of the plane's electrical network, the circuit breaker of the corresponding section is activated, de-energizing the problem system. At the same time, the red button is "pushed out" at the circuit breaker panel. Before re-enabling the failed system, you must wait a few seconds to cool the elements of the circuit breaker. If you cannot turn on the circuit breaker after several attempts, then that particular section of the network has failed completely. A short circuit may have occurred on the network, which cannot be corrected in flight.

Use the radio station sparingly in case of a disabled generator, as it can quickly discharge the battery.

Bad-Weather Landing

Crosswind Landing

The recommended procedure for crosswind landing is as follows:

- Maintain airspeeds slightly higher than for a normal approach.
- Drop the wing into the wind slightly to counteract the drift, and keep the plane straight with the runway.
- Just before touching down, level the wings.
- Make a wheel landing if the crosswind is excessive, gusty, strong, or otherwise doubtful. Use approximately half flaps for any appreciable crosswind.

If crabbing is required during the approach, be sure to straighten out before landing. Never land in a crab as it is very stressful on the landing gear.

Gusty Landing

In a gusty wind condition, maintain speeds slightly faster than normal to minimize the likelihood of a sudden loss of lift between wind gusts.

Watch for the effect of gust on the aircraft. The gust tends to have a ballooning effect. Then, when the gust quits, the aircraft may drop as lift is reduced, resulting in an impact with the ground.

Use about half flaps when performing a landing in gusty conditions.

Wet Landing

Wet landings require special attention in using the brakes.

Avoid jamming the brakes, which could result in skidding out of control.

If visibility out of the front windshield is poor, use the front panels on each side of the windshield.

Emergency Landing

When an emergency occurs, try to find a suitable place for landing. Use the following table to determine the most suitable landing area:

| | |
|----------------|---------------------|
| SAFE | Airfield |
| | Bare field |
| | Grassland |
| CAUTION | Sand |
| | Calm water surface |
| | Ice |
| | Young forest |
| | Rough water surface |
| | Ploughed land |
| DANGER | Thick forest |
| | Hills |
| | Mountains |
| | Stormy waters |

If there are no suitable surfaces for landing, parachuting from the aircraft is recommended.

If an emergency situation occurs at an altitude of less than 1000 meters, it is usually recommended to perform a belly landing without releasing the undercarriage.

If during the process of performing emergency landing the engine suddenly stops, immediately maneuver the aircraft downwards to compensate for the loss in speed.

Maintain a speed of 200–210 km / h if the engine is functional. If the engine is non-operational, maintain 220–230 km / h.

Determine the optimal speed of descent, taking into account the state of the engine, altitude, and distance to the landing site.

Stick to your chosen landing site, even if you find a more suitable site.

Depending on the landing site, consider the following factors:

Field or meadow: on a planted field, try to touch down parallel to the rows of plants if there is enough space for landing. Small bushes and other such plants are usually not dangerous.

Sand: if there is a fairly wide and flat sandy beach, then landing on it is almost as safe as landing on a runway. Do not use brakes.

Ice: Land parallel to the shoreline to avoid cracks. Note that the ice is usually thinner along the coast.

Young forest: ignore the stunted trees but beware of areas with dense clusters of vegetation.

Plowed field: do not pay attention to the direction of the tilled areas - choose the longest section of the field.

Dense forest: landing here has a small chance of success and as such is ill-advised. Only perform if parachuting is no longer possible. Level the plane and let the thin treetops slow it down.

In case the pilot needs to make additional corrective turns while flying with limited engine thrust or none at all, they must raise airspeed to 250-280 km/h.

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.

Emergency Landing in case of Engine Failure

In case of engine failure at low altitudes:

- 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. Fix the handle in place so that the canopy does not get blown off in flight.
- Extend landing gear only when near the airfield - otherwise the aircraft will be in danger of flipping over
- Fully extend flaps, trim the aircraft to be tail-heavy
- Switch the aircraft's electrical systems off.

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

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

Belly landings on the aircraft are relatively safe to perform.

Engine failure occurring at a high altitude gives the pilot more time to glide and cover additional distance. In this case do not deploy the undercarriage until you have made sure that you can safely reach the nearest airfield.

Emergency Load Jettison

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

Parachuting

As far as flight altitude is available and aircraft remains controllable, reduce speed as much as possible.

If possible:

- Switch off the electrical system
- Switch off ignition
- Close fuel shutoff valve

Push the canopy emergency jettison lever at the punched disc. The canopy will be jettisoned immediately by an explosive cartridge. Prior to this, the canopy must be closed: or under no circumstances should it be open by more than 300 mm (check marking!).

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).

COMBAT EMPLOYMENT



COMBAT EMPLOYMENT

This section covers weapon employment on the Fw 190 A-8.

The aircraft's main armament consists of its machine guns and automatic cannons. Additional armaments include a bomb load of up to 500kg, carried on a bomb rack mounted on the aircraft's fuselage, as well as WR-21 rockets under the wings.

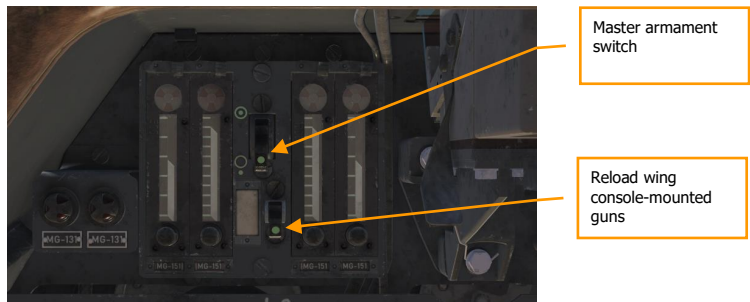
Guns

- Switch on the aircraft's weapons systems. [C]

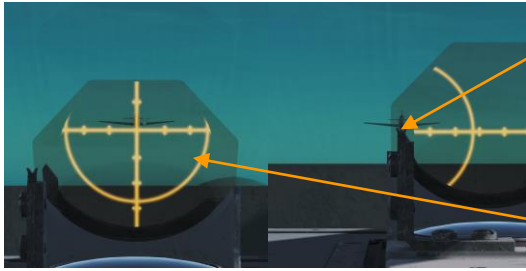
The MG 131 machine guns mounted on the fuselage and the MG 151 guns mounted in the wing roots are both controlled by the master armament switch.

The MG 151 cannons housed in the wing consoles are controlled by the secondary armament switch.

Give an interval of at least 3 seconds before flipping the second switch after you flip the first. The aircraft's system is capable of recharging only four weapons simultaneously and can overload if this limitation is exceeded.



- Maneuver the aircraft to place the target inside the gunsight's crosshairs.



Aiming with the backup iron sights

Aiming with the collimator gunsight

- Once the target is lined up, open fire via **[Space]** or **[RAIt + Space]**.

Bombs

Bomb Delivery

Standard procedure for bomb delivery:

- Set the type of attack and the bomb fuse mode using the bomb fuse mode selector switch. **[LShift + B]** flips it to the left, **[LCtrl + B]** to the right.



Bomb fuse setting rotary switch

- To release bombs, press the B2 button (bomb drop/rocket launch) **[RAIt + Space]** located on the control stick.
- 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 cause the bomb to collide with 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.

"Bomben" – Jettison Fuselage Stores handle [LCtrl + R]

Rockets

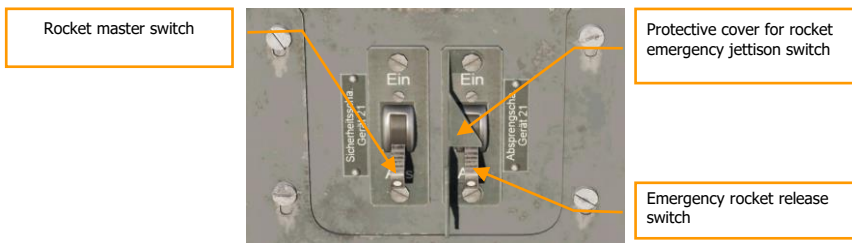
Besides bombs, the Fw 190 A-8 can also carry Werfer-Granate 21 WR-21 (WG 21) type unguided rockets, mounted on pylons under the aircraft's wings.



The WR-21 is a heavy 210-mm diameter anti-aircraft rocket weighing about 110 kg, with a 40 kg warhead containing a 10 kg charge. The BR 21 rocket is equipped with a time fuse designed to detonate the warhead at a certain distance from the carrier.

Owing to its powerful warhead, the WR-21 rocket is capable of defeating targets up to a distance of 15 meters from its point of detonation. The Fw 190 A-8 can carry two rockets of this type.

Rocket Launch



- Turn on the main rocket switch **[Shift + O]**, located in the top of the weapon console.
- Press the B2 bomb-rocket release button **[RAIt + Space]** on the control stick to launch rockets.

Each press of the button launches one WR-21 rocket.

Rocket Emergency Jettison

The rockets may be hastily jettisoned in case of emergency by using the emergency rocket release switch **[LShift+I]**, located to the right of the rocket master switch. The switch is guarded by a safety cover.

RADI COMMUNICATI

N



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 FuG 16ZY radio of the Fw 190 A-8 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.

With "Easy Communications" 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. The **[\]** key will also close the 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.

With "Easy Communications" disabled

When Easy Communications mode is OFF, the Push To Transmit (PTT) button [RAIt + \] located on the throttle handle 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 Menu

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.

F11. Previous Menu

F12. Exit

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 Maneuver...

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

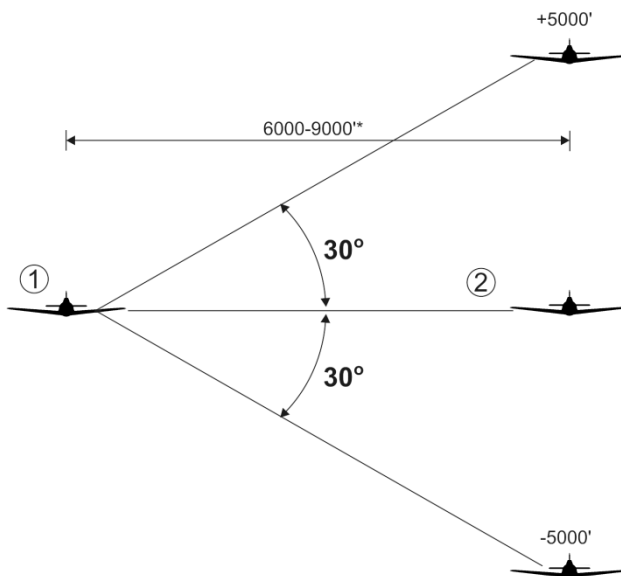
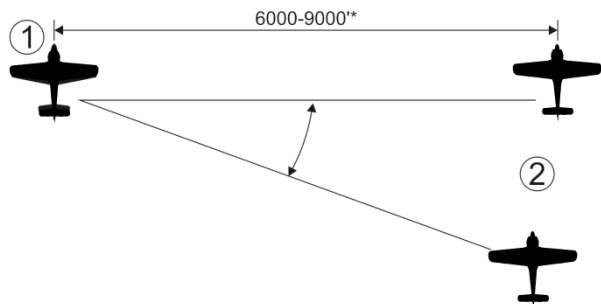


Figure 81: F1 Go Line Abreast



Figure 82: F2 Go Trail

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

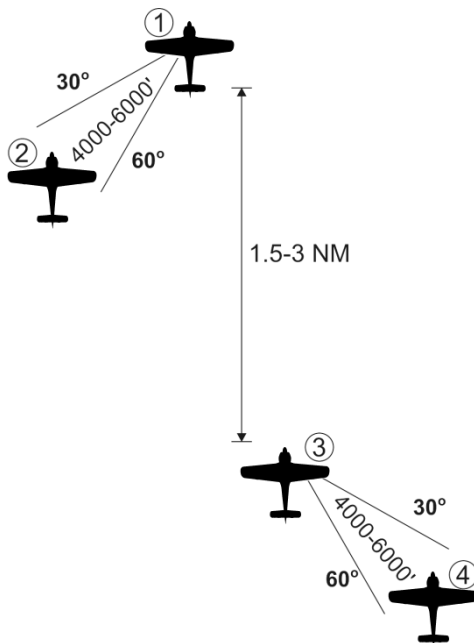


Figure 83: F3 Go Wedge

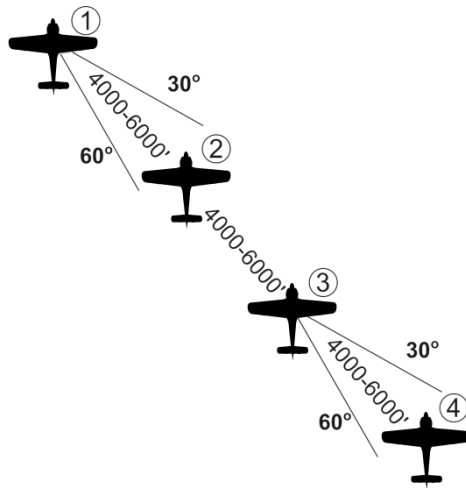


Figure 84: F4 Go Echelon Right

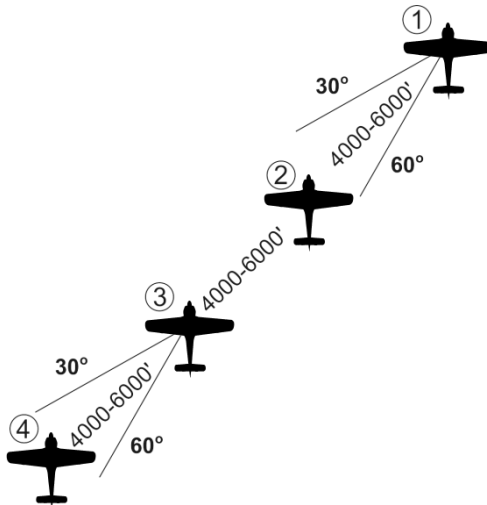


Figure 85: F5 Go Echelon Left

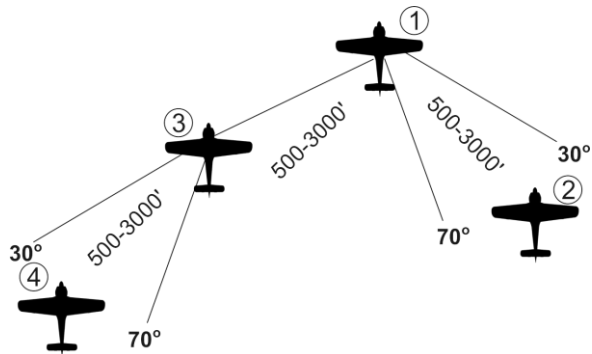


Figure 86: F6 Go Finger Four

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



Figure 87: 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 A-8 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 A-8 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 on 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.

F6 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.

F1 Refuel and Rearm

F2 Ground Electric Power...

F3 Request Repairs

APPENDIX

TERMINOLOGY AND ABBREVIATIONS

| | |
|-------|------------------------------------|
| %Q | Percent Torque |
| AC | Alternating Current |
| ACB | Automatic Circuit Breaker |
| ADF | Automatic Direction Finder |
| AGL | Above Ground Level |
| Ah | Amper x hour |
| AI | Artificial Intelligence |
| ALT | Alternator |
| ALT | Altitude/Altimeter |
| ALTM | Altimeter |
| AM | Amplitude Modulation |
| AMP | Ampere |
| ANT | Antenna |
| ATTD | Attitude |
| AUTO | Automatic |
| AUX | Auxiliary |
| AVGAS | Aviation Gasoline |
| BAT | Battery |
| BDHI | Bearing Distance Heading Indicator |
| BFO | Beat Frequency Oscillator |
| BL | Butt Line |
| BRIL | Brilliance |

| | |
|---------|----------------------------|
| BRT | Bright |
| C | Celsius |
| CARR | Carrier |
| CAS | Callibrated airspeed |
| CCW | Counter Clockwise |
| CDI | Course Deviation Indicator |
| CG | Center of Gravity |
| CL | Centerline |
| CMPS | Compass |
| CNVTR | Converter |
| COLL | Collision |
| COMM | Communication |
| COMPT | Compartment |
| CONT | Control |
| CONT | Continuous |
| CONV | Converter |
| CW | Clockwise |
| DC | Direct Current |
| DCP | Dispenser Control Panel |
| DECR | Decrease |
| deg | degree |
| DELTA A | Incremental Change |
| DET | Detector |
| DF | Direction Finding |
| DG | Directional Gyro |
| DIS | Disable |
| DISP | Dispense |
| DSCRM | Discriminator |
| ECM | Electronic Countermeasures |
| EGT | Exhaust Gas Temperature |
| ELEC | Electrical |

| | |
|--------|--------------------------------------|
| EMER | Emergency |
| END | Endurance |
| ENG | Engine |
| ESS | Essential |
| EXH | Exhaust |
| EXT | Extend |
| EXT | Exterior |
| F | Fahrenheit |
| FAT | Free Air Temperature |
| FCU | Fuel Control Unit |
| FITG | Fitting |
| FM | Frequency Modulation |
| FOD | Foreign Object Damage |
| ftm | feet per minutes |
| FPS | Feet per Second, or Frame per Second |
| FREQ | Frequency |
| FS | Fuselage Station |
| ft | feet |
| ft/min | Feet per Minute |
| ft-in | feet&inch |
| FUS | Fuselage |
| FWD | Forward |
| G | Gravity |
| gal | Gallon |
| GD | Guard |
| GEN | Generator |
| GND | Ground |
| GOV | Governor |
| GPU | Ground Power Unit |
| GRWT | Gross Weight |
| GW | Gross Weight |

| | |
|-------|-----------------------------------|
| HDG | Heading |
| HF | High Frequency |
| HIT | Health Indicator Test |
| HTR | Heater |
| HVAR | High Velocity Aircraft Rocket |
| HYD | Hydraulic |
| Hz | Herz |
| IAS | Indicated Airspeed |
| ICS | Interphone Control Station |
| IDENT | Identification |
| IFF | Identification Friend or Foe |
| IGE | In Ground Effect |
| in | Inch |
| INCR | Increase |
| IND | Indication/Indicator |
| INHG | Inches of Mercury |
| INOP | Inoperative |
| INST | Instrument |
| INT | Internal |
| INT | Interphone |
| INV | Inverter |
| INVTR | Inverter |
| IR | Infrared |
| IRT | Indicator Receiver Transmitter |
| ISA | International Standard Atmosphere |
| KCAS | Knots Calibrated Airspeed |
| kHz | Kilohertz |
| KIAS | Knots Indicated Airspeed |
| km | Kilometer |
| kN | Kilonewton |
| knots | Nautical Miles per Hour |

| | |
|--------|-----------------------------------|
| kp | Kilogram-force |
| KTAS | Knots True Airspeed |
| kVA | Kilovolt-Ampere |
| kW | kiloWatt |
| kW | Kilowatt |
| L | Left |
| LABS | Low-altitude Bombing System |
| lbf | pound-force |
| lbs | Pounds |
| LClick | Left (button) Click Mouse |
| LDG | Landing |
| LH | Left Hand |
| LSB | Lower Sideband |
| LT | Lights |
| LTG | Lighting |
| LTS | Lights |
| MAG | Magnetic |
| MAN | Manual |
| MAX | Maximum |
| MED | Medium |
| MHF | Medium-High Frequency |
| MHz | Megahertz |
| MIC | Microphone |
| mil | millirad, 1\6400 part of a circle |
| MIN | Minimum |
| MIN | Minute |
| MISC | Miscellaneous |
| mm | Millimeter |
| MON | Monitor |
| MPC | Manual Pip Control |
| MWO | Modification Work Order |

| | |
|---------|----------------------------|
| N1 | Gas Turbine Speed |
| N2 | Power Turbine Speed |
| NAV | Navigation |
| NET | Network |
| NM | Nautical Mile |
| nm | Nautical Mile |
| NO | Number |
| NON-ESS | Non-Essential |
| NON-SEC | Non-Secure |
| NORM | Normal |
| NR | Gas Turbine Speed |
| NVG | Night Vision Goggles |
| OGE | Out of Ground Effect |
| PED | Pedestal |
| PLT | Pilot |
| pph | Pounds per Hour |
| PRESS | Pressure |
| PRGM | Program |
| psi | Pounds per Square Inch |
| PVT | Private |
| PWR | Power |
| QTY | Quantity |
| R | Right |
| R/C | Rate of Climb |
| R/D | Rate of Descent |
| RClick | Right (button) Click Mouse |
| RCVR | Receiver |
| RDR | Radar |
| RDS | Rounds |
| REL | Release |
| REM | Remote |

| | |
|--------|----------------------------|
| RETR | Retract |
| RETRAN | Retransmission |
| RF | Radio Frequency |
| RH | Right Hand |
| RI | Remote Height Indicator |
| RPM | Revolutions per Minute |
| SAM | Surface to Air Missile |
| SEC | Secondary |
| SEC | Secure |
| SEL | Select |
| SENS | Sensitivity |
| SL | Searchlight |
| SOL | Solenoid |
| SQ | Squelch |
| SQFT | Square Feet |
| SSB | Single Sideband |
| STA | Station |
| STBY | Standby |
| T/R | Transmit-Receive |
| TAS | True Airspeed |
| TEMP | Temperature |
| TGT | Turbine Gas Temperature |
| TRANS | Transfer |
| TRANS | Transformer |
| TRANS | Transmitter |
| TRQ | Torque |
| UHF | Ultra-High Frequency |
| USB | Upper Sideband |
| V | Volt |
| VAC | Volts, Alternating Current |
| VDC | Volts, Direct Current |

| | |
|------------|--|
| VHF | Very High Frequency |
| VM | Volt Meter |
| VNE | Velocity, Never Exceed (Airspeed) |
| VOL | Volume |
| VOR | VHF Omni Directional Range |
| WL | Water line |
| WPN | Weapon |
| XCVR | Transceiver |
| XMIT | Transmit |
| XMSN | Transmission |
| XMTR | Transmitter |
| ΔF | Increment of Equivalent Flat Plate Drag Area |

CONVERSION OF UNITS, COEFFICIENTS

Metric to Imperial Conversion Table

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 in
1 meter = 10 decimeters = 39.37 in
1 dekameter = 10 meters = 32.8 ft
1 hectometer = 10 dekameters = 328.08 ft
1 kilometer = 10 hectometers = 3,280.8 ft

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. in
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. ft
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. ft
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. in
1 cu. meter = 1000 cu. decimeters = 35.31 cu. ft

Approximate Coefficients for Unit Conversion

| From | To | Multiplication Factor |
|--------------------|--------------------|-----------------------|
| imperial | Metric | |
| in | centimeters | 2.540 |
| ft | meters | .305 |
| yards | meters | .914 |
| miles | kilometers | 1.609 |
| knots | km/h | 1.852 |
| square in | square centimeters | 6.451 |
| square ft | square meters | .093 |
| square yards | square meters | .836 |
| square miles | square kilometers | 2.590 |
| acres | square hectometers | .405 |
| cubic ft | cubic meters | .028 |
| cubic yards | cubic meters | .765 |
| fluid ounces | milliliters | 29,573 |
| pints | liters | .473 |
| quarts | liters | .946 |
| gallons | liters | 3.785 |
| ounces | grams | 28.349 |
| pounds | kilograms | .454 |
| short tons | metric tons | .907 |
| pound-ft | Newton-meters | 1.356 |
| pound-in | Newton-meters | .11296 |
| ounce-in | Newton-meters | .007062 |
| Metric | Imperial | |
| centimeters | in | .394 |
| meters | ft | 3.280 |
| meters | yards | 1.094 |
| kilometers | miles | .621 |
| km/h | knots | 0.54 |
| square centimeters | square in | .155 |
| square meters | square ft | 10.764 |
| square meters | square yards | 1.196 |
| square kilometers | square miles | .386 |
| square hectometers | acres | 2.471 |
| cubic meters | cubic ft | 35.315 |
| cubic meters | cubic yards | 1.308 |
| milliliters | fluid ounces | .034 |

| From | To | Multiplication Factor |
|-------------|------------|-----------------------|
| liters | pints | 2.113 |
| liters | quarts | 1.057 |
| liters | gallons | .264 |
| grams | ounces | .035 |
| kilograms | pounds | 2.205 |
| metric tons | short tons | 1.102 |

Airbase Data

| Airfield | Runway | TACAN Channel | ILS | Tower Comm Frequencies, MHz |
|-------------------------------------|--------------|---------------|----------------------------------|-----------------------------|
| UG23 Gudauta - Bambora (Abkhazia) | 15-33, 2500m | | | 130.0/40.20/209.00 |
| UG24 Tbilisi - Soganlug (Georgia) | 14-32, 2400m | | | 139.0/42.0/218.0 |
| UG27 Vaziani (Georgia) | 14-32, 2500m | 22X (VAS) | 108.75 | 140.0/42.20/219.0 |
| UG5X Kobuleti (Georgia) | 07-25, 2400m | 67X (KBL) | 07 ILS - 111.5 | 133.0/40.80/212.0 |
| UGKO Kutaisi - Kopitnari (Georgia) | 08-26, 2500m | 44X (KTS) | 08 ILS - 109.75 | 134.0/41.0/213.0 |
| UGKS Senaki - Kolkhi (Georgia) | 09-27, 2400m | 31X (TSK) | 09 ILS - 108.9 | 132.0/40.60/211.0 |
| UGSB Batumi (Georgia) | 13-31, 2400m | 16X (BTM) | 13 ILS - 110.3 | 131.0/40.40/210.0 |
| UGSS Sukhumi - Babushara (Abkhazia) | 12-30, 2500m | | | 129.0/40.0/208.0 |
| UGTB Tbilisi - Lochini (Georgia) | 13-31, 3000m | | 13 ILS - 110.3 31 ILS - 108.9 | 138.0/41.80/217.0 |
| URKA Anapa - Vityazevo (Russia) | 04-22, 2900m | | | 121.0/38.40/200.0 |
| URKG Gelendzhik (Russia) | 04-22, 1800m | | | 126.0/39.40/205.0 |

| | | | | |
|--------------------------------------|-----------------|--|----------------------------------|-------------------|
| URKH Maykop - Khanskaya (Russia) | 04-22, 3200m | | | 125.0/39.20/204.0 |
| URKI Krasnodar - Center (Russia) | 09-27, 2500m | | | 122.0/38.60/201.0 |
| URKK Krasnodar - Pashkovsky (Russia) | 05-23, 3100m | | | 128.0/39.80/207.0 |
| URKN Novorossiysk (Russia) | 04-22, 1780m | | | 123.0/38.80/202.0 |
| URKW Krymsk (Russia) | 04-22, 2600m | | | 124.0/39.0/203.0 |
| URMM Mineralnye Vody (Russia) | 12-30, 3900m | | 12 ILS - 111.7 30 ILS - 109.3 | 135.0/41.20/214.0 |
| URMN Nalchik (Russia) | 06-24, 2300m | | 24 ILS - 110.5 | 136.0/41.40/215.0 |
| URMO Beslan (Russia) | 10-28, 3000m | | 10 ILS - 110.5 | 141.0/42.40/220.0 |
| URSS Sochi - Adler (Russia) | 06-24, 3100m | | 06 ILS - 111.1 | 127.0/39.60/206.0 |
| XRMF Mozdok (Russia) | 08-27, 3100m | | | 137.0/41.60/216.0 |

| Airfield | Runway | TACAN, channel | ILS | Tower Comm Frequencies, MHz |
|--------------------------------|---|-------------------|---------------------------|-----------------------------------|
| KXTA Groom Lake AFB (USA) | 14L-32R 3500 m | 18X (GRL) | 32 ILS - 109.30 (GLRI) | 252.0/123.0/38.8 |
| KINS Creech AFB (USA) | 13-31 1500 m, 08-27 2700 m | 87X (INS) | 13 ILS - 108.5 (ICRS) | 251.0/122.0/38.6 |
| KLSV Nellis AFB (USA) | 03L-21R 3000 m, 03R-21L 3000 m | 12X (LSV) | | 254.0/125.0/39.2 |
| KLAS Mc Carran International (| 07K-25D 3100 m 07D-25K 3300 m | 116X (LAS) | 25 ILS - 111.75 (IRLE) | 253.0/124.0/39.0 |

| | | | | |
|--|--|--|--|--|
| | 01K-19D 2500 m 01Д-19K 2500 м | | | |
|--|--|--|--|--|

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