DCS GUIDE
SPITFIRE LF MK IX

By Chuck

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Special thanks to Paul "Goldwolf" Whittingham for creating the guide icons.

The **Supermarine Spitfire** is one of the most iconic aircraft of the Second World War. The Spitfire was built in many variants, using several wing configurations, and was produced in greater numbers than any other British aircraft. It was also the only British fighter to be in continuous production throughout the war. The Spitfire was designed as a short-range, high-performance interceptor aircraft by R. J. Mitchell, chief designer at Supermarine Aviation Works, which operated as a subsidiary of Vickers-Armstrong from 1928.

In accordance with its role as an interceptor, Mitchell supported the development of the Spitfire's distinctive elliptical wing (designed by B. Shenstone) to have the thinnest possible cross-section; this enabled the Spitfire to have a higher top speed than several contemporary fighters, including the Hawker Hurricane. Mitchell continued to refine the design until his death in 1937, whereupon his colleague Joseph Smith took over as chief designer, overseeing the development of the Spitfire through its multitude of variants. Joe Smith is often forgotten, yet he has worked on no fewer than twenty-four Marks of the Spitfire.

Reginald J. Mitchell
(1895-1937)

Joseph Smith
(1897-1956)

I could write about the Spitfire for days, but I prefer to let you read on it yourself. There have been dozens of books written on the men who flew it, tested it, built it, researched it and the mark it left in the bloody pages of History. Needless to say, it remains one of the most interesting masterpieces of british engineering ever built. The Spitfire’s name was ironically hated by Mitchell himself since his boss decided to name the plane after his daughter, his “little spitfire”.

During the Battle of Britain, from July to October 1940, the public perceived the Spitfire to be the main RAF fighter, though the more numerous Hawker Hurricane shouldered a greater proportion of the burden against Germany’s Luftwaffe. However, Spitfire squadrons had a lower attrition rate and a higher victory-to-loss ratio than those flying Hurricanes because of the Spitfire's higher performance. During the battle, Spitfires were generally tasked with engaging Luftwaffe fighters—mainly Messerschmitt Bf 109E-series aircraft, which were a close match for them.

Much loved by its pilots, the Spitfire served in several roles, including interceptor, photo-reconnaissance, fighter-bomber, and trainer, and it continued to serve in these roles until the 1950s. The Seafire was a carrier-based adaptation of the Spitfire that served in the Fleet Air Arm from 1942 through to the mid-1950s. Although the original airframe was designed to be powered by a Rolls-Royce Merlin engine producing 1,030 hp, it was strong enough and adaptable enough to use increasingly powerful Merlins and, in later marks, Rolls-Royce Griffon engines producing up to 2,340 hp. As a result, the Spitfire's performance and capabilities improved over the course of its service life.

During the Second World War, Jeffrey Quill was Vickers Supermarine's chief test pilot, in charge of flight testing all aircraft types built by Vickers Supermarine. He oversaw a group of 10 to 12 pilots responsible for testing all developmental and production Spitfires built by the company in the Southampton area. Quill devised the standard testing procedures, which with variations for specific aircraft designs operated from 1938. Alex Henshaw, chief test pilot at Castle Bromwich from 1940, was placed in charge of testing all Spitfires built at that factory. He coordinated a team of 25 pilots and assessed all Spitfire developments. Between 1940 and 1946, Henshaw flew a total of 2,360 Spitfires and Seafires, more than 10% of total production. Henshaw wrote about flight testing Spitfires:

”I loved the Spitfire in all of her many versions. But I have to admit that the later marks, although they were faster than the earlier ones, were also much heavier and so did not handle so well. You did not have such positive control over them. One test of manoeuvrability was to throw her into a flick-roll and see how many times she rolled. With the Mark II or the Mark V one got two-and-a-half flick-rolls but the Mark IX was heavier and you got only one-and-a-half. With the later and still heavier versions, one got even less. The essence of aircraft design is compromise, and an improvement at one end of the performance envelope is rarely achieved without a deterioration somewhere else.”

The Mark (variant) modelled by Eagle Dynamics and The Fighter Collection is the Spitfire LF Mk IXc, powered by a Rolls-Royce Merlin 66 V-12 engine. By that time, the Spitfire capabilities had changed a lot since the early Mk I used in 1940, mainly in response to the Focke-Wulf FW190 outclassing the Mk V from 1942. The Bf.109, FW190 and Spitfire designs evolved constantly throughout the war, racing towards better performance and armament capabilities. With the Mk IX, the aircraft's new engine dramatically increased its top speed and climb rate over the Mk V. However, these new improvements meant aerodynamic trade-offs had to be made. The Spitfire became a less efficient turn fighter as a result.

The first Mk IX was basically a slightly strengthened Mark Vc airframe coupled to a heavier and more powerful Merlin 61 engine (fitted with a two-stage supercharger and intercooler). A four-bladed propeller was installed to harness the increased horsepower. Apart from the longer nose profile, Mk IX's another distinctive feature was a revised system of underwing radiators (which featured two symmetrical, oblong section radiator housings, one under each wing). Early-production Mk IXs retained the rounded fin and rudder tip of the Mark V. However, the torque produced on take-off by the new, powerful engine was so great that it was necessary to introduce the broad-chord, pointed-tipped rudder. Early production Spitfire IXs suffered from vapour locks in the fuel lines resulting from fuel evaporating if the aircraft was parked in direct sunlight. As a result of this the gun-camera was moved from the port wingroot to the starboard wingroot and a fuel cooler, fed by a small round air-intake was fitted in its place.

Early Mk IXs, fitted with the 'C' type wing, were armed with two 20 mm Hispano cannons and four 0.303-in machine guns. Many late-model Mark IXs, fitted with the 'E' type wing (which was introduced in 1944), exchanged the ineffective 0.303s for two 0.50-in Browning machine guns (one per wing), mounted inboard of the 20 mm cannons.

From spring of 1935, when the prototype assembly began, until February 1948, when the last Mk.24 was built, about 20,400 Spitfires were produced. (No consensus exists as to the exact number). This number does not include the Seafire variant, which remained in production until March 1949. The story of the Spitfire might have turned out differently, had its creator, Reginald Mitchell, still been alive. Mitchell's character was that of an innovator, not a continuer. Most likely, he, much like Sidney Camm of Hawker, would have created a number of new and different aircraft instead of squeezing all the juice from the Spitfire. In any case, the Spitfire saw action from the beginning of the war until its very end, and the Spitfire Mk.24 was regarded as one of the world's best piston engine fighters.

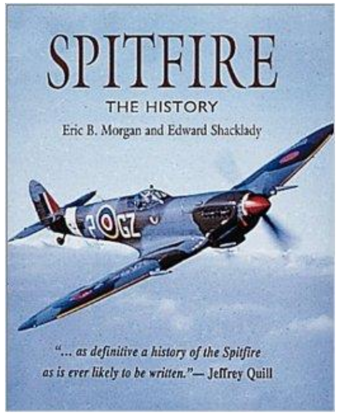
Compared with its prototype, the Mk.24 was a third faster, had twice the rate of climb, and its weapons' burst mass was five times more. In addition, the Mk.24's takeoff weight, in comparison with the prototype's, increased by 3080 kg, which, according to airline rules was equal to the mass of 30 passengers (assuming 20 kg of luggage per passenger). These figures give an idea of how far the development of the aircraft has gone.

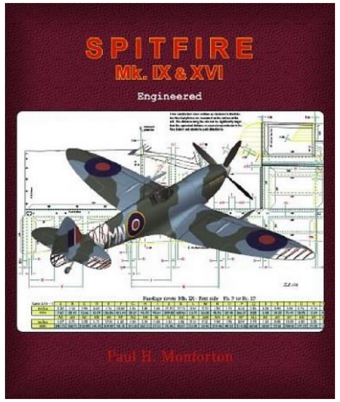
Pilots came from the four corners of the world to fly the Spitfire and fight the Luftwaffe. Famous aces include James "Johnnie" Johnson, Douglas Bader, Robert Stanford Tuck, Paddy Finucane, George Beurling, Adolph "Sailor" Malan, Alan Deere, Colin Falkland Cray and Pierre Clostermann.

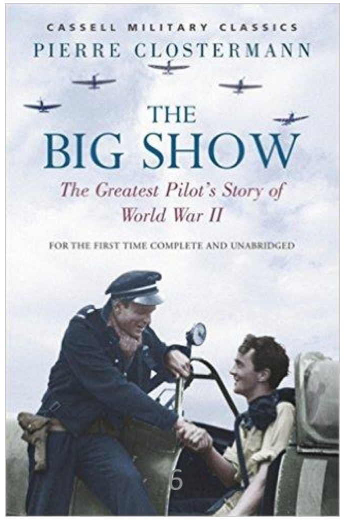
After the Battle of Britain, the Spitfire superseded the Hurricane to become the backbone of RAF Fighter Command, and saw action in the European, Mediterranean, Pacific and the South-East Asian theatres. Much loved by its pilots, the Spitfire served in several roles, including interceptor, photo-reconnaissance, fighter-bomber and trainer, and it continued to serve in these roles until the 1950s.

There are three books that I particularly recommend reading if you are a fan of the Spitfire:

- *Spitfire: The History* by Eric B. Morgan and Edward Shacklady
- *The Big Show* by Pierre Clostermann
- *Spitfire Mk. IX & XVI Engineered* by Paul H. Monforton





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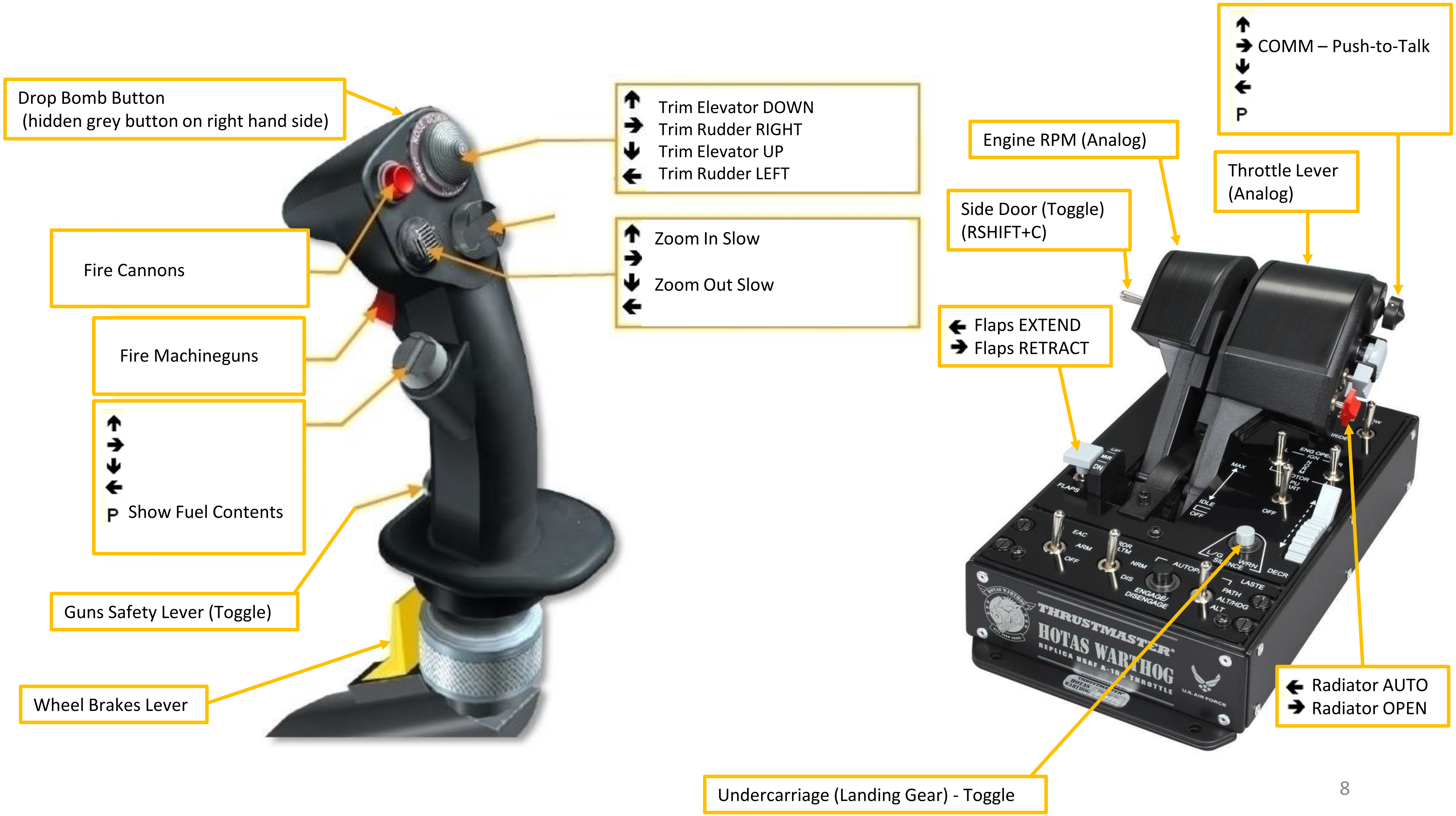
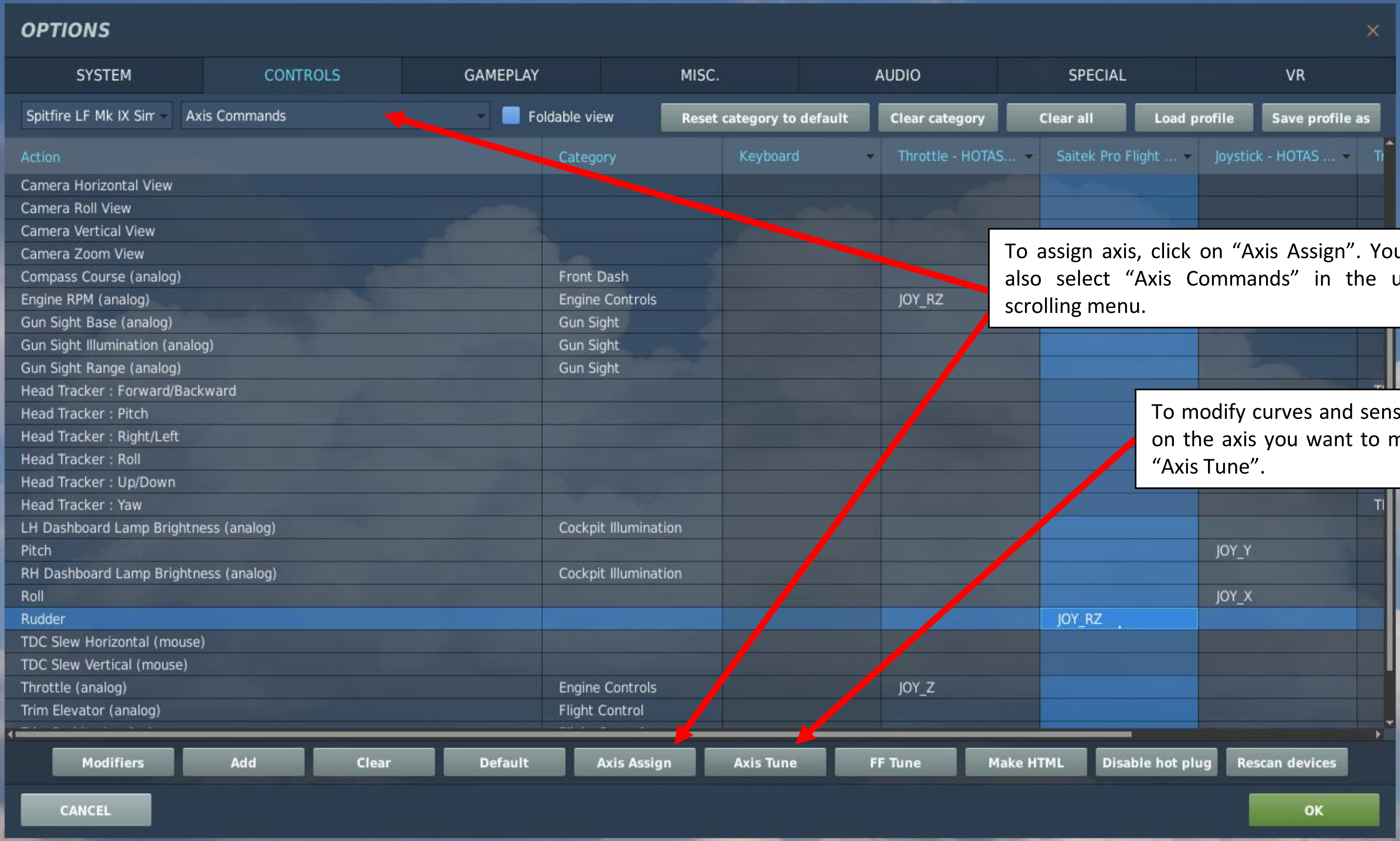
WHAT YOU NEED MAPPED





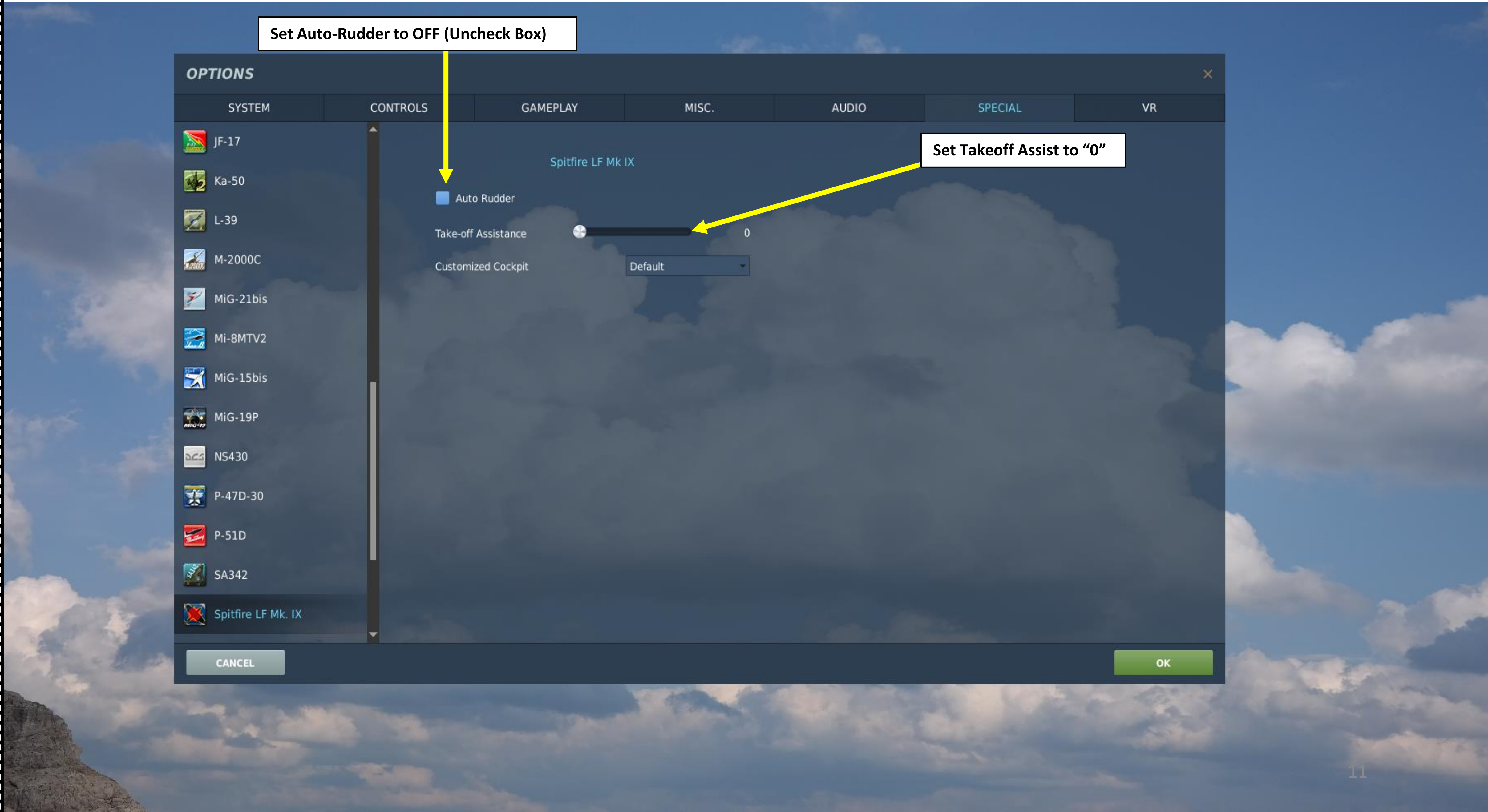
To assign axis, click on "Axis Assign". You can also select "Axis Commands" in the upper scrolling menu.

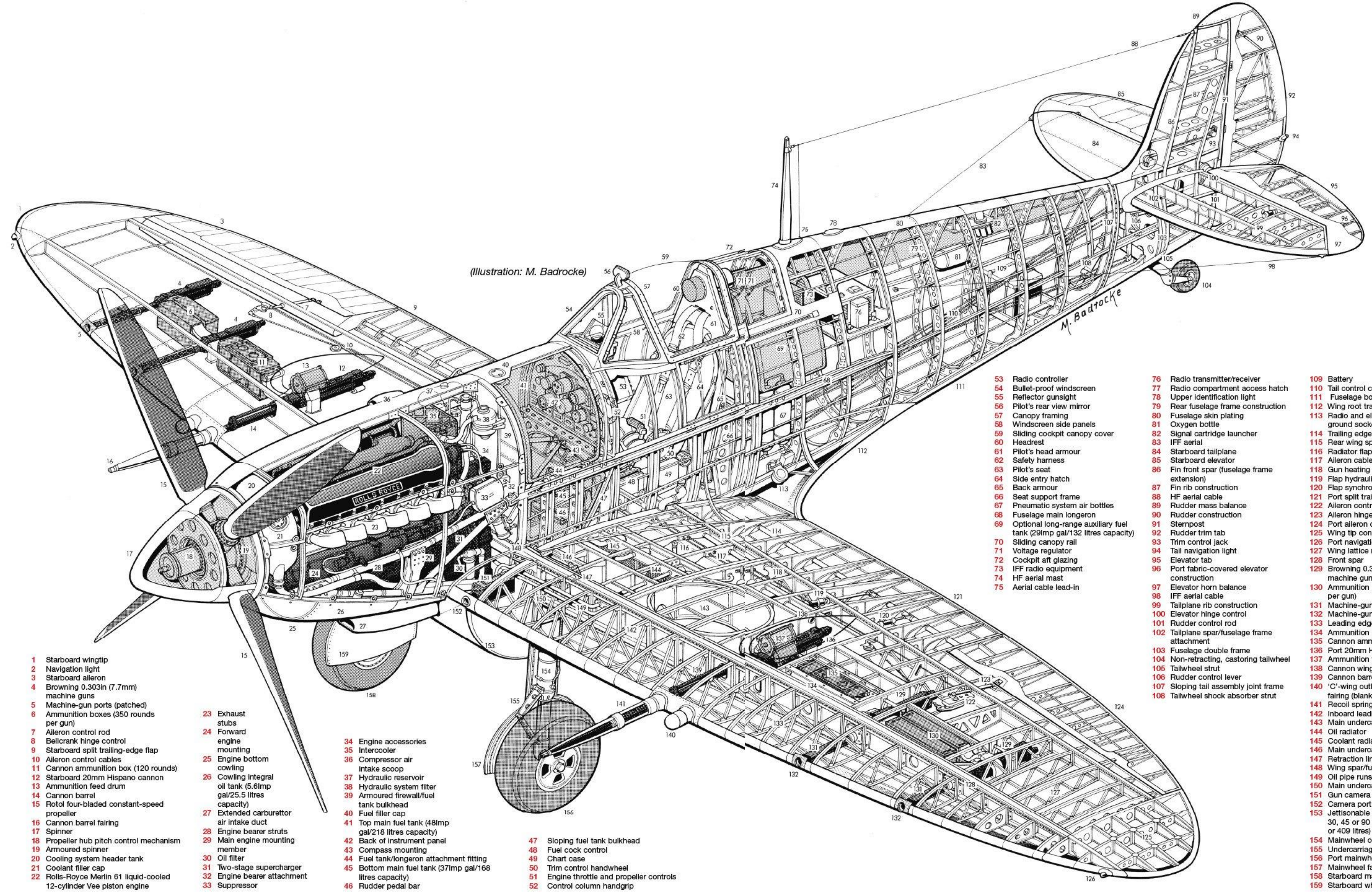
To modify curves and sensitivities of axes, click on the axis you want to modify and then click "Axis Tune".

Bind the following axes:

- Pitch, Roll, Rudder (Deadzone at 5, Saturation X at 100, Saturation Y at 100, Curvature at 15)
- Engine RPM (Analog) – Controls RPM
- Throttle (Analog) – Controls Manifold Pressure / Boost

In the "Special" menu in Options, select the Spitfire LF Mk IX menu. Make sure to have Takeoff Assist set to "0" (turned off). By default it is set to 100 (ON). This will cause you to crash and burn inexplicably during takeoff. Also uncheck the Auto-Rudder box.





(Illustration: M. Badrocke)

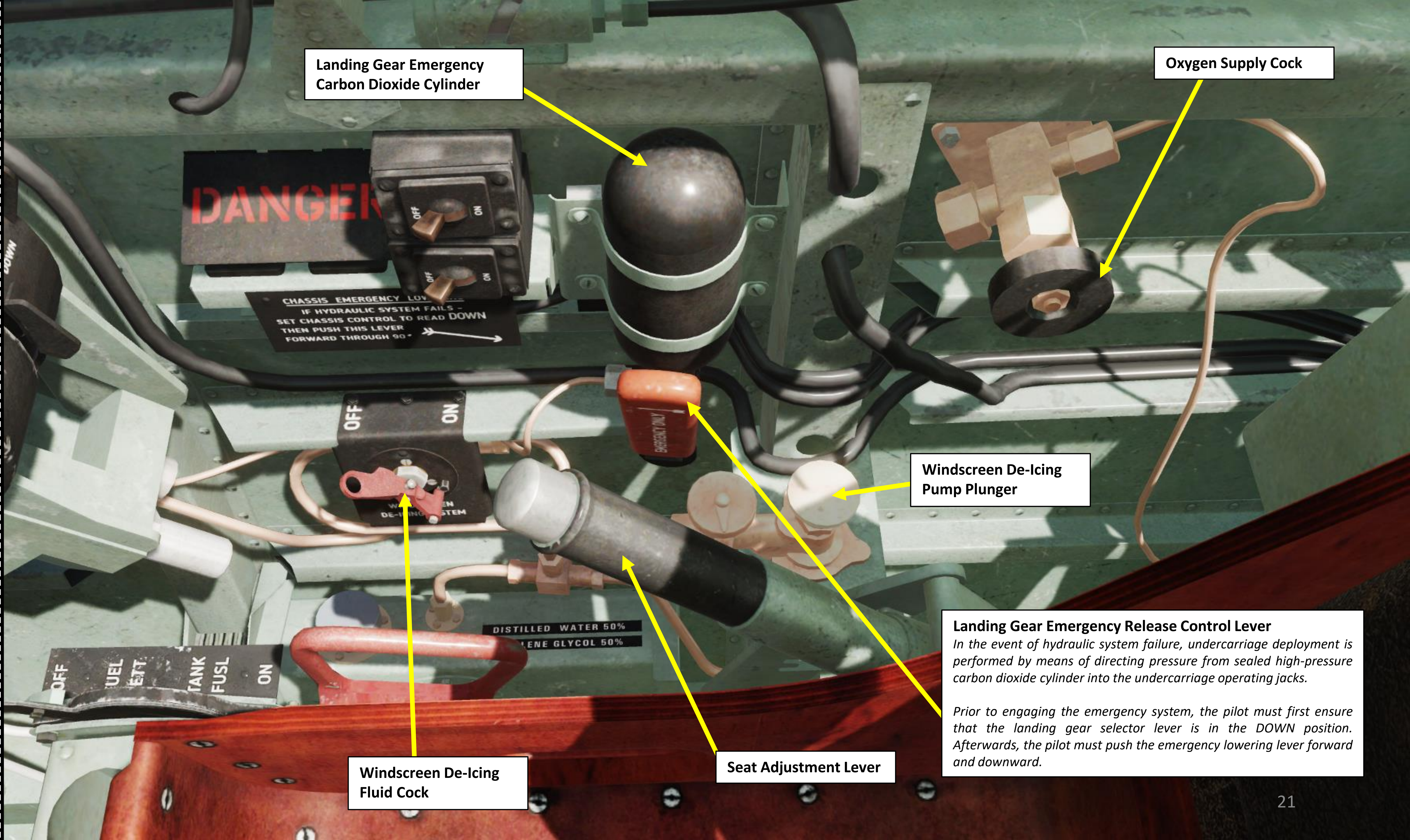
1 Starboard wingtip
2 Navigation light
3 Starboard aileron
4 Browning 0.303in (7.7mm) machine guns
5 Machine-gun ports (patched)
6 Ammunition boxes (350 rounds per gun)
7 Aileron control rod
8 Bellcrank hinge control
9 Starboard split trailing-edge flap
10 Aileron control cables
11 Cannon ammunition box (120 rounds)
12 Starboard 20mm Hispano cannon
13 Ammunition feed drum
14 Cannon barrel
15 Rotol four-bladed constant-speed propeller
16 Cannon barrel fairing
17 Spinner
18 Propeller hub pitch control mechanism
19 Armoured spinner
20 Cooling system header tank
21 Coolant filler cap
22 Rolls-Royce Merlin 61 liquid-cooled 12-cylinder Vee piston engine
23 Exhaust stubs
24 Forward engine mounting
25 Engine bottom cowling
26 Cowling integral oil tank (5.6Imp gal/25.5 litres capacity)
27 Extended carburettor air intake duct
28 Engine bearer struts
29 Main engine mounting member
30 Oil filter
31 Two-stage supercharger
32 Engine bearer attachment
33 Suppressor
34 Engine accessories
35 Intercooler
36 Compressor air intake scoop
37 Hydraulic reservoir
38 Hydraulic system filter
39 Armoured firewall/fuel tank bulkhead
40 Fuel filler cap
41 Top main fuel tank (48Imp gal/218 litres capacity)
42 Back of instrument panel
43 Compass mounting
44 Fuel tank/longeron attachment fitting
45 Bottom main fuel tank (37Imp gal/168 litres capacity)
46 Rudder pedal bar
47 Sloping fuel tank bulkhead
48 Fuel cock control
49 Chart case
50 Trim control handwheel
51 Engine throttle and propeller controls
52 Control column handgrip
53 Radio controller
54 Bullet-proof windscreen
55 Reflector gunsight
56 Pilot's rear view mirror
57 Canopy framing
58 Windscreen side panels
59 Sliding cockpit canopy cover
60 Headrest
61 Pilot's head armour
62 Safety harness
63 Pilot's seat
64 Side entry hatch
65 Back armour
66 Seat support frame
67 Pneumatic system air bottles
68 Fuselage main longeron
69 Optional long-range auxiliary fuel tank (29Imp gal/132 litres capacity)
70 Sliding canopy rail
71 Voltage regulator
72 Cockpit aft glazing
73 IFF radio equipment
74 HF aerial mast
75 Aerial cable lead-in
76 Radio transmitter/receiver
77 Radio compartment access hatch
78 Upper identification light
79 Rear fuselage frame construction
80 Fuselage skin plating
81 Oxygen bottle
82 Signal cartridge launcher
83 IFF aerial
84 Starboard tailplane
85 Starboard elevator
86 Fin front spar (fuselage frame extension)
87 Fin rib construction
88 HF aerial cable
89 Rudder mass balance
90 Rudder construction
91 Sternpost
92 Rudder trim tab
93 Trim control jack
94 Tail navigation light
95 Elevator tab
96 Port fabric-covered elevator construction
97 Elevator horn balance
98 IFF aerial cable
99 Tailplane rib construction
100 Elevator hinge control
101 Rudder control rod
102 Tailplane spar/fuselage frame attachment
103 Fuselage double frame
104 Non-retracting, castoring tailwheel
105 Tailwheel strut
106 Rudder control lever
107 Sloping tail assembly joint frame
108 Tailwheel shock absorber strut
109 Battery
110 Tail control cable runs
111 Fuselage bottom longeron
112 Wing root trailing edge fillet
113 Radio and electrical system ground socket
114 Trailing edge flap shroud ribs
115 Rear wing spar
116 Radiator flap jack
117 Aileron cable runs
118 Gun heating air duct
119 Flap hydraulic jack
120 Flap synchronising jack
121 Port split trailing-edge flap
122 Aileron control bellcrank
123 Aileron hinge control rod
124 Port aileron construction
125 Wing tip construction
126 Port navigation light
127 Wing lattice rib construction
128 Front spar
129 Browning 0.303in (7.7mm) machine guns
130 Ammunition boxes (350 rounds per gun)
131 Machine-gun muzzle blast tubes
132 Machine-gun ports (patched)
133 Leading edge nose ribs
134 Ammunition box armour protection
135 Cannon ammunition box (120 rounds)
136 Port 20mm Hispano cannon
137 Ammunition feed drum
138 Cannon wing fairing
139 Cannon barrel
140 'C'-wing outboard cannon muzzle fairing (blanked-off)
141 Recoil spring
142 Inboard leading edge lattice ribs
143 Main undercarriage wheel well
144 Oil radiator
145 Coolant radiator
146 Main undercarriage retraction jack
147 Retraction link
148 Wing spar/fuselage attachment joint
149 Oil pipe runs to radiator
150 Main undercarriage leg pintle
151 Gun camera
152 Camera port
153 Jettisonable slipper tank, capacity 30, 45 or 90 Imp gal (136, 205 or 409 litres)
154 Mainwheel oleo damper
155 Undercarriage torque links
156 Port mainwheel
157 Mainwheel fairing door
158 Starboard mainwheel
159 Starboard wheel fairing door

Tip: Pilot body can be toggled ON/OFF with "RSHIFT+P"


STORES REF. Nº 8B/2361
REFLECTOR GUN SIGHT MARK II
RANGE | 100 YARDS
BASE | FEET
UP
UP
DOWN
RPM
BOOST
OIL
FUEL TANK PRESSURE


NOSE DOWN
NOSE UP
CHASSIS
UP
DOWN
CONTROL IS SET TO
IDLE
KEEP LEVER IN LOWER GATE ON GROUND
BEFORE USING CO2 SET TO DOWN
OFF
ON
RUDDER
BIAS
STBD
PORT

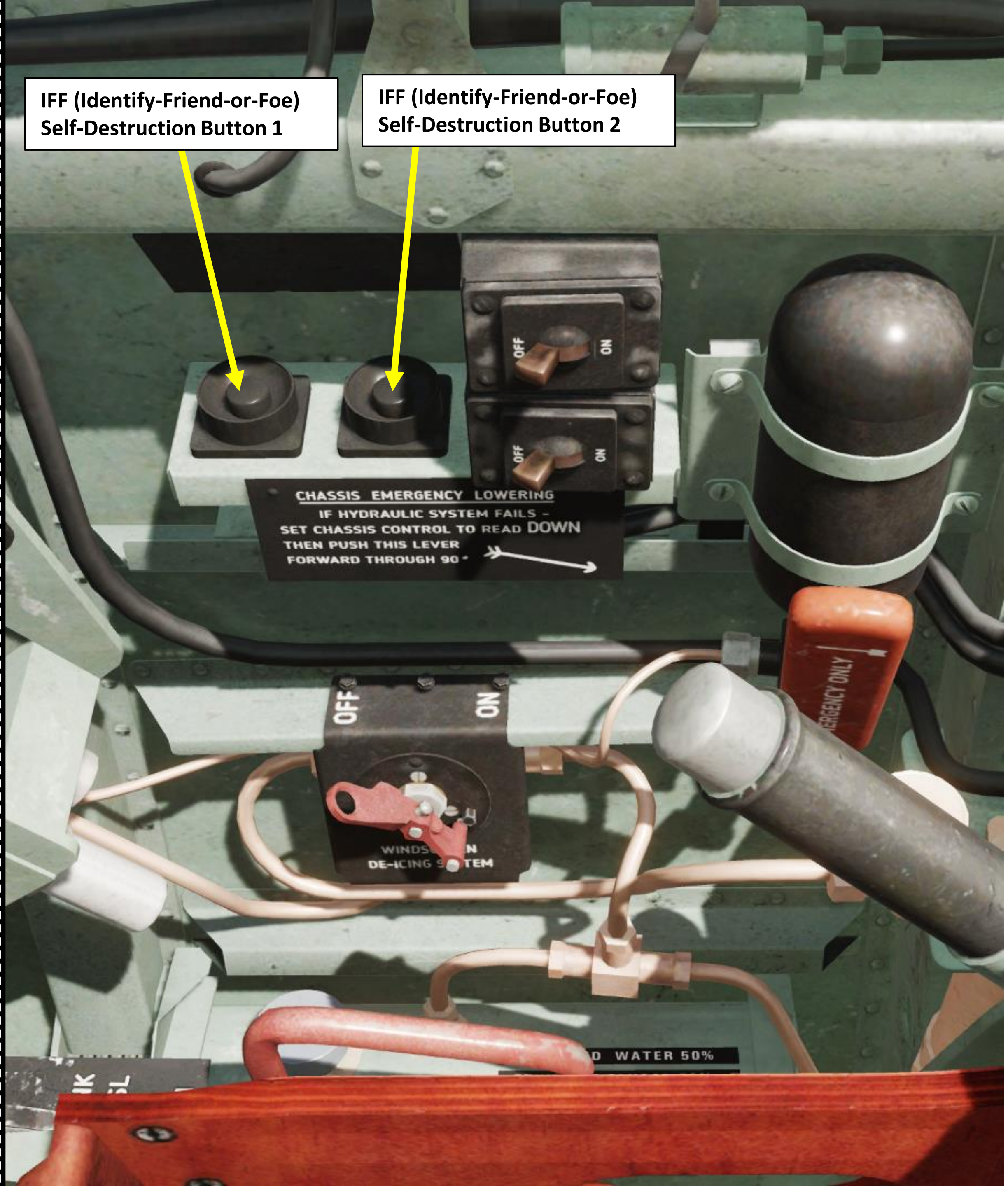

DANGER
CHASSIS
← UP
DOWN →
FUEL TANK PRESSURE
OFF
ON
DISTILLED WATER 50%

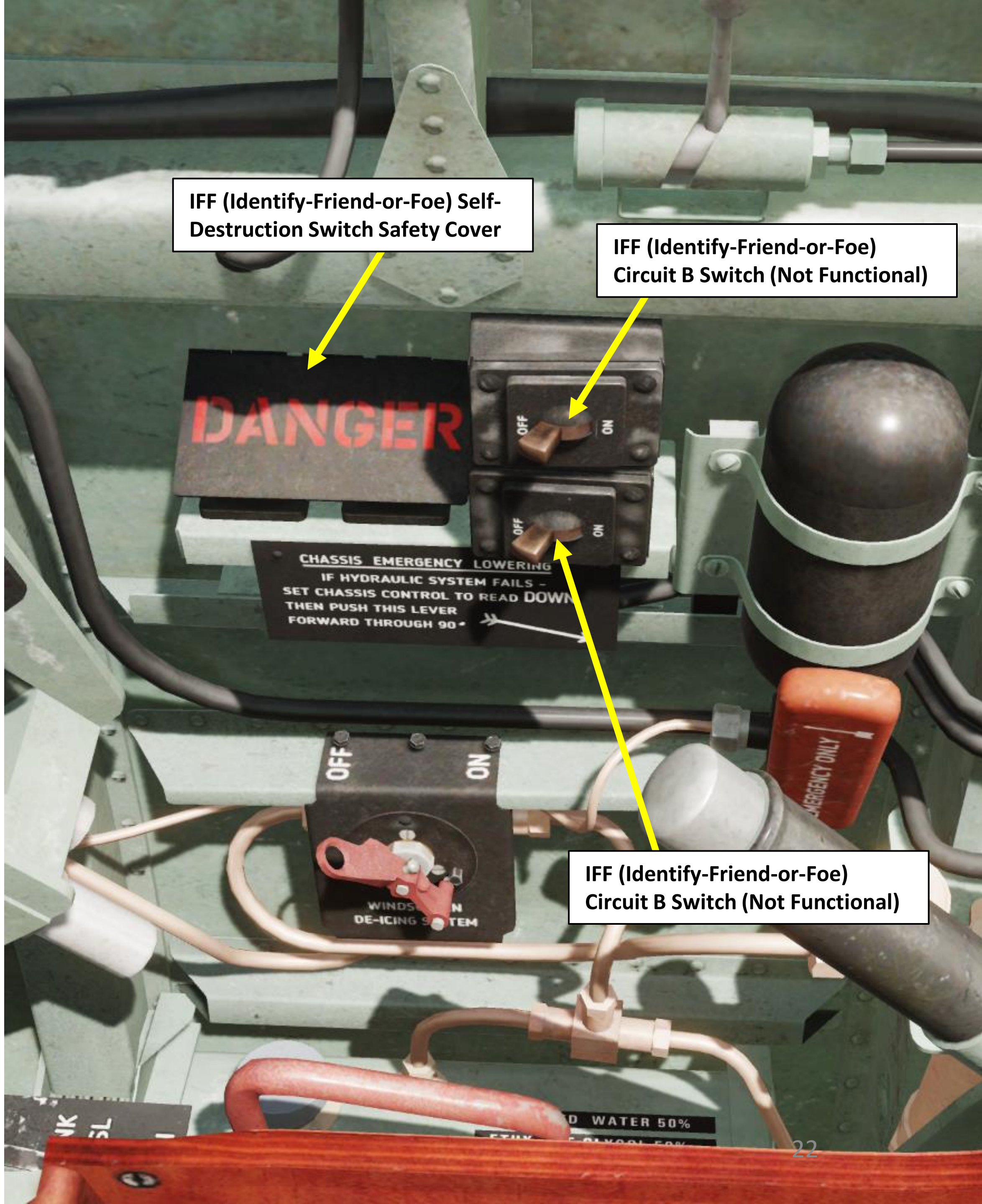


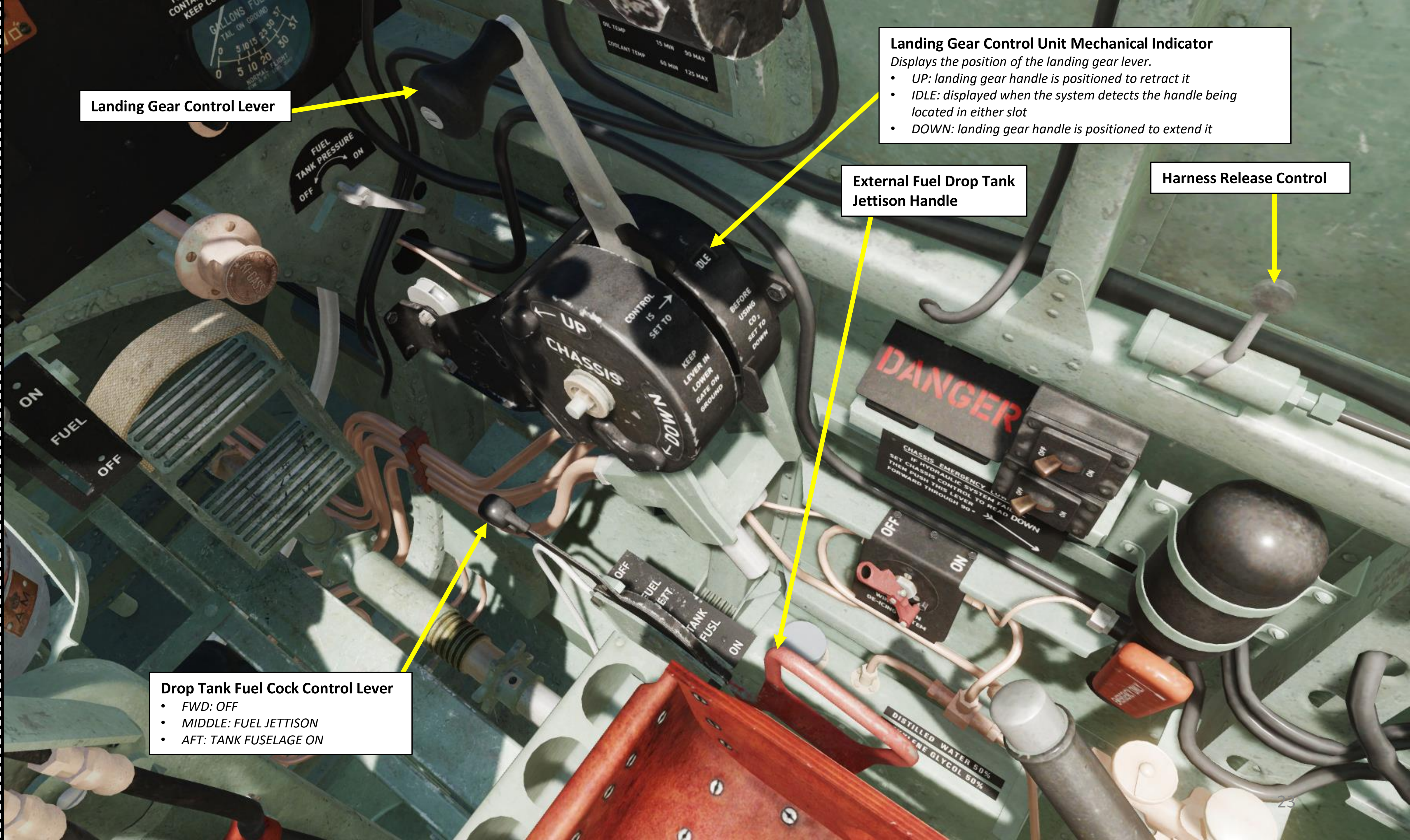
Landing Gear Emergency Release Control Lever

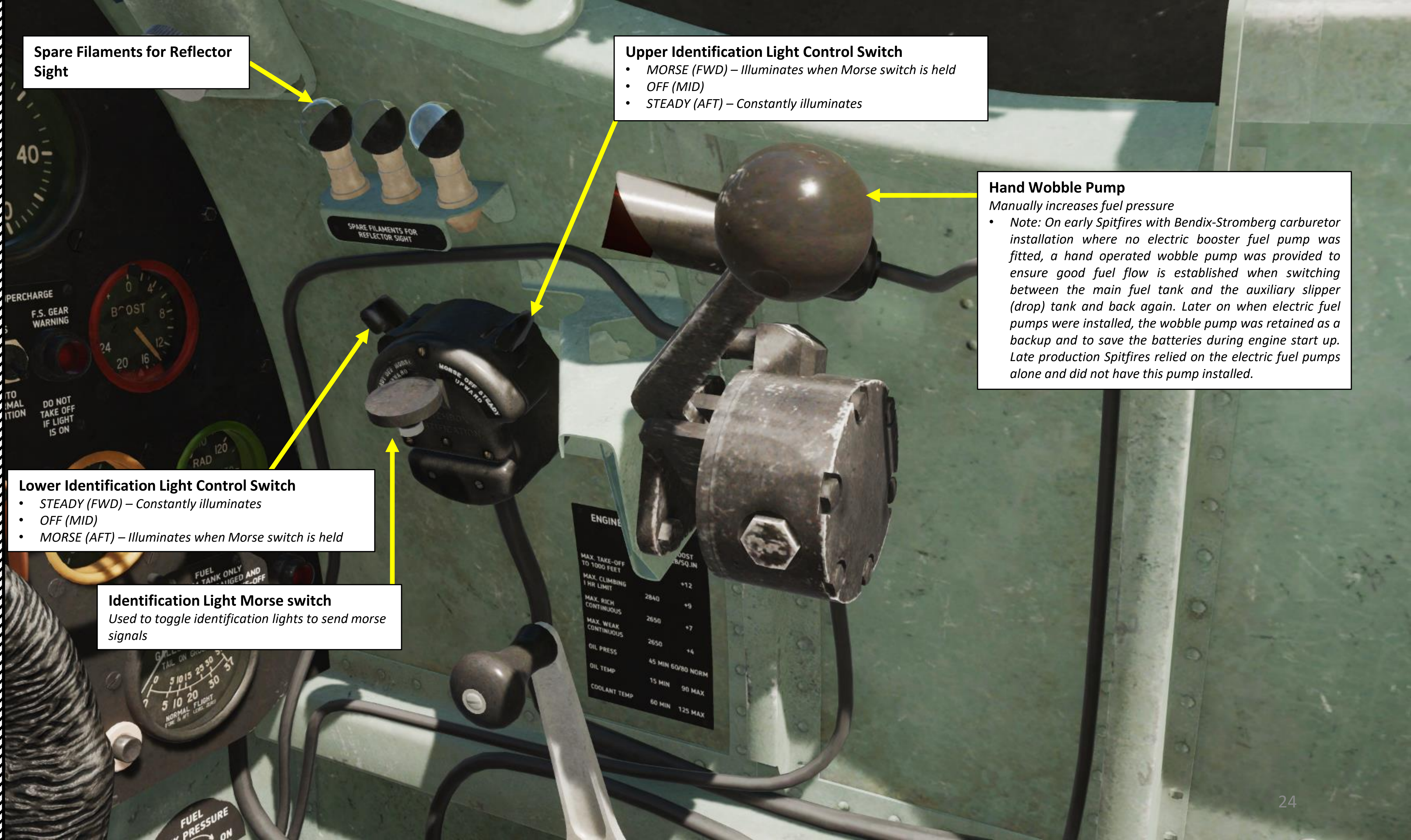
In the event of hydraulic system failure, undercarriage deployment is performed by means of directing pressure from sealed high-pressure carbon dioxide cylinder into the undercarriage operating jacks.

Prior to engaging the emergency system, the pilot must first ensure that the landing gear selector lever is in the DOWN position. Afterwards, the pilot must push the emergency lowering lever forward and downward.


IFF (Identify-Friend-or-Foe) Self-Destruction Button 1
IFF (Identify-Friend-or-Foe) Self-Destruction Button 2
OFF
ON
CHASSIS EMERGENCY LOWERING
IF HYDRAULIC SYSTEM FAILS -
SET CHASSIS CONTROL TO READ DOWN
THEN PUSH THIS LEVER
FORWARD THROUGH 90°
OFF
ON


IFF (Identify-Friend-or-Foe) Self-Destruction Switch Safety Cover
IFF (Identify-Friend-or-Foe) Circuit B Switch (Not Functional)
DANGER
IFF (Identify-Friend-or-Foe) Circuit B Switch (Not Functional)
CHASSIS EMERGENCY LOWERING
IF HYDRAULIC SYSTEM FAILS -
SET CHASSIS CONTROL TO READ DOWN
THEN PUSH THIS LEVER
FORWARD THROUGH 90°
OFF
ON


Landing Gear Control Lever
Landing Gear Control Unit Mechanical Indicator
Displays the position of the landing gear lever.
• UP: landing gear handle is positioned to retract it
• IDLE: displayed when the system detects the handle being located in either slot
• DOWN: landing gear handle is positioned to extend it
External Fuel Drop Tank Jettison Handle
Harness Release Control
Drop Tank Fuel Cock Control Lever
• FWD: OFF
• MIDDLE: FUEL JETTISON
• AFT: TANK FUSELAGE ON
FUEL TANK PRESSURE
ON
OFF
UP
CHASSIS
DOWN
CONTROL IS SET TO
KEEP LEVER IN LOWER GATE ON GROUND
BEFORE USING CO2 SET TO DOWN
IDLE
DANGER
ON
FUEL
OFF



Spare Filaments for Reflector Sight

Upper Identification Light Control Switch

- *MORSE (FWD) – Illuminates when Morse switch is held*
- *OFF (MID)*
- *STEADY (AFT) – Constantly illuminates*

Hand Wobble Pump

Manually increases fuel pressure

- *Note: On early Spitfires with Bendix-Stromberg carburetor installation where no electric booster fuel pump was fitted, a hand operated wobble pump was provided to ensure good fuel flow is established when switching between the main fuel tank and the auxiliary slipper (drop) tank and back again. Later on when electric fuel pumps were installed, the wobble pump was retained as a backup and to save the batteries during engine start up. Late production Spitfires relied on the electric fuel pumps alone and did not have this pump installed.*

Lower Identification Light Control Switch

- *STEADY (FWD) – Constantly illuminates*
- *OFF (MID)*
- *MORSE (AFT) – Illuminates when Morse switch is held*

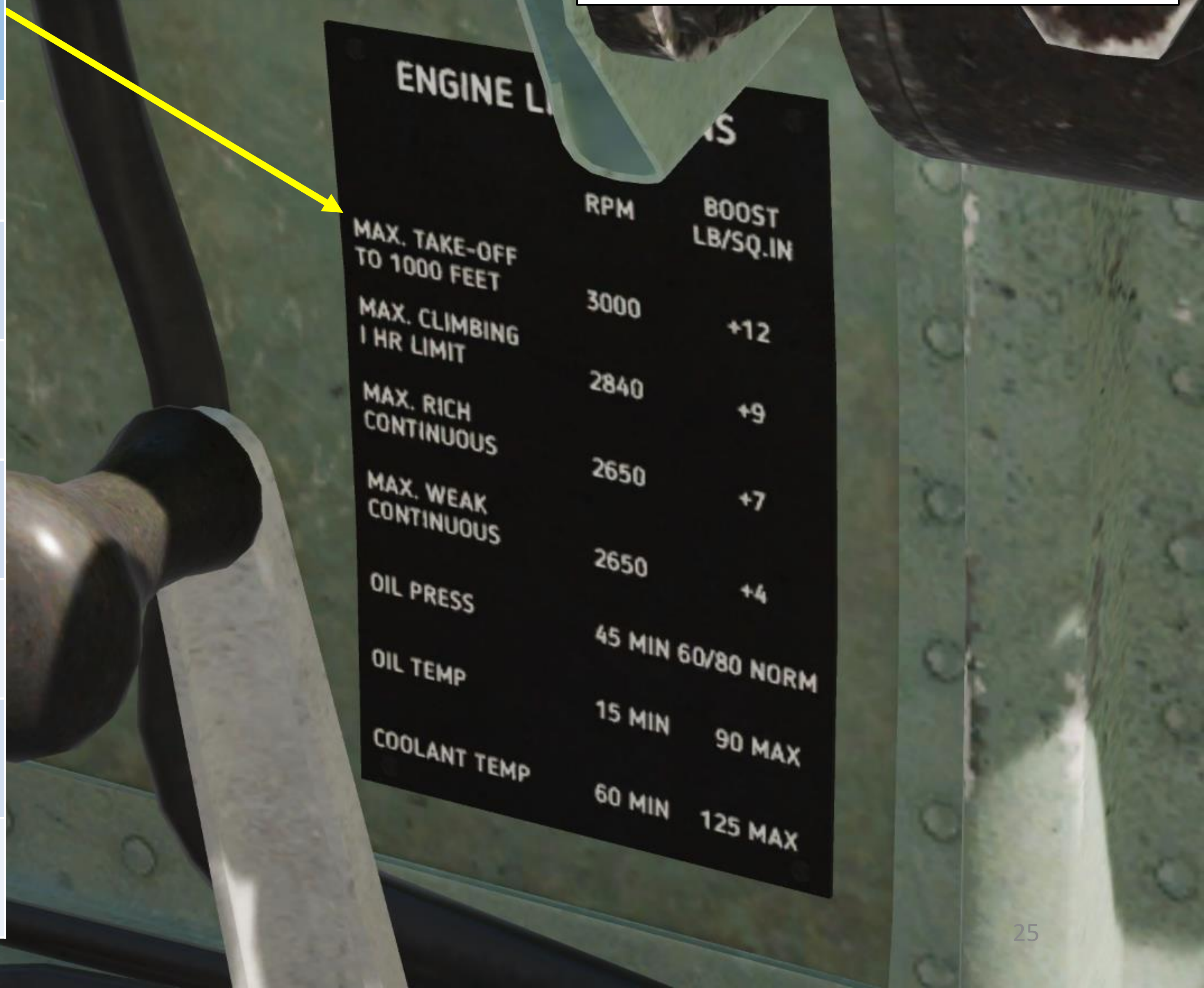
Identification Light Morse switch

Used to toggle identification lights to send morse signals

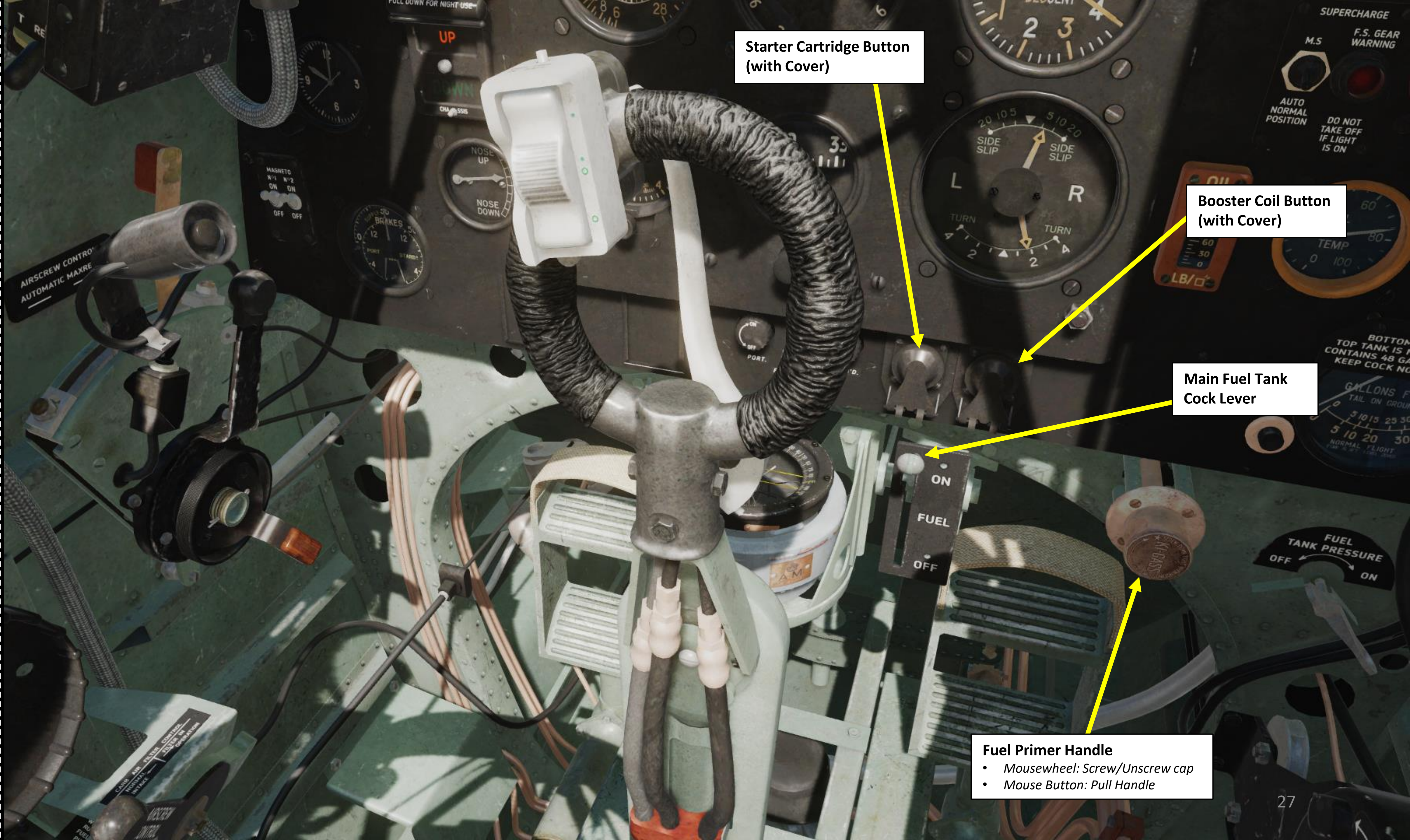
ENGINE LIMITATIONS

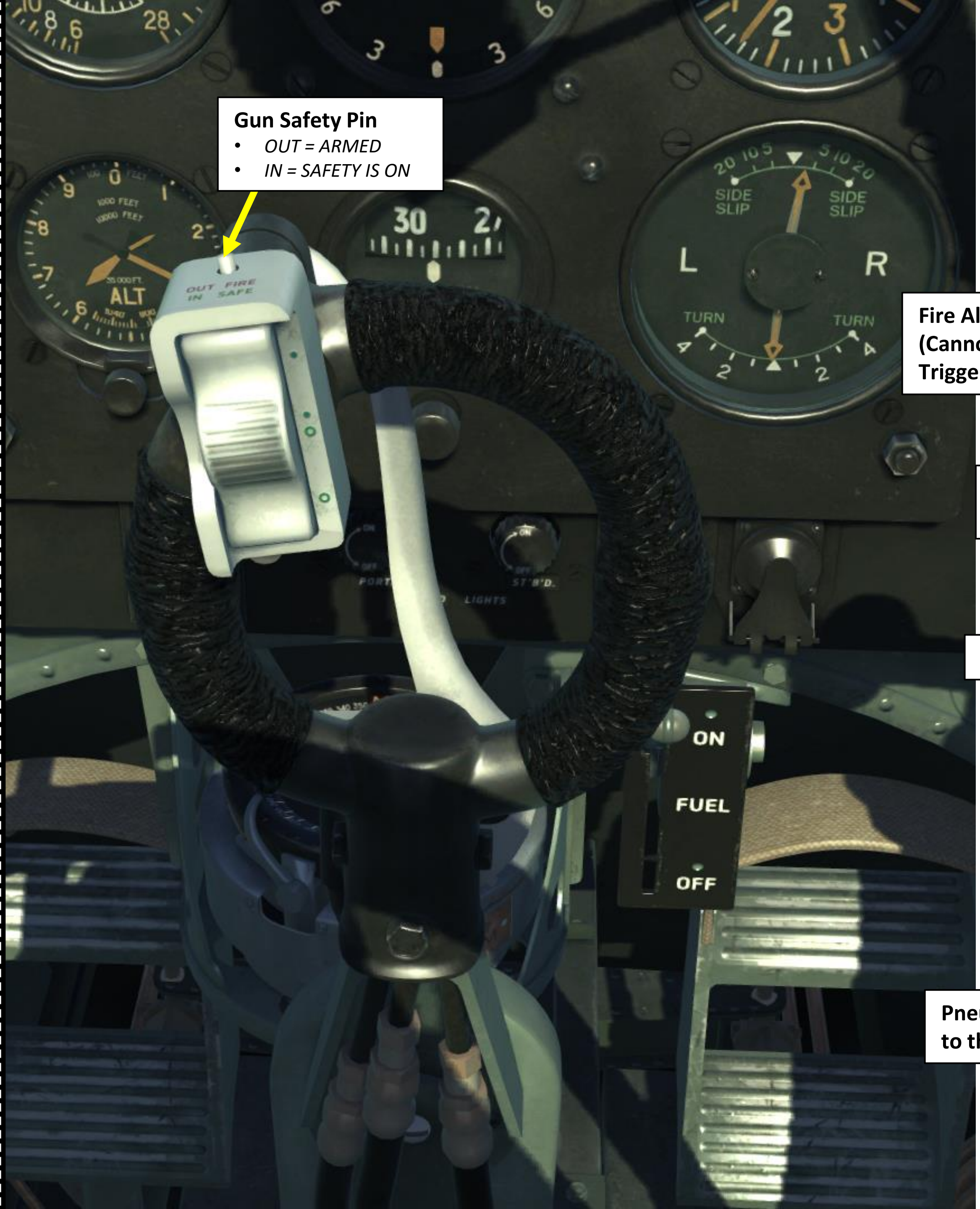
Power Setting	RPM	BOOST (psi)
Max Take-Off to 1000 ft (Altitude)	3000	+12
Max Climbing Power (1 hour limit)	2840	+9
Max Rich Continuous	2650	+7
Max Weak Continuous	2650	+4
Oil Pressure (psi)	45 min 60/80 psi NORMAL	
Oil Temperature (deg C)	15 min 90 deg C MAX	
Coolant Temperature (deg C)	60 min 125 deg C MAX	

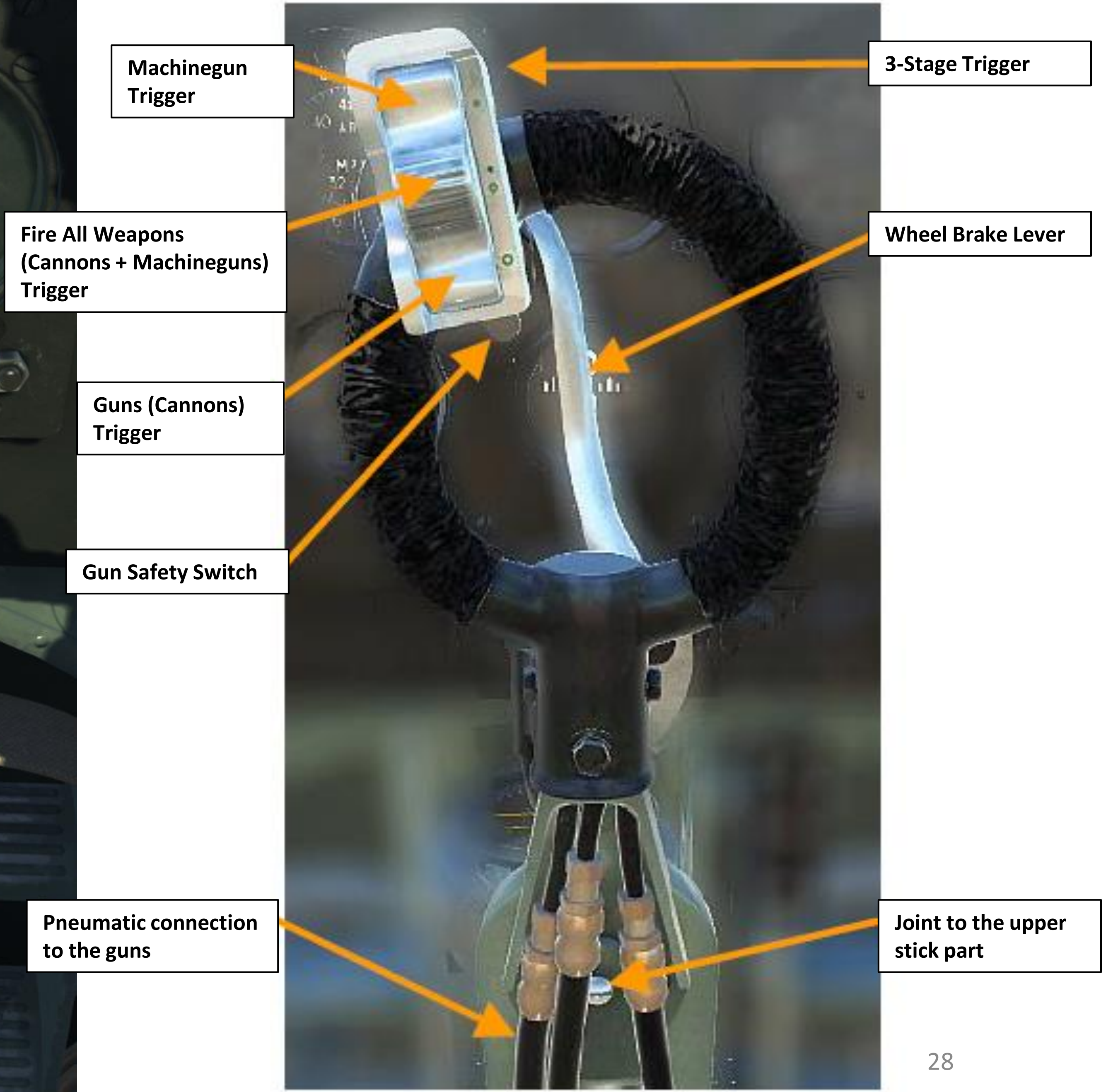
NOTE: Boost is also known as “engine manifold pressure”. Typical WW2-era boost units are:
UK: psi (pound per square inch)
US: inches of Mercury (in Hg)
RUSSIA: mm of Mercury (mm Hg)
GERMANY: ATA (Atmosphere absolute pressure)

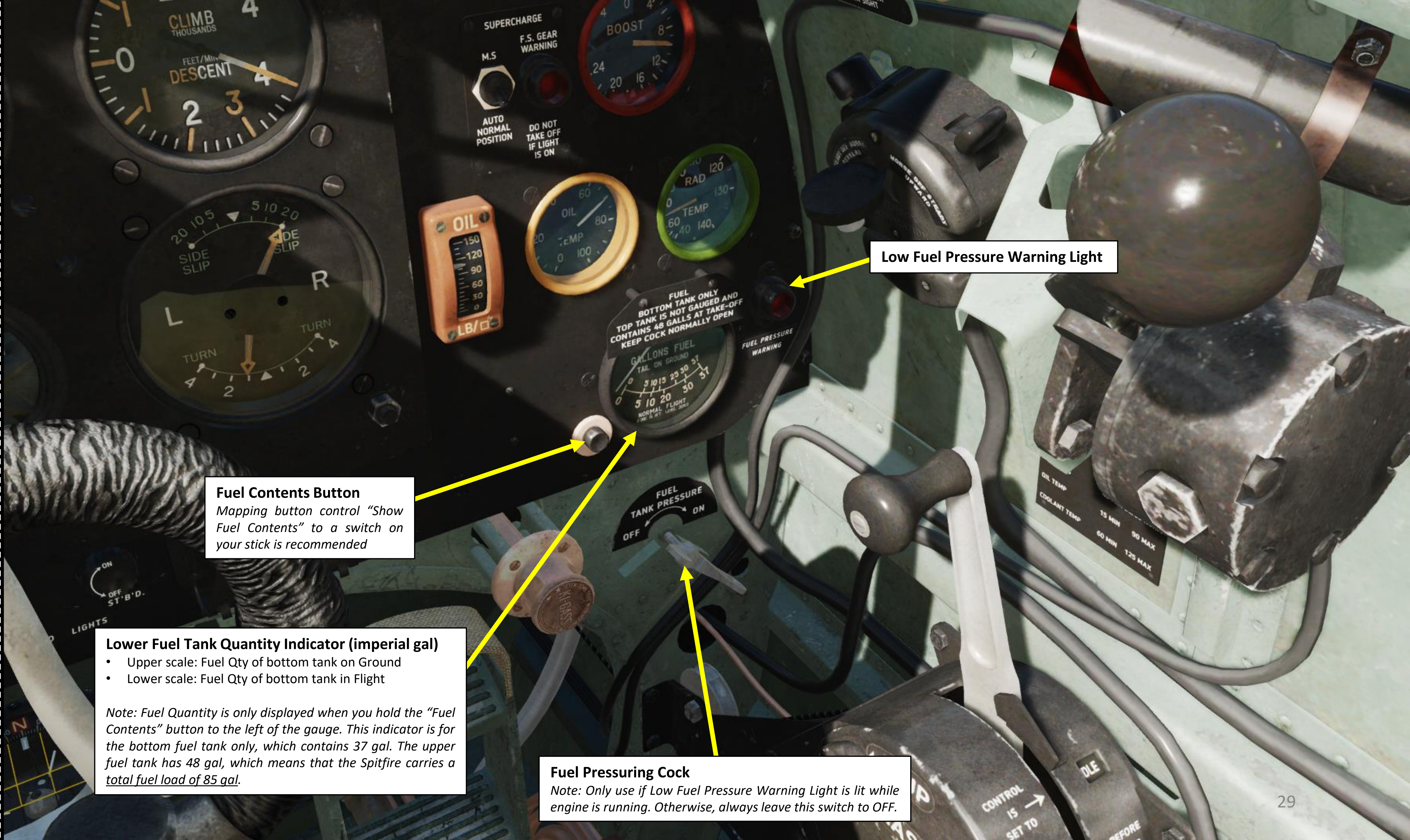



UP
RPM


Starter Cartridge Button (with Cover)
Booster Coil Button (with Cover)
Main Fuel Tank Cock Lever
Fuel Primer Handle
• Mousewheel: Screw/Unscrew cap
• Mouse Button: Pull Handle


Gun Safety Pin
• OUT = ARMED
• IN = SAFETY IS ON
ON
FUEL
OFF


Machinegun Trigger
3-Stage Trigger
Fire All Weapons (Cannons + Machineguns) Trigger
Wheel Brake Lever
Guns (Cannons) Trigger
Gun Safety Switch
Pneumatic connection to the guns
Joint to the upper stick part



Fuel Contents Button

Mapping button control "Show Fuel Contents" to a switch on your stick is recommended

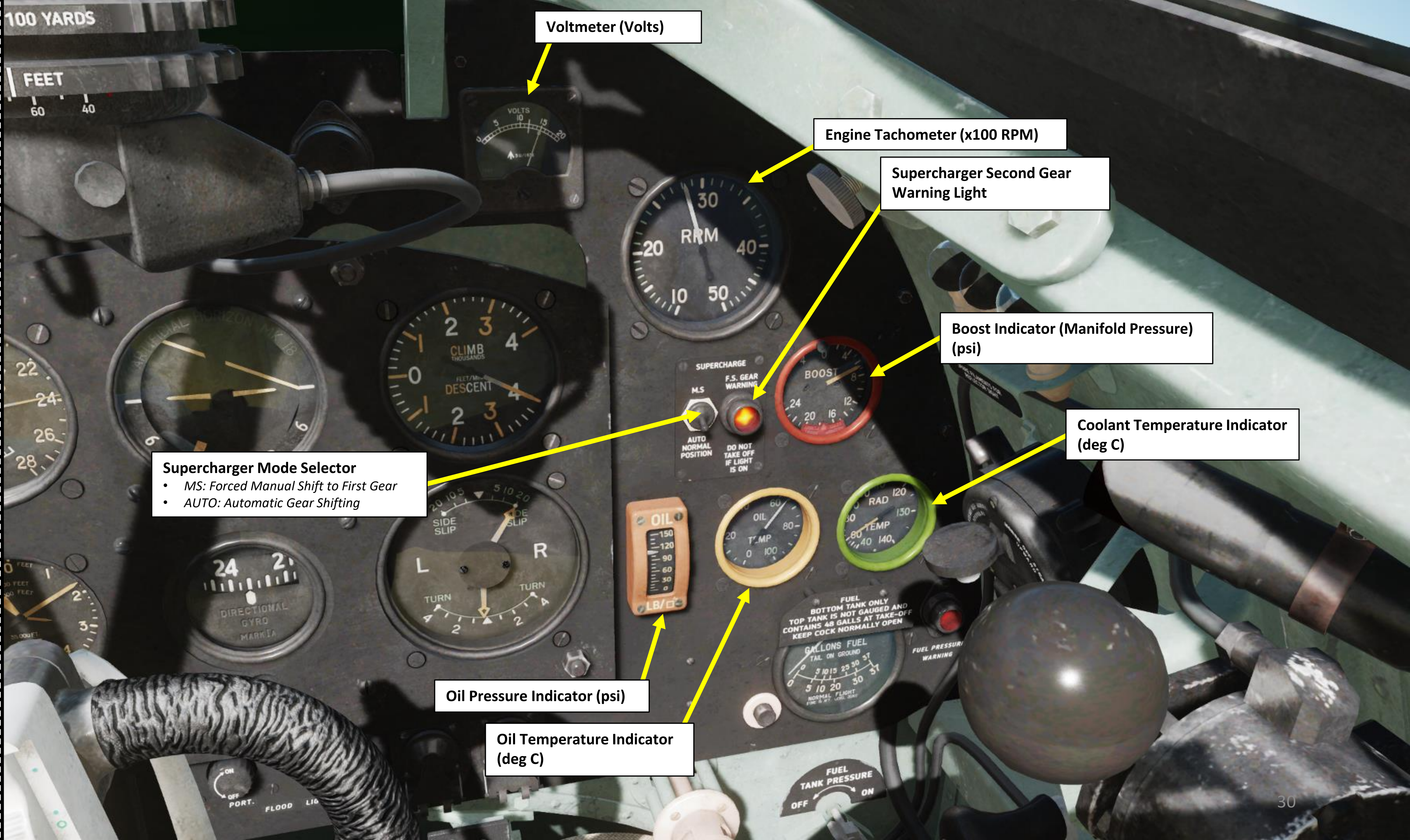
Lower Fuel Tank Quantity Indicator (imperial gal)

- Upper scale: Fuel Qty of bottom tank on Ground
- Lower scale: Fuel Qty of bottom tank in Flight

Note: Fuel Quantity is only displayed when you hold the "Fuel Contents" button to the left of the gauge. This indicator is for the bottom fuel tank only, which contains 37 gal. The upper fuel tank has 48 gal, which means that the Spitfire carries a ***total fuel load of 85 gal****.*

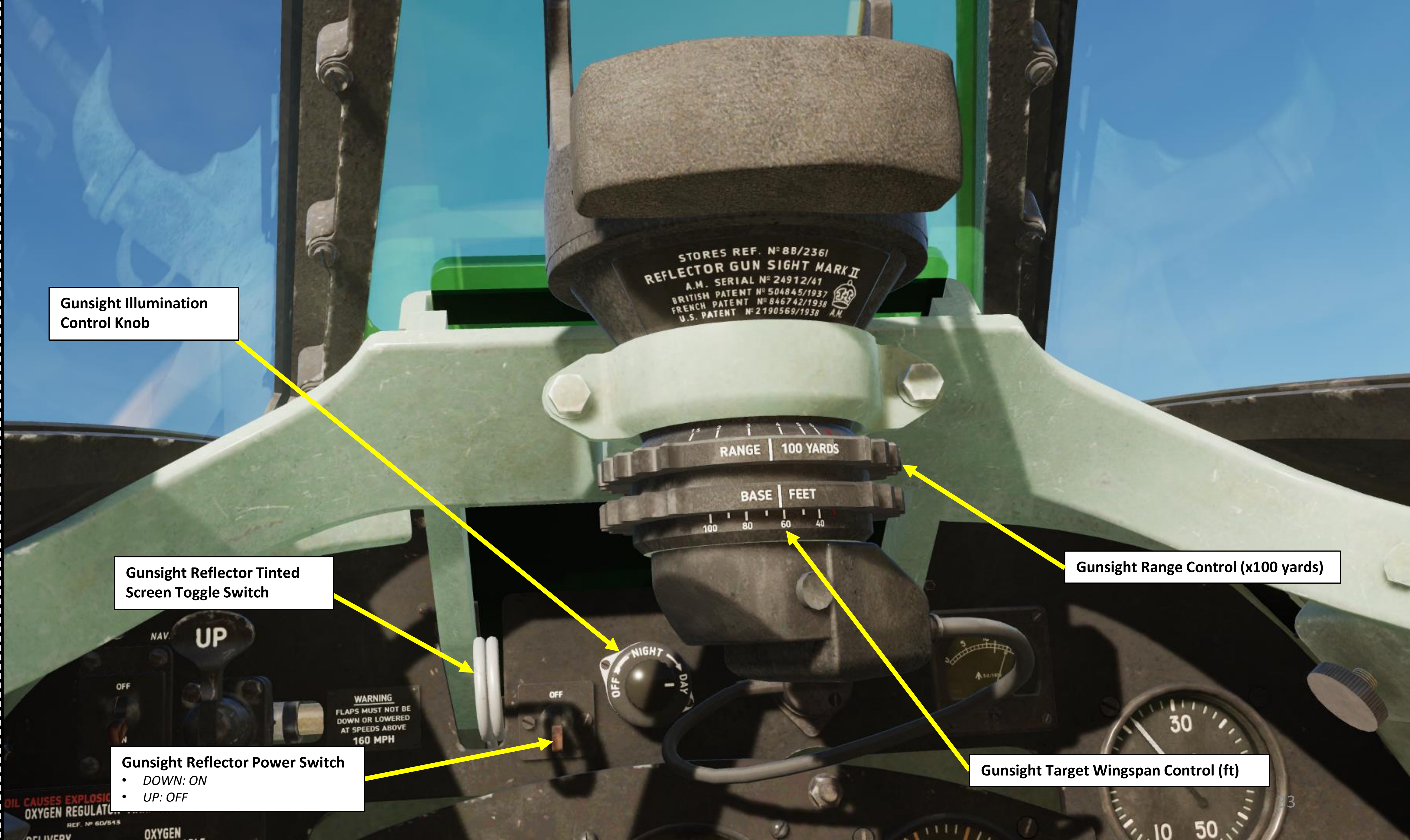
Fuel Pressuring Cock

Note: Only use if Low Fuel Pressure Warning Light is lit while engine is running. Otherwise, always leave this switch to OFF.

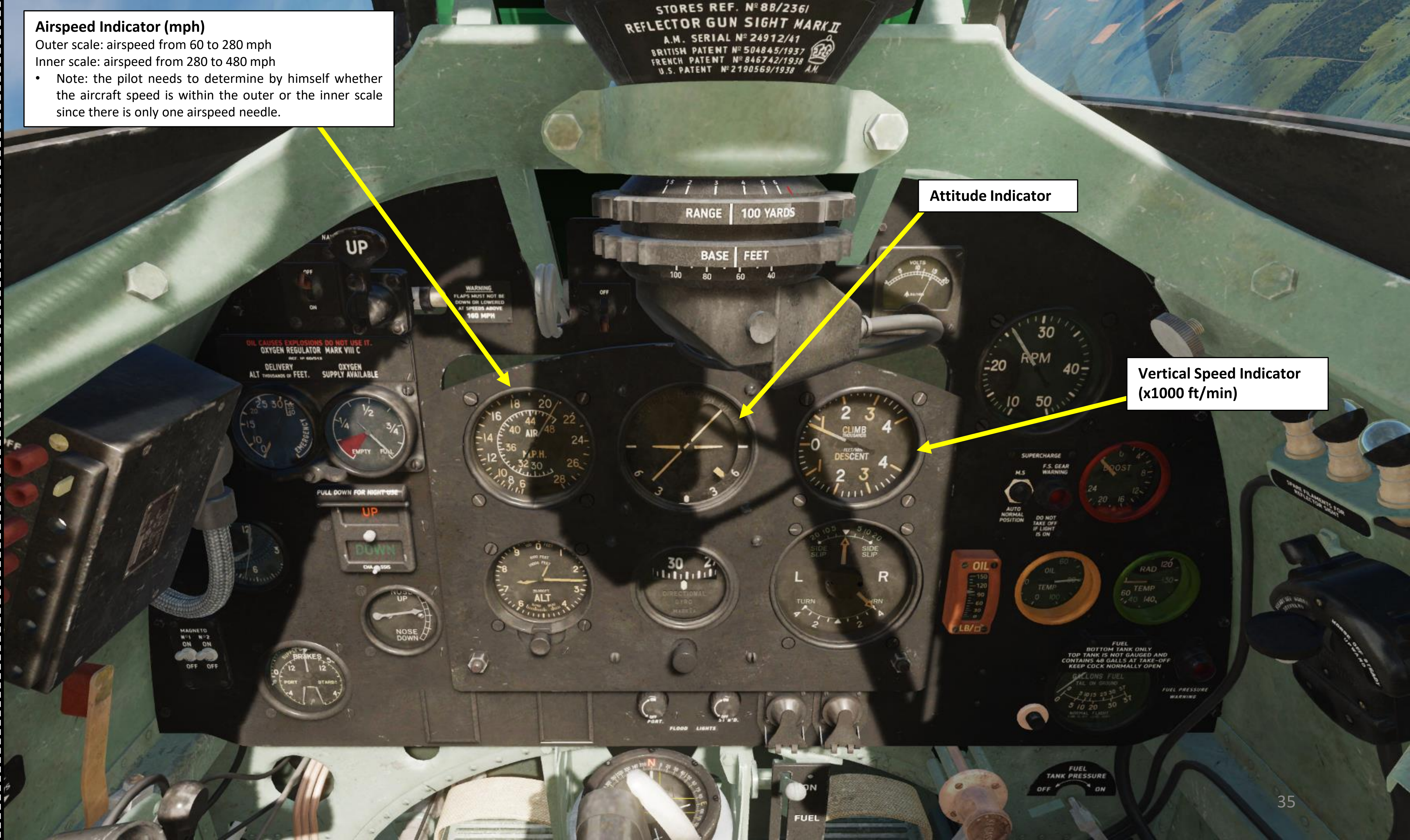

Voltmeter (Volts)
Engine Tachometer (x100 RPM)
Supercharger Second Gear Warning Light
Boost Indicator (Manifold Pressure) (psi)
Coolant Temperature Indicator (deg C)
Supercharger Mode Selector
• MS: Forced Manual Shift to First Gear
• AUTO: Automatic Gear Shifting
Oil Pressure Indicator (psi)
Oil Temperature Indicator (deg C)

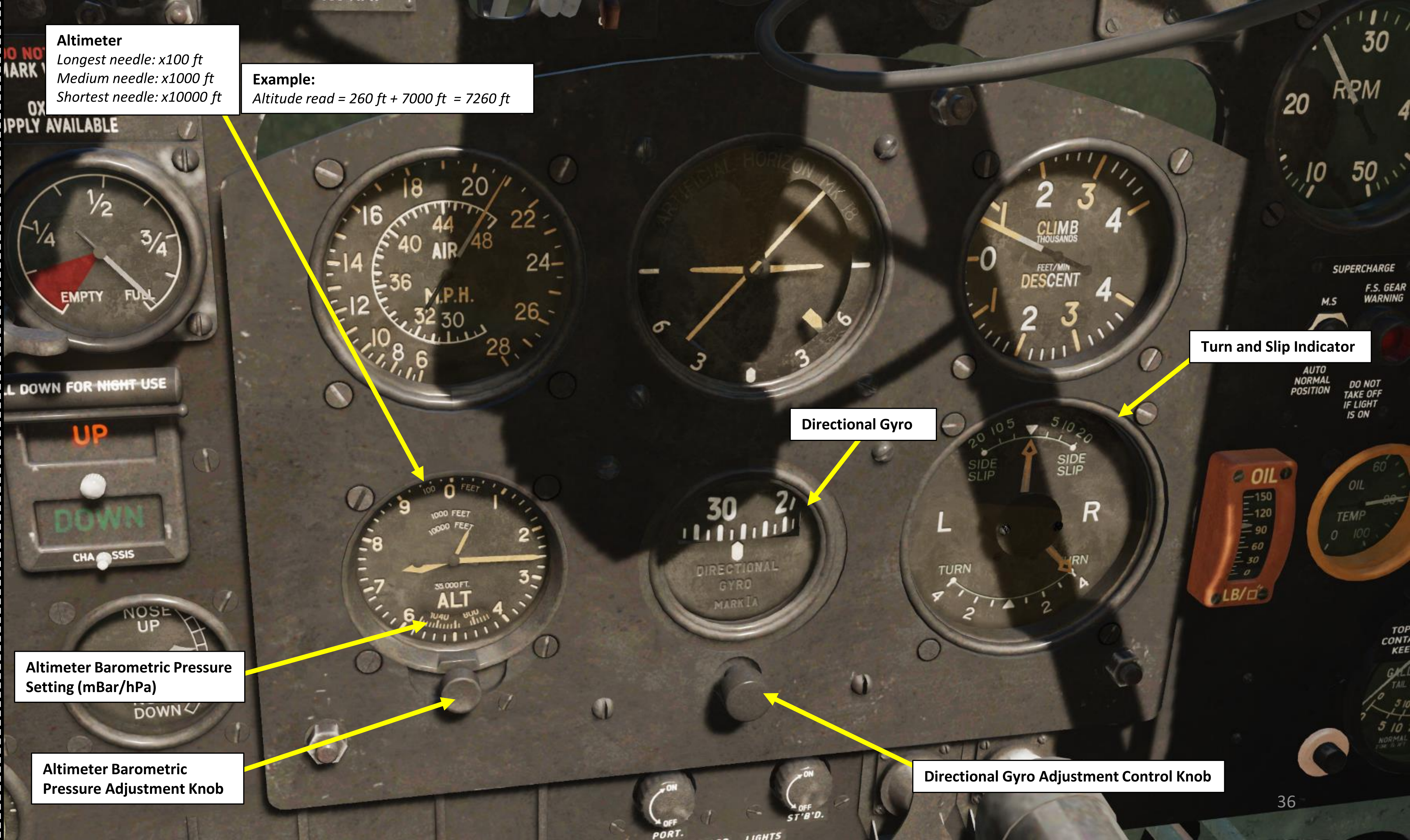

Gunsight
RANGE
100 YARDS
BASE
FEET
RPM

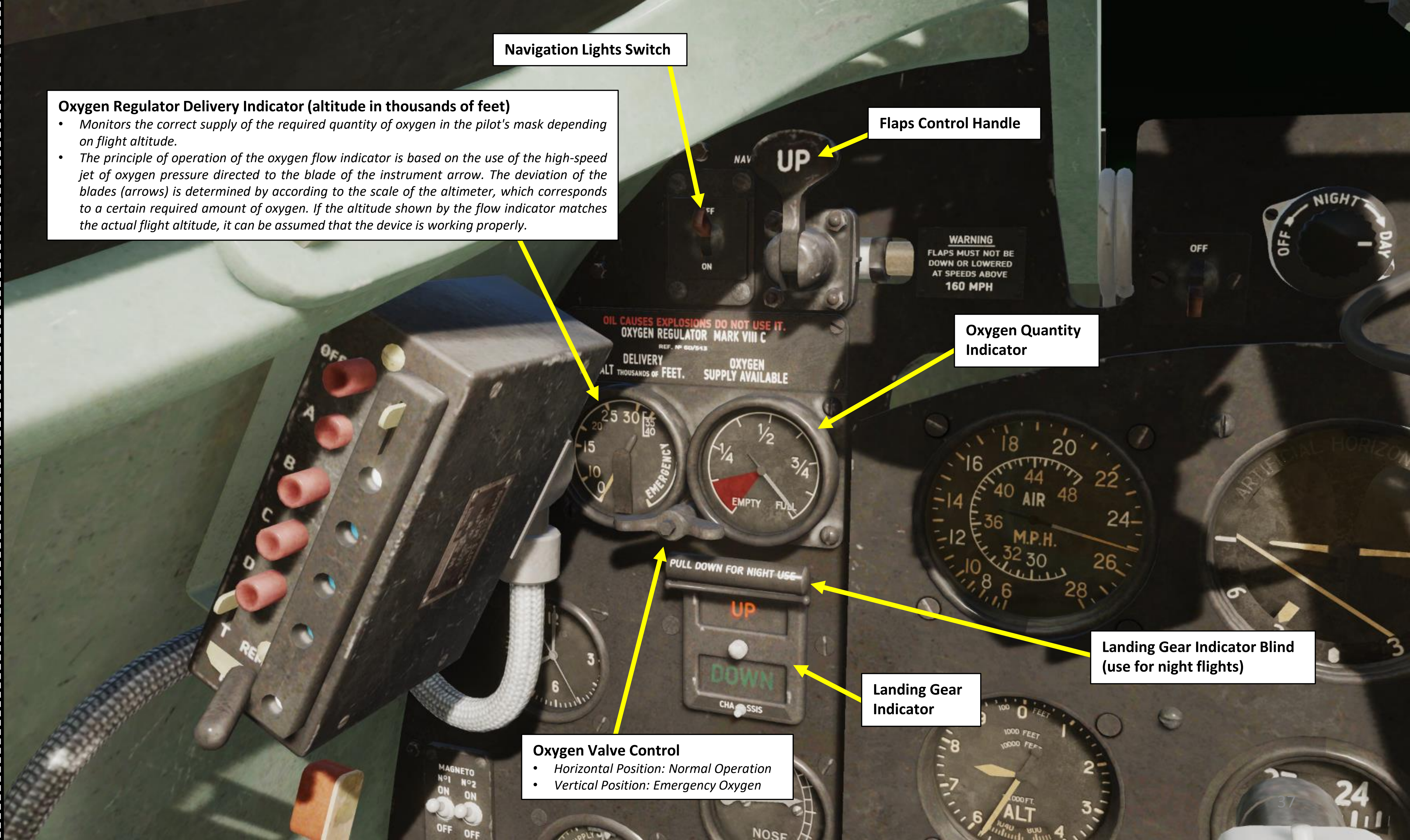

Gunsight Reflector Tinted Screen
Gunsight Reflector Tinted Screen Toggle Switch
RANGE | 100 YARDS
BASE | FEET

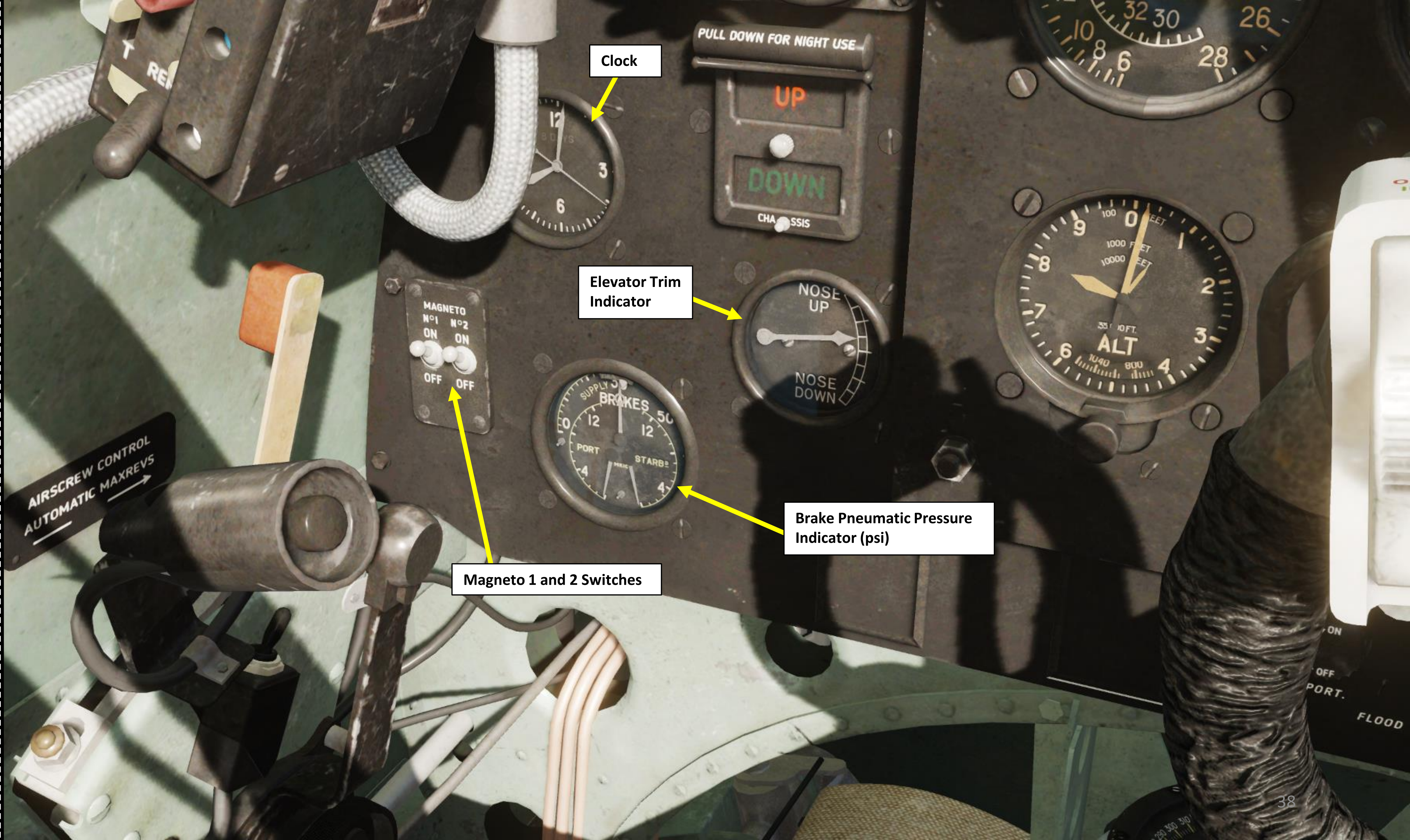

STORES REF. Nº 8B/2361
REFLECTOR GUN SIGHT MARK II
A.M. SERIAL Nº 24912/41
BRITISH PATENT Nº 504845/1937
FRENCH PATENT Nº 846742/1938
U.S. PATENT Nº 2190569/1938
RANGE | 100 YARDS
BASE | FEET
100 80 60 40
NIGHT
DAY
OFF
UP
NAV.
WARNING
FLAPS MUST NOT BE DOWN OR LOWERED AT SPEEDS ABOVE 160 MPH
OXYGEN REGULATOR
Gunsight Illumination Control Knob
Gunsight Reflector Tinted Screen Toggle Switch
Gunsight Reflector Power Switch
• DOWN: ON
• UP: OFF
Gunsight Range Control (x100 yards)
Gunsight Target Wingspan Control (ft)

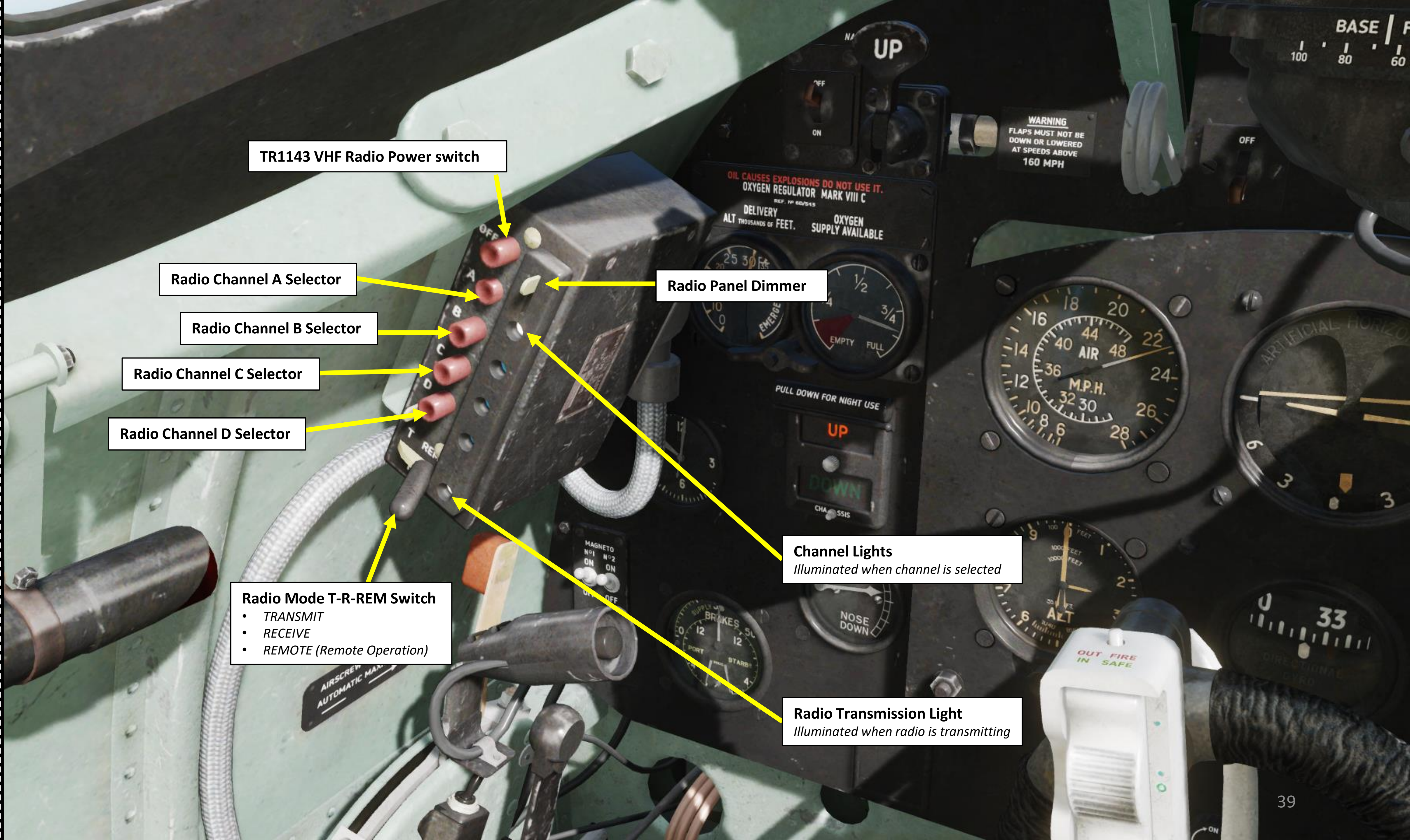

Mirror
Canopy Jettison Handle
Canopy Handle


Airspeed Indicator (mph)
Outer scale: airspeed from 60 to 280 mph
Inner scale: airspeed from 280 to 480 mph
• Note: the pilot needs to determine by himself whether the aircraft speed is within the outer or the inner scale since there is only one airspeed needle.
Attitude Indicator
Vertical Speed Indicator (x1000 ft/min)
STORES REF. Nº 8B/2361
REFLECTOR GUN SIGHT MARK II
RANGE 100 YARDS
BASE FEET
UP
OXYGEN REGULATOR MARK VIII C
DELIVERY
OXYGEN SUPPLY AVAILABLE
AIR M.P.H.
CLIMB
DESCENT
RPM
ALT
DIRECTIONAL GYRO
SIDE SLIP
TURN
BOOST
OIL
RAD TEMP
BRAKES
NOSE UP
NOSE DOWN
FUEL

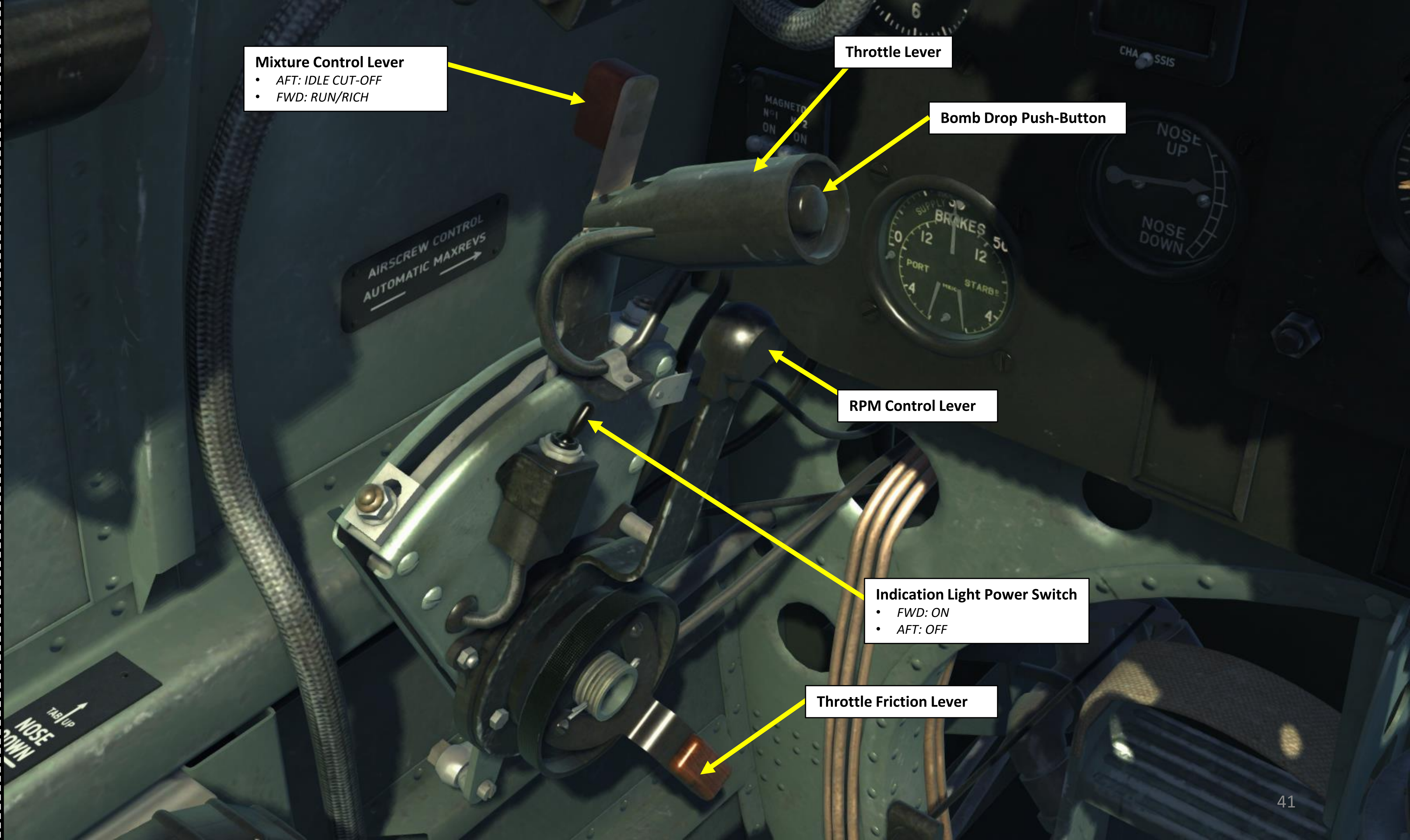

Altimeter
Longest needle: x100 ft
Medium needle: x1000 ft
Shortest needle: x10000 ft
Example:
Altitude read = 260 ft + 7000 ft = 7260 ft
Turn and Slip Indicator
Directional Gyro
Altimeter Barometric Pressure Setting (mBar/hPa)
Altimeter Barometric Pressure Adjustment Knob
Directional Gyro Adjustment Control Knob

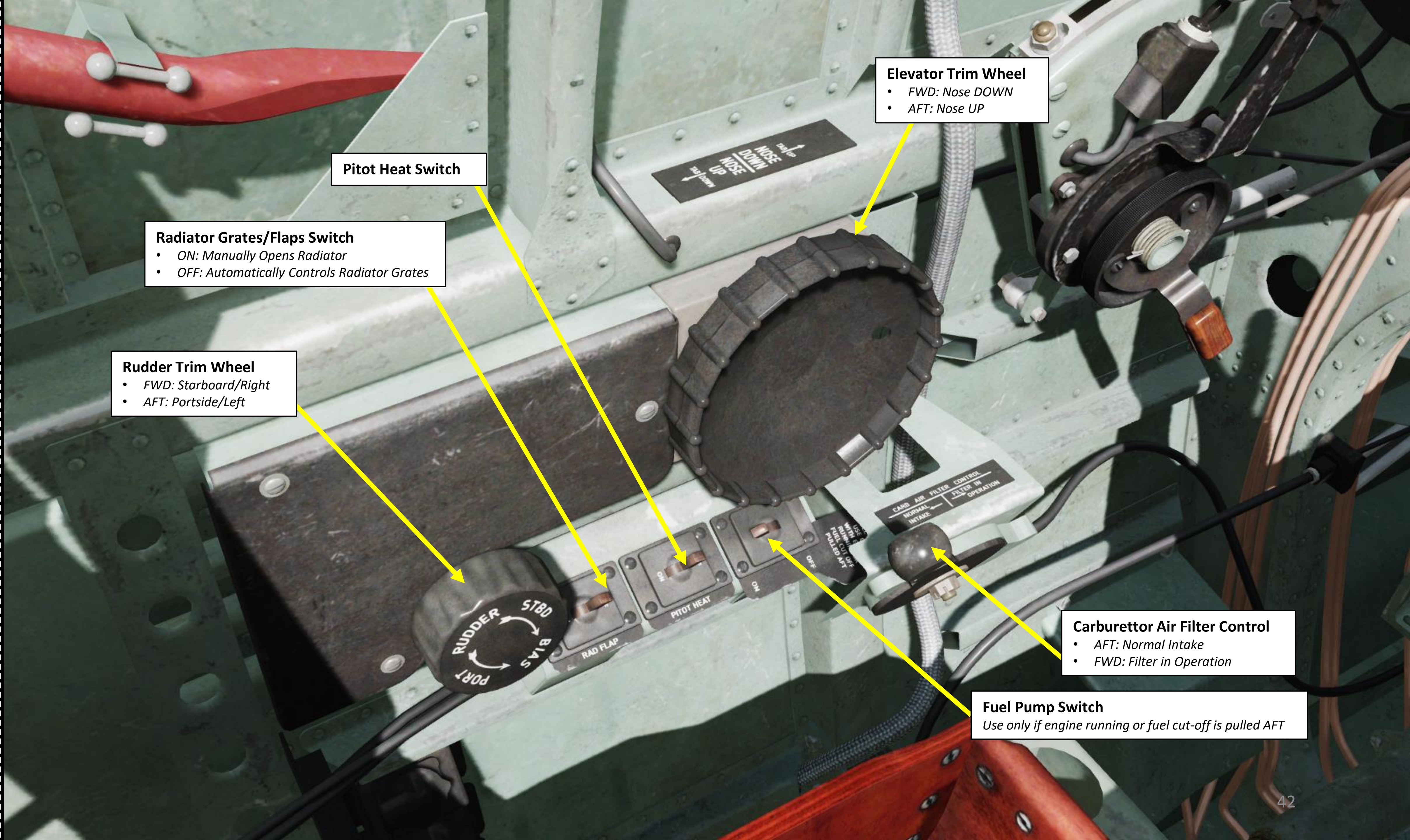

Navigation Lights Switch
Flaps Control Handle
Oxygen Regulator Delivery Indicator (altitude in thousands of feet)
• Monitors the correct supply of the required quantity of oxygen in the pilot's mask depending on flight altitude.
• The principle of operation of the oxygen flow indicator is based on the use of the high-speed jet of oxygen pressure directed to the blade of the instrument arrow. The deviation of the blades (arrows) is determined by according to the scale of the altimeter, which corresponds to a certain required amount of oxygen. If the altitude shown by the flow indicator matches the actual flight altitude, it can be assumed that the device is working properly.
Oxygen Quantity Indicator
Landing Gear Indicator Blind (use for night flights)
Landing Gear Indicator
Oxygen Valve Control
• Horizontal Position: Normal Operation
• Vertical Position: Emergency Oxygen


Clock
Elevator Trim Indicator
Brake Pneumatic Pressure Indicator (psi)
Magneto 1 and 2 Switches
PULL DOWN FOR NIGHT USE
UP
DOWN
CHASSIS
MAGNETO
Nº1 Nº2
ON ON
OFF OFF
NOSE UP
NOSE DOWN
BRAKES
SUPPLY
PORT
STARBD
ALT
AIRSCREW CONTROL
AUTOMATIC MAXREVS
FLOOD

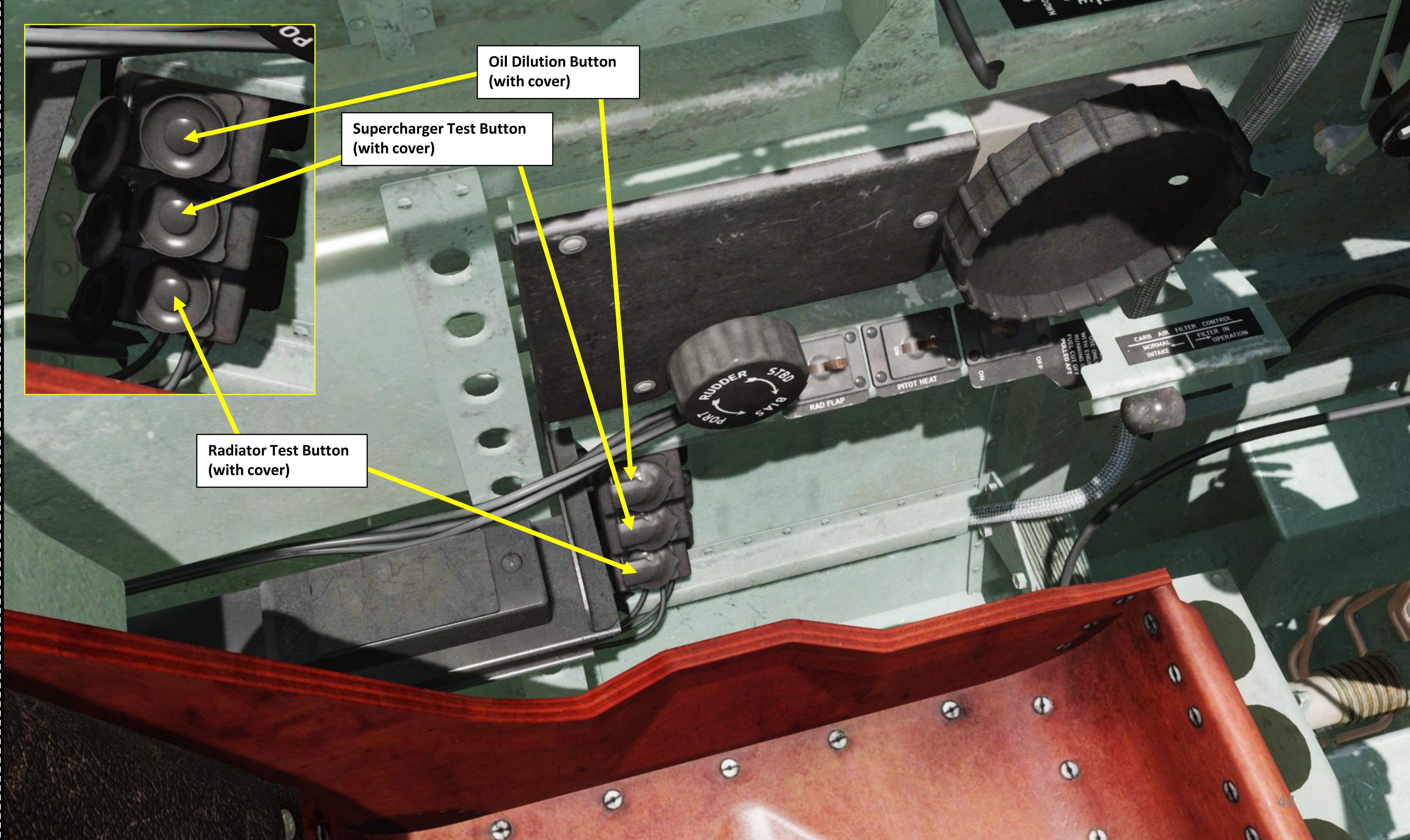

TR1143 VHF Radio Power switch
Radio Channel A Selector
Radio Channel B Selector
Radio Channel C Selector
Radio Channel D Selector
Radio Panel Dimmer
Channel Lights
Illuminated when channel is selected
Radio Mode T-R-REM Switch
• TRANSMIT
• RECEIVE
• REMOTE (Remote Operation)
Radio Transmission Light
Illuminated when radio is transmitting
UP
WARNING
FLAPS MUST NOT BE DOWN OR LOWERED AT SPEEDS ABOVE 160 MPH
OIL CAUSES EXPLOSIONS DO NOT USE IT.
OXYGEN REGULATOR MARK VIII C
DELIVERY
ALT THOUSANDS OF FEET.
OXYGEN SUPPLY AVAILABLE
PULL DOWN FOR NIGHT USE
AIR M.P.H.
BASE
NOSE DOWN
BRAKES
MAGNETO
OUT FIRE
IN SAFE

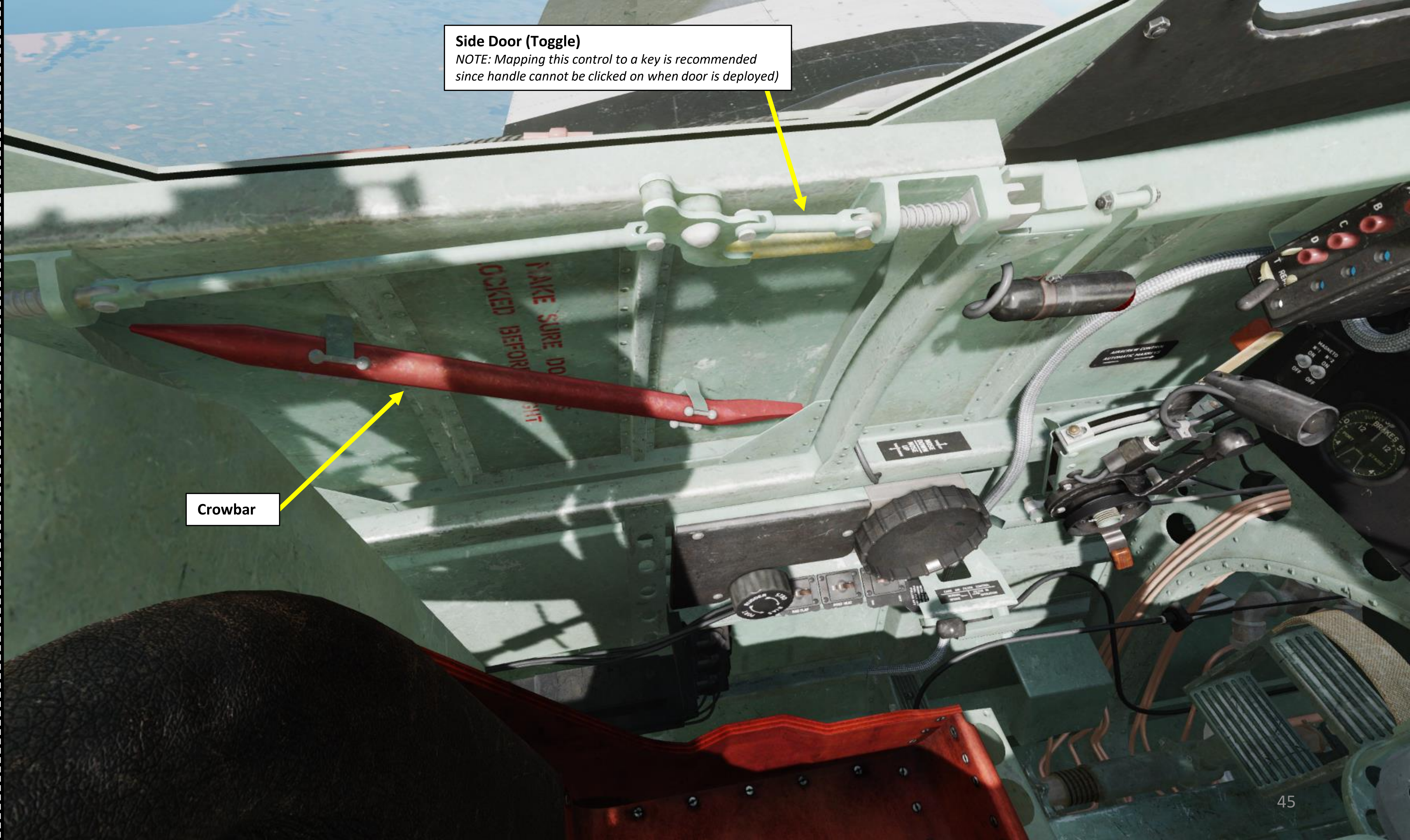

Portside (Left) Flood Lights Control Knob
Starboard (Right) Flood Lights Control Knob
P8 Magnetic Compass
ON
OFF
PORT.
FLOOD
LIGHTS
ST'B'D.
N
E
W
ON
FUEL
OFF

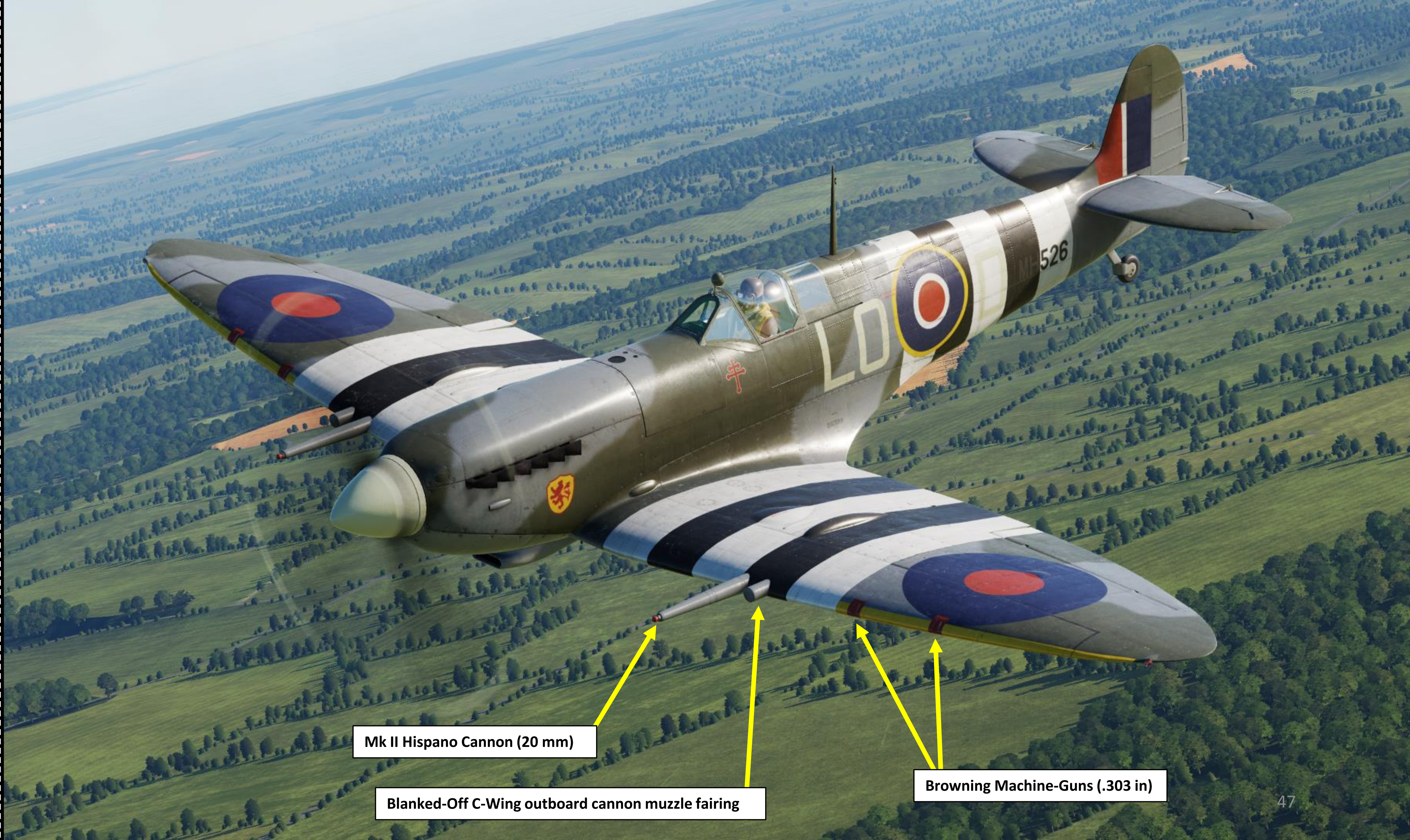

Mixture Control Lever
• AFT: IDLE CUT-OFF
• FWD: RUN/RICH
Throttle Lever
Bomb Drop Push-Button
RPM Control Lever
Indication Light Power Switch
• FWD: ON
• AFT: OFF
Throttle Friction Lever
AIRSCREW CONTROL
AUTOMATIC MAXREVS
BRAKES
NOSE UP
NOSE DOWN

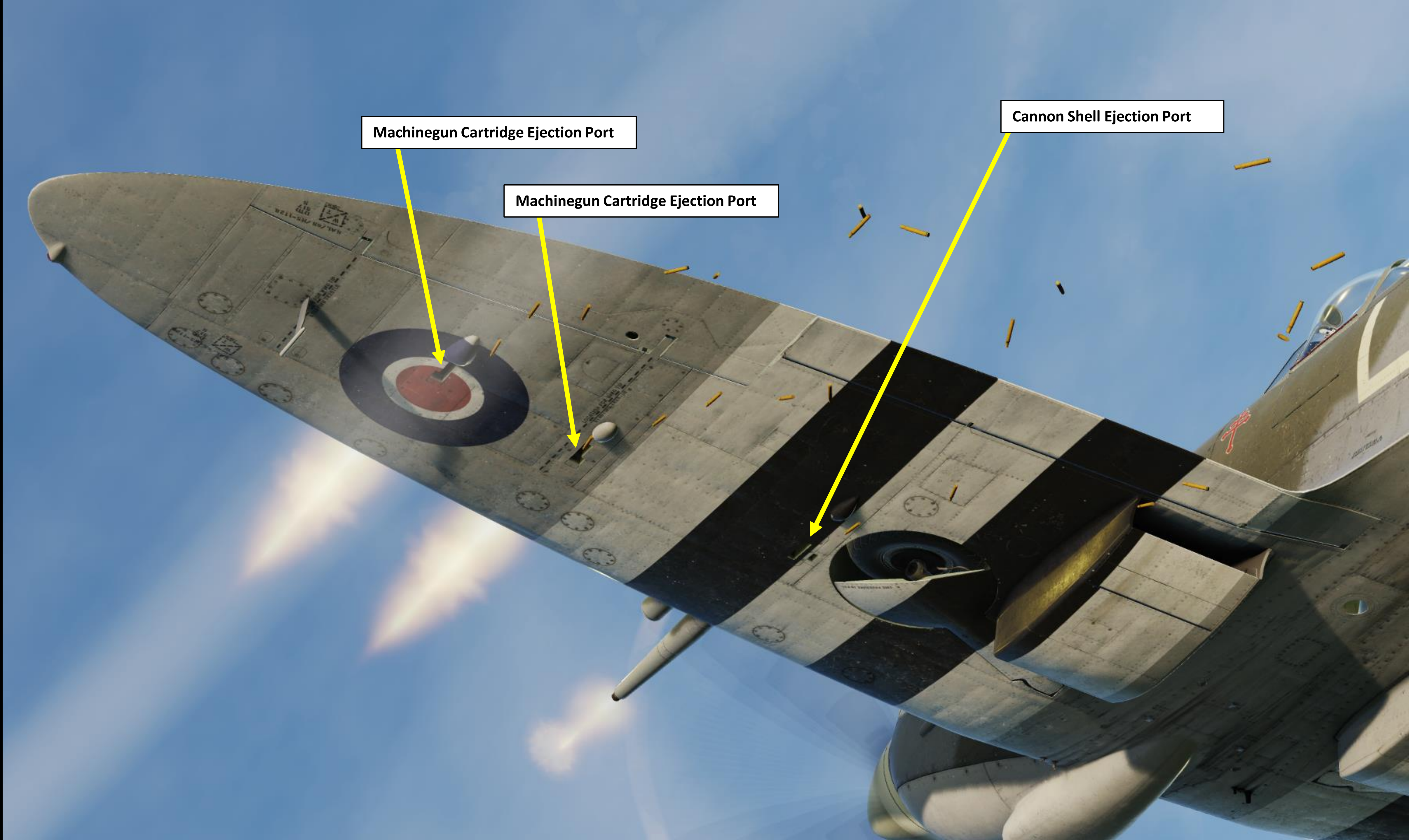

Elevator Trim Wheel
• FWD: Nose DOWN
• AFT: Nose UP
Pitot Heat Switch
Radiator Grates/Flaps Switch
• ON: Manually Opens Radiator
• OFF: Automatically Controls Radiator Grates
Rudder Trim Wheel
• FWD: Starboard/Right
• AFT: Portside/Left
Carburettor Air Filter Control
• AFT: Normal Intake
• FWD: Filter in Operation
Fuel Pump Switch
Use only if engine running or fuel cut-off is pulled AFT
NOSE DOWN
NOSE UP
RUDDER
STBD
BIAS
PORT
RAD FLAP
PITOT HEAT
ON
OFF
CARB AIR FILTER CONTROL
NORMAL INTAKE
FILTER IN OPERATION


UP
RANGE / 100 YARDS
BASE / FEET
CLIMB
DESCENT
UP


Oil Dilution Button (with cover)
Supercharger Test Button (with cover)
Radiator Test Button (with cover)
RUDDER
STBD
PORT
BIAS
RAD FLAP
PITOT HEAT
CARB AIR FILTER CONTROL
NORMAL INTAKE
FILTER IN OPERATION


Side Door (Toggle)
NOTE: Mapping this control to a key is recommended since handle cannot be clicked on when door is deployed)
Crowbar


Mk II Hispano Cannon (20 mm)
Blanked-Off C-Wing outboard cannon muzzle fairing
Browning Machine-Guns (.303 in)

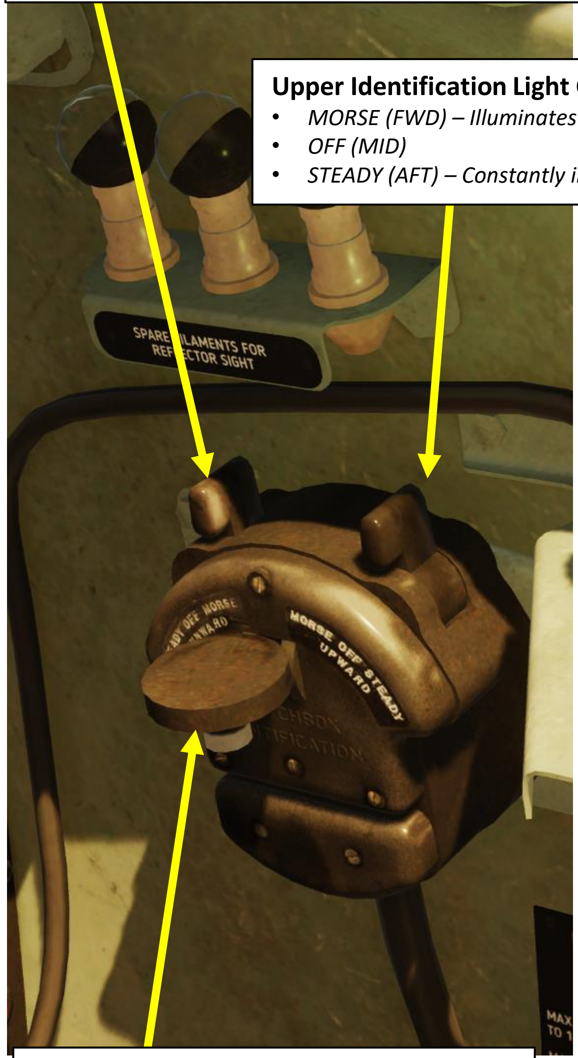

Machinegun Cartridge Ejection Port
Machinegun Cartridge Ejection Port
Cannon Shell Ejection Port


Fuel Cap

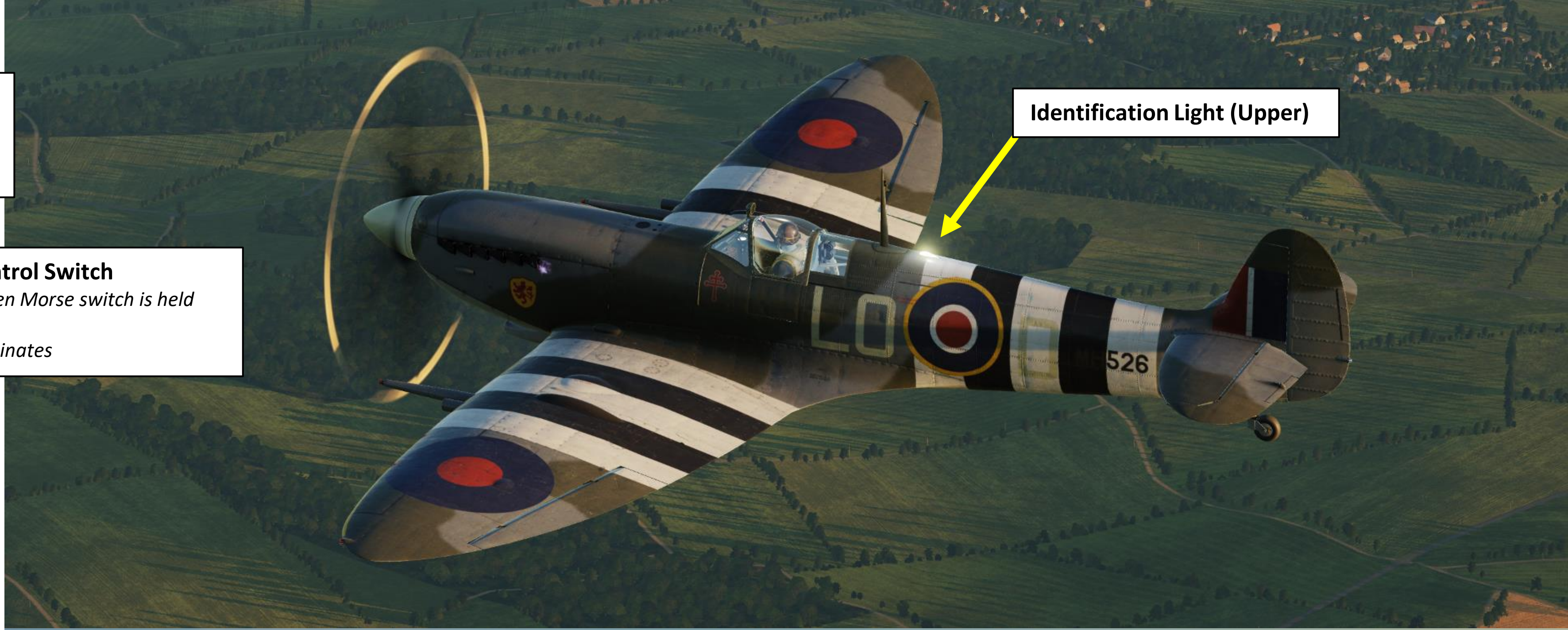

Tailwheel

Lower Identification Light Control Switch
- *STEADY (FWD) – Constantly illuminates*
- *OFF (MID)*
- *MORSE (AFT) – Illuminates when Morse switch is held*

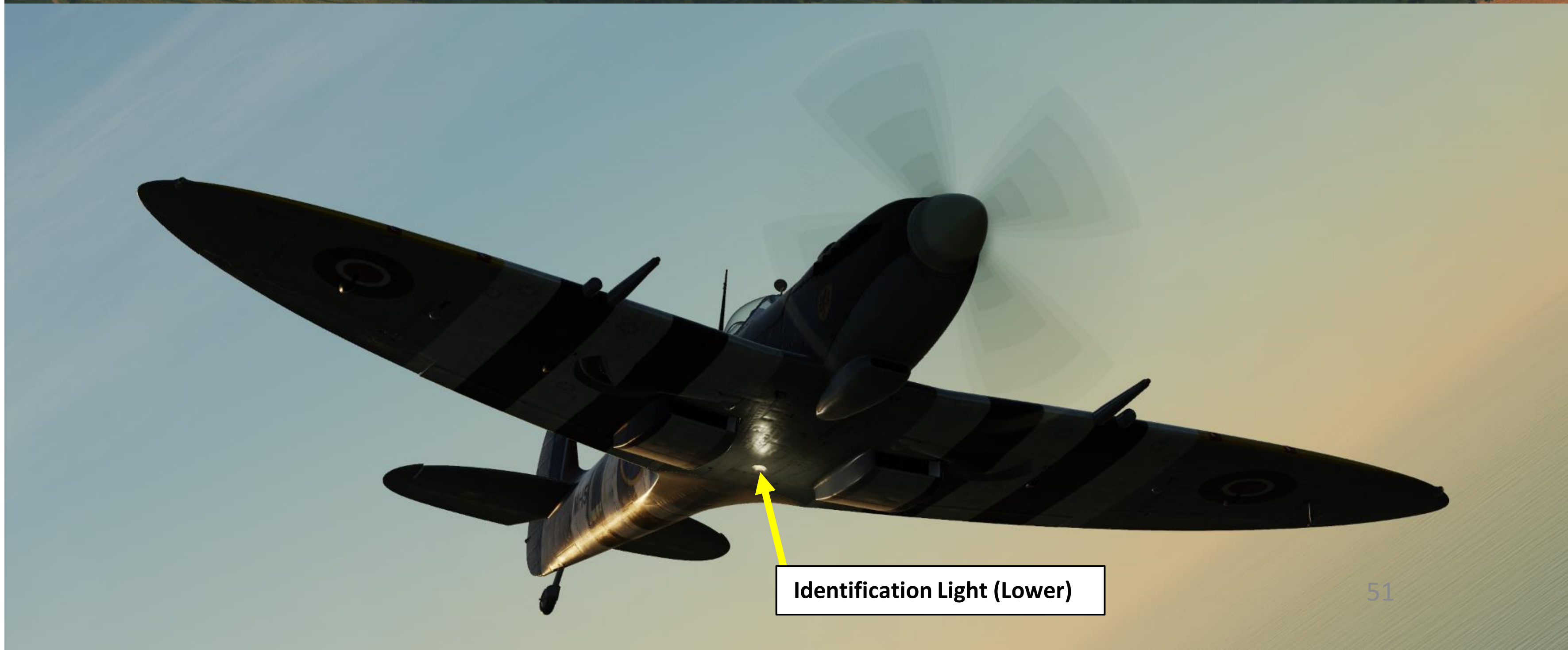
Upper Identification Light Control Switch
- *MORSE (FWD) – Illuminates when Morse switch is held*
- *OFF (MID)*
- *STEADY (AFT) – Constantly illuminates*



Identification Light Morse switch
Used to toggle identification lights to send morse signals



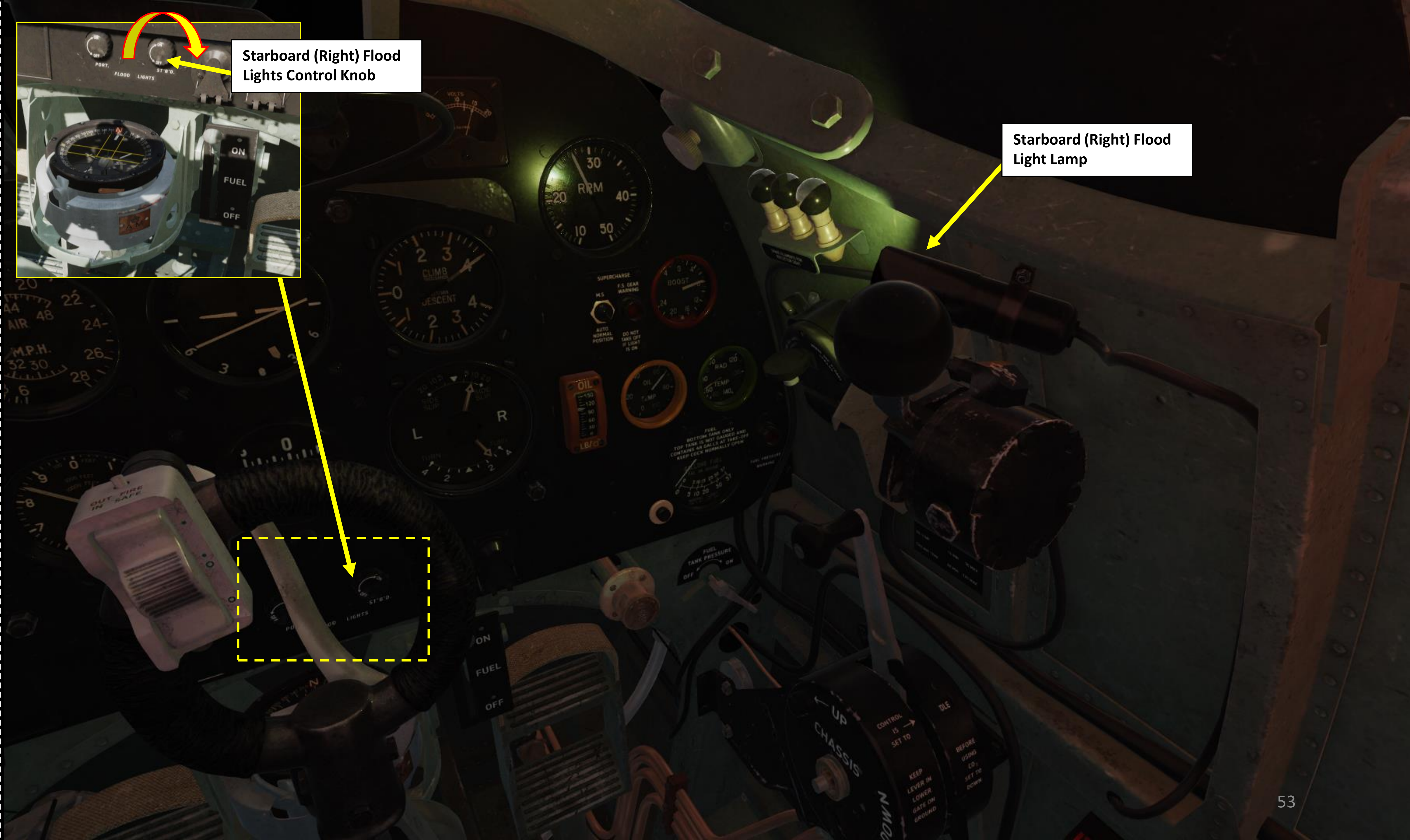
Identification Light (Upper)

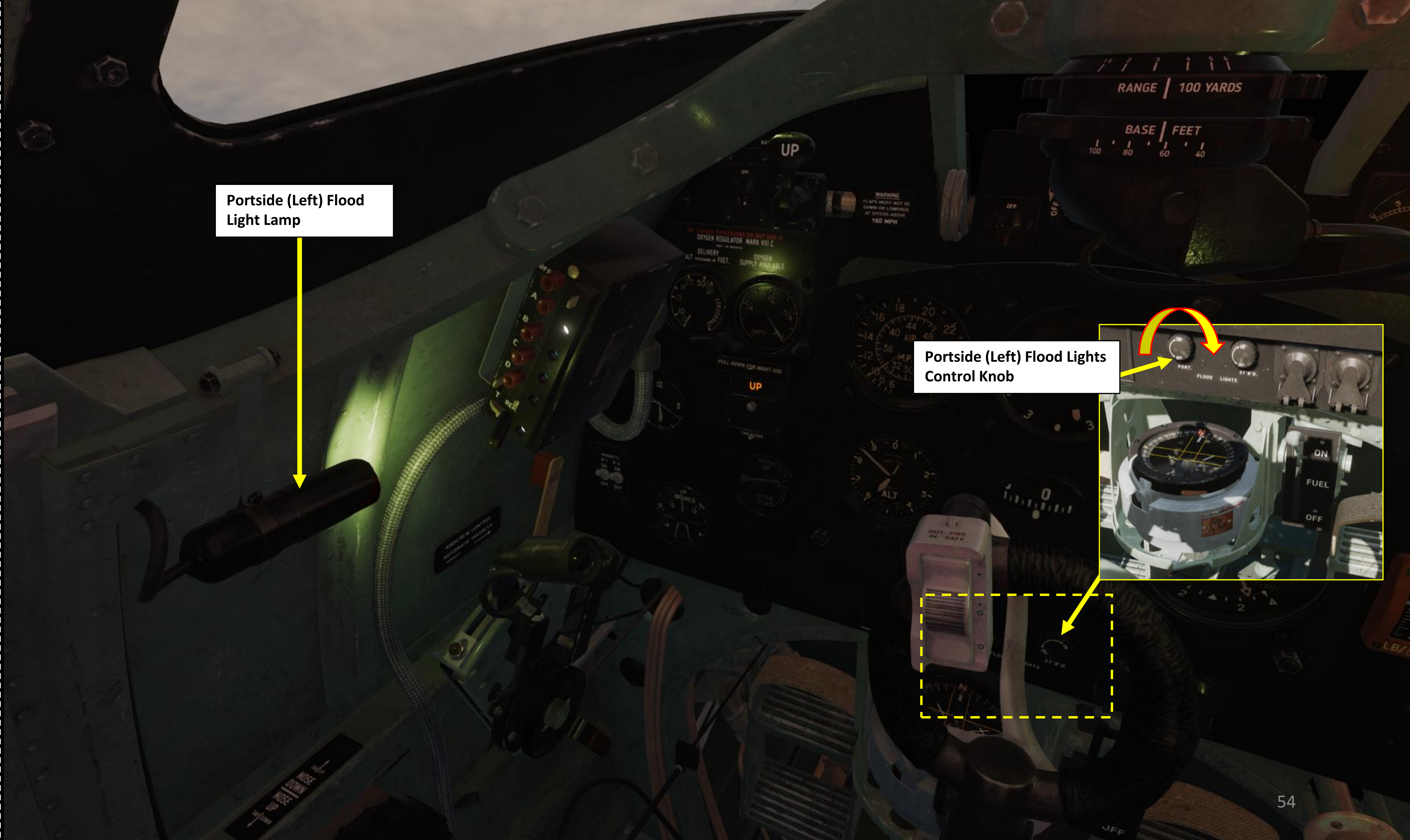


Identification Light (Lower)

Navigation Light Control Switch

- *UP: OFF*
- *DOWN: ON*


Starboard (Right) Flood Lights Control Knob
Starboard (Right) Flood Light Lamp


Portside (Left) Flood Light Lamp
Portside (Left) Flood Lights Control Knob
RANGE 100 YARDS
BASE FEET
UP
ON
FUEL
OFF

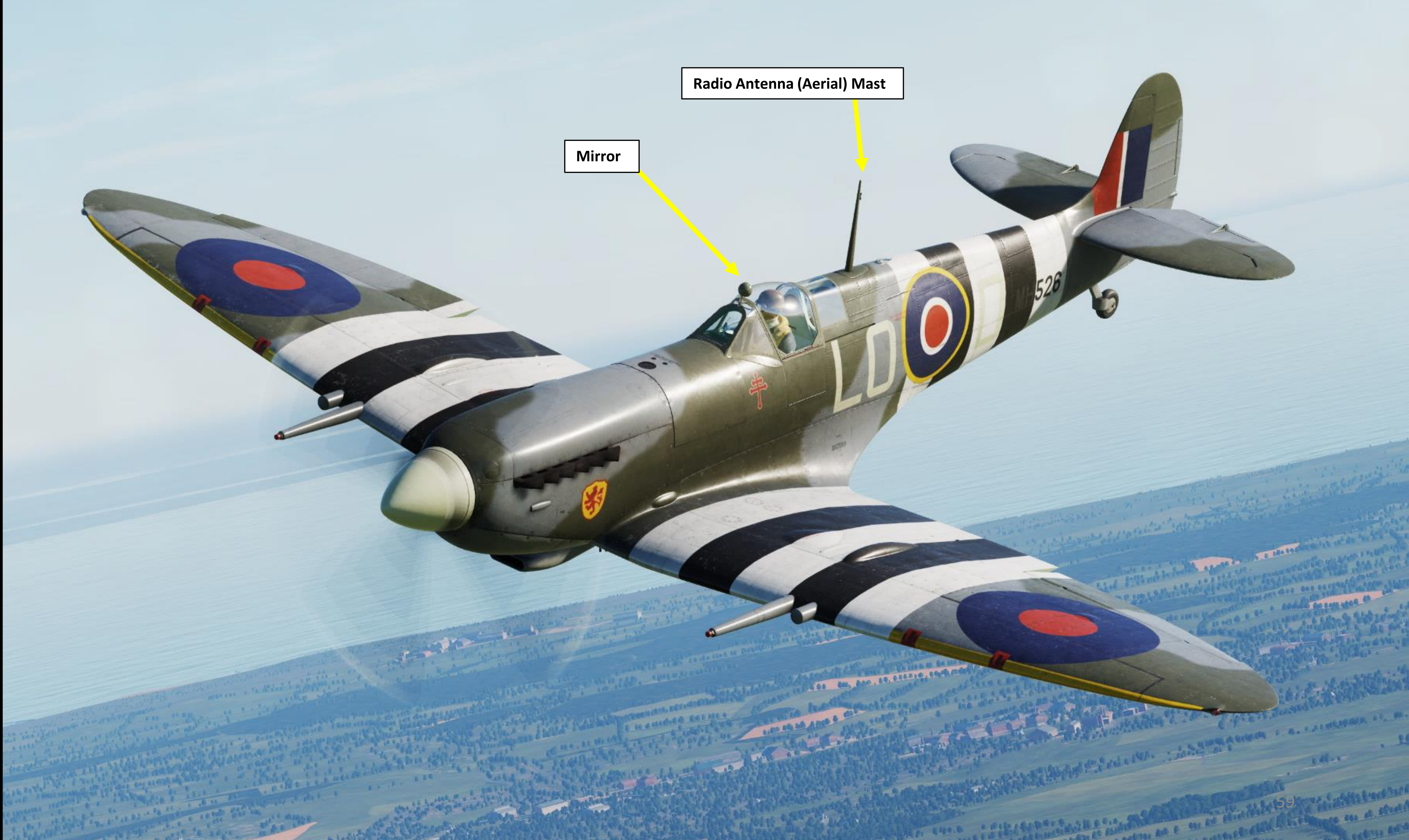

Engine Exhaust


45 gallons "Slipper" External Fuel Tank
45 gallons "Torpedo" External Fuel Tank


250 Lbs Mk IV Bomb
500 Lbs Mk IV Bomb
250 Lbs Mk IV Bomb

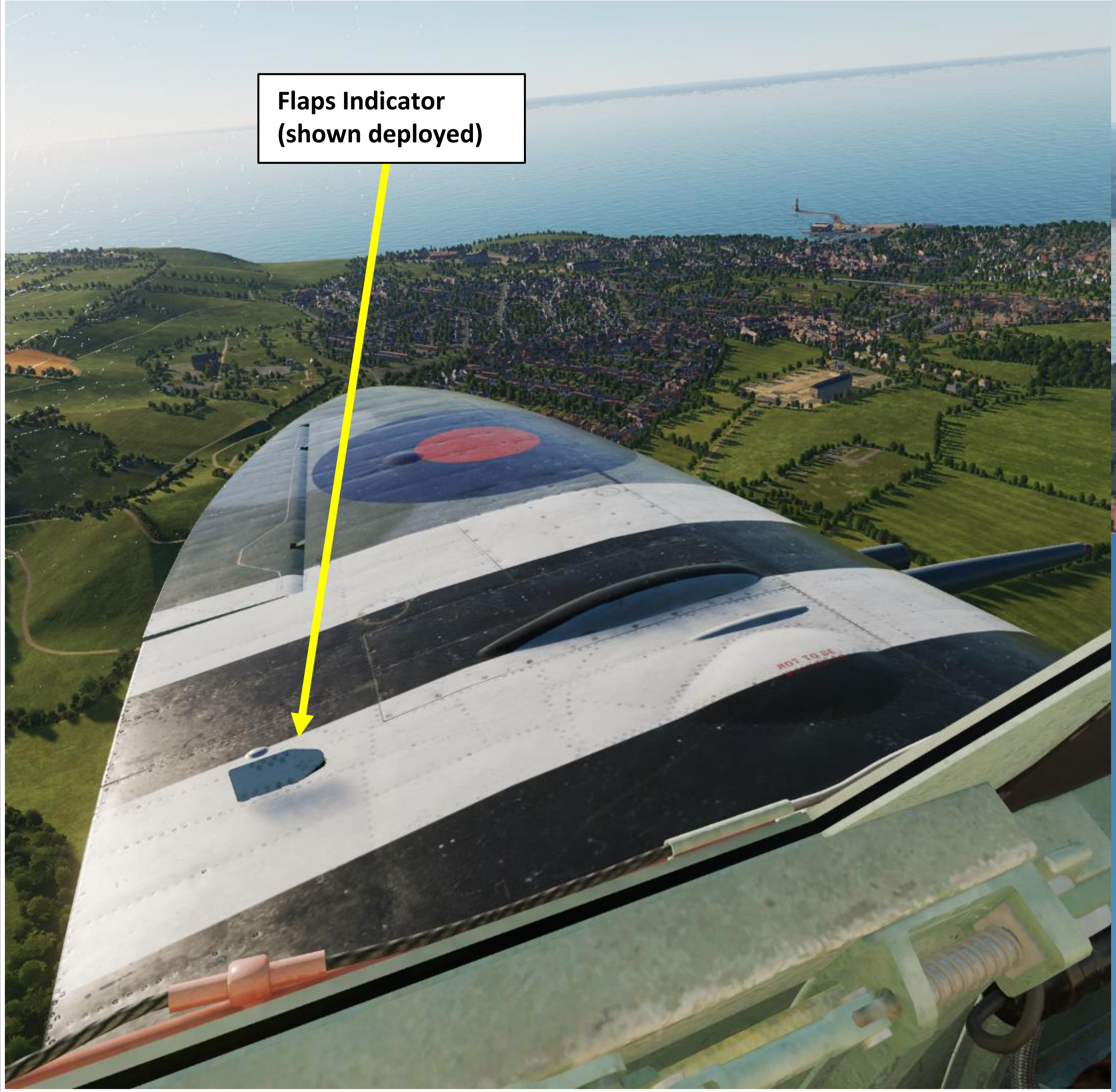
Invasion Stripes

“Invasion stripes” were alternating black and white bands painted on the fuselages and wings of Allied aircraft during World War II to reduce the chance that they would be attacked by friendly forces during and after the Normandy Landings. After a study concluded that the thousands of aircraft involved in the invasion would saturate and break down the IFF (Identify-Friend-or-Foe) system, the marking scheme was approved on May 17, 1944, by Air Chief Marshal Sir Trafford Leigh-Mallory, commanding the Allied Expeditionary Air Force.


Radio Antenna (Aerial) Mast
Mirror

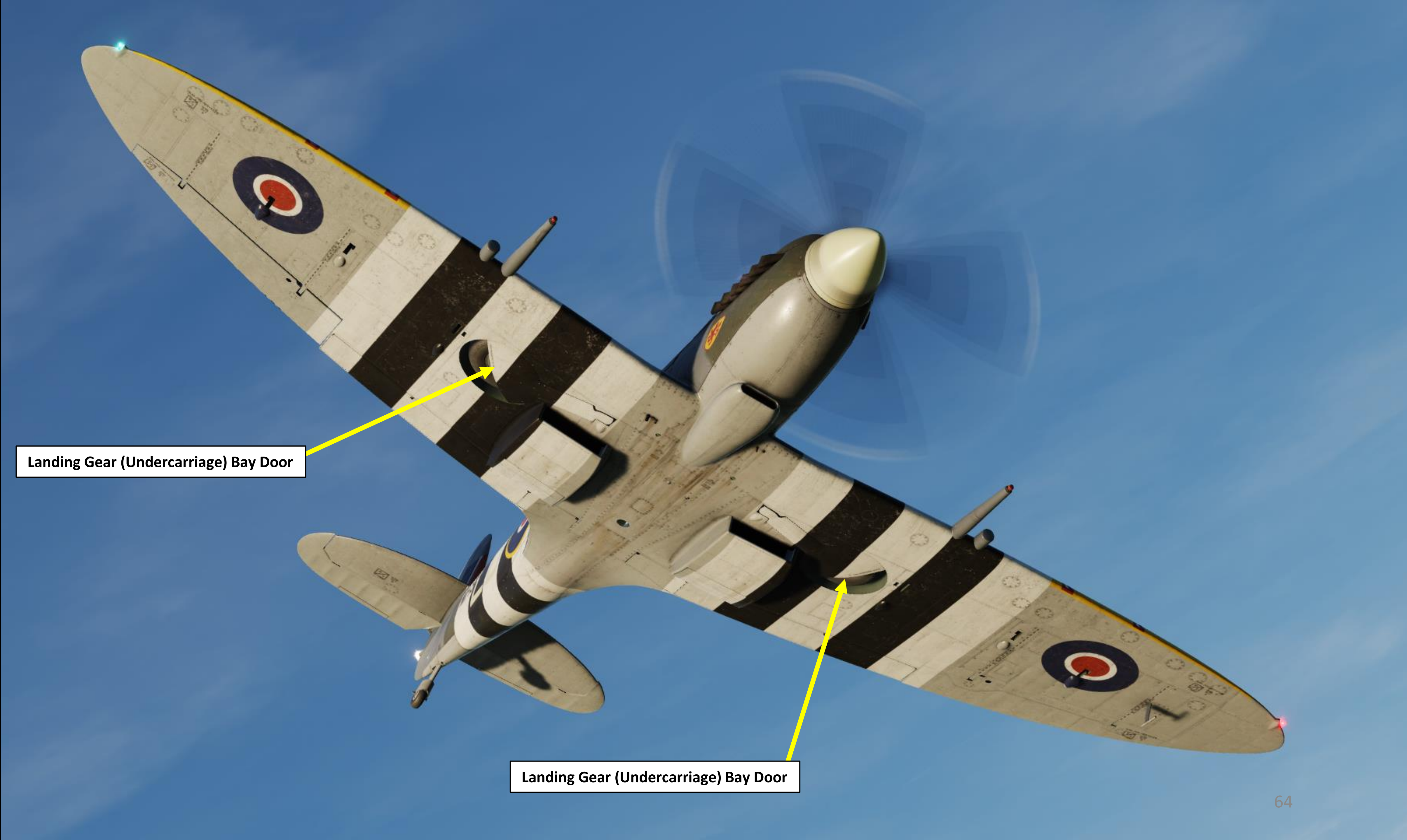

Pitot Tube
Air Intake
Cooling Radiators
526


Rudder Trim Tab
Elevator Trim Tab
Elevator Trim Tab


Flaps Indicator
(shown deployed)


526
Flaps (shown deployed)
Pneumatically actuated

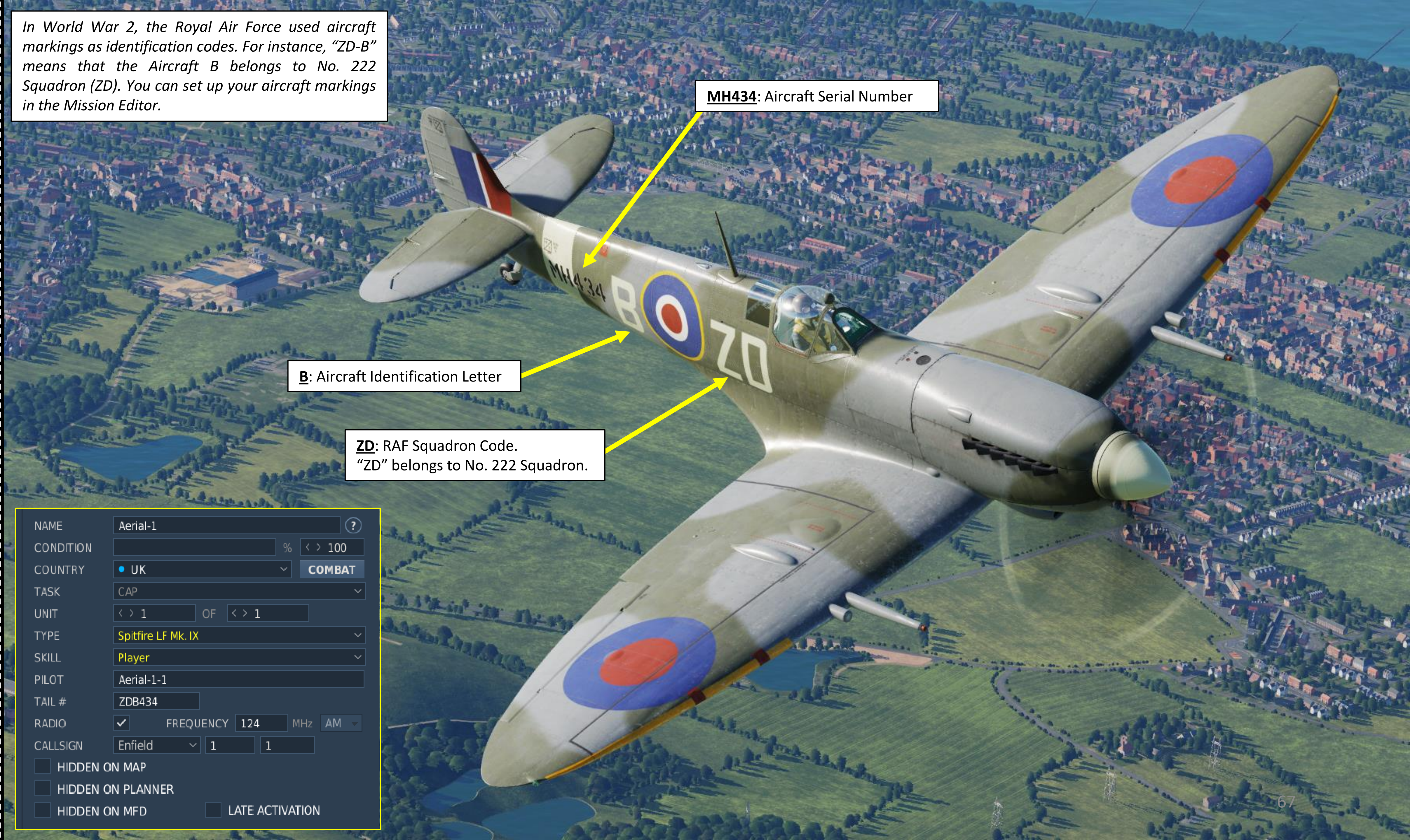

Landing Gear (shown deployed)
Hydraulically actuated


Landing Gear (Undercarriage) Bay Door
Landing Gear (Undercarriage) Bay Door

In real life, the Spitfire's battery (called "Accumulator") switch is actually accessible by an external panel and is turned on or off by the ground crew. By default, the battery is always left on.

Some variants of the Spitfire had clipped wings, which were designed to improve its combat fighting qualities by reducing the aircraft's wingspan.

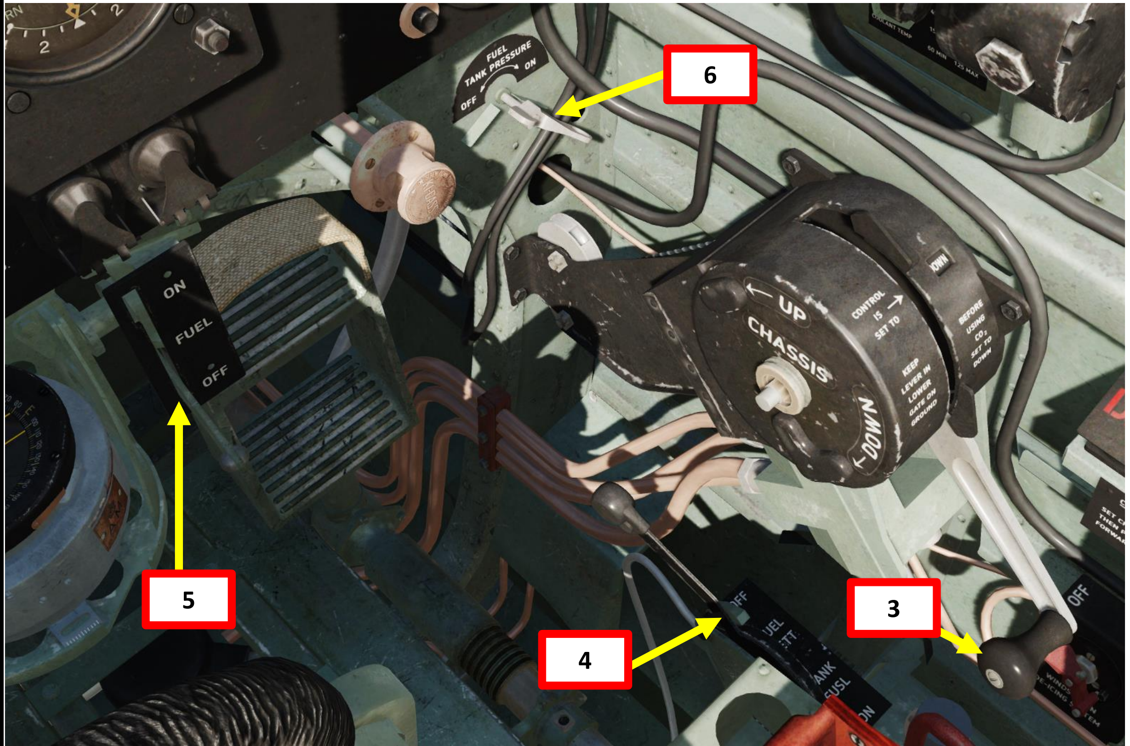
In World War 2, the Royal Air Force used aircraft markings as identification codes. For instance, "ZD-B" means that the Aircraft B belongs to No. 222 Squadron (ZD). You can set up your aircraft markings in the Mission Editor.



PRE-FLIGHT

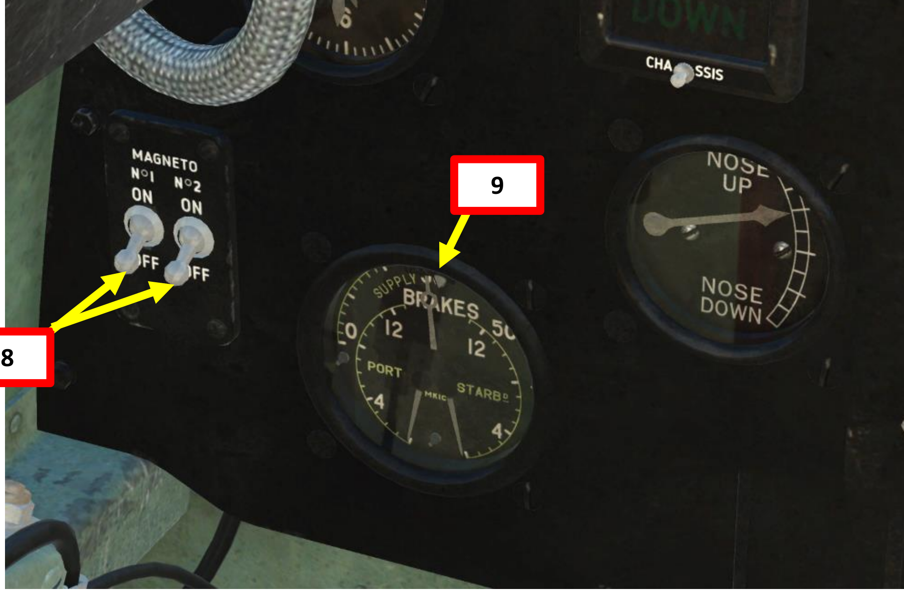
PRE-FLIGHT

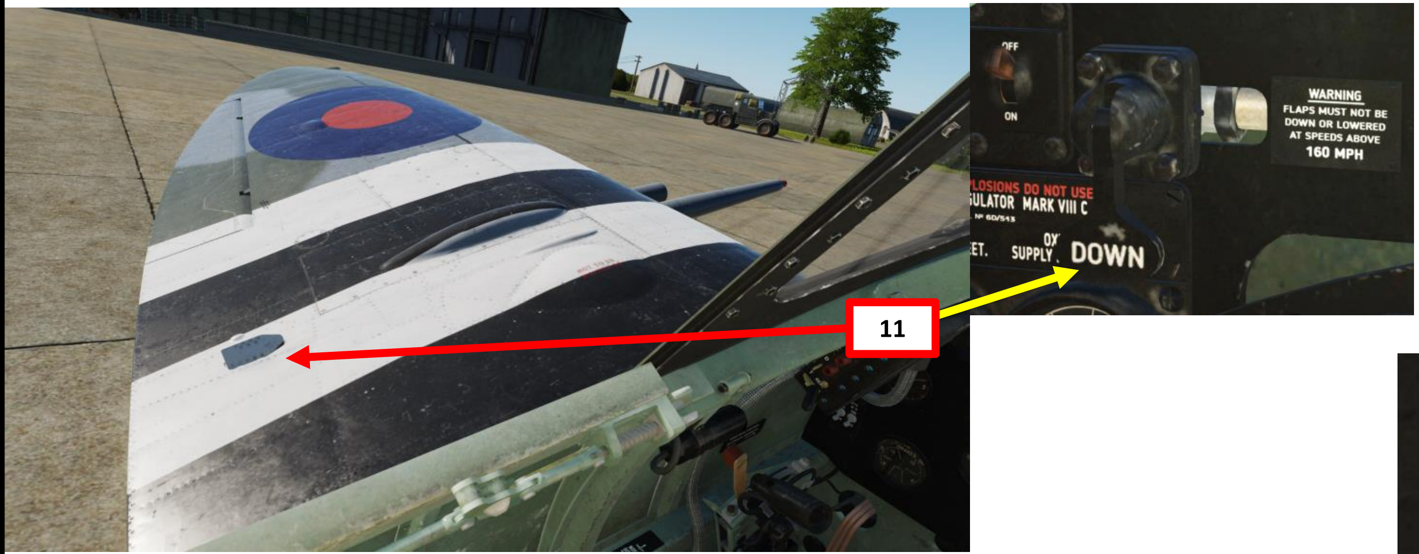
1. Close Side Door by pressing the “SIDE DOOR (TOGGLE)” key (*recommended binding: RShift+C*).
2. Mixture Control Lever – CUT-OFF (FULLY AFT)
3. Landing Gear Lever – DOWN
4. Drop Tank Fuel Cock Lever – OFF
5. Main Fuel Tank Cock Lever – OFF
6. Fuel Tank Pressure Cock – OFF

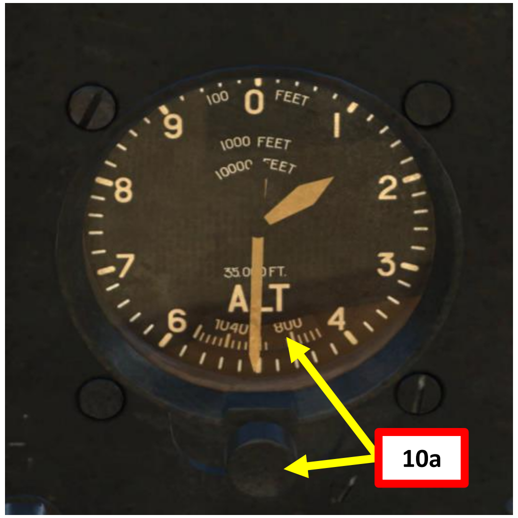


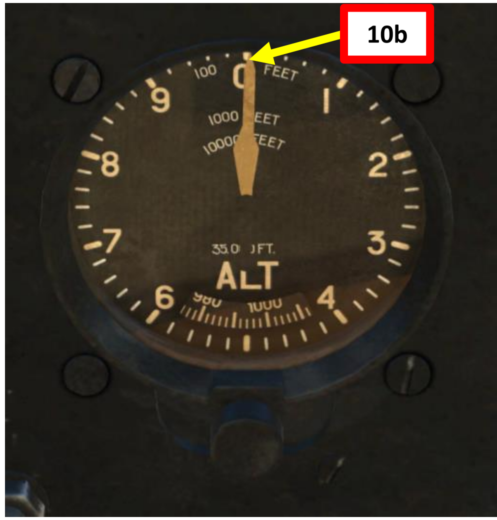
PRE-FLIGHT

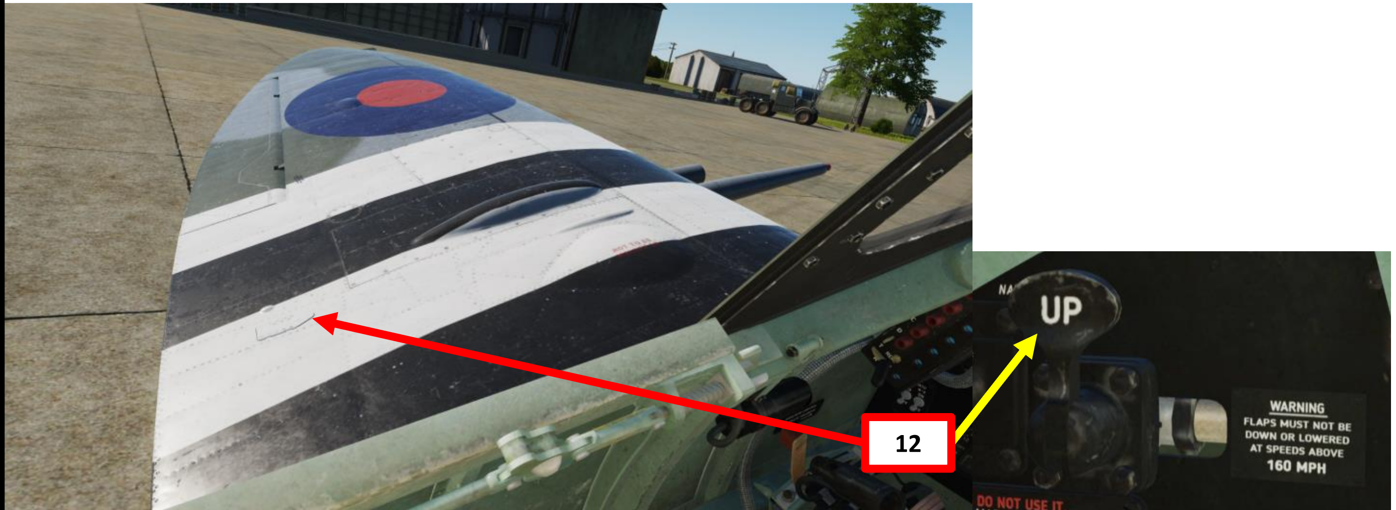
7. Ensure elevator, aileron and rudder controls are working by moving stick and rudder pedals
8. Magneto Ignition M1 & M2 Switches – BOTH OFF
9. Pneumatic Supply Pressure – Check no less than 220 psi *(central needle displays 300 psi)*
10. Scroll mousewheel on the “Altimeter Barometric Pressure Setting” knob to adjust the altimeter needle to 0.
11. Set Flaps Control Lever DOWN and check that mechanical flaps indicator are deployed
12. Set Flaps Control Lever UP and check that mechanical flaps indicator are retracted





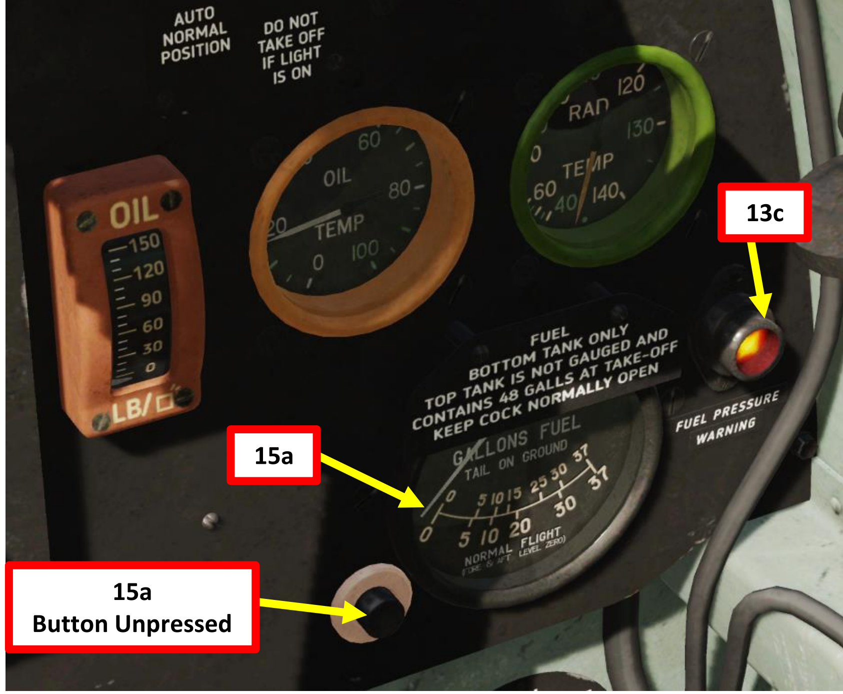


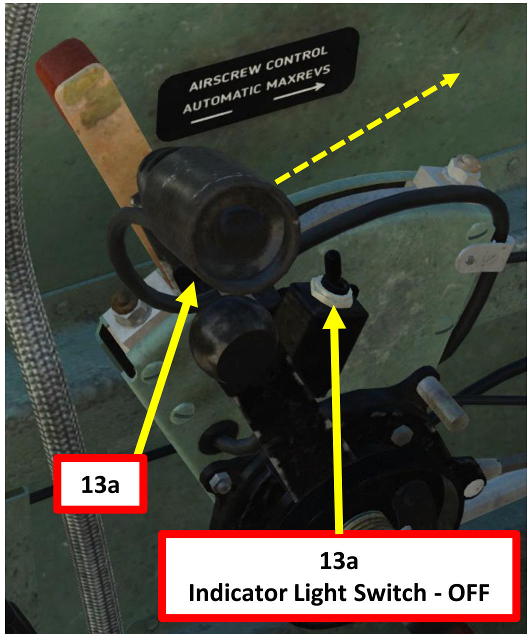


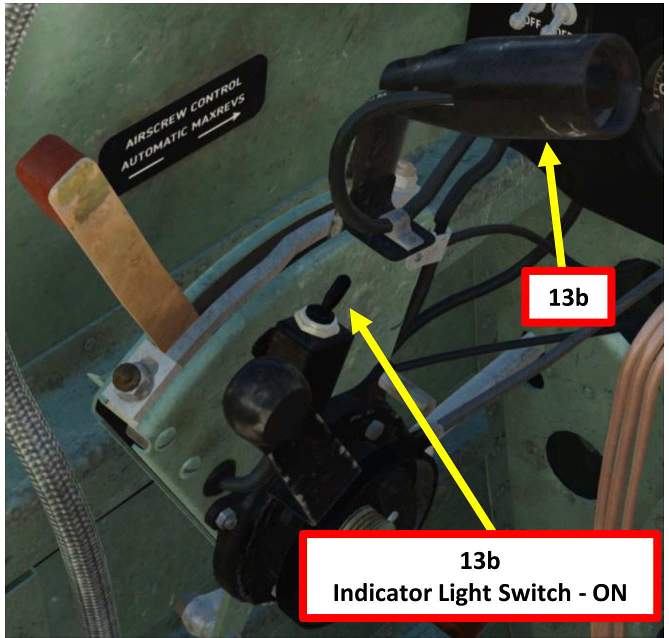


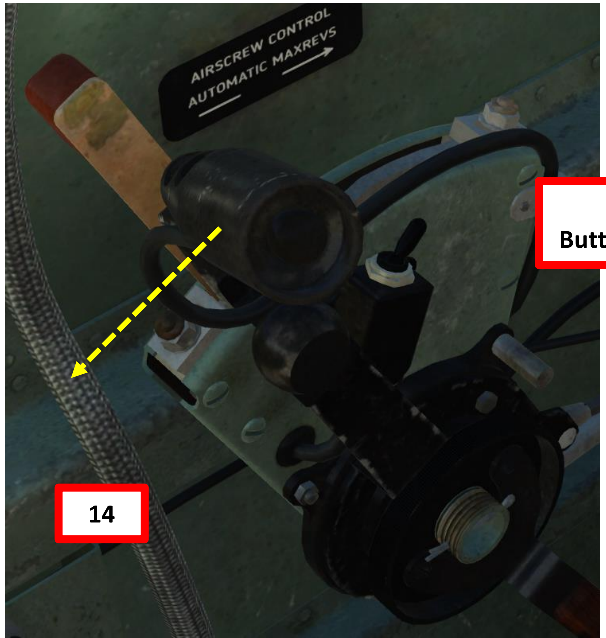
PRE-FLIGHT

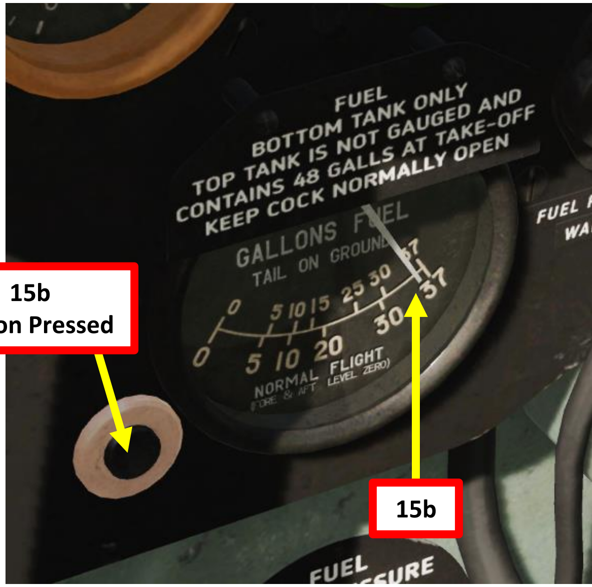
13. Advance throttle forward until you physically trigger the indication light power switch.
    - Once Indicator Light switch is tripped forward (ON), the Landing Gear and Low Fuel Pressure Warning lights should illuminate.
14. Retract throttle fully AFT. The indication light power switch should remain on (FWD).
15. Push the “Show Fuel Contents” button to display fuel quantity in the lower fuel tank.





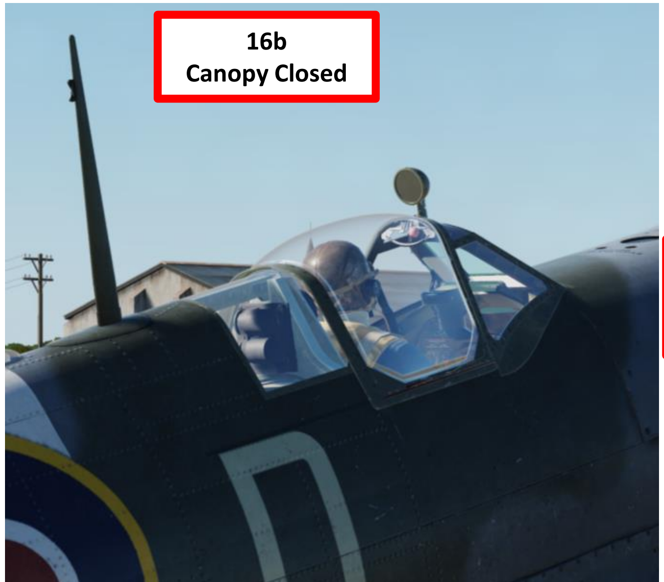


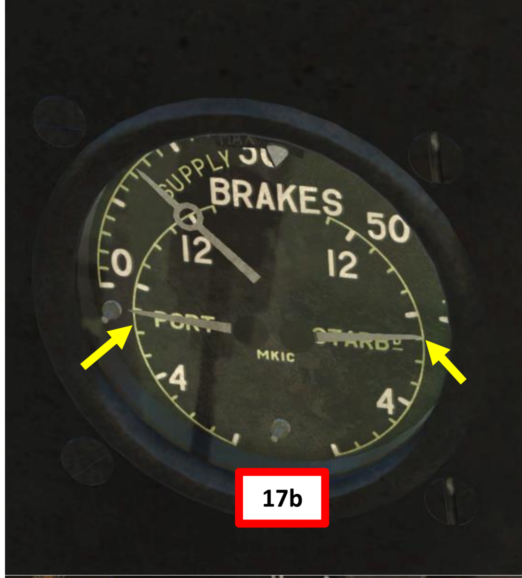


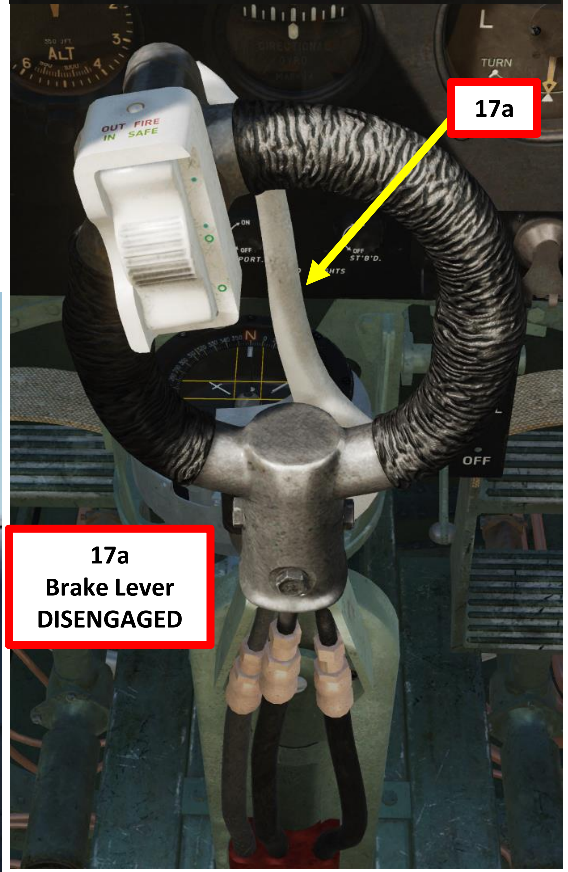


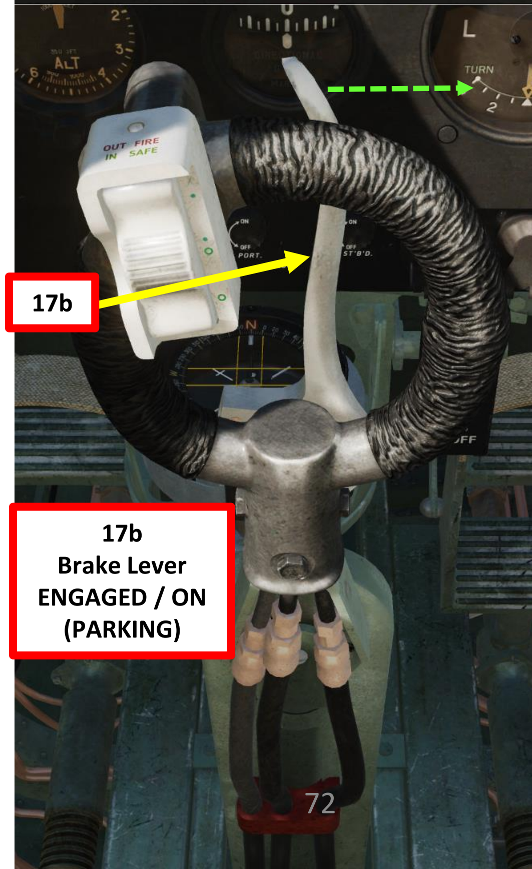
PRE-FLIGHT

16. Close Canopy by clicking on sliding hood handle (LCTRL+C)
17. Scroll mousewheel on Wheel Brake lever to stick it in the PARKING position (fully to the right).







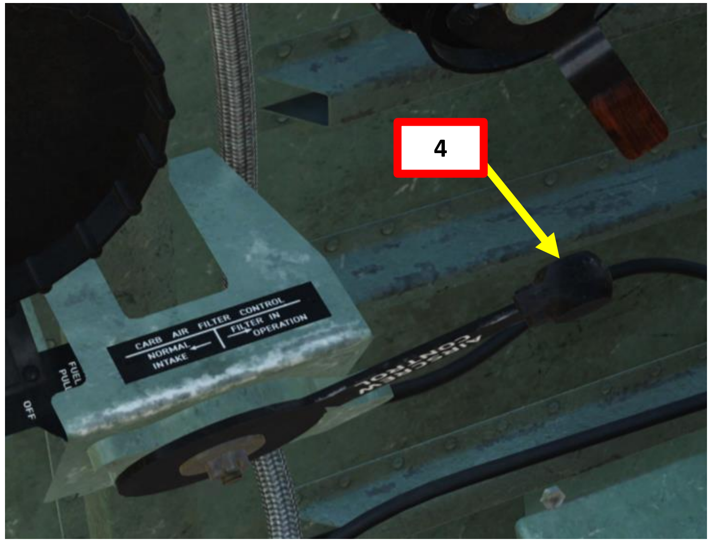


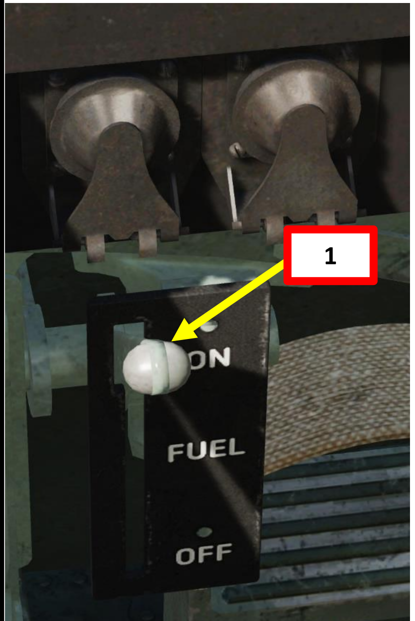
A FEW NOTES ON ENGINE START

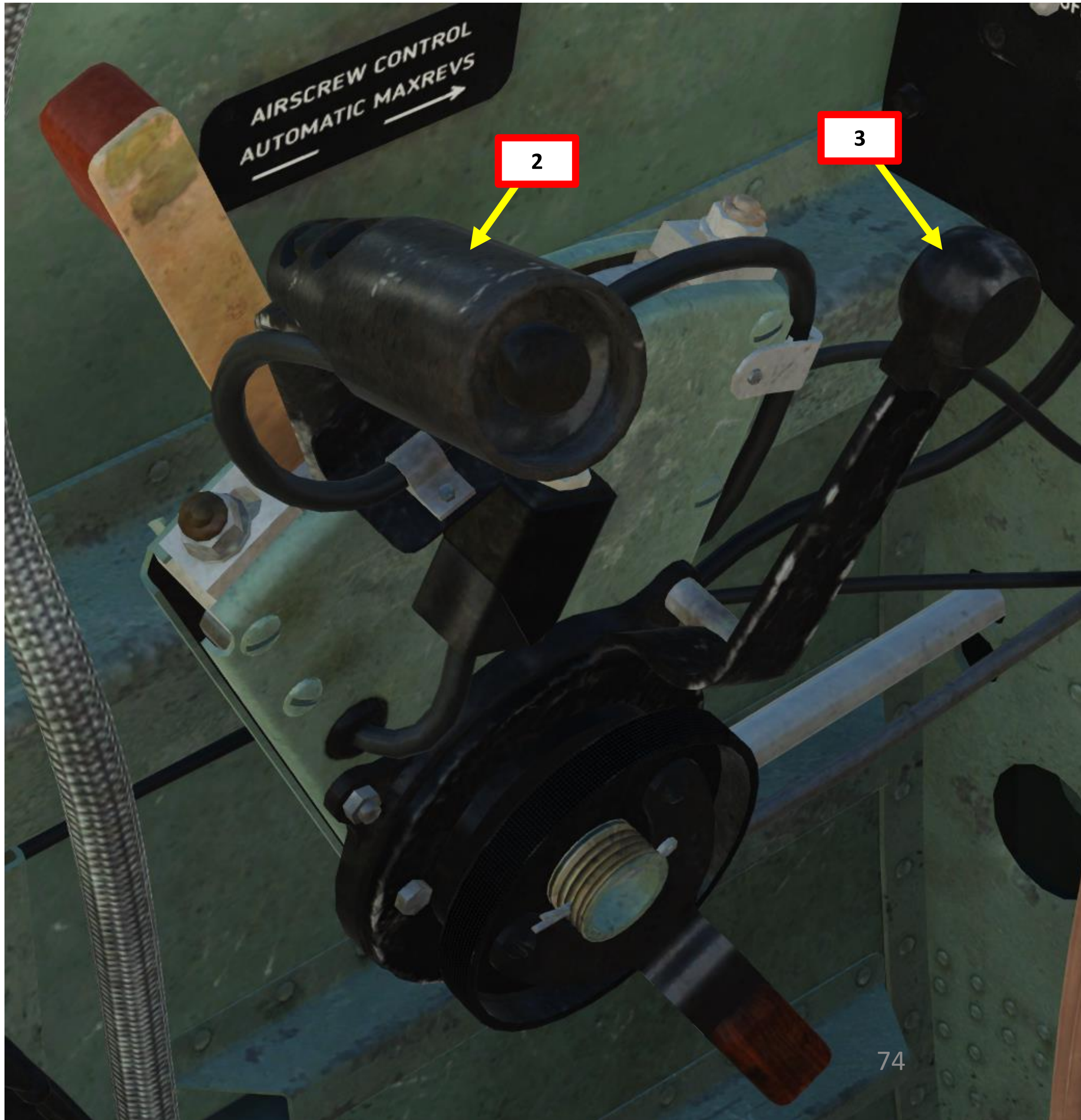
When starting up the Spitfire, you might overprime the engine. In cases where there is excess fuel but the engine isn't flooded, you will get flames momentarily coming out of the exhaust. In cases where there is excess fuel in the lines and the engine is flooded, the aircraft should be sent back to the maintenance hangar.

ENGINE START

1. Main Fuel Tank Cock Lever – ON
2. Set Throttle Lever – 1 INCH FORWARD
3. RPM Control Lever – FULLY FORWARD
4. Carburettor Air Intake Control Lever – FORWARD (FILTER IN OPERATION)
5. Set both Magneto Ignition M1 & M2 switches to ON



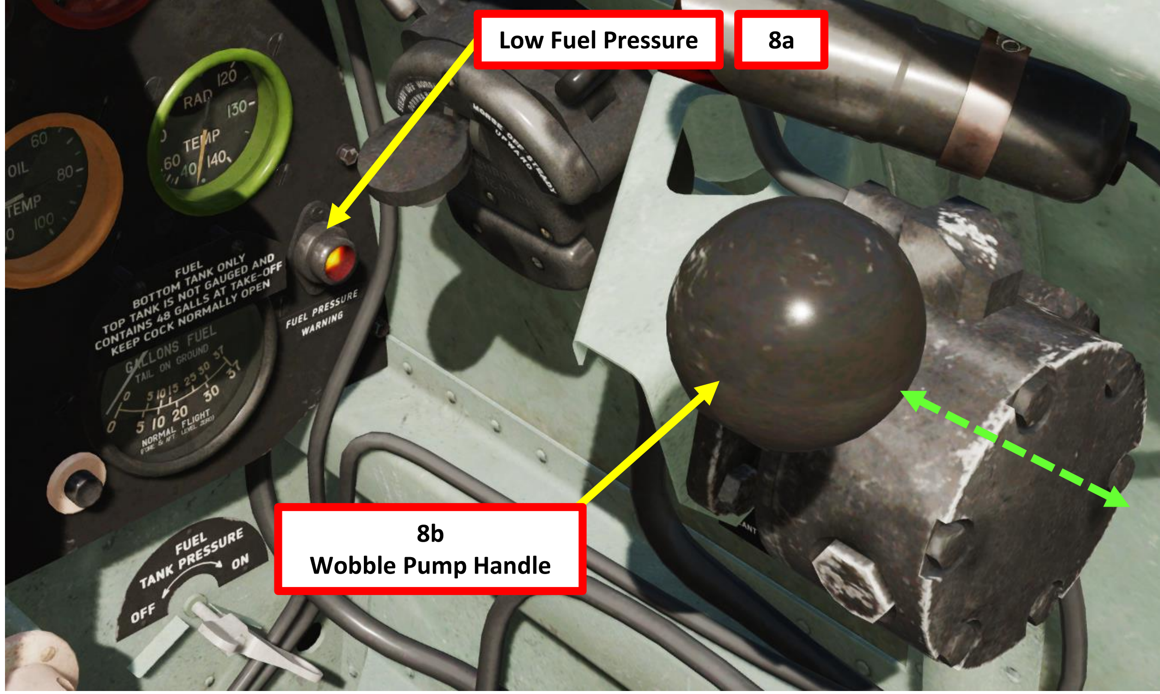




ENGINE START

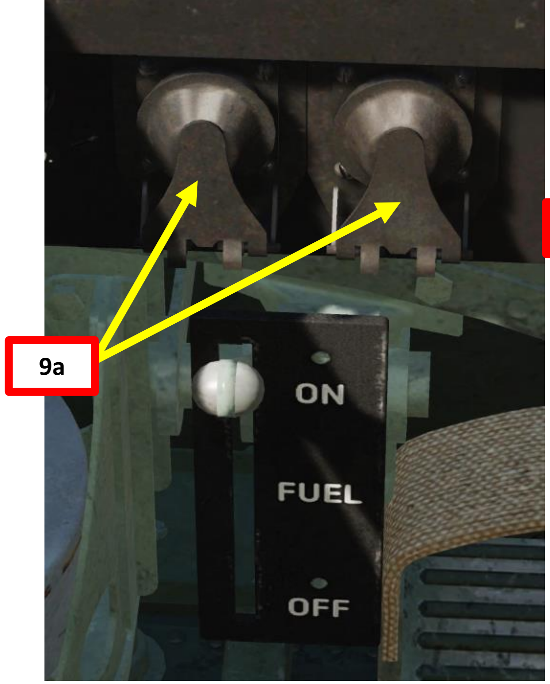
6. Unscrew Primer Pump Handle Cap by scrolling mousewheel
7. Click and hold primer pump handle (pull handle aft) and give 5 full strokes (push handle forward). Consult table for required number of strokes based on Outside Air Temperature.
8. Increase fuel pressure by operating the manual wobble pump handle (10 strokes). Low Fuel Pressure light will extinguish when required fuel pressure is high enough.

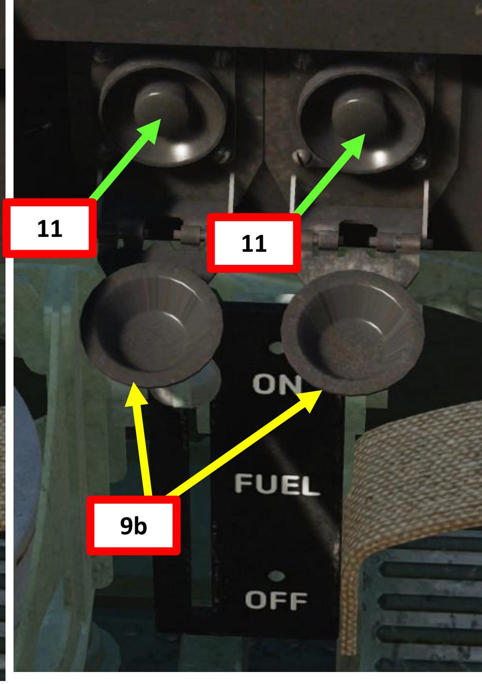
Primer Pump Strokes Required for OAT (Outside Air Temperature) in deg C					
Outside air temperature, °C	+30°	+20°	+10	0°	-10° ~ - 20°
Number of complete movements	2 - 3	4	5	5 - 6	Up to 15

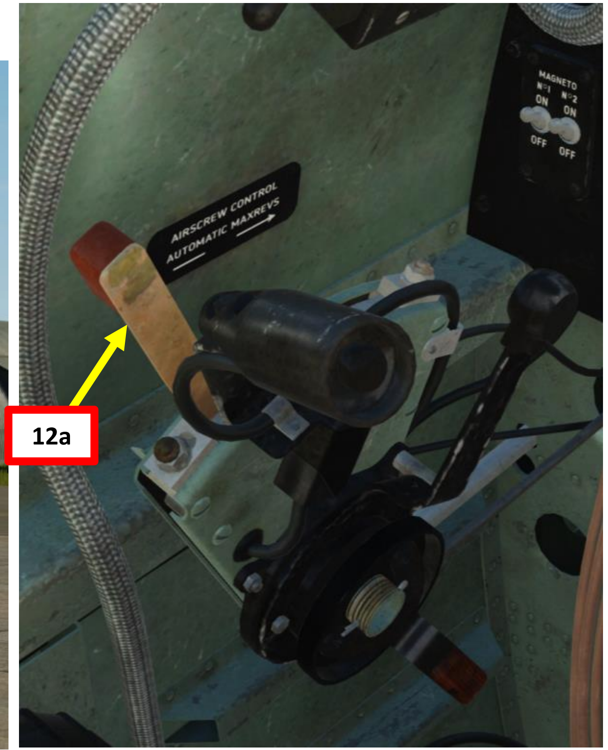


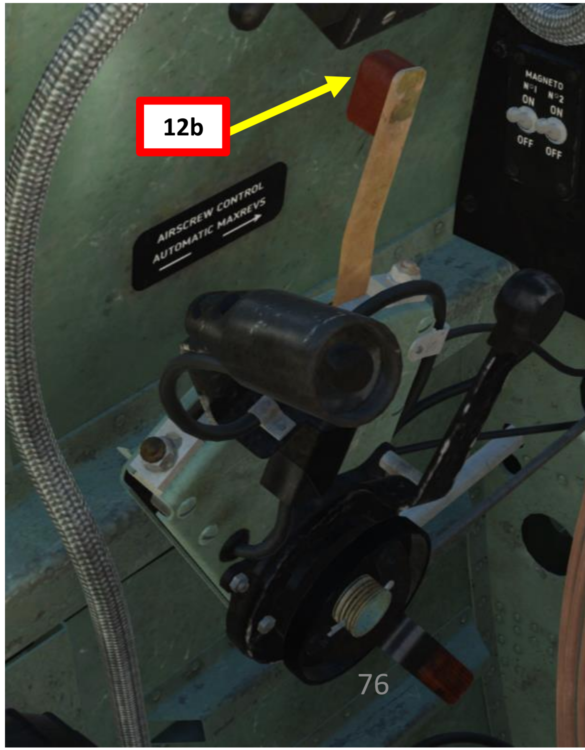
ENGINE START

9. Flip Booster Coil and Starter covers (in real life, these spring-loaded caps provide protection against accidental pressing).
10. Verify that the propeller is clear and command « Clear prop! » to warn people around you that you are about to start the engine.
11. When ready, press and Hold Starter and Booster Coil buttons simultaneously. (Key bindings recommended: “DELETE” for Booster Coil button and “HOME” for Starter button).
    - Starter activation time should not exceed 10 seconds, after which a break of 10 - 15 seconds becomes necessary.
    - Fun fact: Merlin engine variants earlier than the Merlin 66 used a Coffman-type starter cartridge, which would detonate and start the engine after the initial cranking. However, the Merlin 66 uses an electrical starter, which relies on battery power (or external ground power) to start the propeller.
12. While pressing and holding the Booster Coil and Starter buttons with your left hand, use your right hand to use the mouse to set the Mixture Control Lever to RUN (FULLY FORWARD) when the engine motor first sparks (you will hear an audible cough once the propeller catches up).
    - In real life, you would use your right hand to press the Booster Coil and Starter Buttons



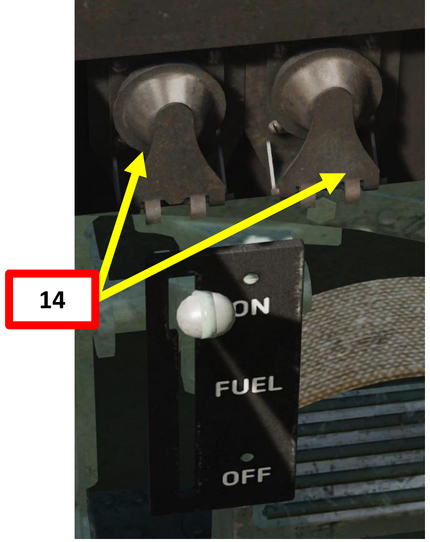


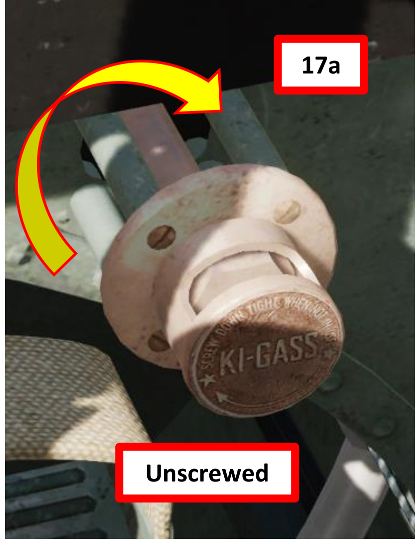


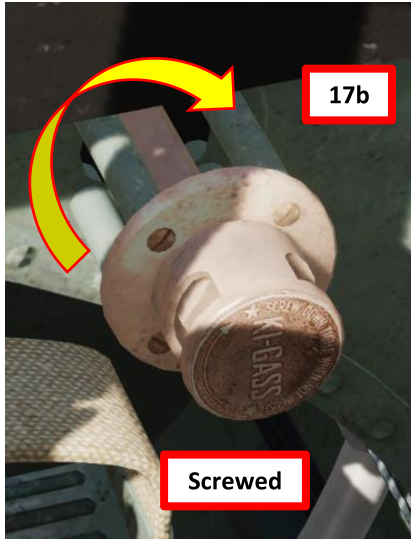


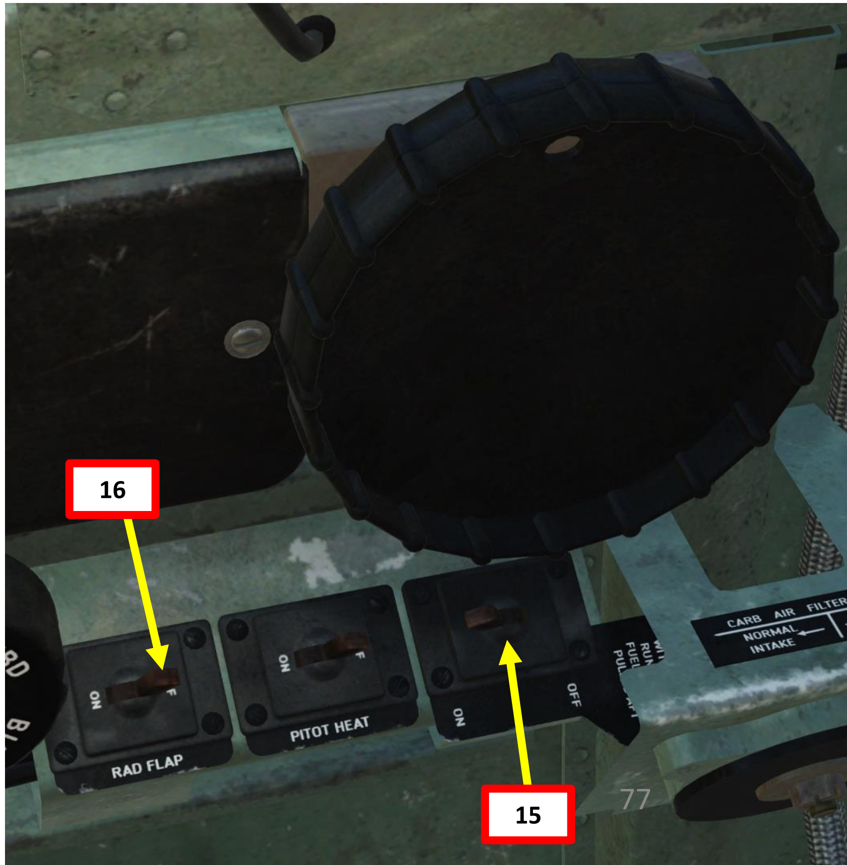
ENGINE START

13. Throttle back to avoid a prop strike (can happen if too much power is applied).
14. Close the Booster Coil and Starter button covers.
15. Fuel Pump switch – ON (AFT)
16. Verify that the Radiator Grates/Flaps Switch is OFF. When OFF, control of the radiator grates is automatic depending on the coolant temperature. The grates open at radiator temperatures above 115°C.
17. Screw the Primer Pump Handle Cap by scrolling mousewheel.



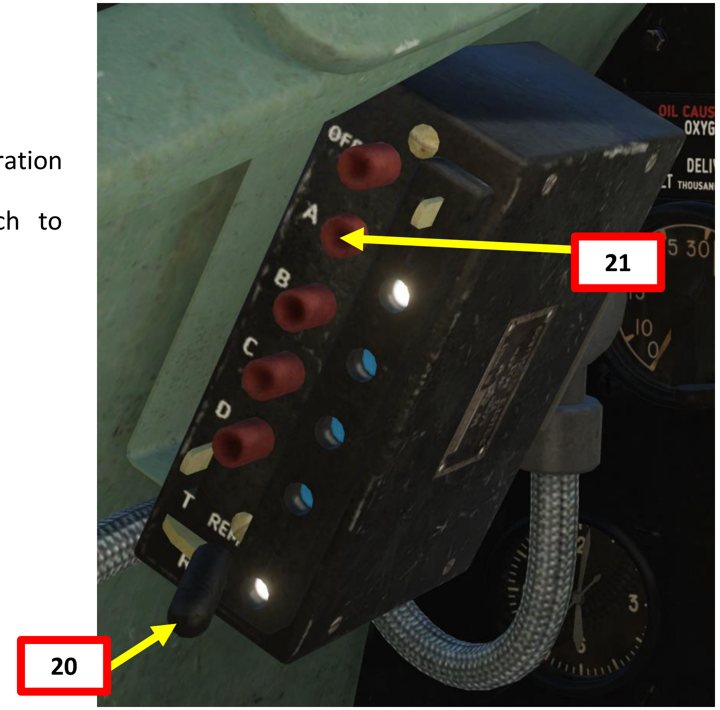


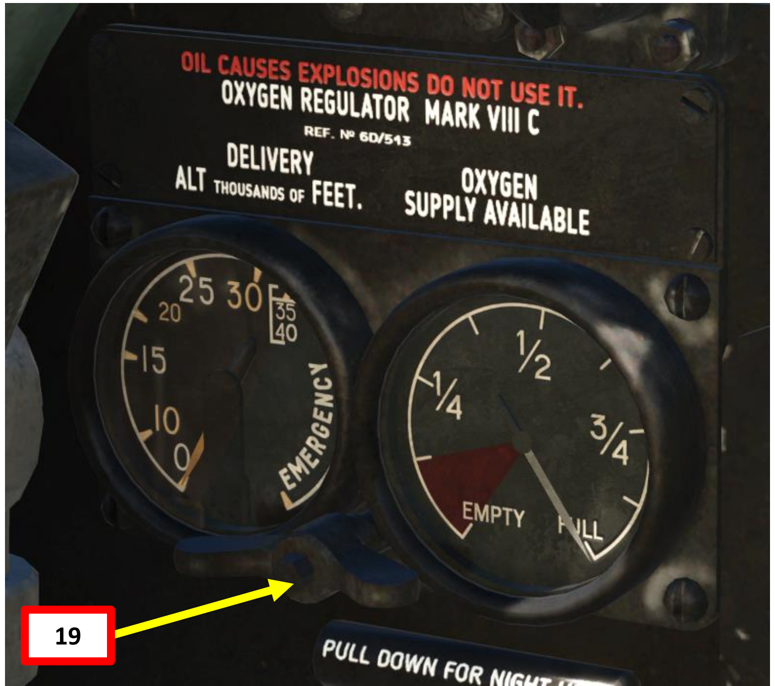


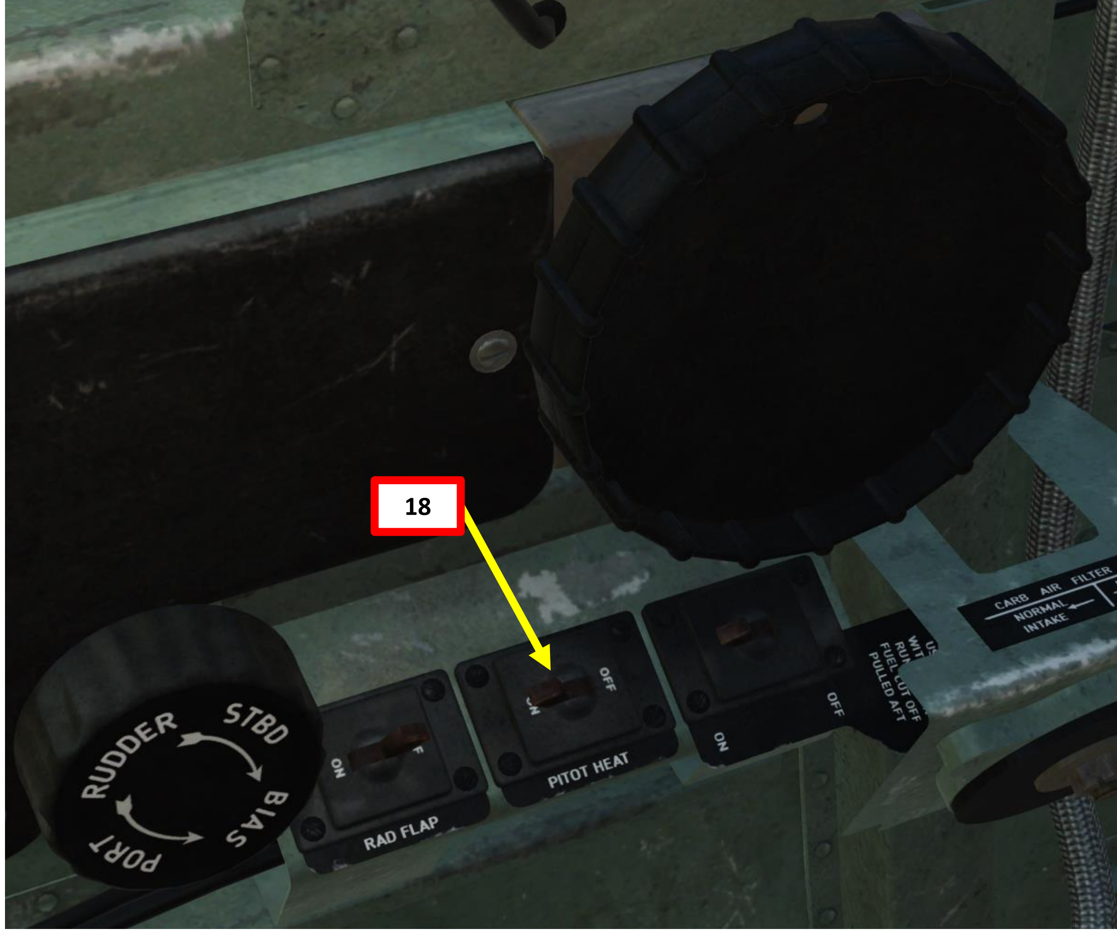


POST-START

18. Pitot Heat – ON (if required)
19. Oxygen Valve Control – Normal Operation Mode (Horizontal Position)
20. Set the radio Transmit-Receive switch to “REM” (Remote Operation)
21. Select desired channel (A, B, C or D)

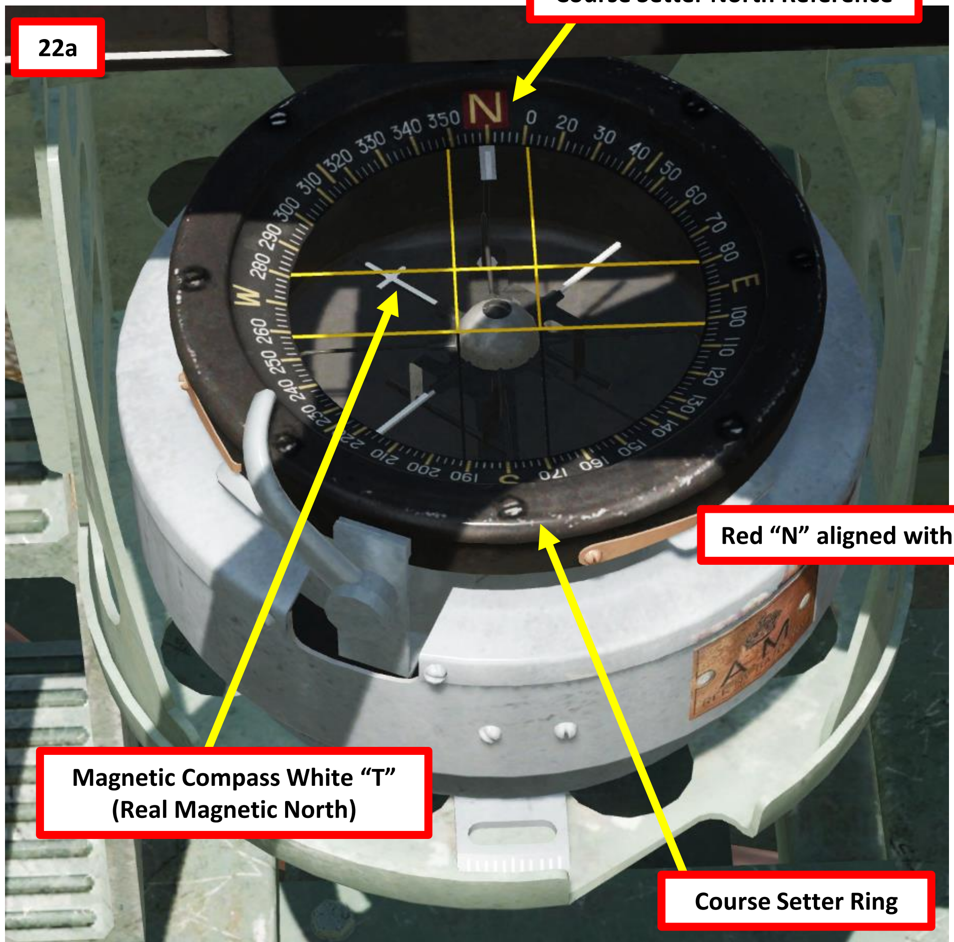


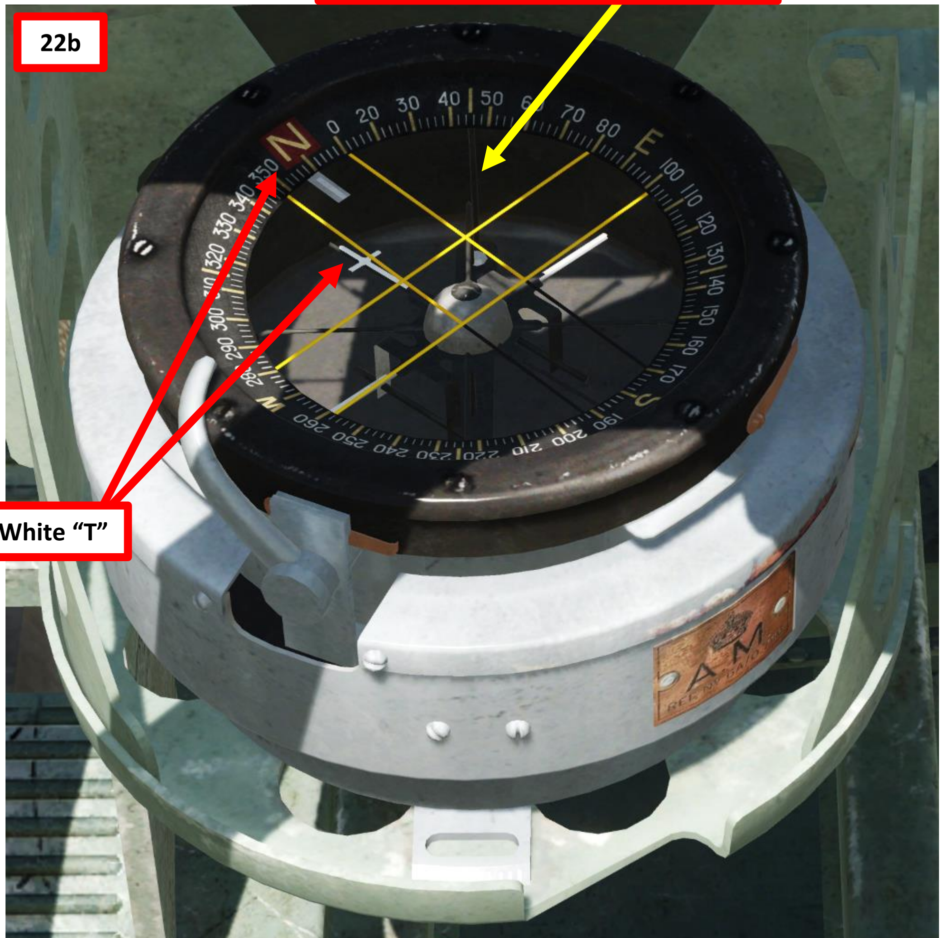




POST-START

22. Turn the Course Setter ring of the P8 Magnetic Compass (scroll mousewheel on course setter ring) to align the red "N" (North Reference of the course setter) with the white "T" cross (real magnetic North of the compass). The lubber line will display your current heading.
23. Turn the Directional Gyro adjustment knob to match the heading of the directional gyro with the one shown by the magnetic compass' lubber line.

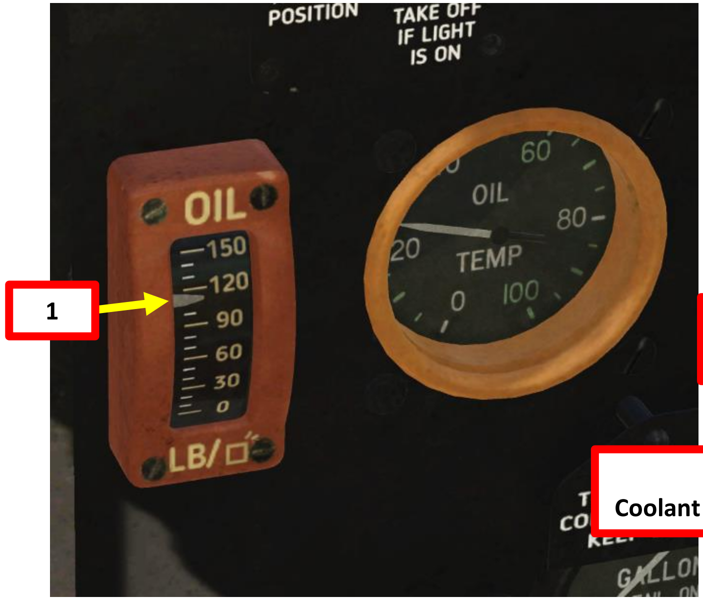


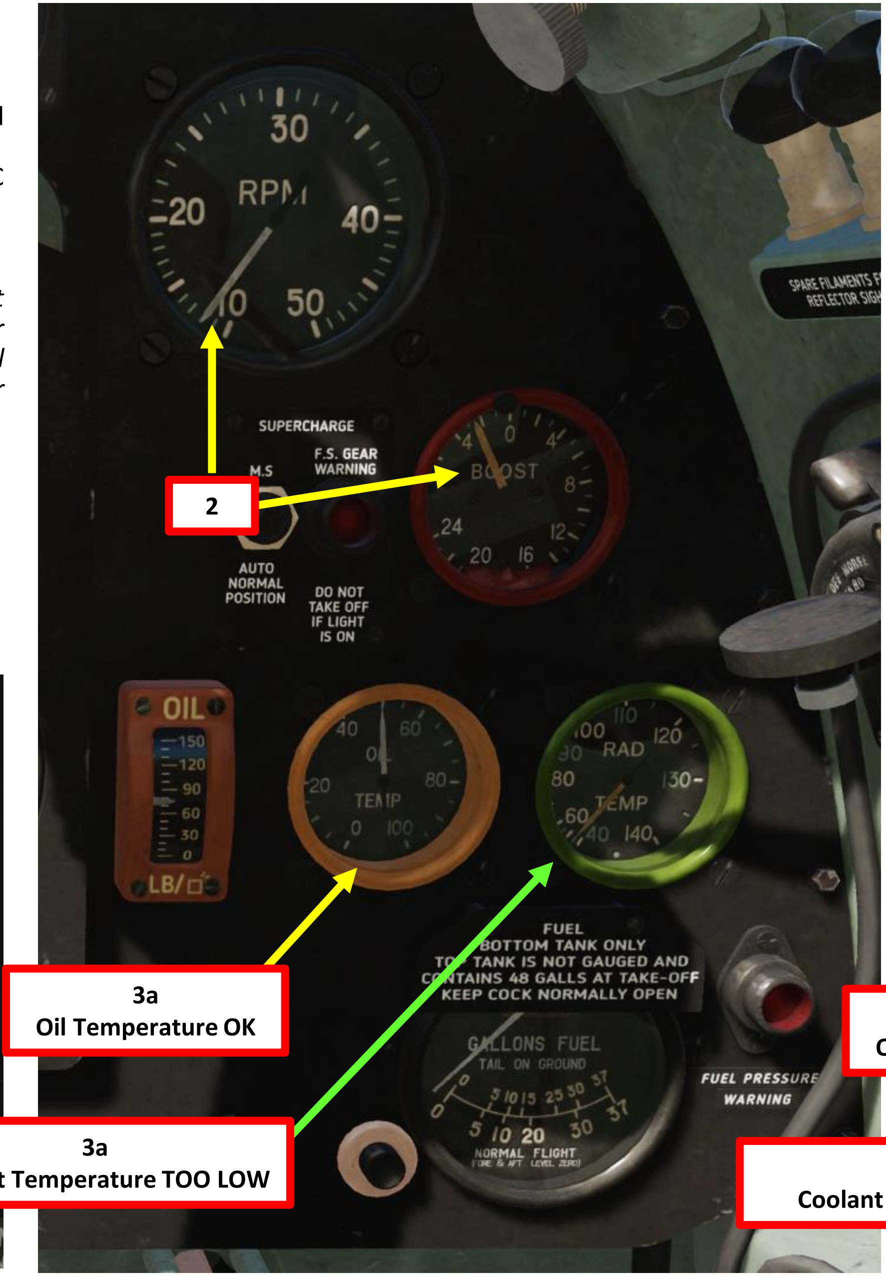


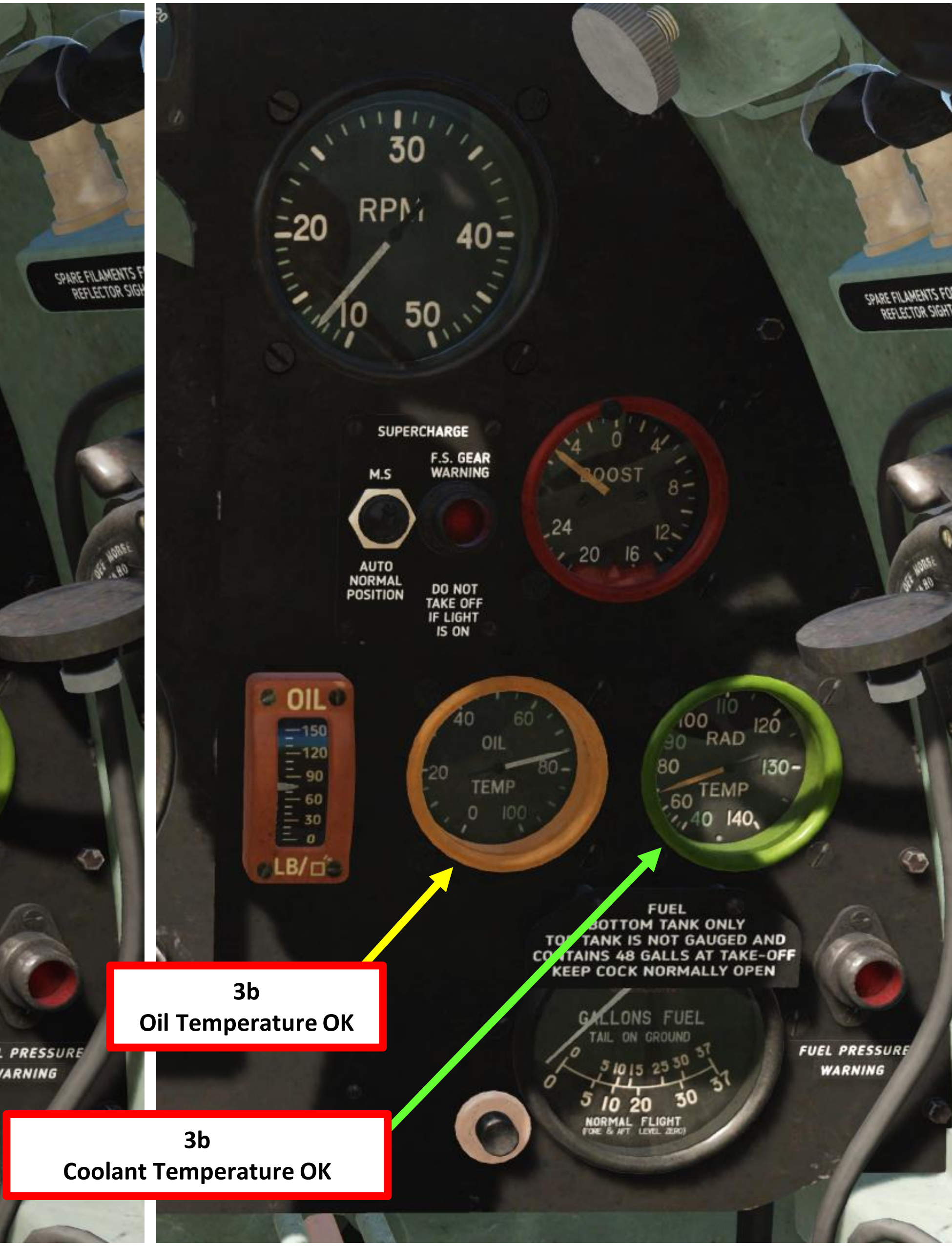
ENGINE WARM-UP

1. Ensure oil pressure is in the 60-120 psi range.
2. Adjust throttle to reach a RPM between 1000 and 1200 (IDLE range).
3. Wait until engine oil warms up to at least 20 deg C and coolant temperature is at least 60 deg C.
4. Once engine is warmed up, you may start taxiing.

Note: *Attempting a takeoff with low oil or coolant temperature can lead to dire consequences. Waiting for proper engine warm-up is often overlooked by virtual pilots and the Merlin engine leaves no room for error when engine temperatures are concerned.*



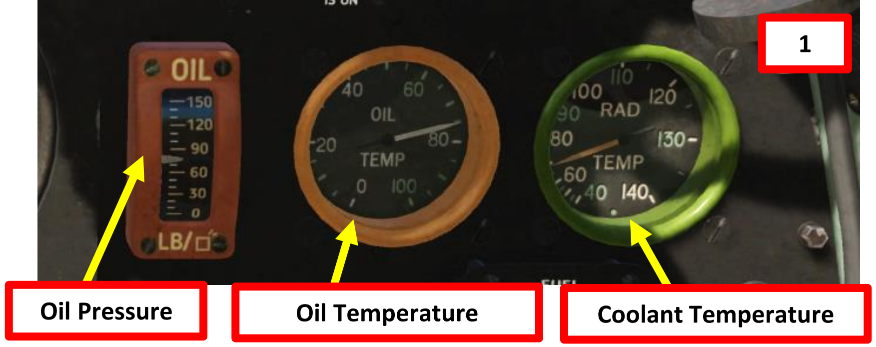


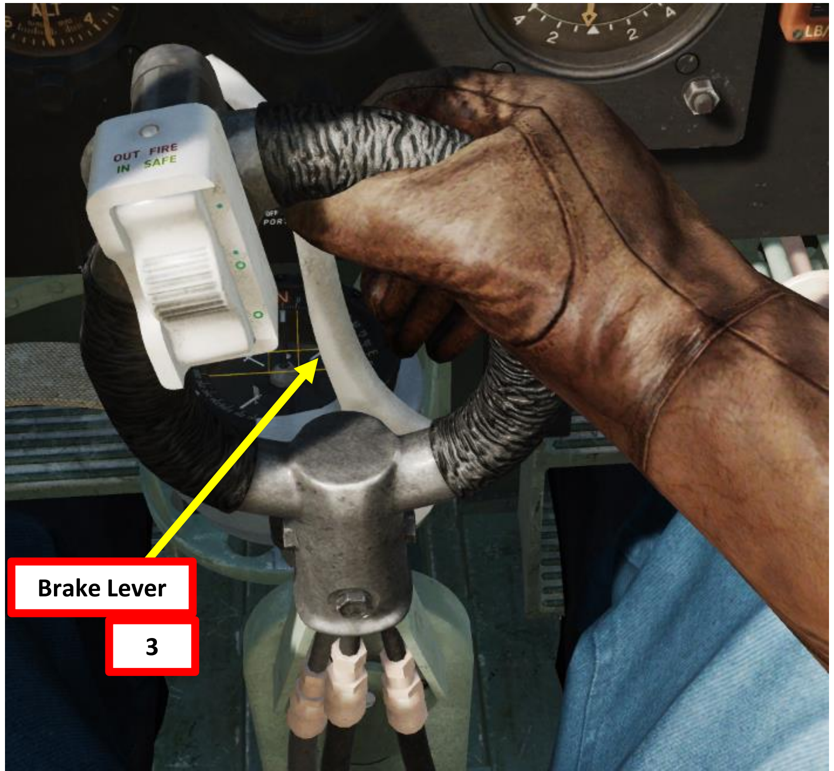


TAXI PROCEDURE

1. Ensure engine oil temperature is between 20 and 80 deg C and coolant temperature is between 60 and 120 deg C.
2. Ensure pneumatic pressure is no less than 220 psi.
3. Start taxiing when engine is warmed up by releasing the Wheel Brake Lever from the PARKING position (press on the Brake Lever to release the brakes).
4. Set throttle to 1800 RPM and check brake effectiveness.
5. Set throttle to 1500 RPM, open canopy and start taxiing. Reduce throttle as required to maintain a safe taxi speed. While taxiing, keep the stick pulled fully aft.
6. To execute a turn, press and hold the wheel brake lever while simultaneously giving rudder input in the desired direction. The brakes are pneumatically actuated.
7. Line up on the runway, then close canopy.

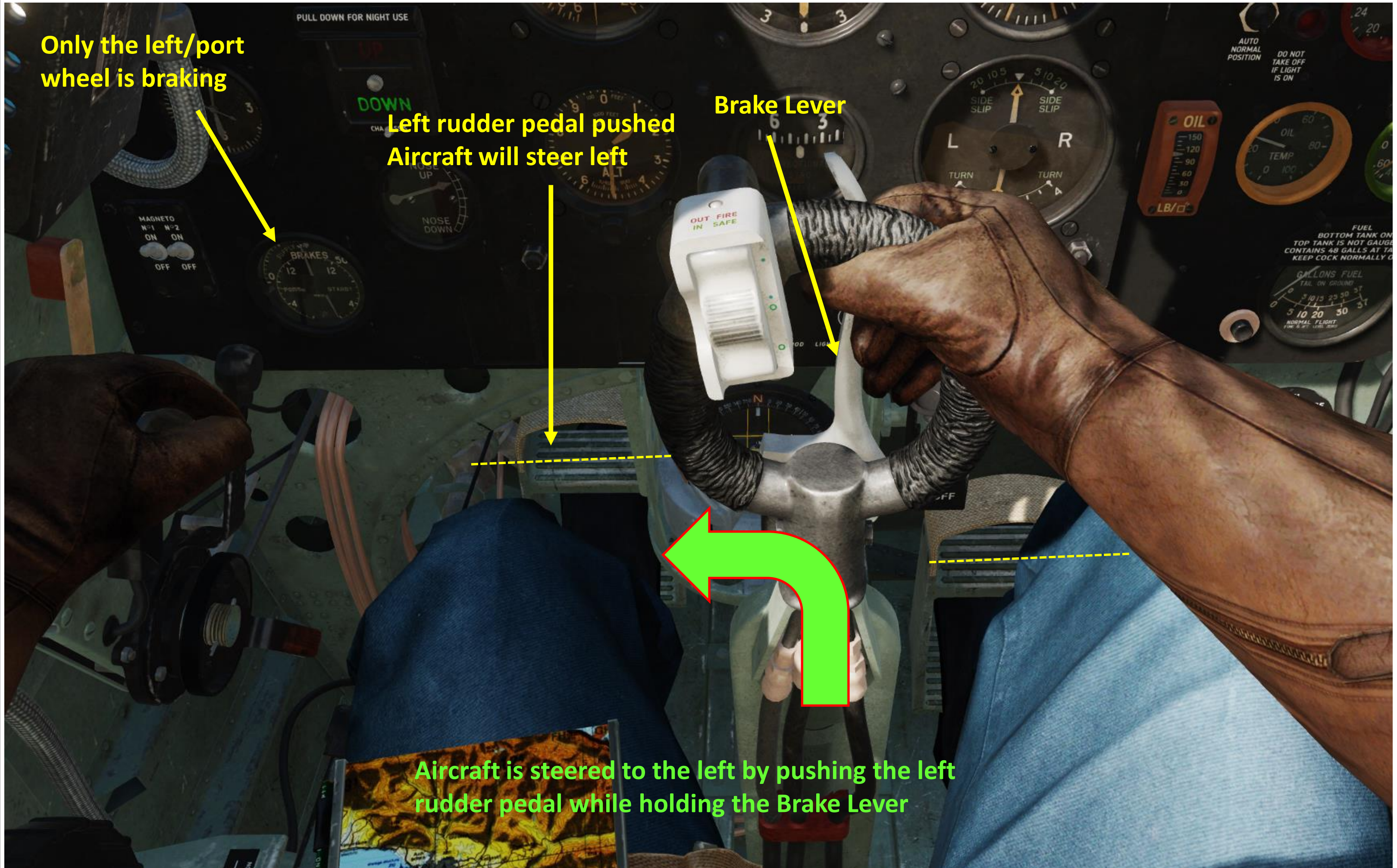
Note: *During taxi, keep the control stick pulled completely AFT to ensure that the tailwheel remains straight.*

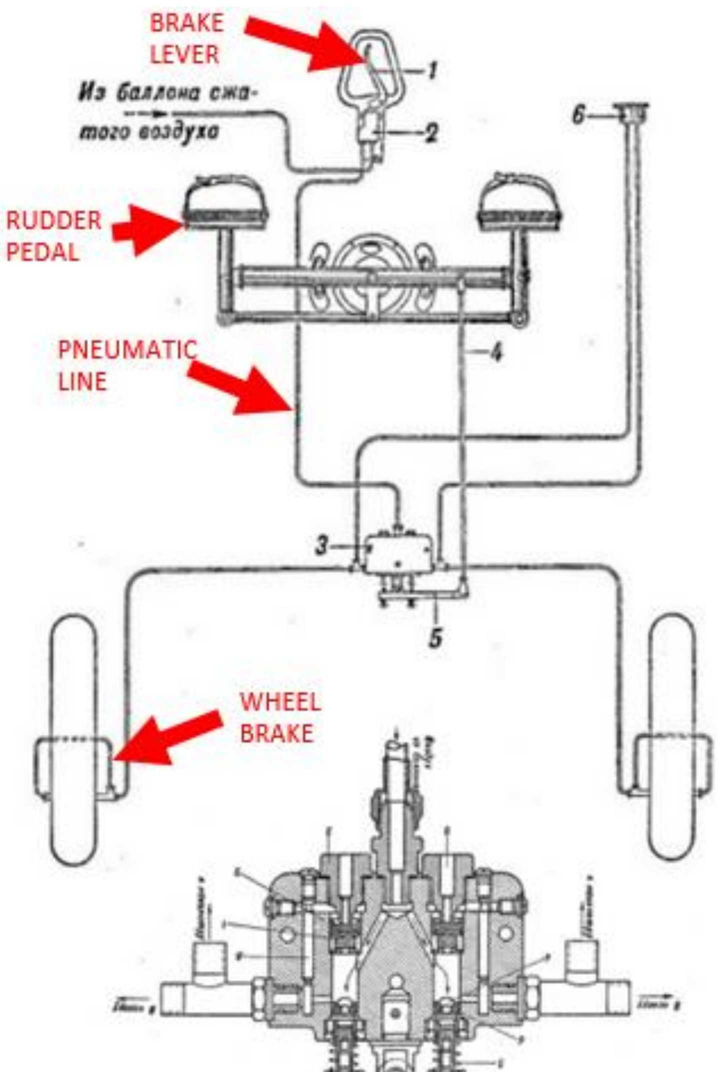




BRAKING TIPS

Braking is done by holding the braking lever while giving rudder input to steer the aircraft in the direction you want to turn. Make sure you have adequate RPM and Boost/Manifold Pressure settings or your turn radius will suffer. The Spitfire is a very tricky aircraft to taxi on the ground because of the narrow landing gear, the high power of the engine and poor cockpit visibility when taxiing. The best way to move safely on the tarmac is to give very gentle throttle input to ensure you maintain control of the aircraft while steering left and right once in a while to check for obstacles to ensure that the tailwheel remains straight.

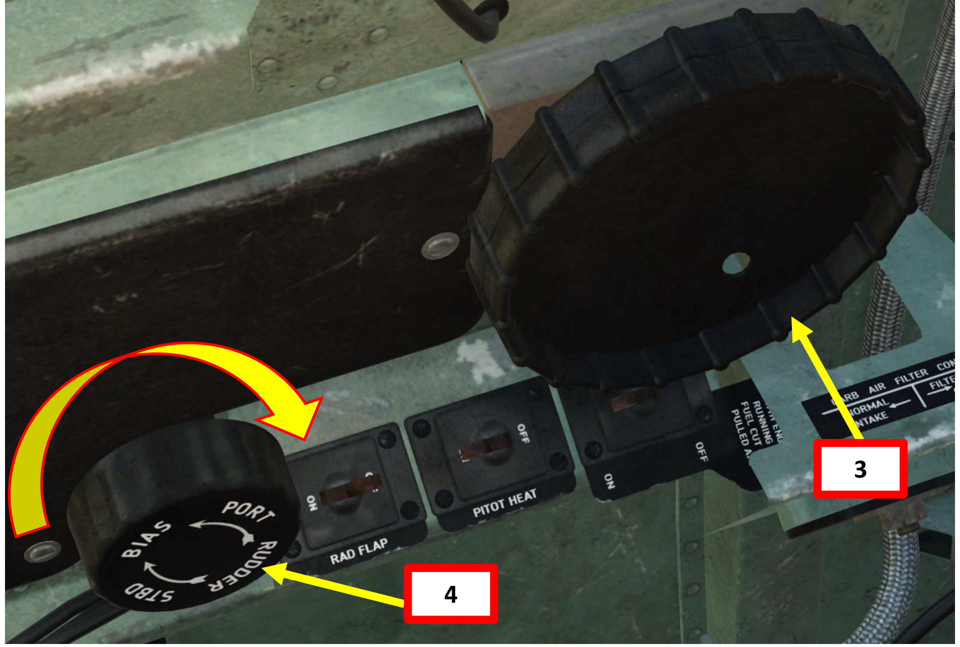


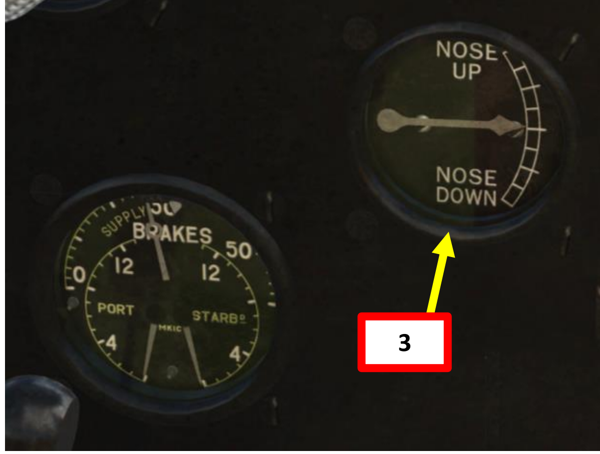


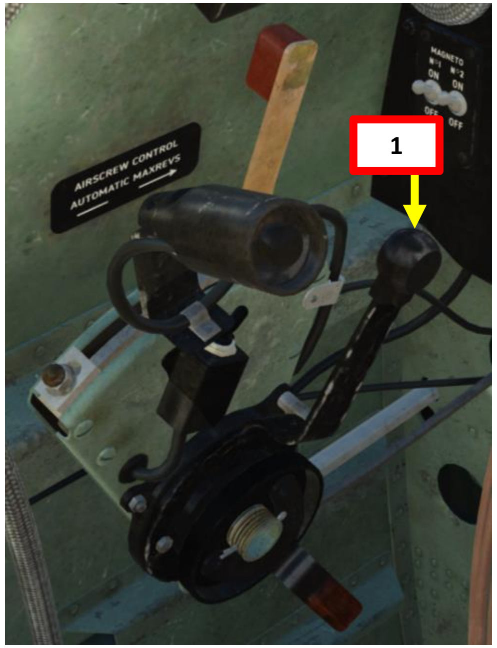
EXAMPLE OF DIFFERENTIAL BRAKING SYSTEM ADAPTED FROM RUSSIAN LAGG-3

TAKEOFF PROCEDURE

1. Ensure RPM Control lever is fully forward
2. Flaps – UP
3. Set Elevator Trim for takeoff setting
   - NEUTRAL for normal load (full main tanks, ammunition + 45 gallon drop tank)
   - 1 div. NOSE DOWN for heavy load configuration (when carrying bombs)
4. Set Rudder Trim FULL RIGHT (no indicator, just turn the wheel in the STBD (Starboard/Right) direction
5. Ensure Supercharger Control Switch is set to AUTO-NORMAL position (DOWN).
6. Pull stick fully back to ensure that tailwheel remains straight.
7. Gradually throttle up to +8 psi of boost (between +8 and +12 psi is acceptable for takeoff). Compensate engine torque (left yaw) with rudder input (right rudder to counter left yaw).
   - The slower your increase the throttle, the better control you will have over the acceleration and engine torque of the aircraft.
8. Slowly release control stick to center position as aircraft gains speed and tailwheel leaves the ground.
9. Rotate when reaching 90 mph.





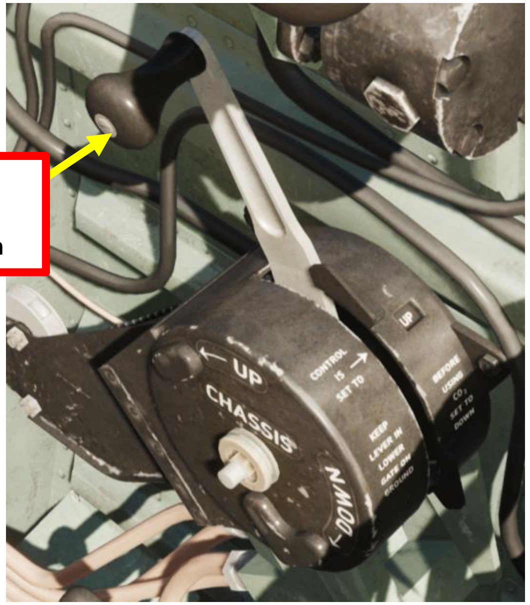


TAKEOFF PROCEDURE

TAKEOFF PROCEDURE

10. Once in the air, raise Landing Gear (Undercarriage) using the Landing Gear Lever FWD when reaching 140 mph.

10
FWD: Gear Up
AFT: Gear Down



Gear Down

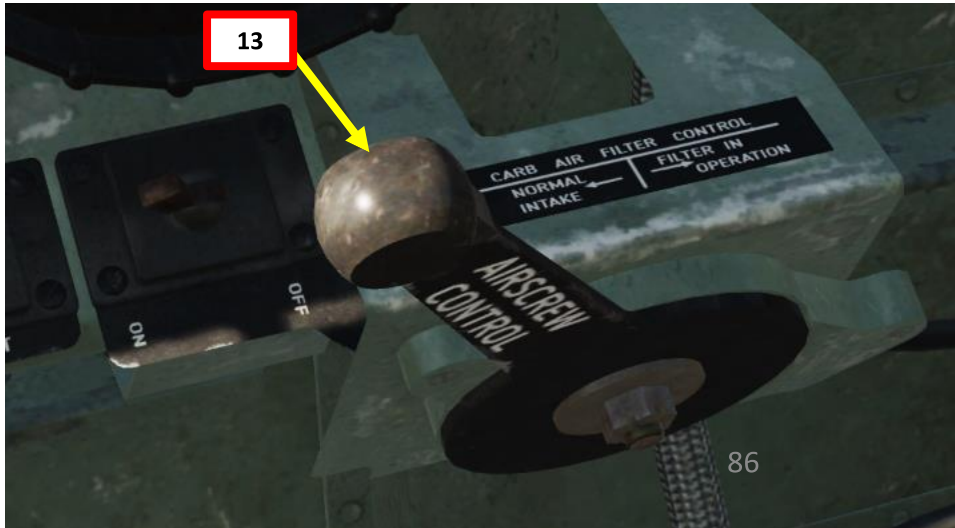
Gear In Transition

Gear Up

TAKEOFF PROCEDURE

11. Start climbing and adjust power with throttle and RPM control lever
    - If maximum continuous rate of climb is required, use +12 psi boost and 2850 RPM.
    - If maximum rate of climb is not required, use +7 psi boost and 2650 RPM. Doing so conserves fuel and increases total flight range.
    - In extreme situations, you can use the +18 psi boost and 3000 RPM for a maximum of 5 minutes
12. As you reach 1,000 ft or higher, set Carburettor lever to NORMAL INTAKE (AFT).

VIDEO DEMO:
https://www.youtube.com/watch?v=0iEMZb-dk_E



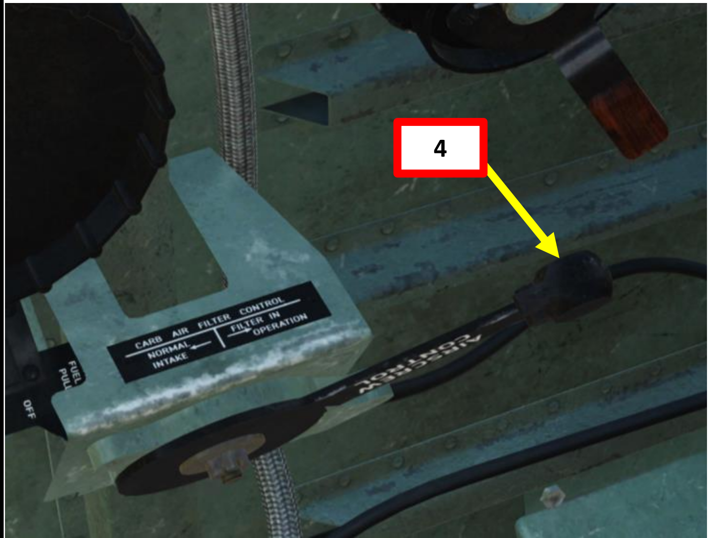
THROTTLE, STICK AND RUDDER INPUT DURING TAKEOFF

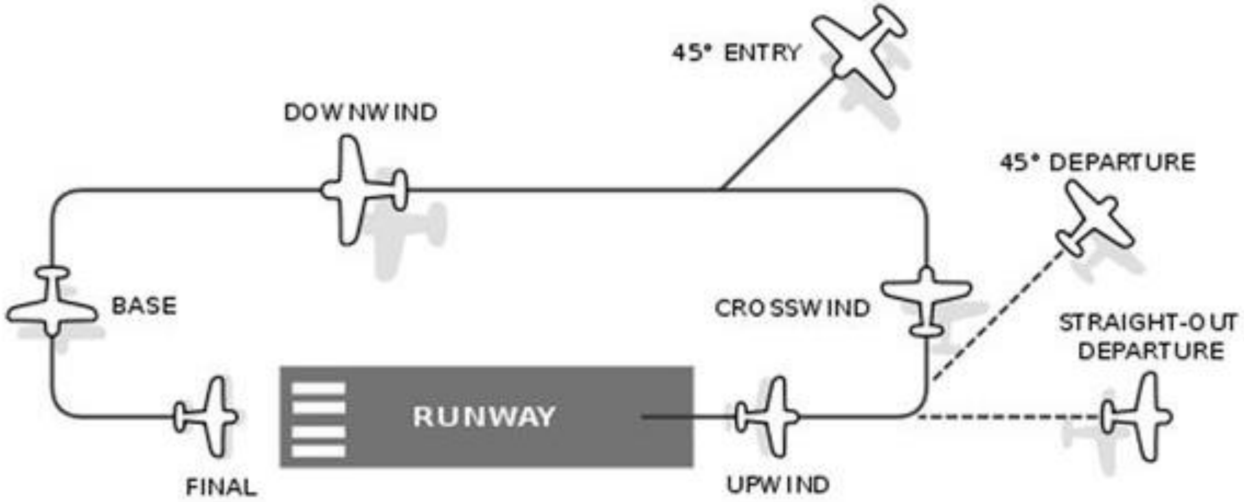
Here is an example of takeoffs at different engine power settings.

LINK: https://www.youtube.com/watch?v=Iqo7juJD3fU&feature=youtu.be

LANDING PROCEDURE

1. Enter approach at 2600 RPM and +6 psi Boost.
2. Reduce throttle to -2 psi (Minus 2, yep!) Boost as you enter downwind leg.
3. Enter downwind leg at 1000 ft altitude.
4. Set Carburettor control lever to FILTER IN OPERATION (FWD).



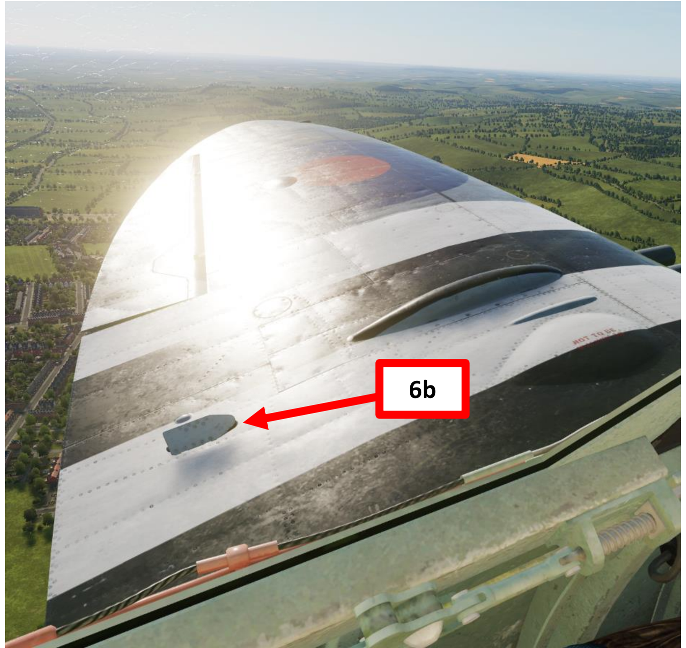


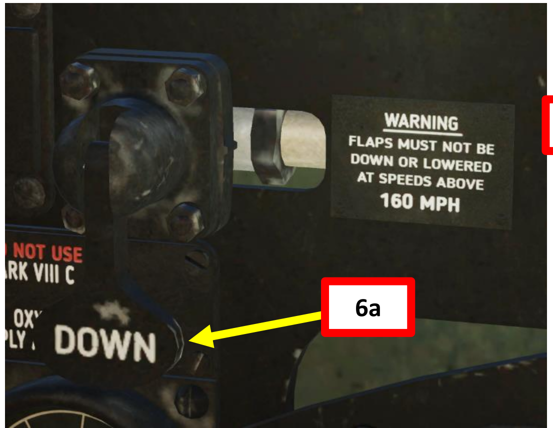
LANDING PROCEDURE

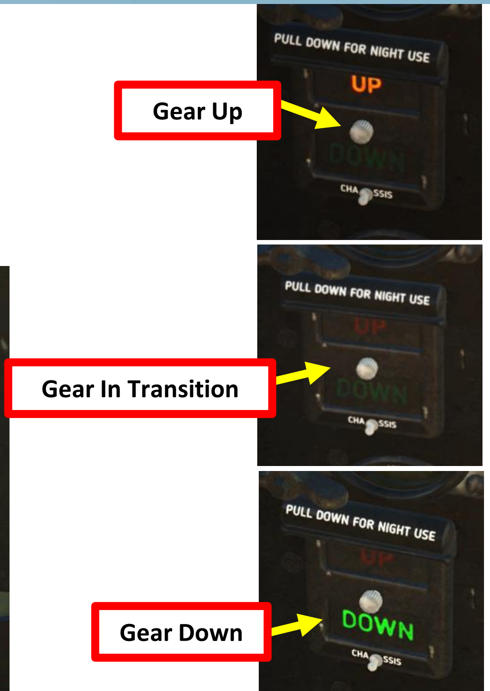
5. Deploy landing gear as you slow down to 150 mph.
6. Once your wingtip is abeam the runway threshold, deploy flaps (at 150 mph or less) and enter base leg with a descending turn.
7. Maintain eyesight of the runway threshold as your turn and enter final at 500 ft altitude.
8. Fly over runway threshold at 90 mph.
9. Gently flare for a three-point landing and maintain attitude until your touchdown at 60-70 mph.
10. Use rudder pedals to stay straight on the runway as you decelerate.
11. Start using the wheel brake lever in short bursts when rudder movement becomes ineffective.
    - *WARNING: Excessive braking may cause the aircraft to nose over.*
12. Raise flaps and taxi back to hangar.

Note: *During landing, the aircraft will feel extremely floaty when flaps are deployed. The narrow landing gear of the Spitfire also makes it even more difficult. Controlling the speed at which you touch the ground is essential in order to avoid nasty bounces. Avoid pulling aft on the stick when going for a three-point landing.*

VIDEO DEMO:
https://www.youtube.com/watch?v=0iEMZb-dk_E&t=116s







LANDING PROCEDURE

LANDING PROCEDURE

LANDING PROCEDURE

AVOIDING SCRAPING YOUR WING

Your first landings in the Spitfire may often result in the following scenario: you touch the ground, think you've finally made it home and then feel your wing dip down and strike the ground. The reason this happens is that many pilots will come in slightly crabbed and reduce their throttle suddenly once they touch the ground, which causes a destabilizing yaw motion to the aircraft because of the changing torque generated by the change in engine power.

The best way to avoid this is to use your **rudder trim** to make sure that you come in as straight as possible. The turn and slip indicator will help you judge whether you are coming in straight or side-slipping. **Minimize your side slip** on touchdown with your rudder trim wheel and you will finally nail those landings.

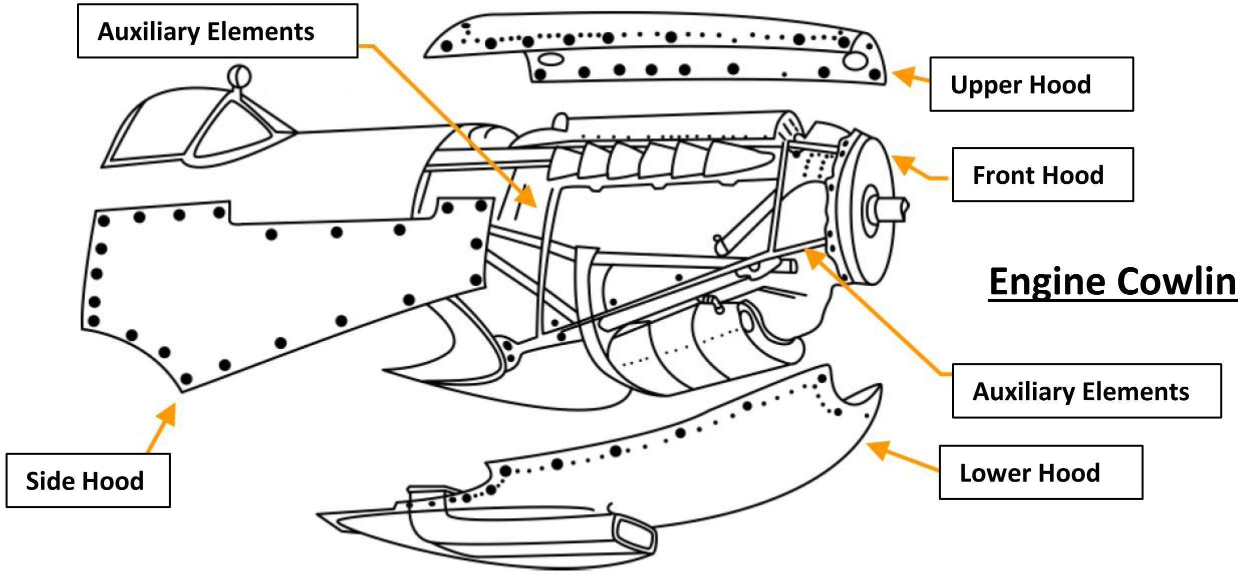
Too Much Side Slip Bad!

Minimal Side Slip Good!

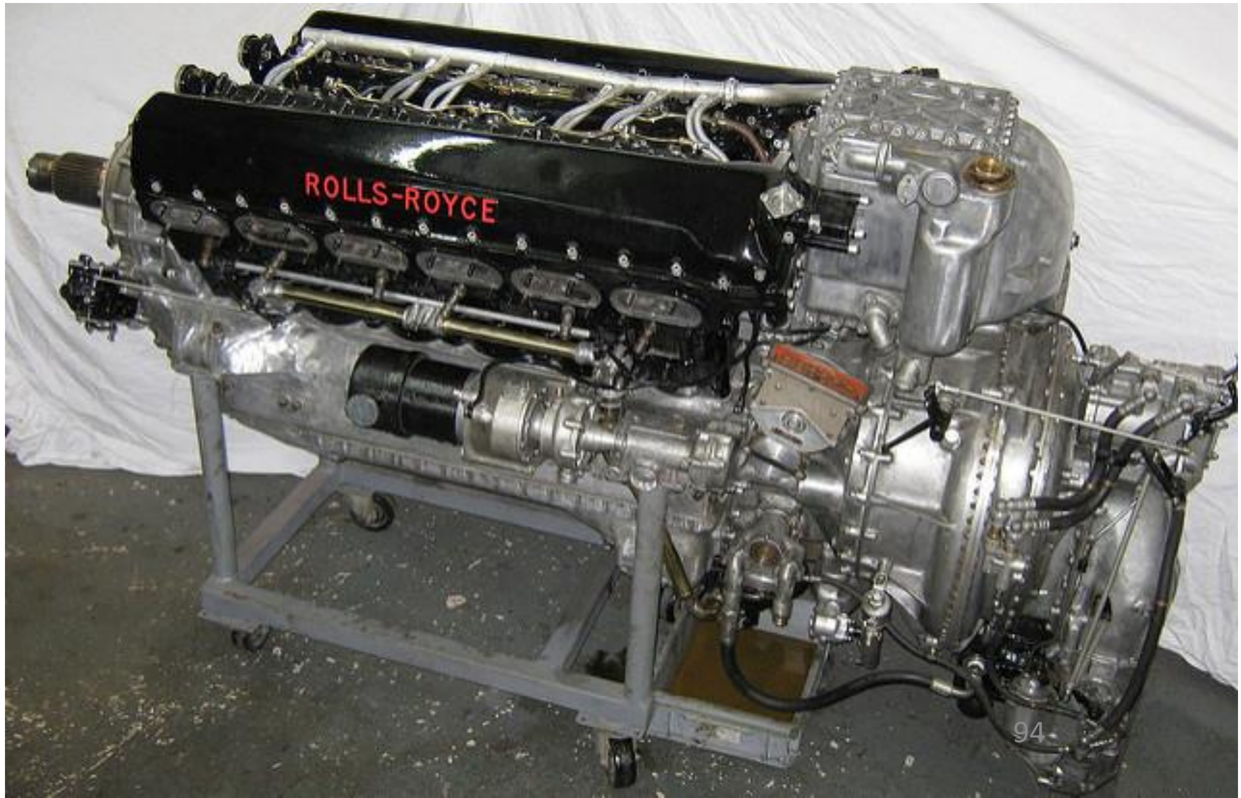
THE MERLIN 66 ENGINE

The Spitfire Mk IX is powered by the Merlin 66 engine. This liquid-cooled, 12-cylinder V-twin four-stroke internal-combustion engine has a capacity of 27 liters. It is equipped with a Bendix-Stromberg 8D-44-1 pressure carburetor capable of operating under negative G-loads, and a two-stage, two-speed drive centrifugal compressor with an intercooler for cooling the air-fuel mixture supplied to the cylinders.

Engine Type	V-type, liquid-cooled, geared, equipped with two-stage two-speed supercharger with liquid cooling and intercooler
Number of Cylinders	12
Cylinder Arrangement	2 blocks of 6 cylinders with an angle of 60°
Piston – diameter and throw	5.4 * 6 inches
Working Capacity	1648 in^3, 27 liters
Compression Ratio	6
Supercharger	2-stage, 2-speed
Gear ratio	First speed - 1:5,79; Second speed - 1:7,06

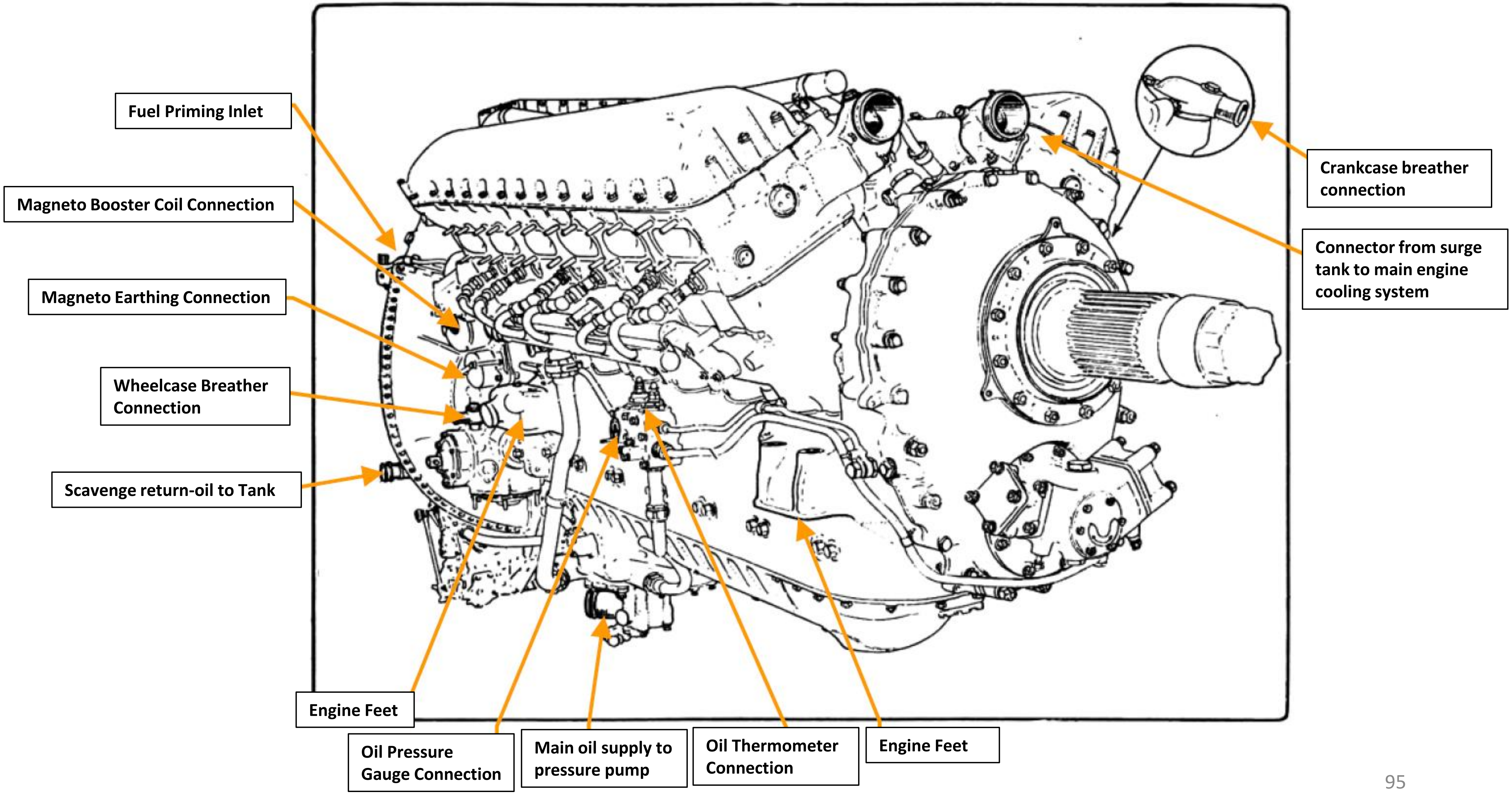


Engine Cowlings



THE MERLIN 66 ENGINE

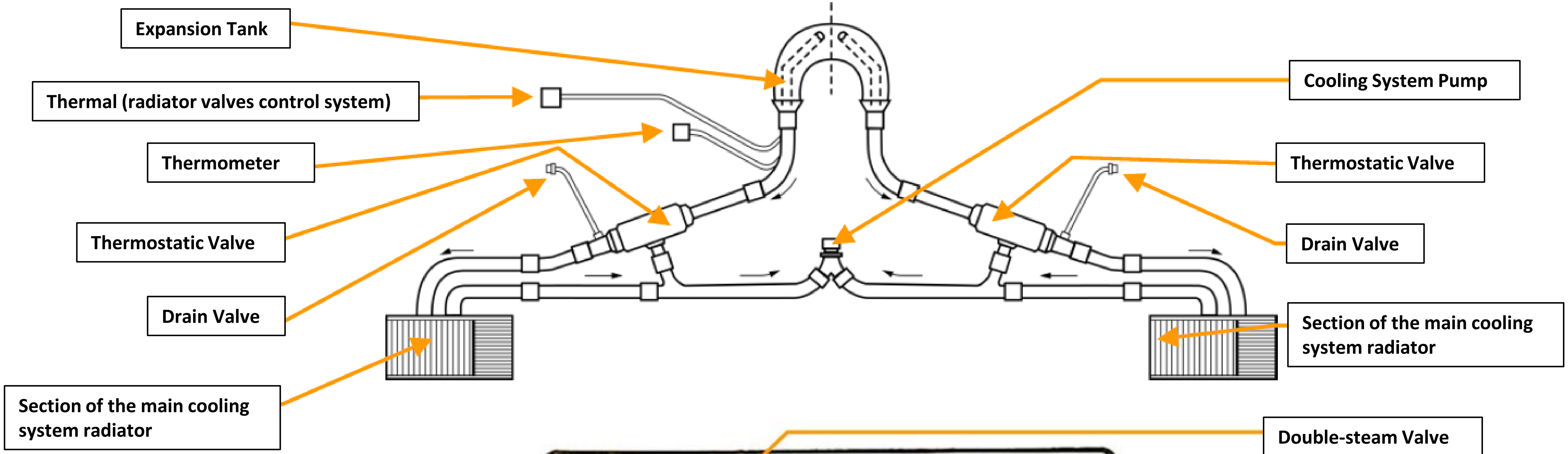
Motor Assembly

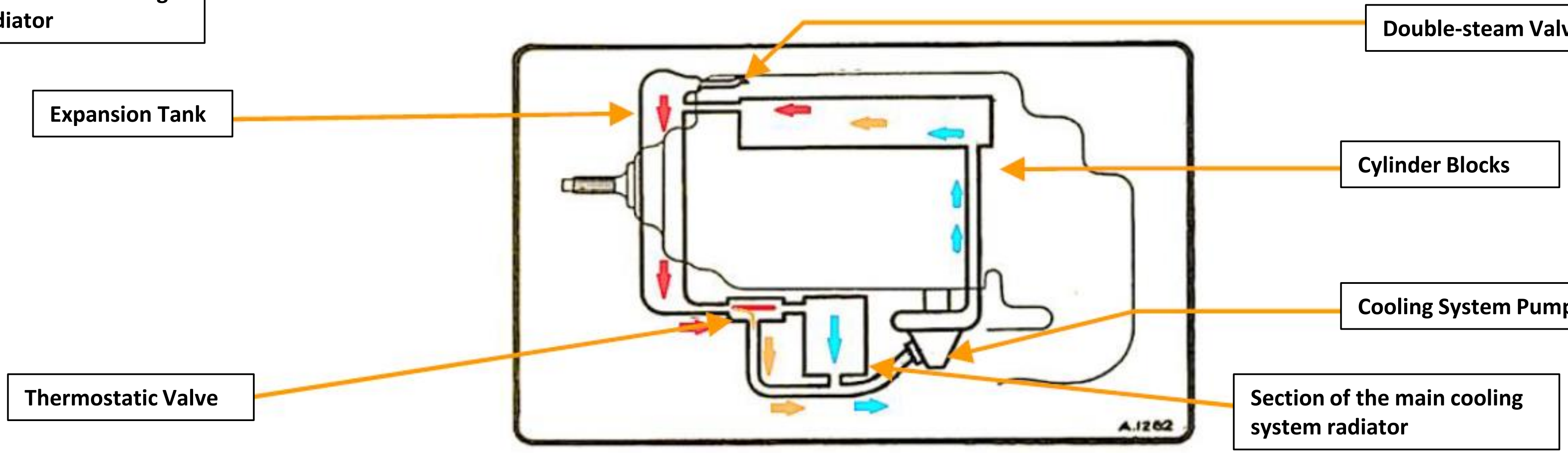


THE MERLIN 66 ENGINE

The cooling system uses a mixture of 70% water and 30% ethylene glycol and has a volume of 13.5 gallons. An expansion tank in the shape of a horseshoe is mounted above the propeller gearbox. The centrifugal pump has two output lines of feed lines for each cylinder block and one output for the pump line. The pump delivers the coolant to the cylinder block, where the fluid, flowing through the cavity in the cylinder jackets and cylinder heads, is heated, thereby cooling the engine parts. The warmed fluid is then directed to the expansion tank, in the form of a horseshoe and mounted above the propeller gearbox.

Motor Cooling System





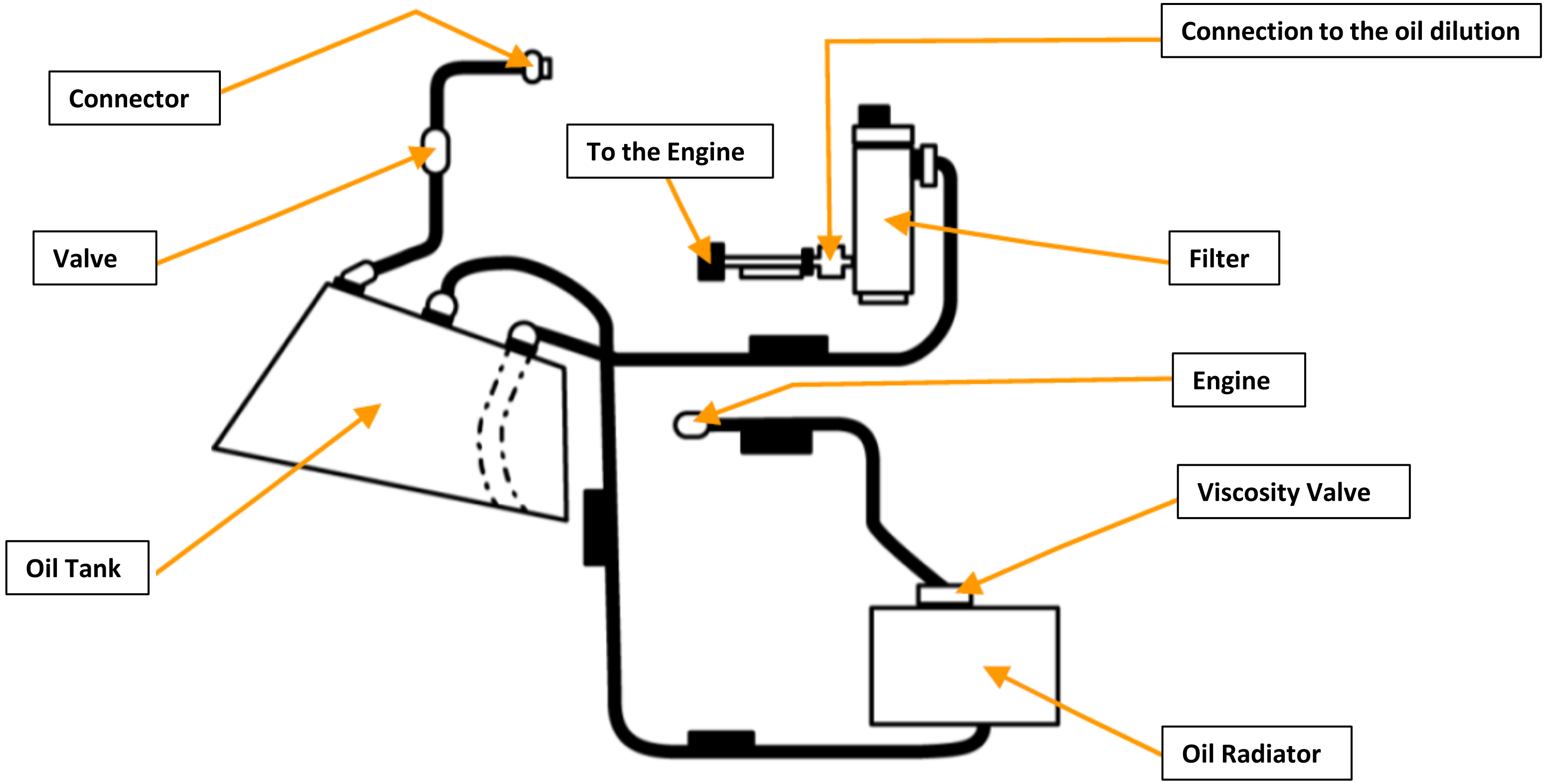
THE MERLIN 66 ENGINE

Friction generated in the mechanism of the operating motor causes a loss of power, as well as heating and wear of its parts. To reduce friction, the rubbing surfaces of the parts are lubricated by pressurized oil which, by filling the gaps, form an oil cushion and separate the friction surfaces of each other thereby reducing friction, heat and wear. In addition, the oil circulating in the gaps between the parts washes away particles of waste material. With this, the oil system provides a cooling effect for the motor.

The engine oil system is realized through the dry sump setup. A block of gear-type oil pump is mounted in the rear of the oil trough (the bottom of the crankcase) below. It consists of a single pressurizing stage and two oil suction stages. In addition to the main task to ensure lubrication of the engine, the oil system ensures both the operation of the variable pitch propeller by means of a high-pressure line, as well as the operation of the hydraulic cylinder in switching the supercharger speed by means of a low-pressure line. Pressure relief valve reduces oil pressure for the the low-pressure line. Lubrication of the propeller gearbox, cam rollers, traverse valves and auxiliary drives is provided by the low-pressure line.

The oil tank is located under the engine and is completely covered by the lower hood.

Oil System

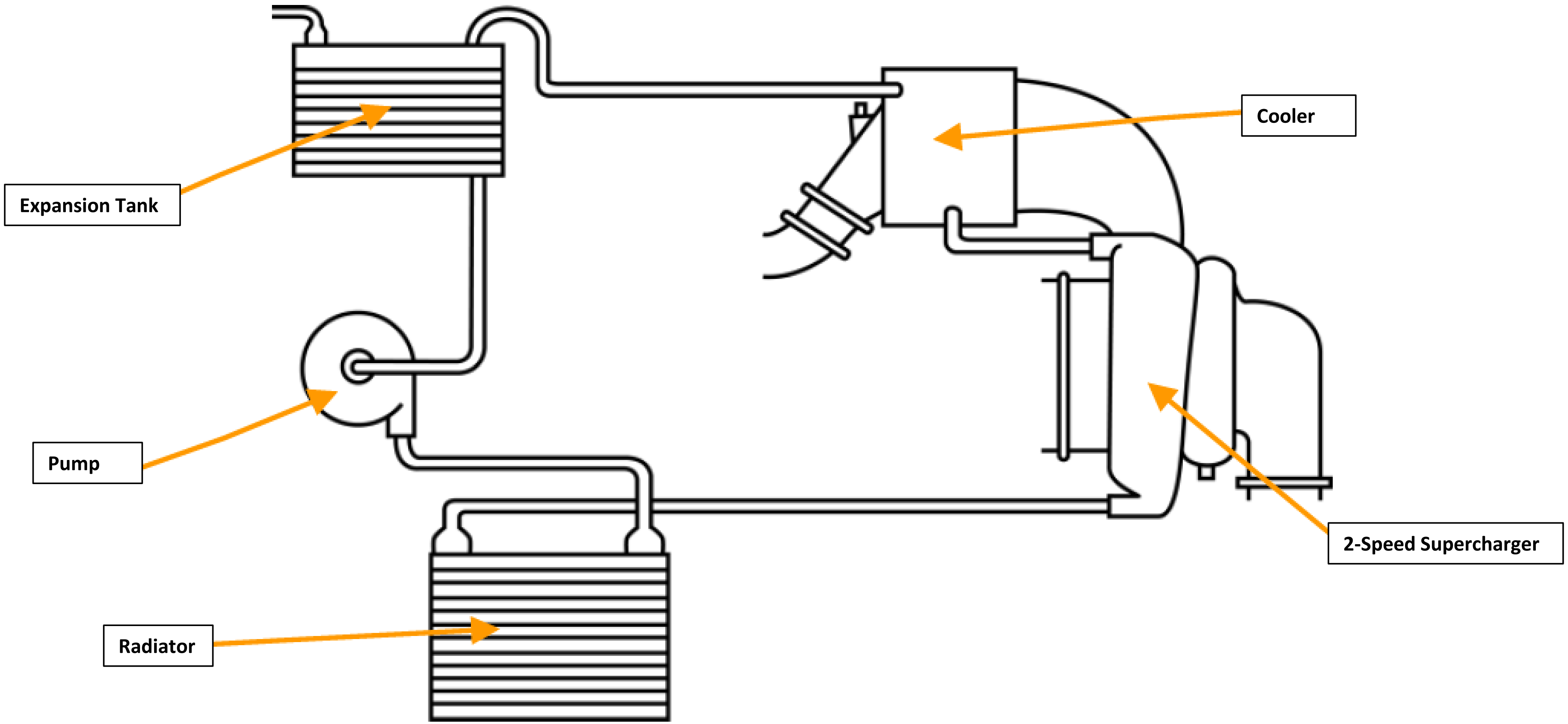


THE MERLIN 66 ENGINE

A separate cooling system is in place for reducing the temperature of the fuel-air mixture after its exit from the supercharger. This system consists of a tubular-plate intercooler, centrifugal pump, expansion tank and radiator for cooling the fluid circulating in the supercharger and intercooler. The intercooler is mounted between the supercharger and the intake manifold.

The coolant from the surge tank is fed by a separate centrifugal pump into to the radiator located in the tunnel under the right half-plane. Next, the cooled liquid washes the body of the supercharger and is supplied to the intermediate cooler. After passing through the radiator, the coolant fluid enters the surge tank. The differential pressure is provided by the radiator relief valve built into the drainage line. The system is autonomous and does not require pilot input to function.

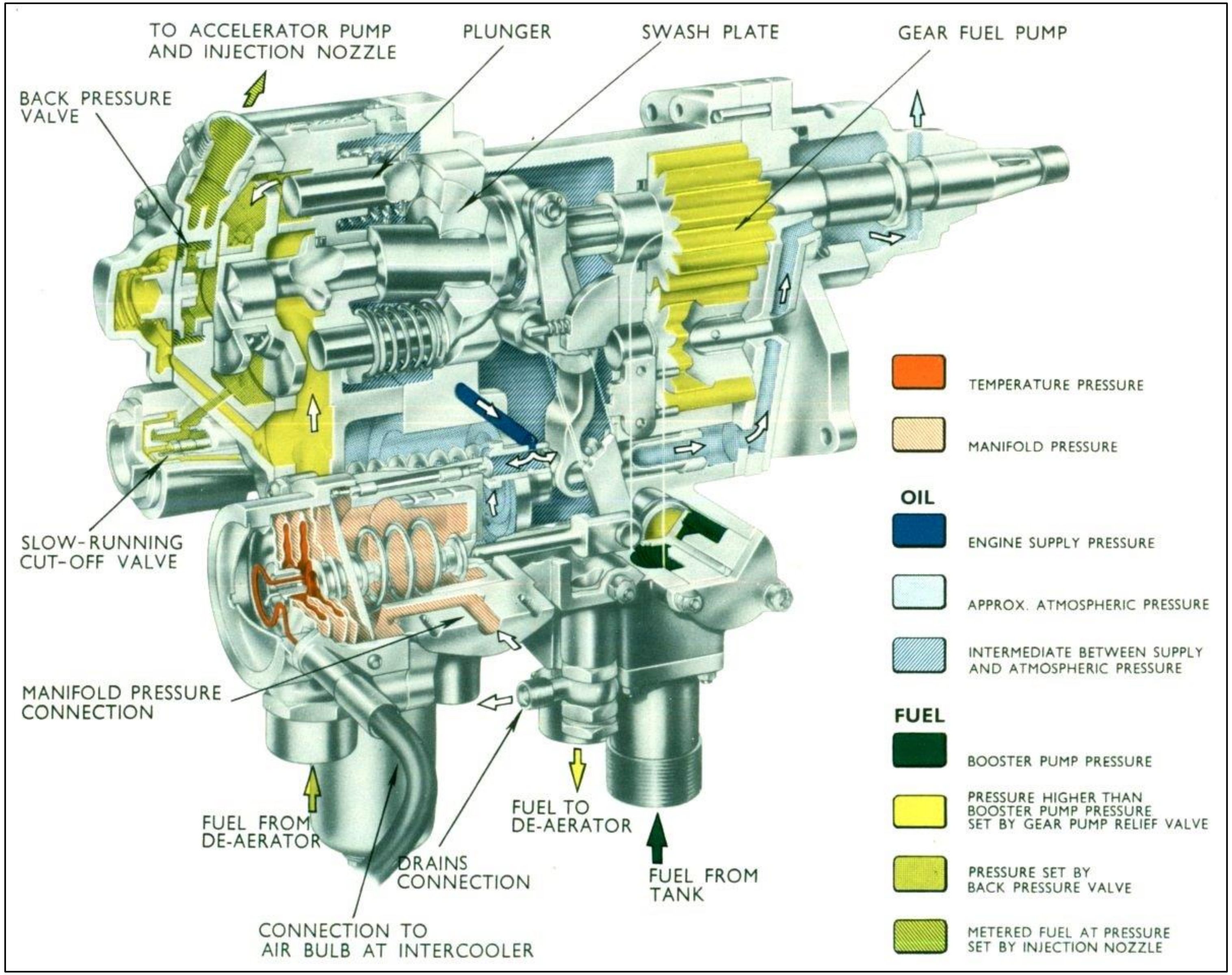
Supercharger Cooling System



THE MERLIN 66 ENGINE

Rolls-Royce Speed-Density Fuel Injection Pump

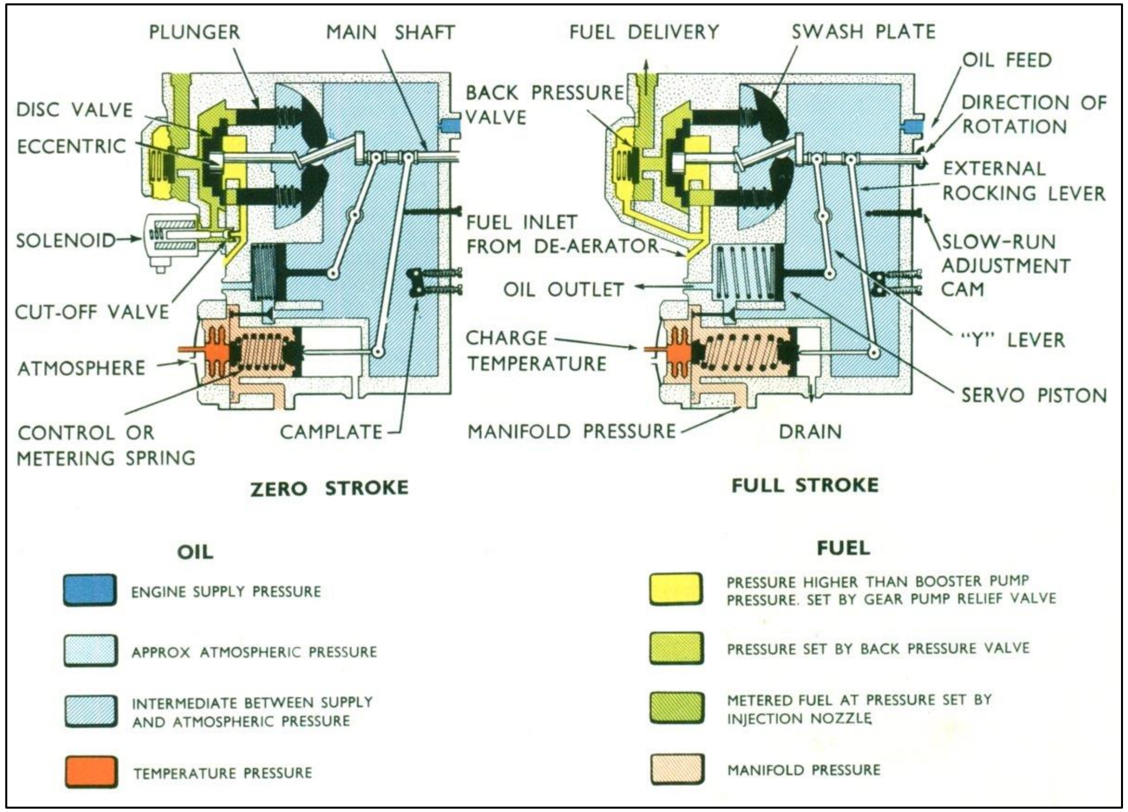
Source: http://www.enginehistory.org/Accessories/HxFuelSys/FuelSysHx09.shtml



THE MERLIN 66 ENGINE

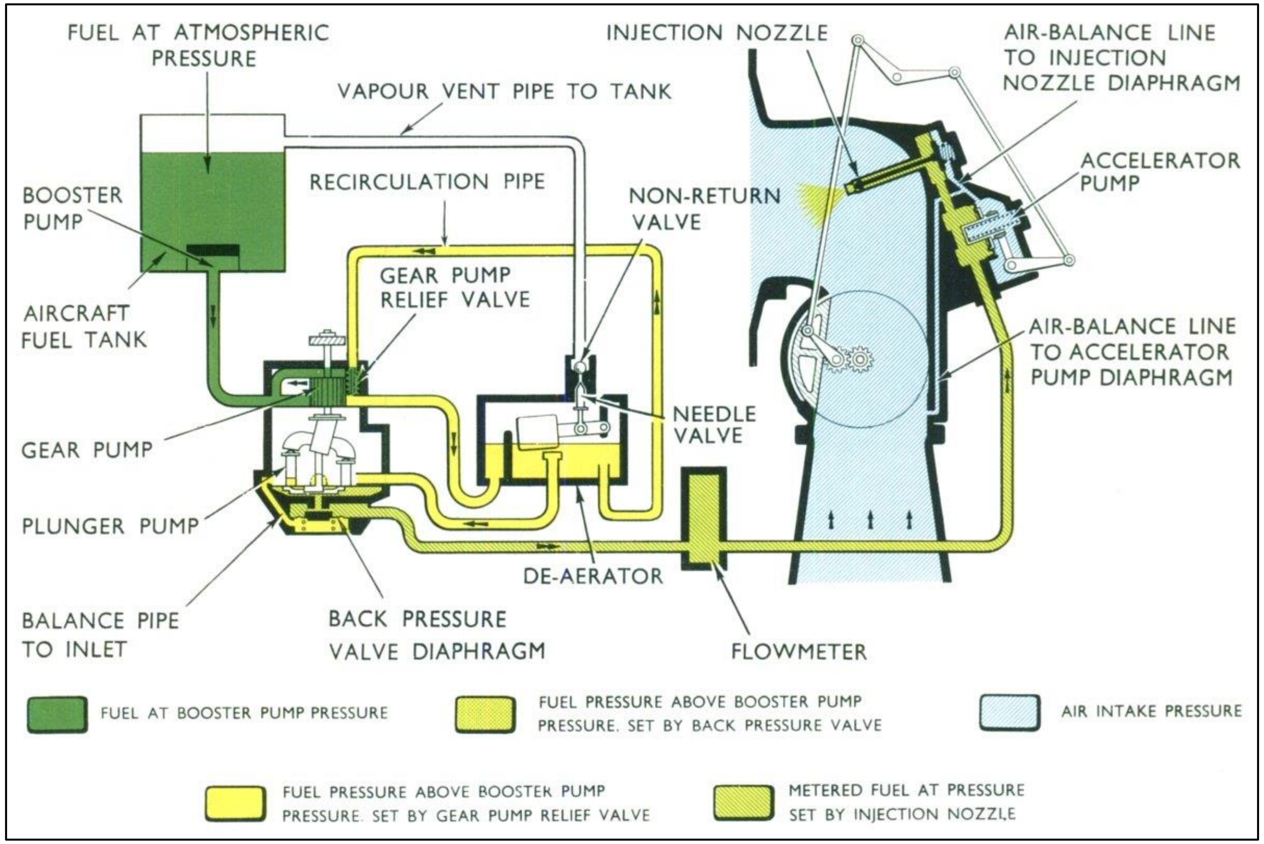
Rolls-Royce Speed-Density Fuel Injection Pump Schematic

Source: http://www.enginehistory.org/Accessories/HxFuelSys/FuelSysHx09.shtml



Rolls-Royce Speed-Density Engine Fuel System

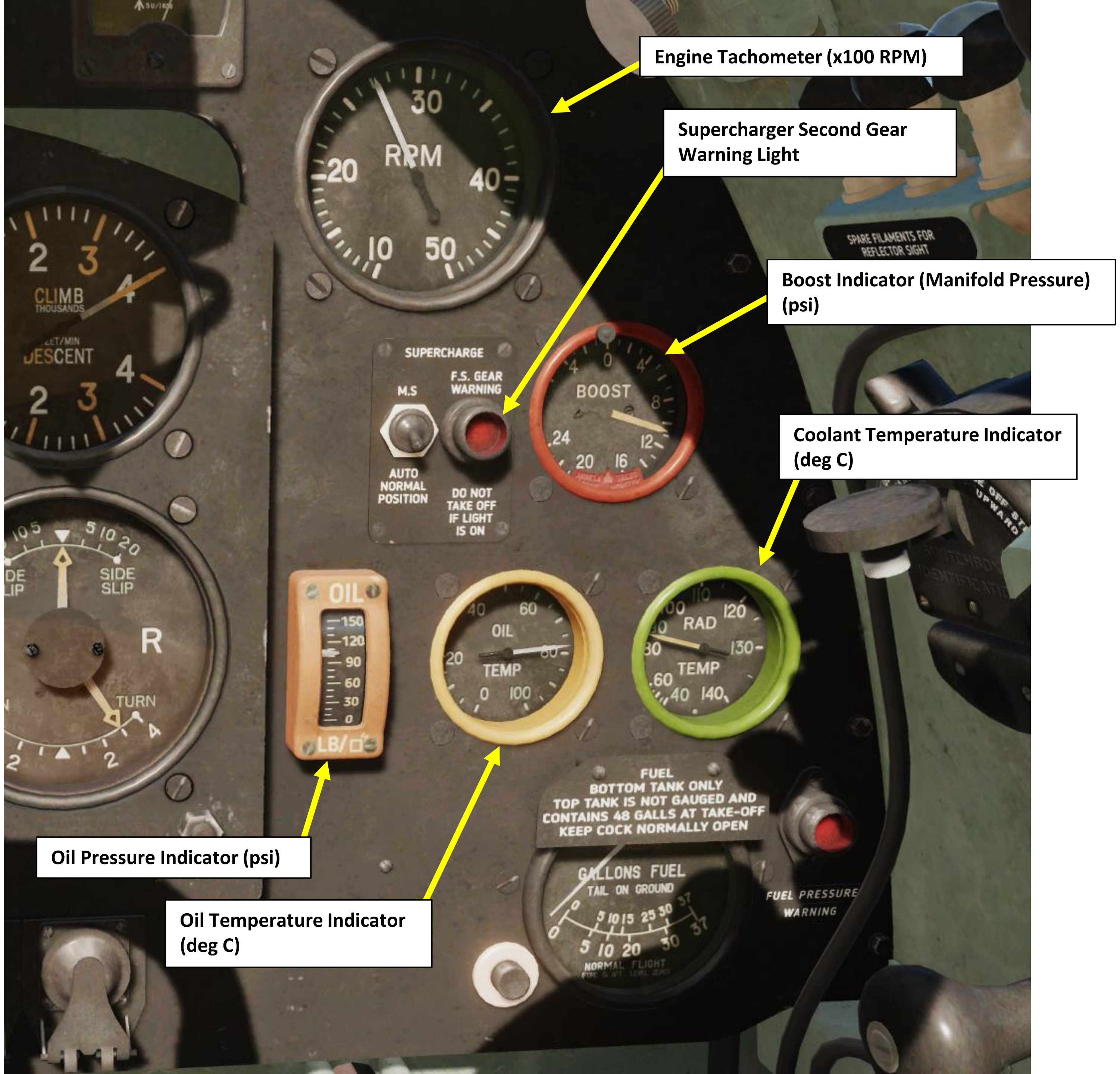
Source: http://www.enginehistory.org/Accessories/HxFuelSys/FuelSysHx09.shtml



ENGINE INDICATIONS

Here is an overview of the various engine indications you have to monitor:

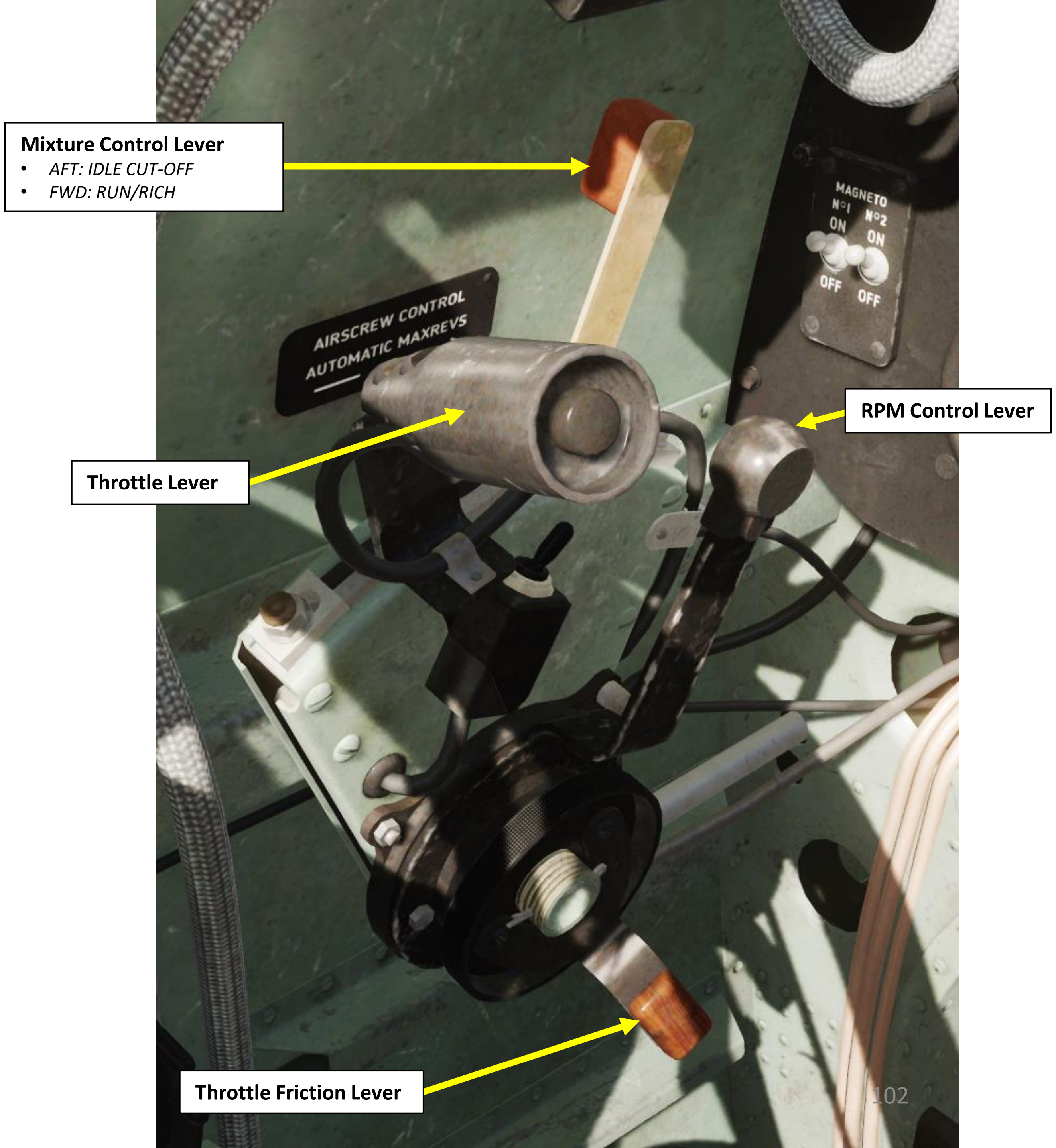
- **Engine Tachometer (x100 RPM)**: Controlled by the engine RPM lever. Indicates engine speed turning the constant speed propeller.
- **Boost Indicator (psi)**: Similar to a Manifold Pressure indicator, Boost indicates the difference between the absolute pressure after the supercharger and the atmospheric pressure in psi. Positive boost values indicate a pressure higher than atmospheric pressure, while negative boost values indicate a pressure below atmospheric pressure. In ISA (standard) conditions, +0 Boost at sea level is roughly 14.7 psi, 760 mm Hg, 29.92 in Hg, 1013.25 mBar, or 101.325 kPa.
- **Coolant Temperature (deg C)**: indicates the water-glycol coolant temperature. High coolant temperatures may indicate an engine setting that is too high or a perforated radiator leaking coolant.
- **Oil Temperature (deg C)**: indicates the oil temperature in the engine lubrication system.
- **Oil Pressure Indicator (psi)**: indicates the oil pressure of the engine lubrication system.
- **Supercharger Second Gear Warning Light**: indicates the supercharger is in second gear (Full Supercharger Mode).



ENGINE CONTROLS

The main engine controls of the Spitfire are:

- **Throttle**: Controls boost pressure (manifold pressure).
- **RPM Control Lever**: Controls engine speed turning the constant speed propeller.
- **Supercharger Mode Selector**: Controls manual or automatic gear shifting of the supercharger at high altitudes.

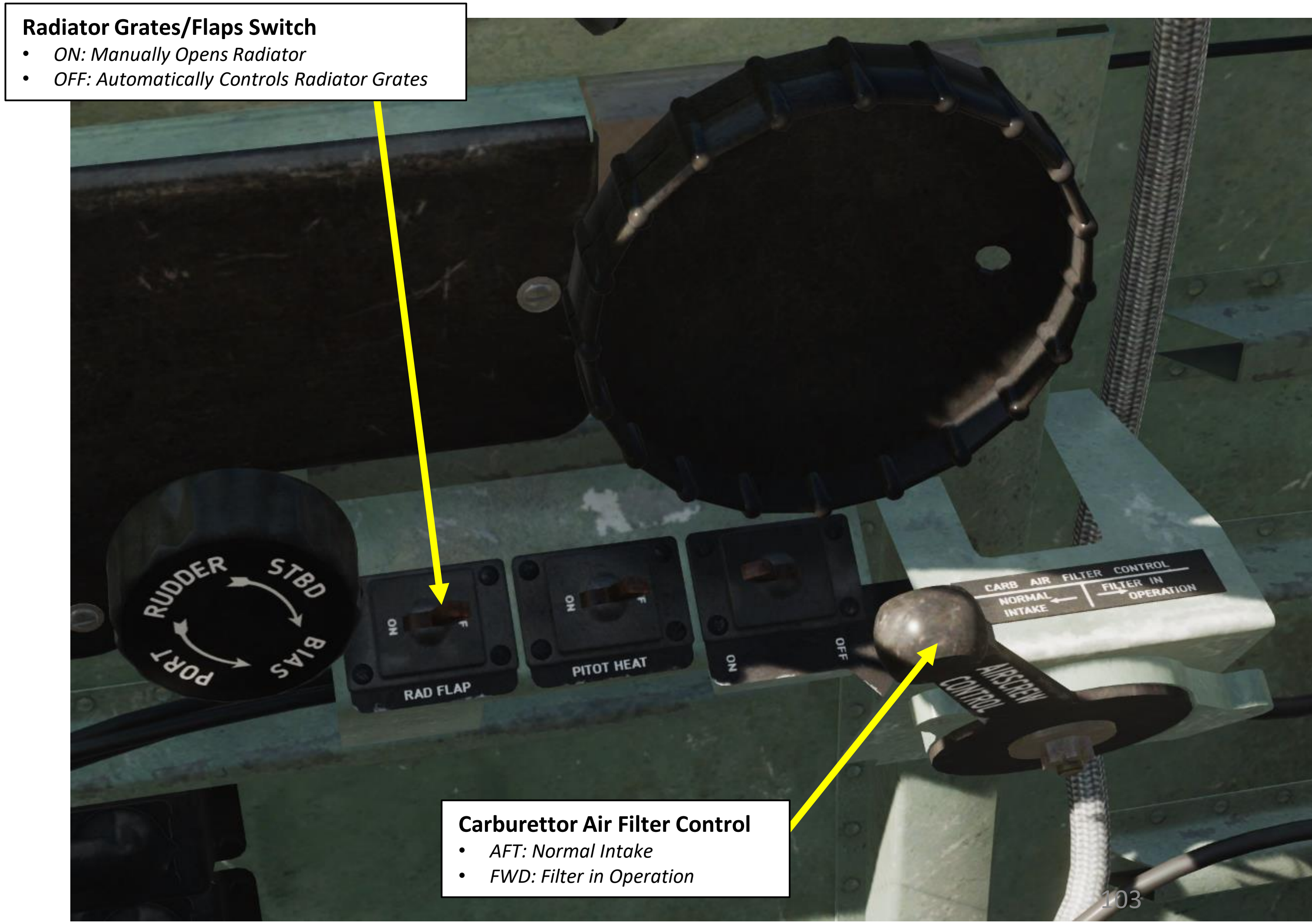


ENGINE CONTROLS

The main engine controls of the Spitfire are:

- **Radiator Grates/Flaps Switch**: Sets automatic control of the radiator grates/flaps. Unlike older variants of the Spitfire (which required manual control of the radiators), the Spitfire Mk IX has an automatic radiator flaps control based on measured temperature.

- **Carburettor Air Filter Control**: Controls damper covering passageway of the air intake to the carburettor.
    - AFT: Normal Intake (Damper is Open)
    - FWD: Filter In Operation (damper is shut and air comes from the engine compartment).

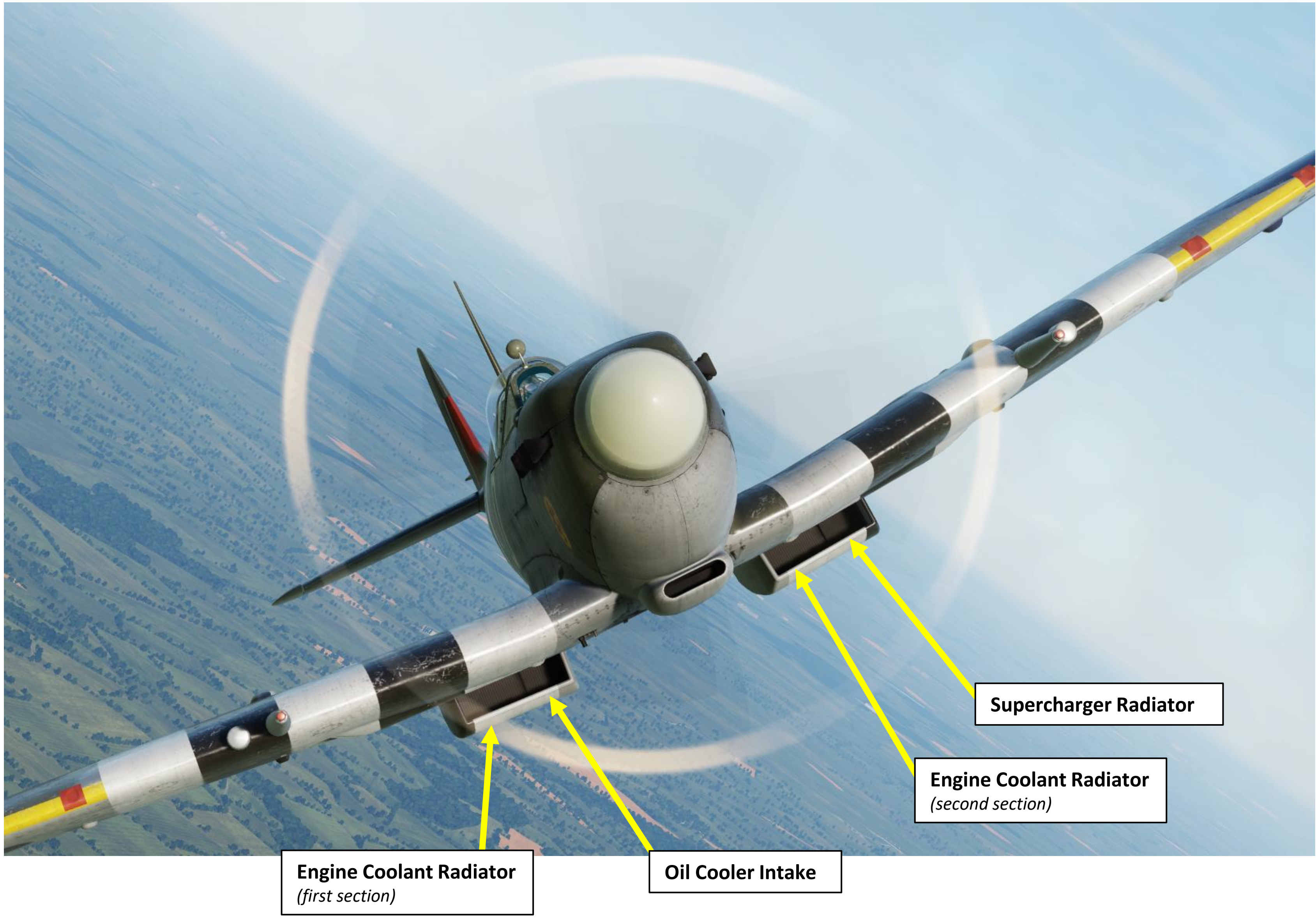


ENGINE CONTROLS

The radiators of the engine cooling systems, supercharger, intermediate radiator and oil system are housed in two symmetrical boxes located under the wings.

Under the right wing is one section of the engine radiator and the oil cooler.

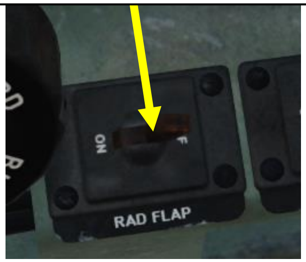
Under the left wing is the supercharger radiator and the second section of the motor cooling system radiator.

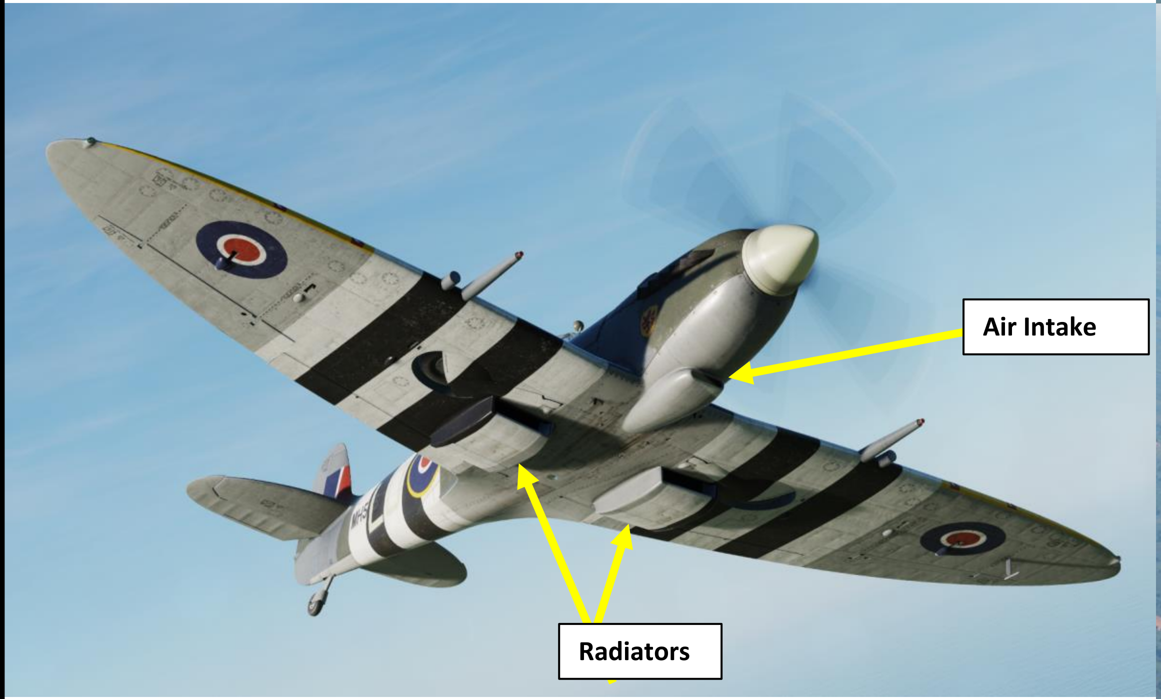


ENGINE CONTROLS

The radiators themselves are of a tunnel type. Adjustment of the radiator scoops is automatic (provided the Radiator Grates/Flaps Switch is set to OFF), performed by a thermostat that opens up the flaps when the temperature begins to be too high.

Fun fact: the system blocked the activation of the second stage compressor at temperatures close to the maximum - 115°.

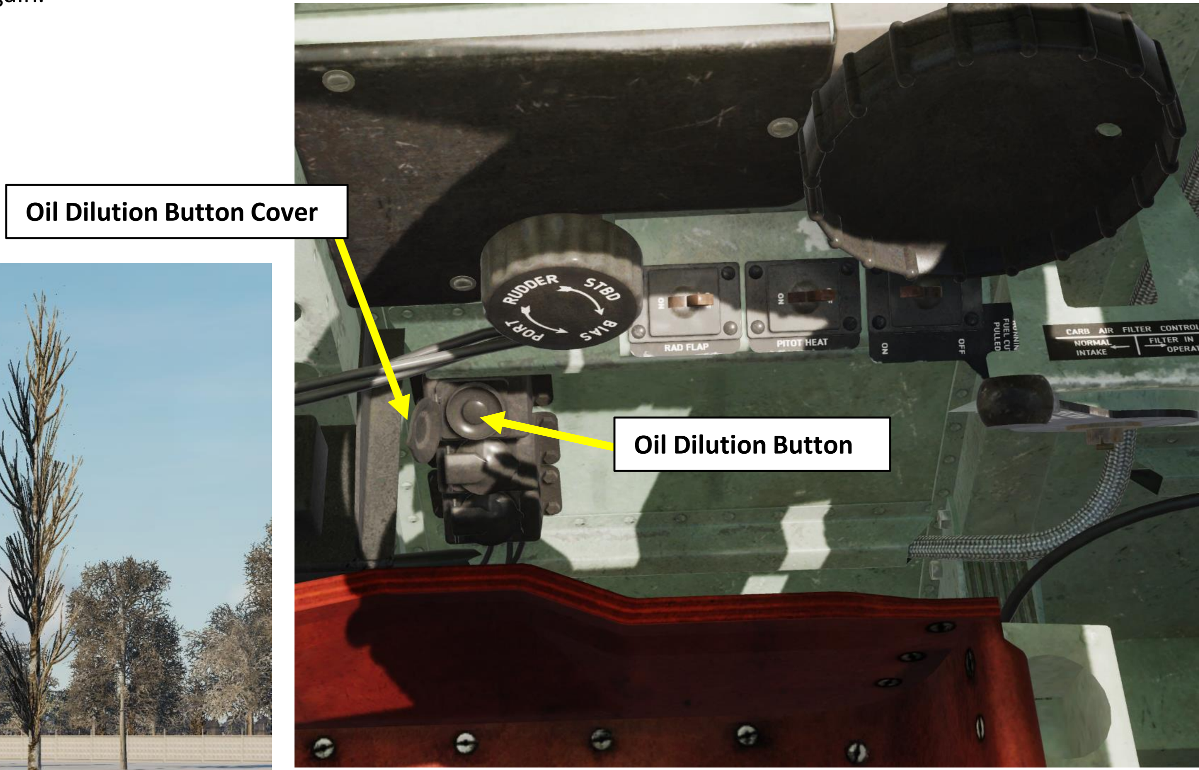




ENGINE CONTROLS

The oil system uses standard Air Force oil dilution equipment. This allows the oil to be thinned with gasoline to make the engine easier to start in ambient temperatures below 40°F or 4°C.

Thinning the oil requires allowing the engine to idle with the coolant flap open until the oil temperature drops to 50°C or less. Then, before stopping the engine, oil is diluted using the Dilution switch on the Engine Control panel of the front dash. This will dilute the oil until the engine is ready to be started again. Once the engine warms up, the gasoline in the oil is quickly evaporated.



ENGINE OPERATION & LIMITS

Engine Settings and Fuel Consumption Quick Reference Guide

	RPM	Boost	IAS @ SL (mph)	IAS @ 5,000ft (mph)	IAS @ 10,000ft (mph)	IAS @ 17,000ft (mph)	IAS @ 25,000ft (mph)	Fuel Consumption (Gal/hr)	Endurance on Main Tanks Only	Endurance on Main Tanks + 45 Gal DT	Fuel Consumption (Gal/min)
War Emergency Power (WEP) 5 min limit	3000	+18lb	330	~325	~315	~290	N/A	145	0hr 35min	54min	2.42
Takeoff Power (TO)	3000	+8lb	-	-	-	-	-	98	0hr 52min	1hr 19min	1.63
Combat, 1 hour limit	2850	+12lb	~300	~295	~295	~280	~260	105	0hr 49min	1hr 14min	1.75
Max Rate Climb, 1 hour limit			160	160	160	180	180				
Max Continuous	2650	+7lb	~270	~270	~265	~250	~245	80	1hr 4min	1hr 38min	1.33
Economy Climb			180	180	180	180	180				
	2400	+4lb	~250	~250	~250	~235	~230	66	1hr 17min	1hr 58min	1.10
		+2lb	~235	~235	~235	~220	~215	61	1hr 24min	2hr 8min	1.02
		0lb	~215	~220	~220	~200	~195	55	1hr 33min	2hr 22min	0.92
Combat Cruise	2200	+4lb	~250	~245	~250	~225	N/A	61	1hr 24min	2hr 8min	1.02
		+2lb	~235	~235	~235	~215	N/A	57	1hr 29min	2hr 17min	0.95
		0lb	~215	~215	~215	~210	~195	51	1hr 40min	2hr 33min	0.85
	2000	+2lb	~225	~220	~230	~215	N/A	50	1hr 42min	2hr 36min	0.83
		0lb	~210	~215	~220	~210	N/A	45	1hr 53min	2hr 53min	0.75
	1800	+2lb	~215	~220	~220	~210	N/A	43	1hr 59min	3hr 1min	0.72
		0lb	~205	~210	~210	~190	N/A	39	2hr 11 min	3hr 20 min	0.65

All speeds are given for a clean airframe (no stores) and will vary with air pressure. Max permissible – 450mph IAS below 20,000ft (clean), 430mph IAS with ordinance.

Max Coolant temperature: 125°C Max Oil Temperature: 90°C

All Fuel Consumptions given are per the A.P 1565I, P&L-P.N. Pilot's Notes for Spitfire IX, XI & XVI (September 1946) or are extrapolated from them. As such they are guidance only and actual performance will vary. Actual DCS fuel consumption figures are currently unavailable but are planned to be investigated for future reference.

N/A indicates boost setting unachievable due to altitude and/or RPM setting.

ENGINE OPERATION & LIMITS

If engine overheats, you can:

1. Enter a dive to increase airspeed and airflow to the engine intake.
2. Reduce throttle and RPM
3. Decrease rate of climb
4. Set the RADIATOR switch to ON (will force the radiator flap to open manually)

CHECK YOUR ENGINE TEMPERATURES EVERY 30 SECONDS OR SO. IT WILL SAVE YOUR LIFE.

ENGINE LIMITS

Power Setting	RPM	BOOST (psi)
Max Take-Off to 1000 ft (Altitude)	3000	+12
Max Climbing Power (1 hour limit)	2840	+9
Max Rich Continuous	2650	+7
Max Weak Continuous	2650	+4
Oil Pressure (psi)	Minimum: 60 psi Maximum: 120 psi	
Oil Temperature (deg C)	Minimum: 15 deg C Maximum: 90 deg C	
Coolant Temperature (deg C)	Minimum: 60 deg C Maximum: 125 deg C	

Basic modes of operation of the Merlin 66 engine, with 100 octane fuel

Basic data \ Mode		Takeoff		Combat		Nominal		Cruising	
		I spd.	II spd.	I spd.	II spd.	I spd.	II spd.	I spd.	II spd.
Horsepower		1325	-	1680*	1440	1310	1135	985	865
				1750**	1630	1410	1315	1095	1030
RPM		3000	-	3000	3000	2850	2850	2650	2650
Boost	lb/in^2	+12	-	+18	+18	+12	+12	+7	+7
	mm Mercury	1350		1690	1690	1380	1380	1120	1120
Altitude limits in m. (w/o ram air flow)		305	-	1680	4960	2750	5800	3660	6330
Time for uninterrupted operation, in minutes		5	-	5	5	60	60	Unltd	unltd

*- Data for sea level
** - Data on approximate altitudes.

SUPERCHARGER BASICS

A **supercharger is an engine-driven air pump or compressor that provides compressed air to the engine to provide additional pressure to the induction air so the engine can produce additional power.** It increases manifold pressure and forces the fuel/air mixture into the cylinders. The higher the manifold pressure, the more dense the fuel/air mixture, and the more power an engine can produce.

With a normally aspirated engine, it is not possible to have manifold pressure higher than the existing atmospheric pressure. A supercharger is capable of boosting manifold pressure above 30 "Hg. For example, at 8,000 feet a typical engine may be able to produce 75 percent of the power it could produce at mean sea level (MSL) because **the air is less dense at the higher altitude**. The supercharger compresses the air to a higher density allowing a supercharged engine to produce the same manifold pressure at higher altitudes as it could produce at sea level.

Thus, an engine at 8,000 feet MSL could still produce 25” Hg of manifold pressure whereas without a supercharger it could produce only 22 "Hg. Superchargers are especially valuable at high altitudes (such as 18,000 feet) where the air density is 50 percent that of sea level. The use of a supercharger in many cases will supply air to the engine at the same density it did at sea level. With a normally aspirated engine, it is not possible to have manifold pressure higher than the existing atmospheric pressure.

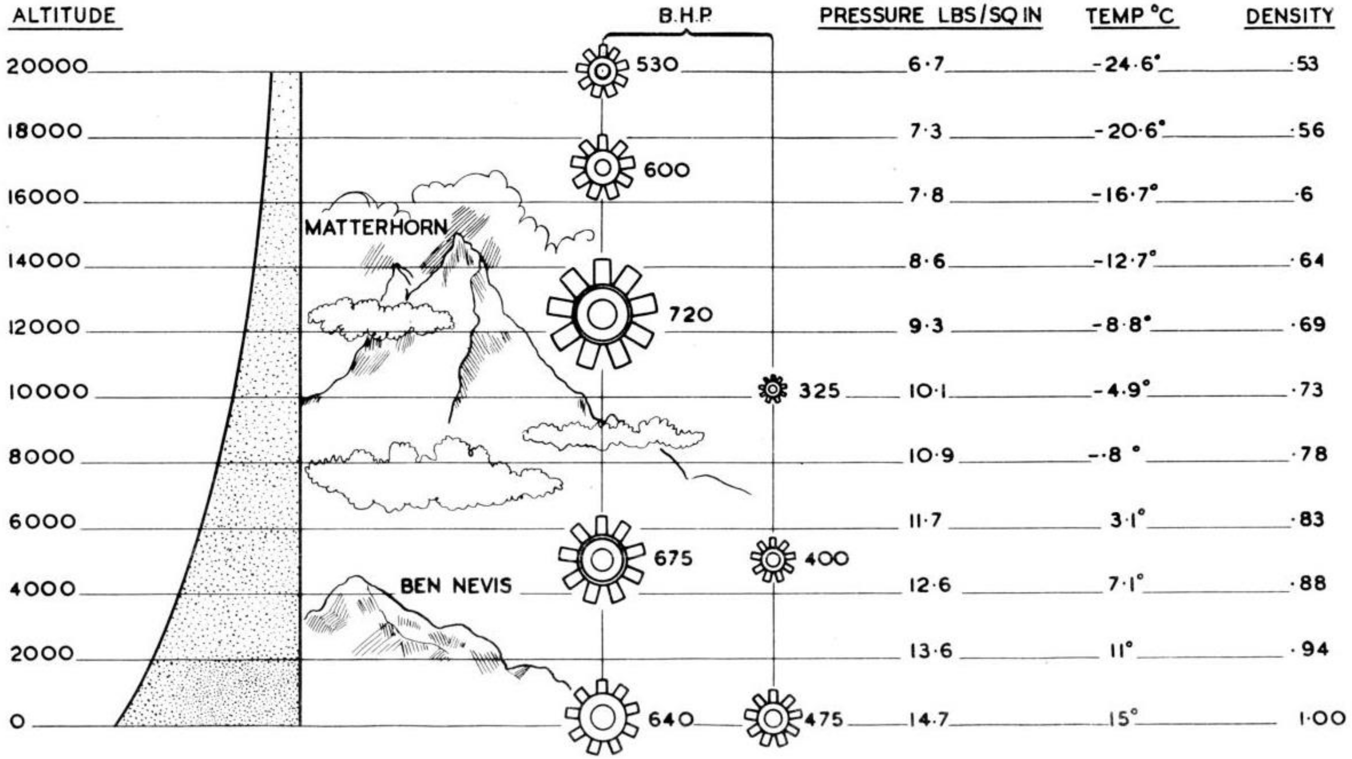
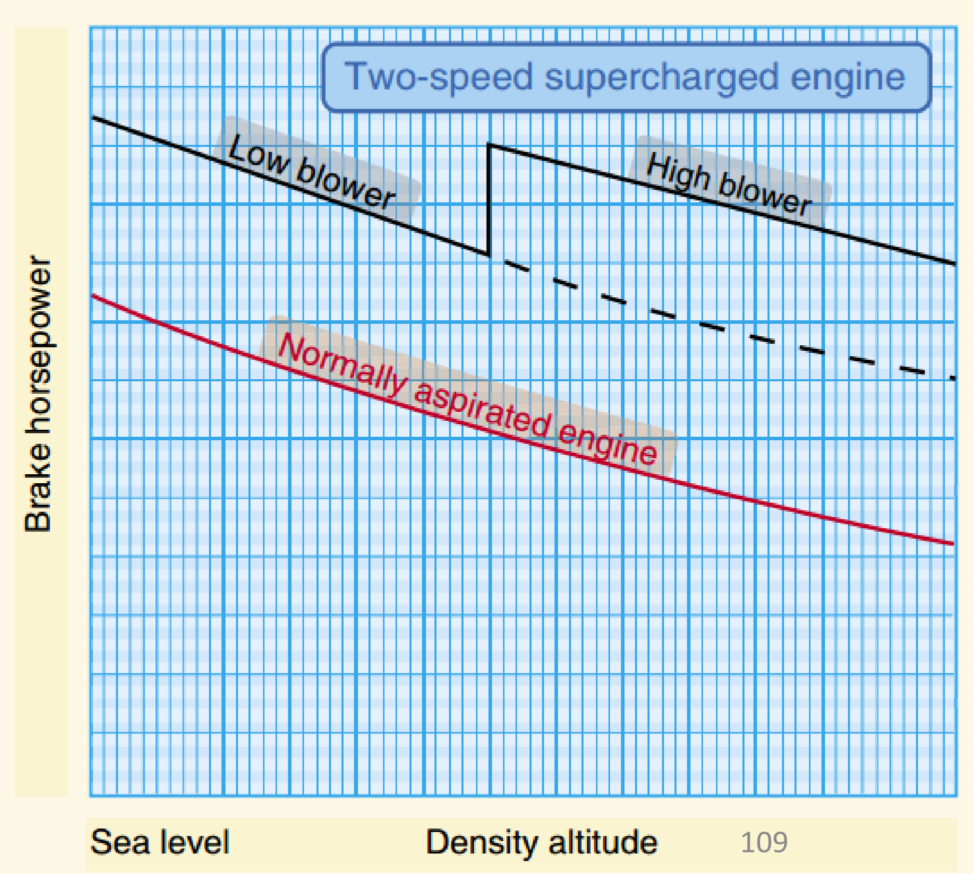


DIAGRAM SHOWING ATMOSPHERIC AND POWER VARIATIONS

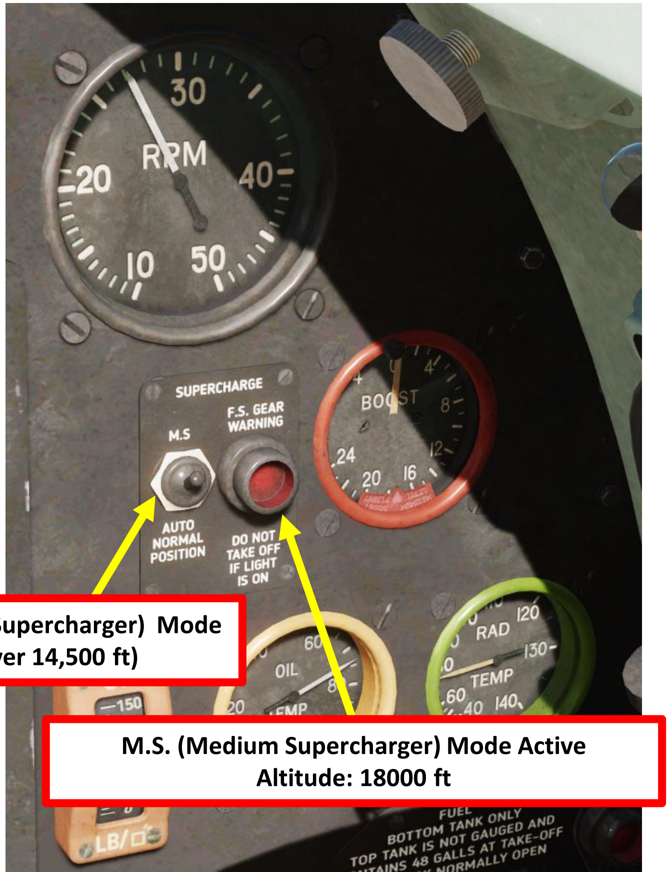


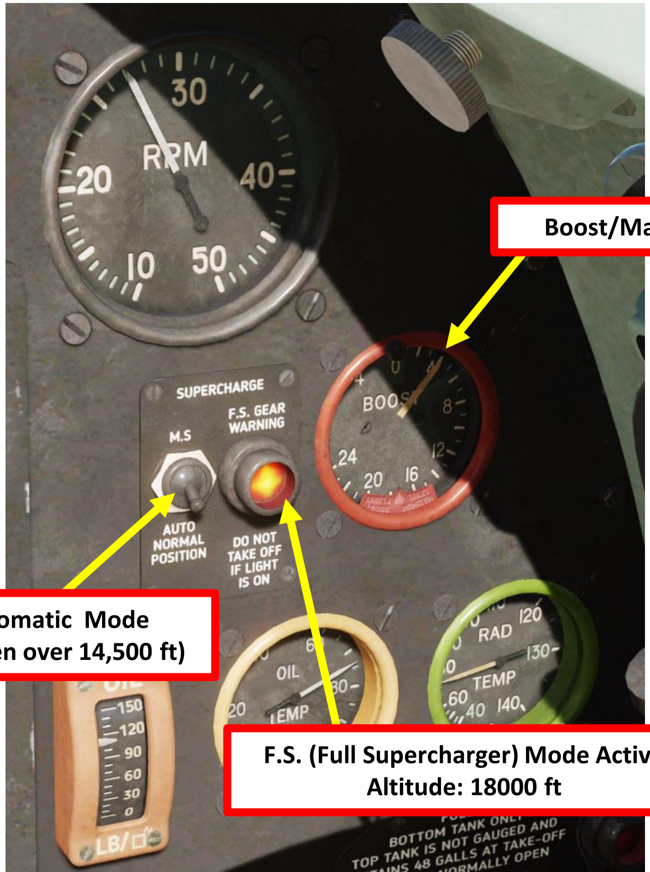
SUPERCHARGER OPERATION

The gear-driven centrifugal-type supercharger mounted on the Merlin engine has a two-stage compressor that raises air pressure at the entrance to the engine cylinders in order to increase both the coefficient of admission and engine power, as well as to maintain a constant air pressure at the entrance to the cylinders during increases in altitude. The supercharger works in either low or high blower mode, selection of which can be automatic or manually set by the pilot. In normal operations, high blower mode starts automatically from 14,500 to 19,500 feet, depending on the amount of ram air being delivered through the carburetor. The supercharger increases the blower-to-engine compression ratio from a low of 5.8 to 1 to a high of 7.35 to 1.

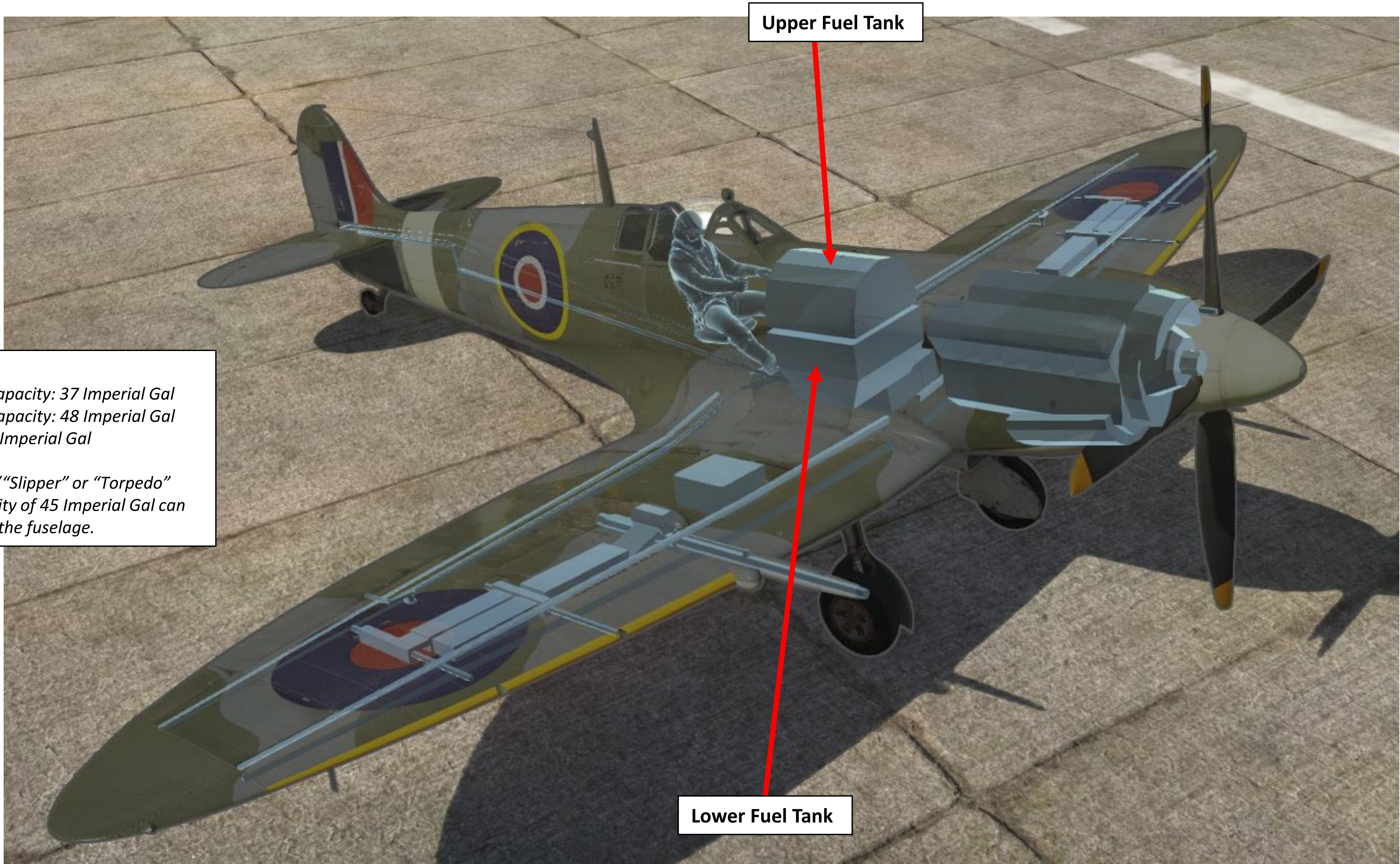
Shifting between the first gear “M.S” (medium supercharger) and second gear “F.S” (full supercharger) speeds may be performed automatically if the 2-stage switch in the cockpit is left in the AUTO (DOWN) position, or manually if set to M.S., forcing the supercharger in first gear.

First Gear = Low Blower = Low Manifold Pressure = used between 0 and 14500 ft
Second Gear = High Blower = High Manifold Pressure = used at 14500 ft or higher





FUEL TANKS



Fuel Capacity
Lower Fuel Tank Capacity: 37 Imperial Gal
Upper Fuel Tank Capacity: 48 Imperial Gal
Total Capacity: 85 Imperial Gal

Note: a drop tank ("Slipper" or "Torpedo" type) with a capacity of 45 Imperial Gal can be installed under the fuselage.

FUEL MANAGEMENT

The fuel system uses 100-octane fuel and obtains its supply from two banks mounted in the fuselage behind the fireproof bulkhead. One tank, of 37 gallons capacity, is mounted on the bottom of fuselage frames 6 and 7. The other, of 48 gallons capacity, is mounted above the lower tank on four brackets on the top longerons, and is protected by a sheet of armour covering the tank from behind the fireproof bulkhead. Fuel from the upper tank flows on its own into the lower tank. From the cock on the lower tank, a pipe leads forward to an A.G.S. type filter on the forward side of the bulkhead.

When feeding fuel from external tanks, access to the air separator is shut off by a special valve in order to prevent the upper tank from overflowing. This valve is connected to the fuel intake valve of the external tanks.

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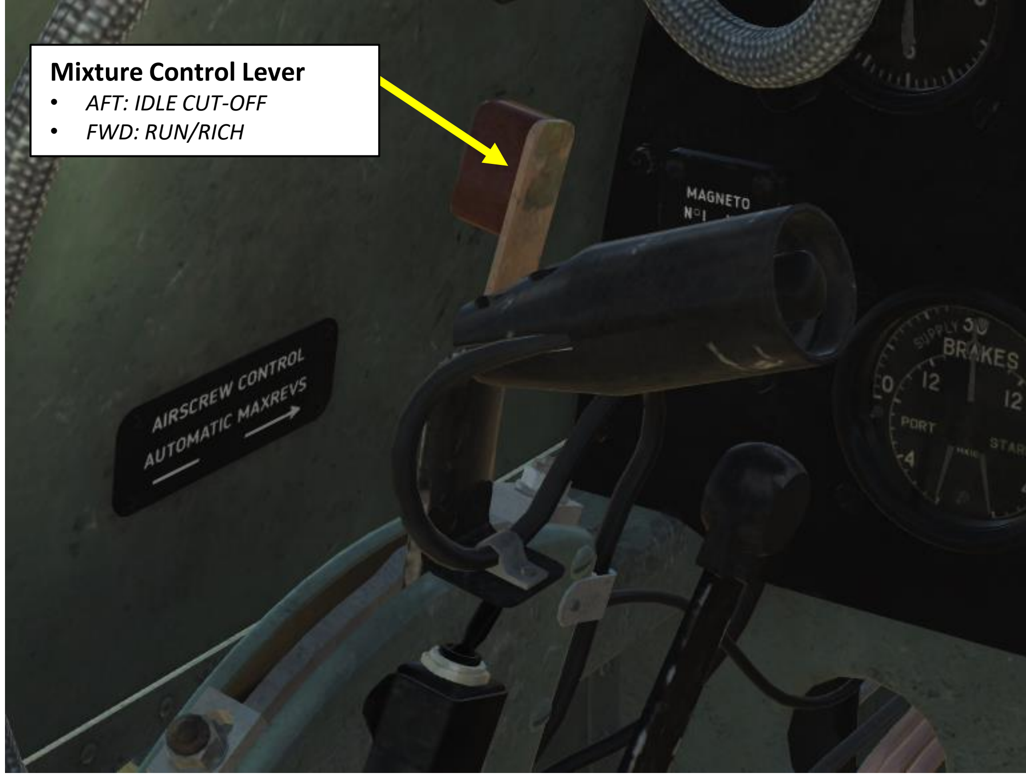
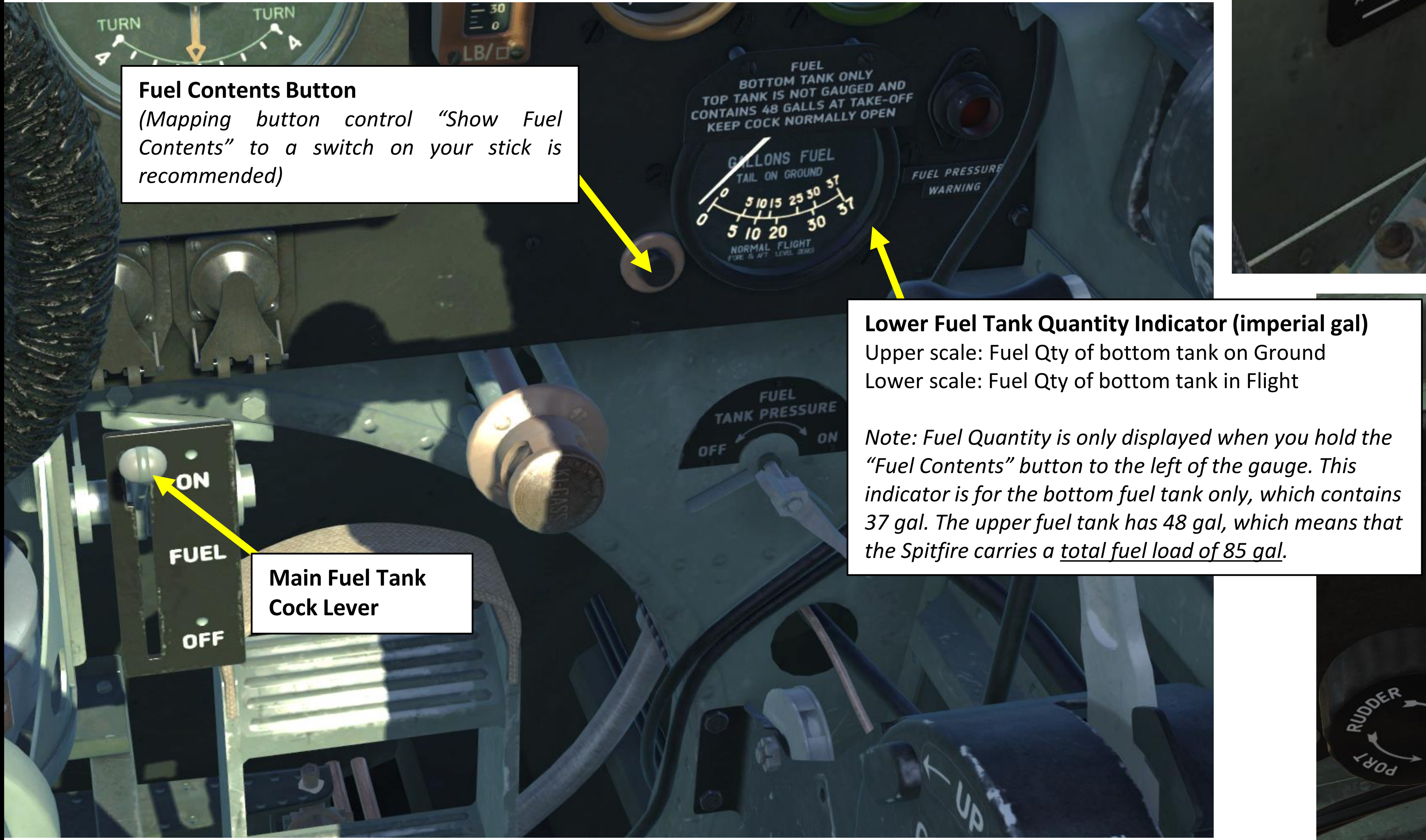
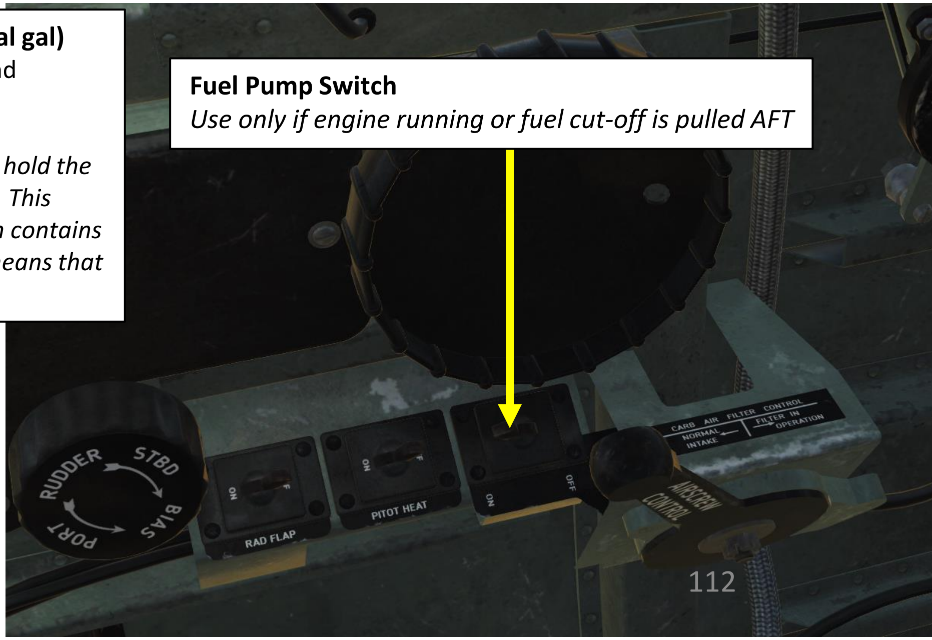






FUEL MANAGEMENT

In order to prevent fuel boiling at high altitudes in warm weather conditions, the fuel system is equipped with a fuel tank pressurizer system that switches on automatically at altitudes above 20000 feet. An aneroid valve feeds air, pressurized by a vacuum pump, into the fuel tanks. Pressurizing, however, impairs the self-sealing of the tanks and should be turned on only when the fuel pressure warning lamp lights up. In very warm weather at very high altitudes a rich cut may occur with the tanks pressurized, and pressure must then be turned off. The pressurizing cock is on the starboard side of the cockpit immediately below the instrument panel.

The default position of the pressurizer system is OFF, and must be turned ON only when a red warning light signalizes that the fuel pressure has dropped below 10 psi.

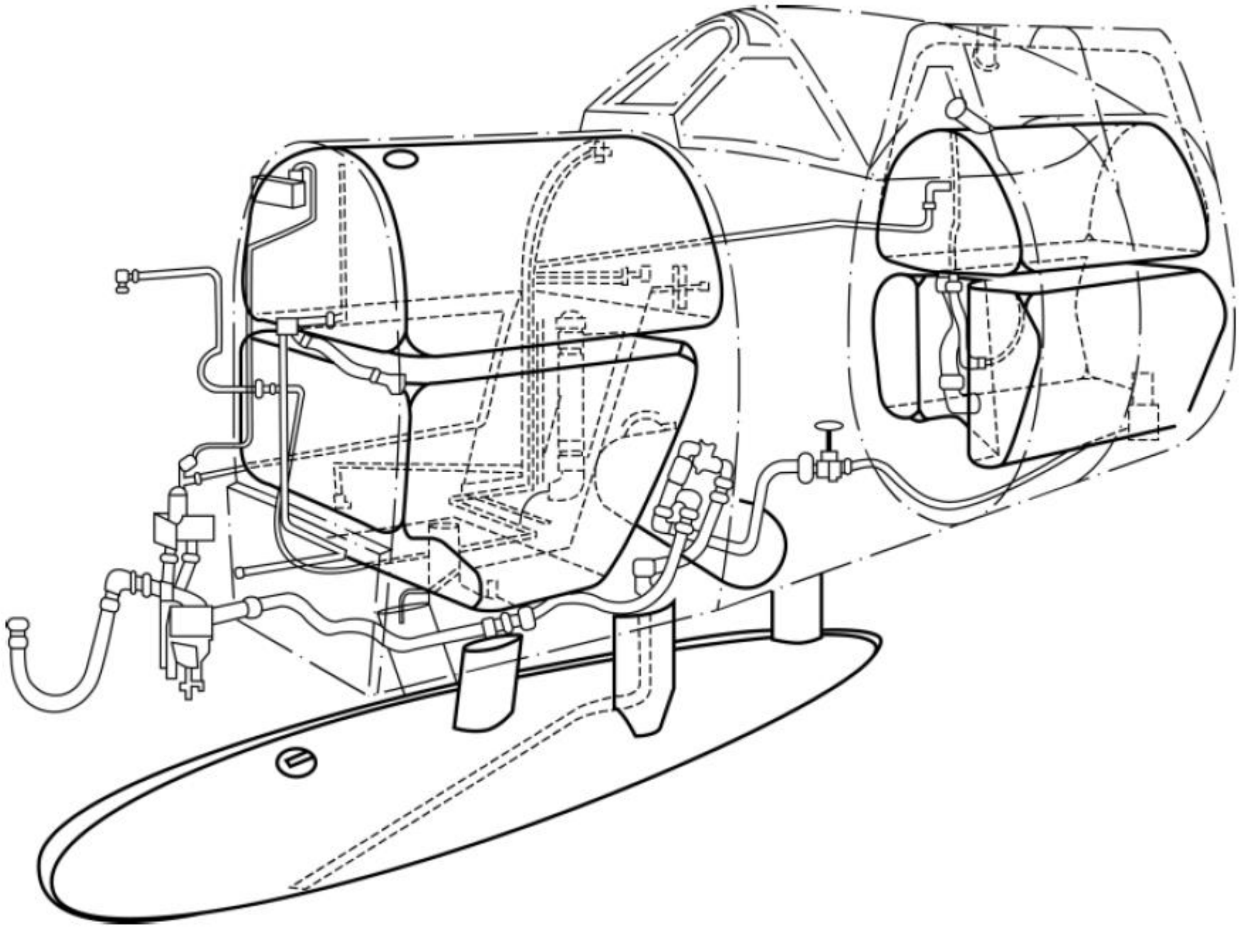
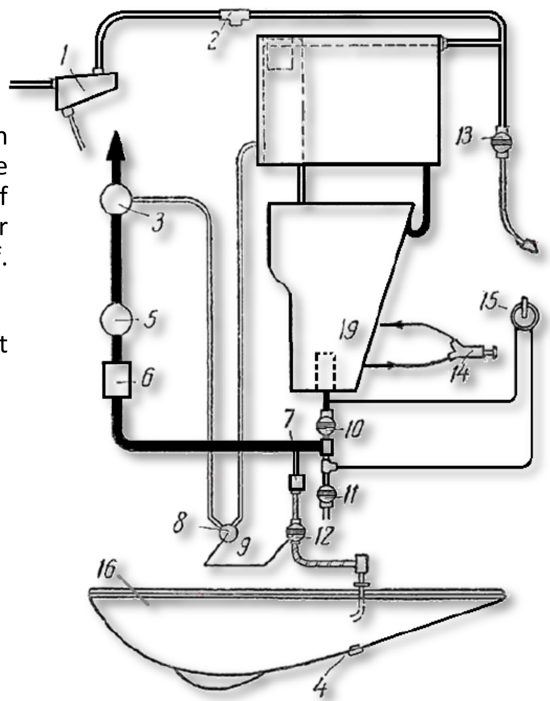


Figure 40: Fuel System Components on the Aircraft



1. Vacuul system oil separator
2. Pressure control valve and vent
3. De-aerator on carburettor
4. Drain
5. Fuel pump
6. Filter
7. Non-return valves
8. Separator valve
9. Valve junction
10. Main fuel cock
11. Drain cock
12. Auxiliary fuel cock
13. Drain system valve
14. Priming pump
15. Hand wobble pump
16. 30 or 90 gallons drop tank
17. 47-gallon upper fuel tank
18. 38-gallon lower fuel tank

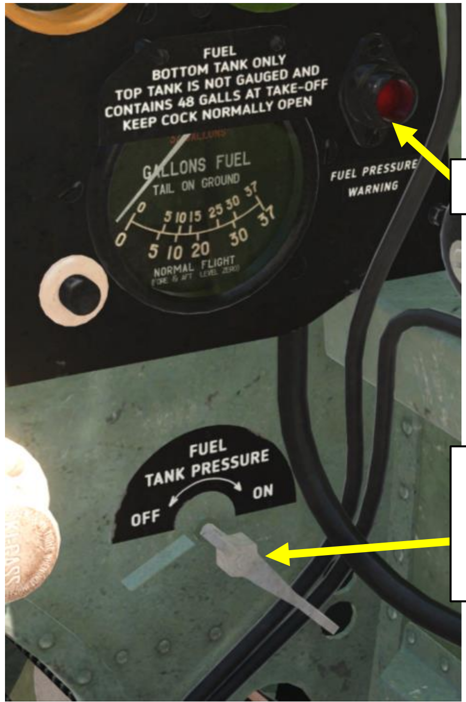


Figure 41: Fuel feed system

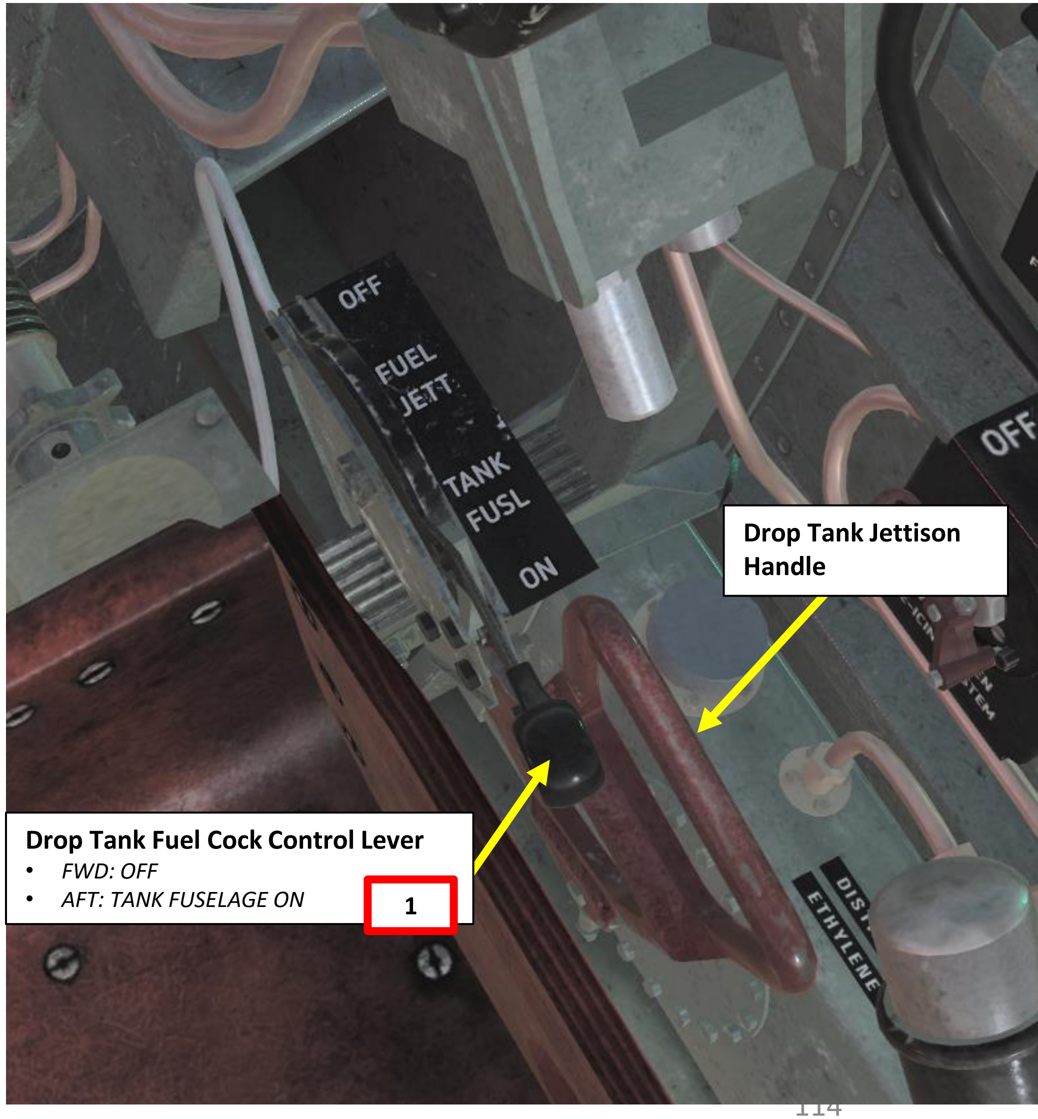
Low Fuel Pressure Warning Light

Fuel Pressuring Cock
Note: Only use if Low Fuel Pressure Warning Light is lit while engine is running. Otherwise, always leave this switch to OFF.

FUEL MANAGEMENT - FLYING WITH AN EXTERNAL FUEL TANK

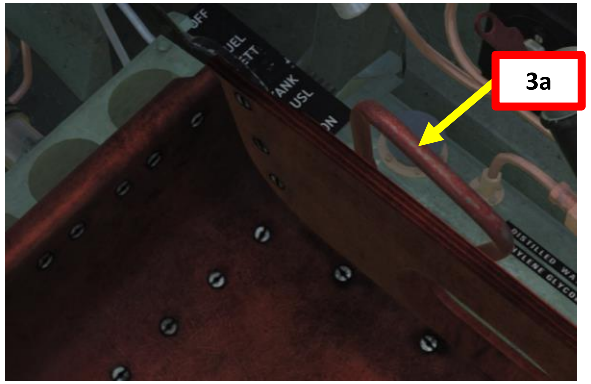
When flying with an external tank, make sure to do the following:

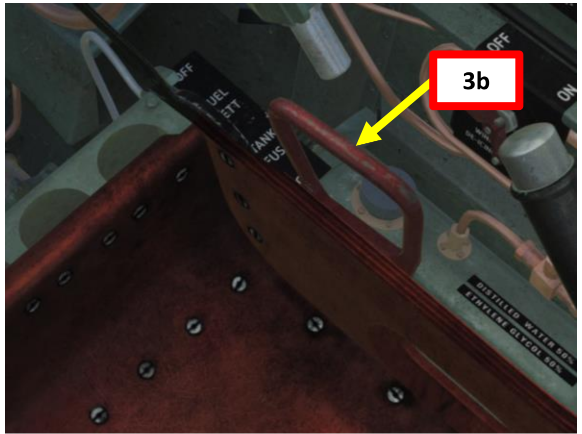
1. Set the Drop Tank Fuel Cock ON
2. Set the Main Fuel Tank Cock to OFF to allow the engine to take fuel directly from the external tank.

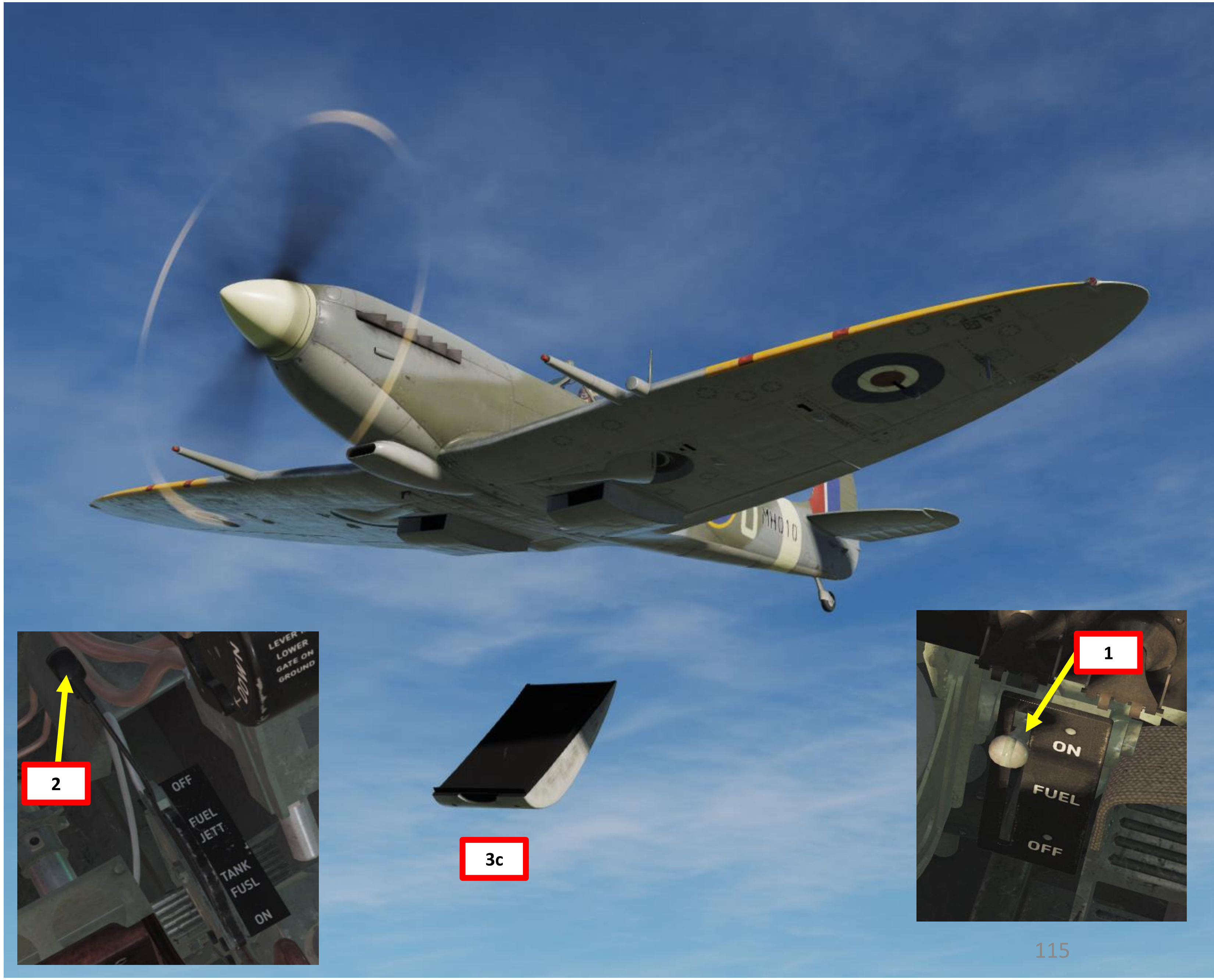


EXTERNAL FUEL TANK JETTISON

1. Set Main Fuel Tank Cock lever to ON
2. Set Drop Tank Fuel Cock Control Lever – OFF / FUEL JETT.
3. There is no indication to see the remaining external tank fuel. Just keep in mind that both “slipper” and “torpedo” tanks contain 45 gal.
4. You can jettison external fuel tanks by raising and pushing the “drop tank” handle forward.







Distance and duration of flight under different modes
(without external tanks) G_n=3392 KG, V_{rop}=392 L.

Flight mode	Altitude ft / m	IAS mph / kph	RPM	Fuel consumption L/km	Fuel consumption L/hr	Until tanks are emptied: Distance of horizontal flight, km	Until tanks are emptied: Duration of horizontal flight, H:MIN
Distance, maximum speed	21600 / 6600	256 / 410	2570	0.52	295	595	1:03
Distance, relative maximum speed	16400 / 5000	245 / 394	2360	0.475	237	685	1:22
Maximum distance	3280 / 1000	187 / 300	1800	0.395	125	880	2:46

Optimal Climb Speeds

Altitude From (ft)	Altitude To (ft)	Speed mph
0	12000	185
12000	15000	180
15000	20000	170
20000	25000	160
25000	30000	150
30000	33000	140
33000	37000	130
37000	40000	120
40000	-	110

Maximum Diving Speed for Mach 0.85 (without external stores)

Between SL and 20,000 ft	450 mph
Between 20,000 and 25,000 ft	430 mph
Between 25,000 and 30,000 ft	390 mph
Between 30,000 and 35,000 ft	340 mph
Above 35,000 ft	310 mph
Undercarriage down	160 mph
Flaps Down	160 mph

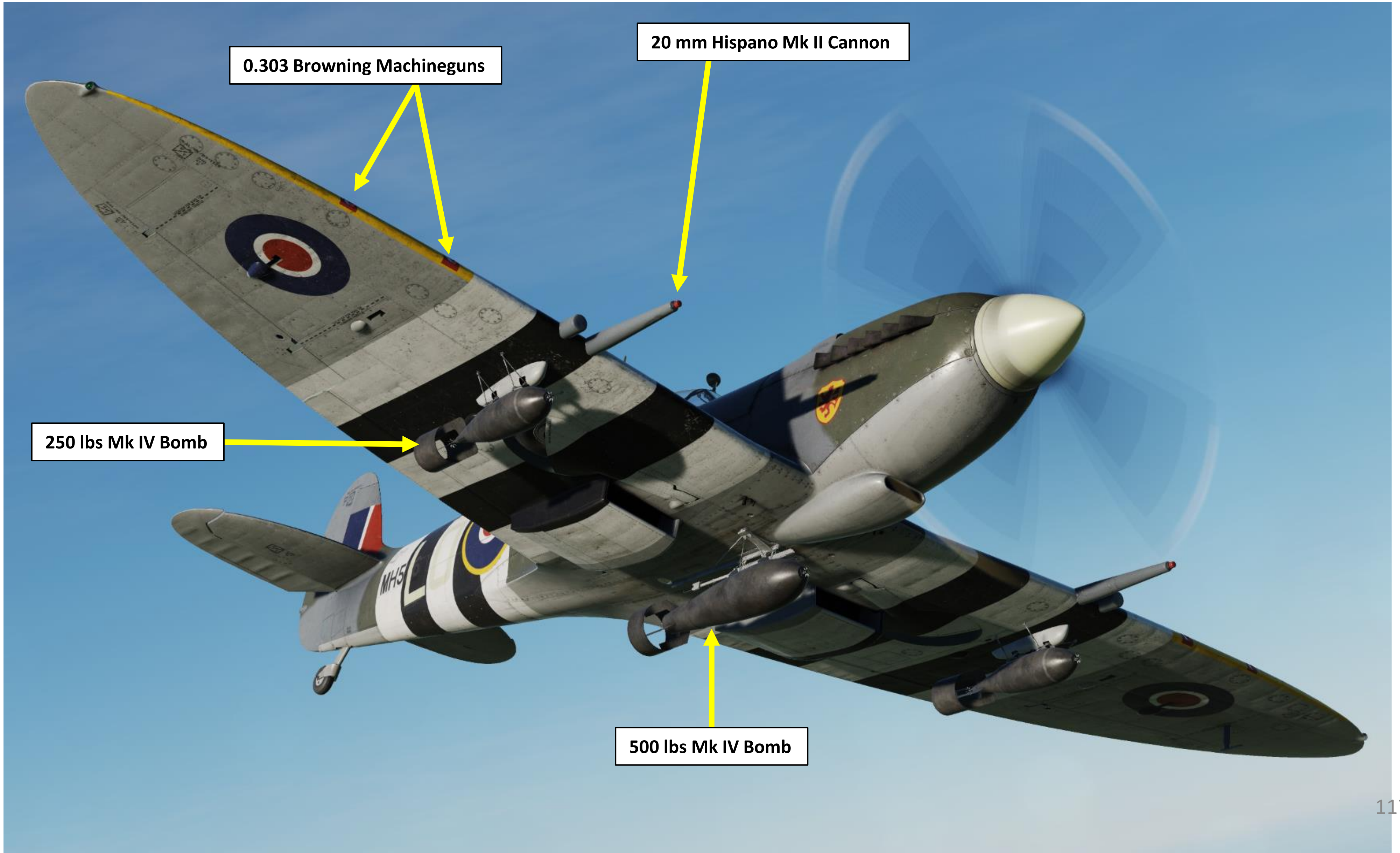
Maximum Weight

For take-off and gentle manoeuvres only	8,700 lbs
For landing (except in emergency)	7,450 lbs
For take-off, all forms of flying and landing	7,800 lbs

*Note: At this weight, take-off must be made only from a smooth hard runway.

ARMAMENT OVERVIEW

- 4 x Colt Browning .303 Machineguns (350 rounds per gun)
- 2 x Hispano Mk. II 20 mm Cannons (120 rounds per cannon)
- 2 x 250 lbs bombs + 1 x 500 lbs bomb

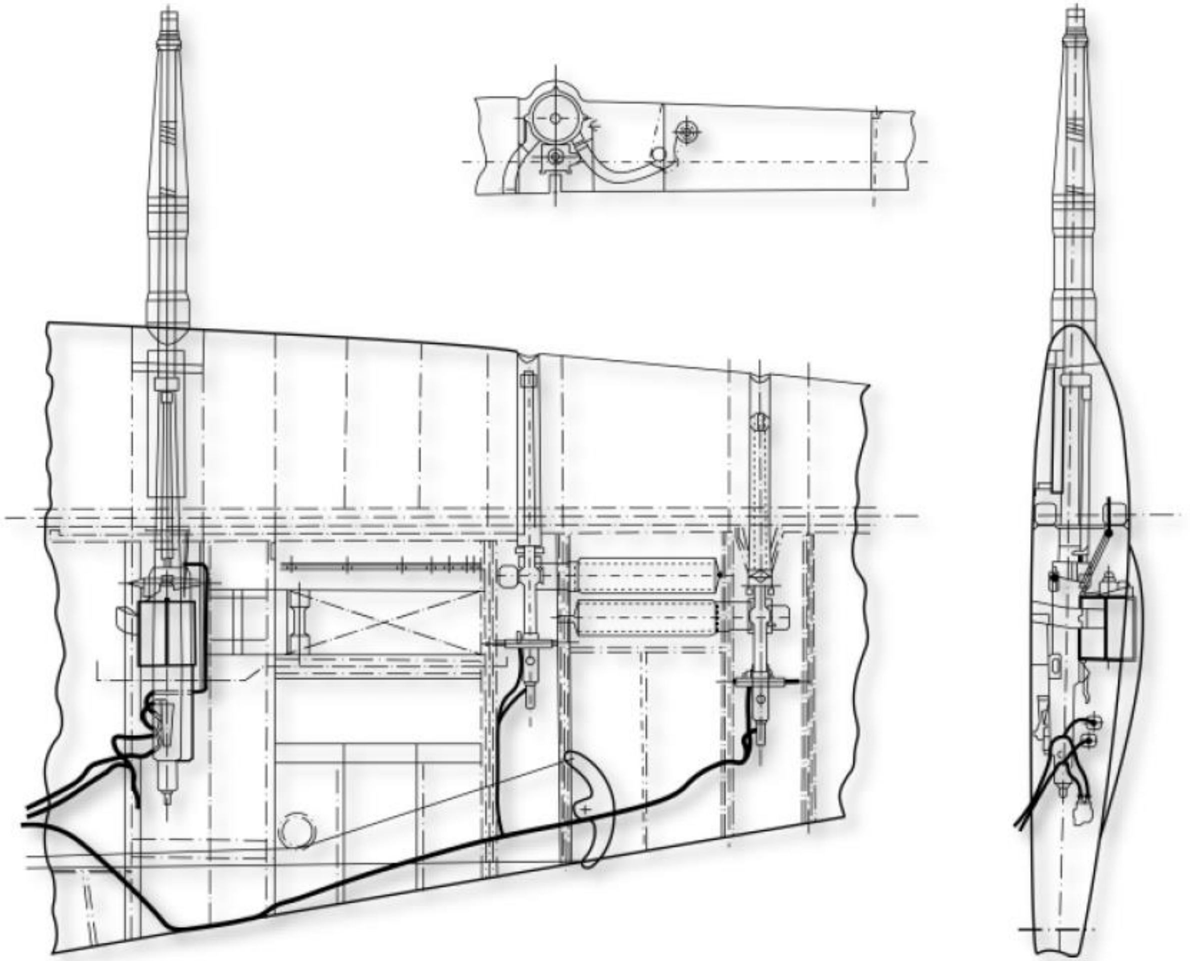


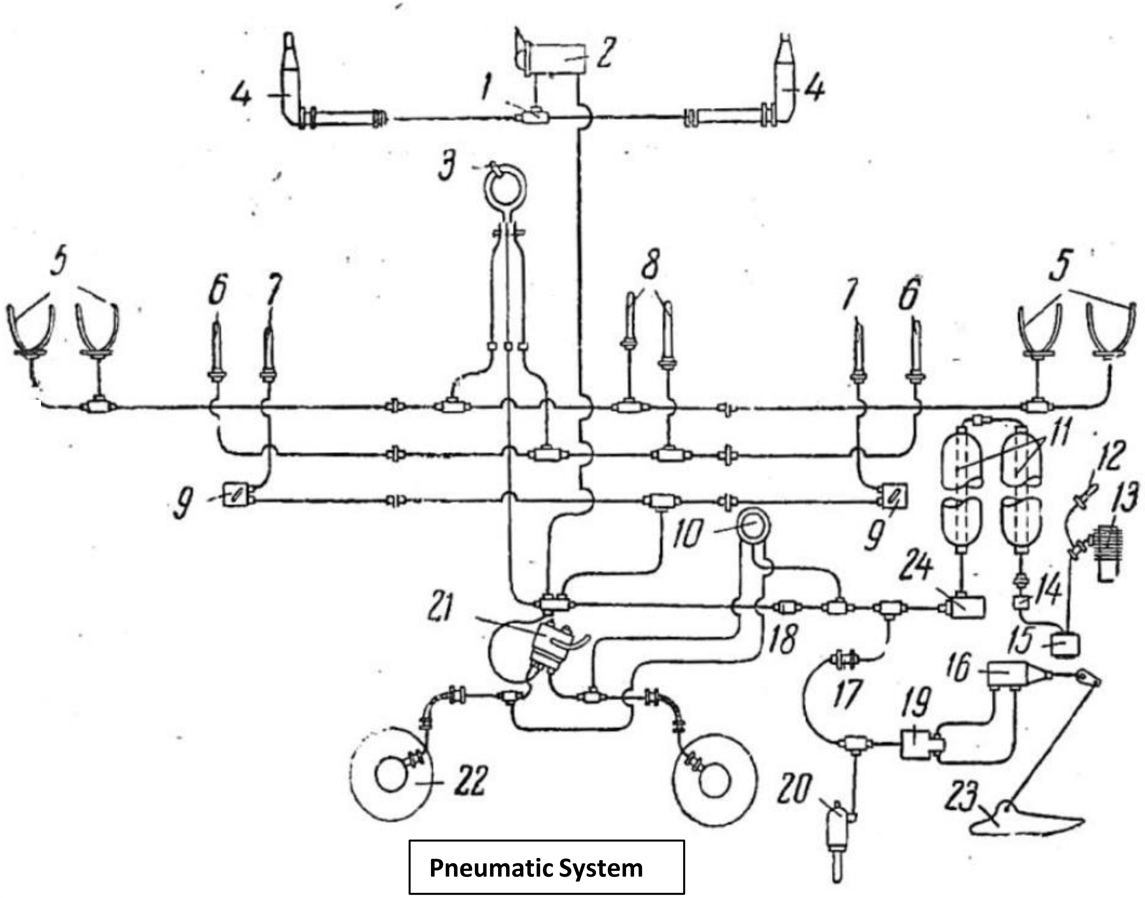
ARMAMENT MECHANISMS

The pneumatic system operates the wheel brakes, the Browning guns, Hispano guns, cine-camera, and flaps. Two storage cylinders are kept charged by an engine-driven compressor and from them the supply is led to the various units in the system.

For the armament systems, pneumatic pressure controls the following components:

- Hispano cannons reload & firing mechanism
- Browning machineguns’ firing, reloading & safety mechanism
- Camera gun
- Weapon fire buttons (on the control stick)



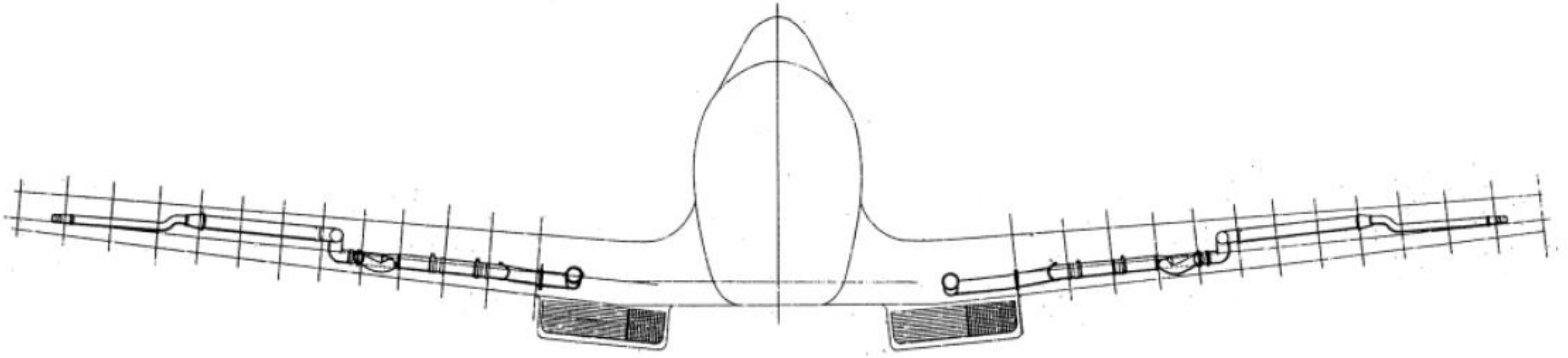


Pneumatic System

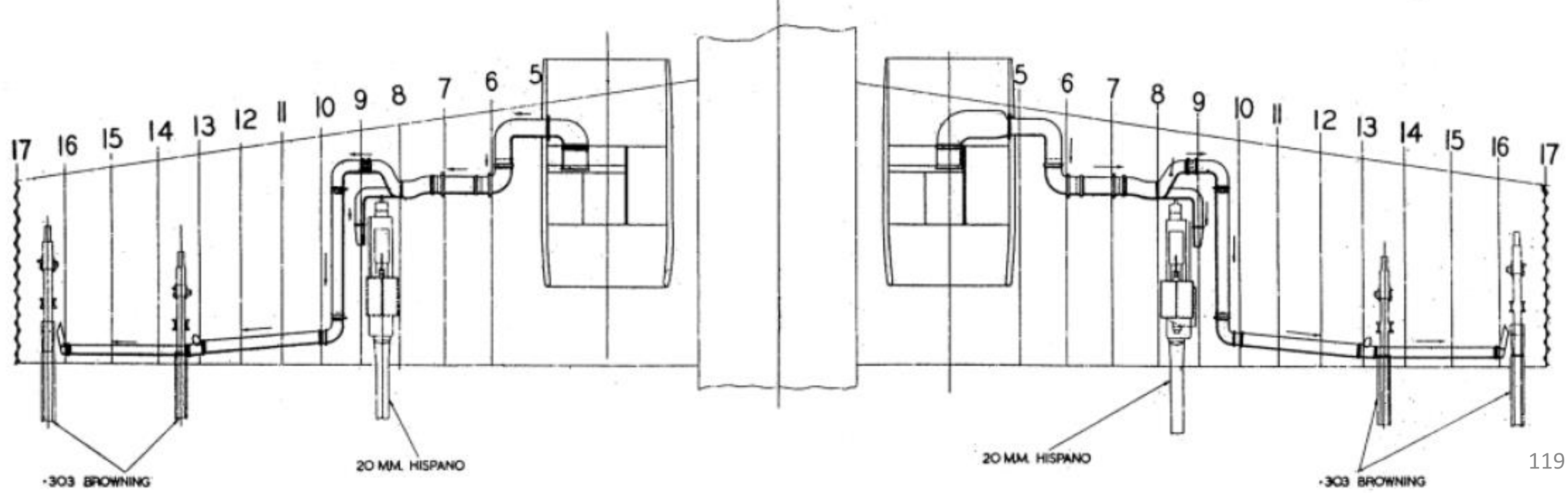
1. Cutoff valve
2. Flaps control valve
3. Weapon fire button
4. Flaps cylinder
5. Machinegun fire, safety mechanism and reload
6. Cannon fire
7. Cannon reload
8. Cinegun (Camera)
9. Cannon reload control valve
10. Three-pointer pressure gauge
11. Onboard air container
12. Onboard charging nozzle
13. Heywood compressor
14. Pressure reducer valve
15. Oil and mist separator
16. Radiator valve cylinder
17. Minimum pressure valve
18. Pressure reducer valve
19. Electromagnetic control valve for the radiator valve
20. Supercharger speed control cylinder
21. Brake differentials
22. Main Landing Gear wheel
23. Radiator Valve
24. Air Filter

ARMAMENT HEATING SYSTEM

Often, on early versions of aircraft, weapons malfunctioned due to frozen lubricant on the moving parts. To ensure trouble-free operation of weapons, aircraft began to use heating systems for their weaponry. Hot air for heating is taken past the cooling radiators is sent to the machine-gun compartments by pipelines. The heating system is automated and requires no input from the pilot.



Weapons Heating System



MARK II GUNSIGHT - OVERVIEW

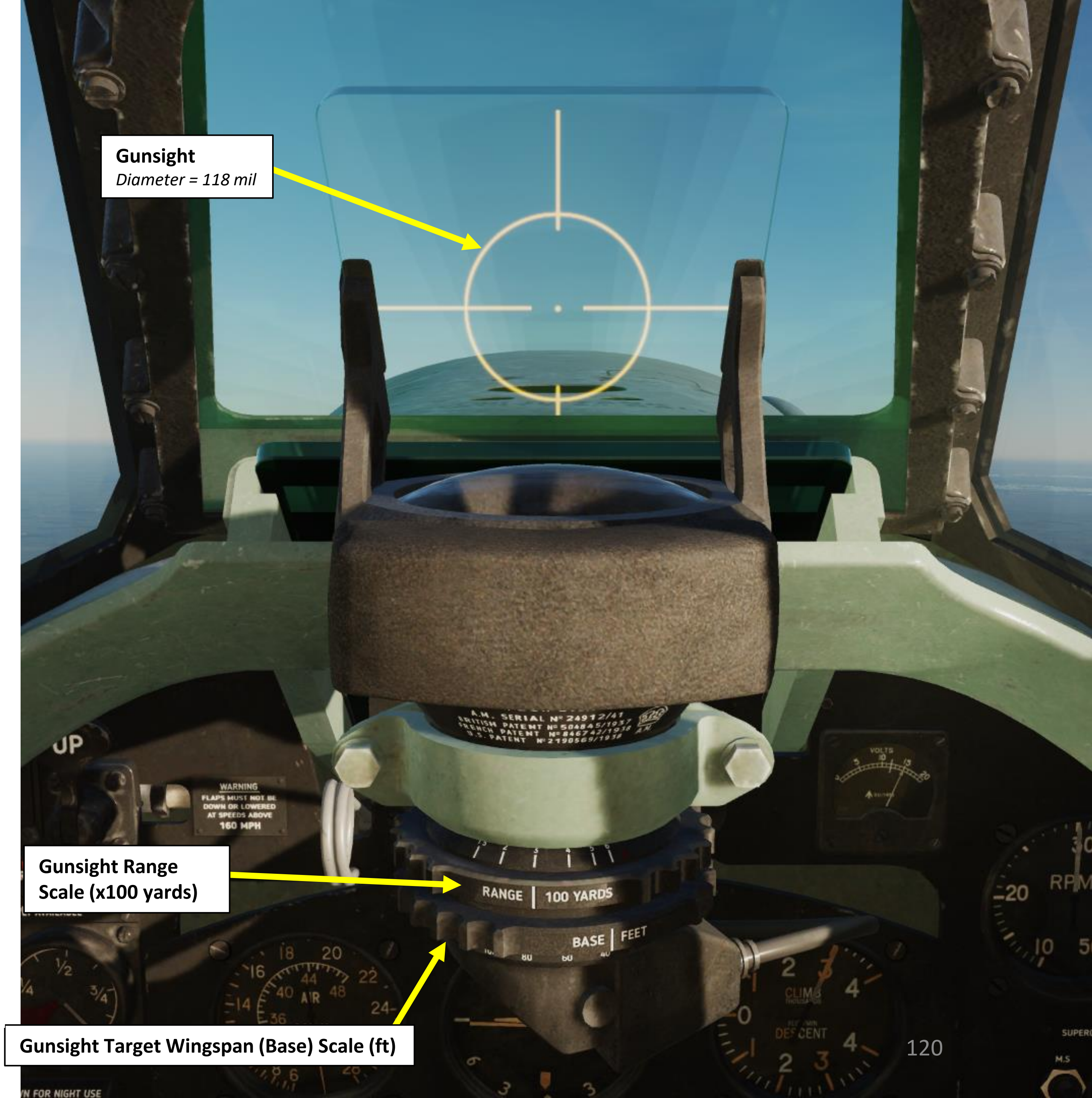
Your gunsight will show you where to shoot and when to shoot a target.

Gunsight Specifications:

1. Reticle ring diameter – angular values:
    - In degrees: 6° 44’
    - In thousandths (milliradians): 118
2. Reticle rings radius - angular values:
    - In degrees: 3° 22’
    - In thousandths (milliradians): 59
3. When shooting, this ring corresponds for allowance at an aspect of 2/4 and target speed of 200 mph (322 km/h).
4. At target aspect of 1/4, target speed should be 400 mph (644 km/h) .

Range scale						
In hundreds of yards	1	2	3	4	5	6
Yards	100	200	300	400	500	600
Meters	91,4	182,8	274,2	365,6	457	548,4

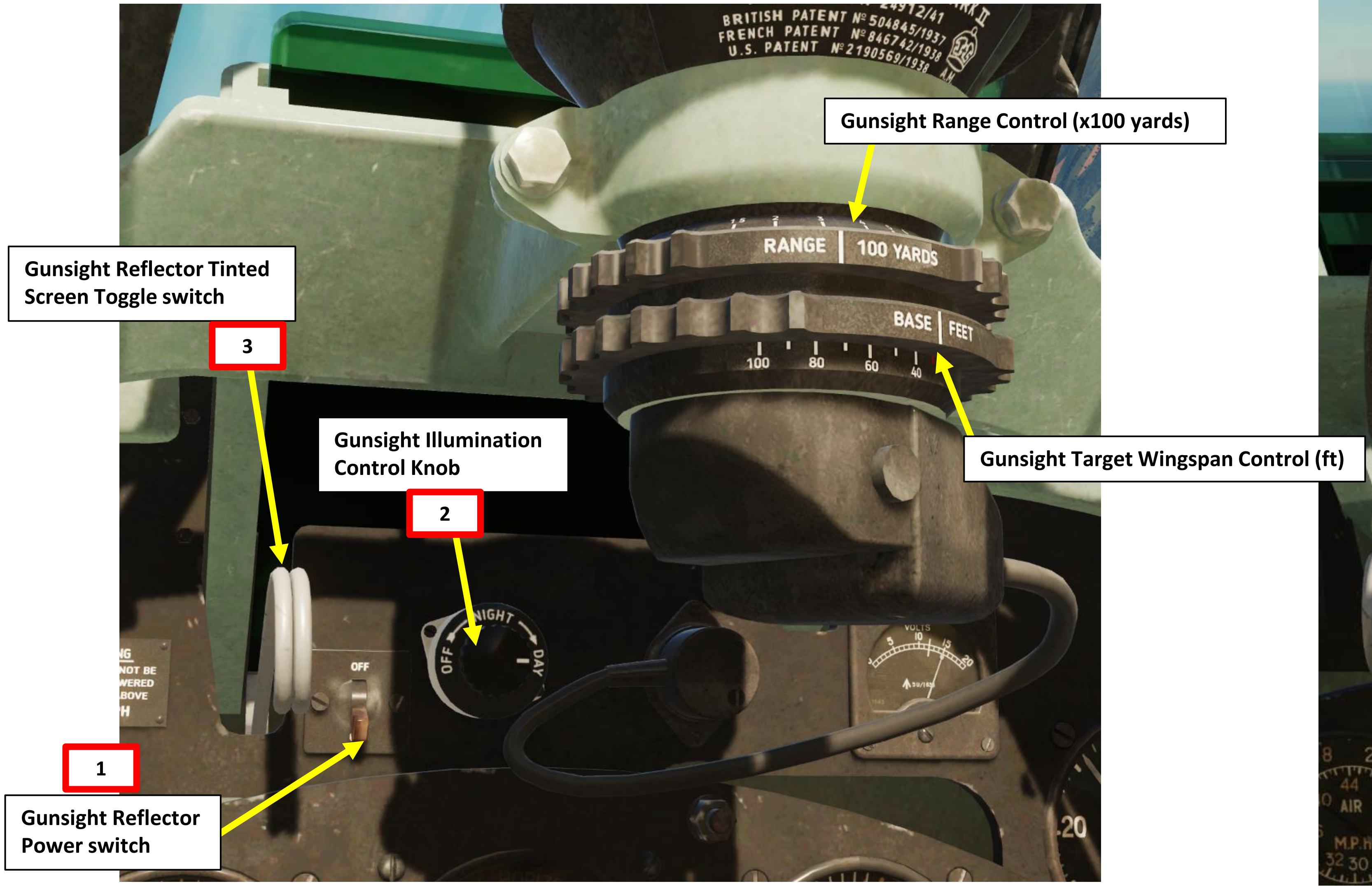
Base scale							
Feet	40	50	60	70	80	90	100
Meters	12,2	15,2	18,3	21,3	24,4	27,4	30,5

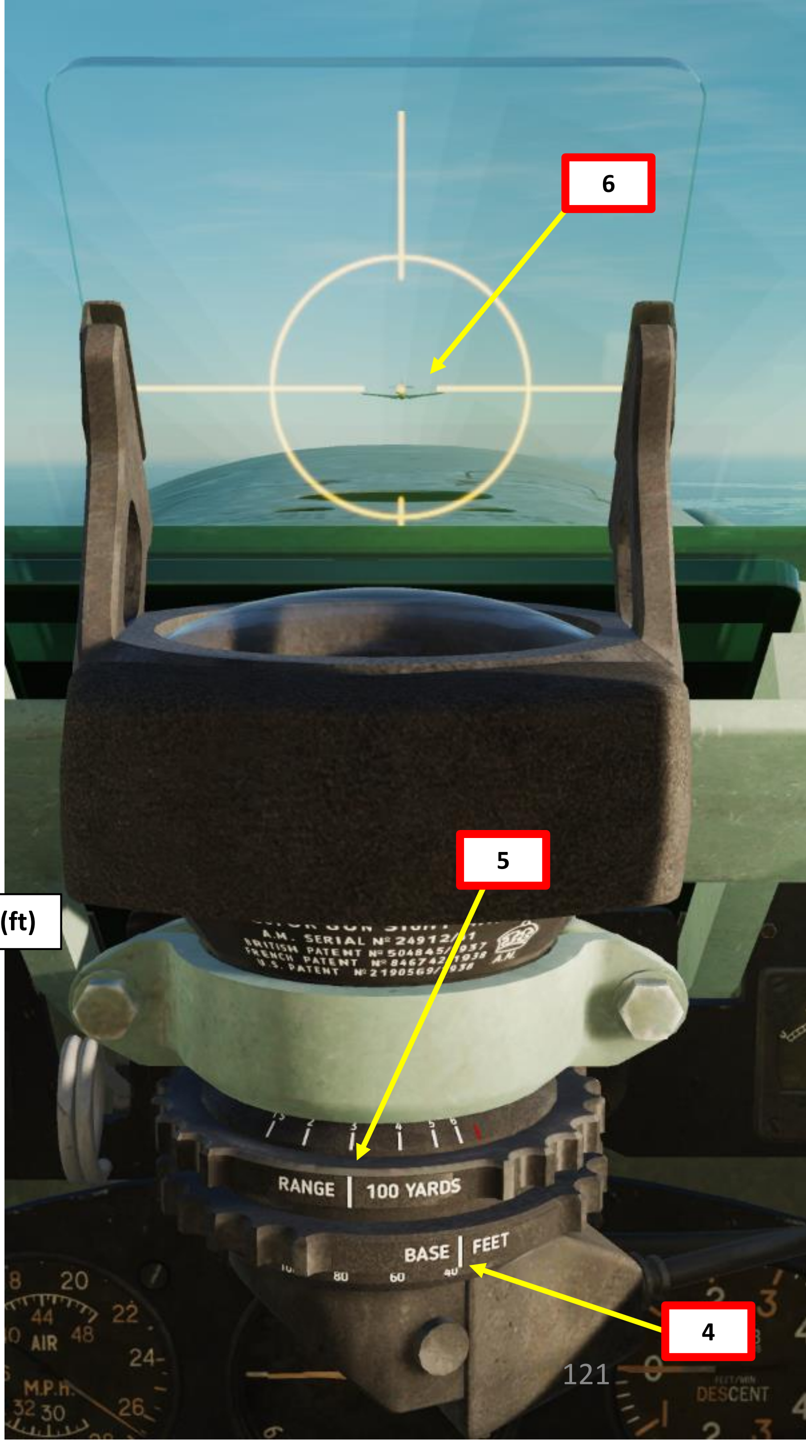


MARK II GUNSIGHT - TUTORIAL

To use the gunsight properly:

1. Set Reflector Power switch to ON (DOWN)
2. Adjust Gunsight brightness as required
3. Use Gunsight Reflector Tinted Screen if required
4. Set Gunsight Wingspan to 32 ft (typical FW190 and Bf.109 wingspan)
5. Set Gunsight Range to 300 yards (Typical Spitfire gun convergence was set to this value after the Battle of Britain).
6. When the wing of the target fits in your gunsight, you are now in the range set in previous step.





MARK II GUNSIGHT - RANGE ESTIMATION

Now… how do we know when the target is in range to fire? Typically, you choose a firing range/distance first (as an example, 300 yards / 275 meters), then place the fixed sight on the target and approach until it fits reference marks in "mils" (milliradians, which is an angle) for the desired firing distance.

As an example, let's take a Bf.109, which has a wingspan (length) of about 32 ft (10 meters).

There is a rule in trigonometry that states that "in a right triangle, the tangent (tan) of an angle is the length of the opposite side divided by the length of the adjacent side". For very small angles, simplifications can be made. I'll spare you the math, but the bottom line is:

$$\frac{\theta}{2} = \arctan\left(\frac{L/2}{D}\right)$$

$$\text{For small angles, } \arctan\left(\frac{L/2}{D}\right) \; \textit{can be approximated to} \; \frac{L/2}{D}$$

$$\text{Therefore: } \theta = \frac{L}{D}$$

We know the reticle diameter represents an angle of 118 milliradians (118 thousandths of a radian, or 6° 44' in degrees). From the equation above, we can determine what distance D_1 the target is from us when its wingspan (L_1) fits within the reticle diameter.

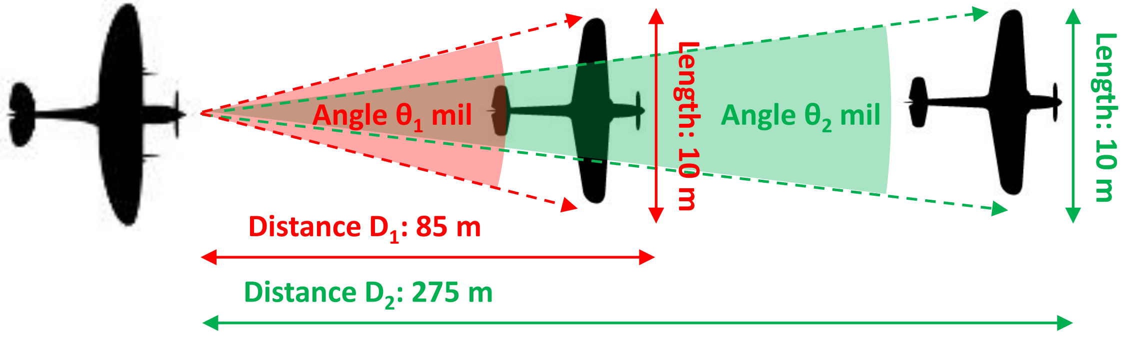
For a target with a length L_1 = 10 m that fits within the reticle angle θ_1 of 118 milliradians:

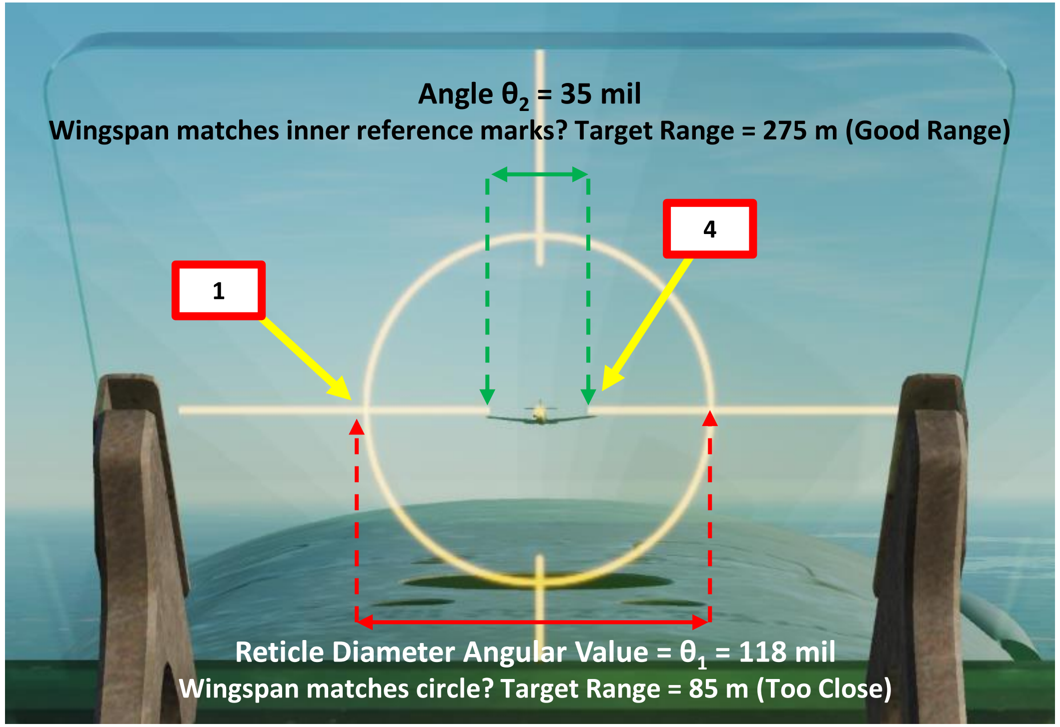
$$\theta_1 = 118\ mil = \frac{L_1}{D_1}$$

$$D_1 = \frac{L_1}{\theta_1} = \frac{10\ m}{0{,}118\ rad} = 85\ meters$$

For a target with a length L_2 = 10 m at a distance D_2 of 275 m (the range we actually want to fire at):

$$\theta_2 = \frac{L_2}{D_2} = \frac{10\ m}{275\ m} = 0.036\ rad \approx 35\ mil\ (milliradians)$$



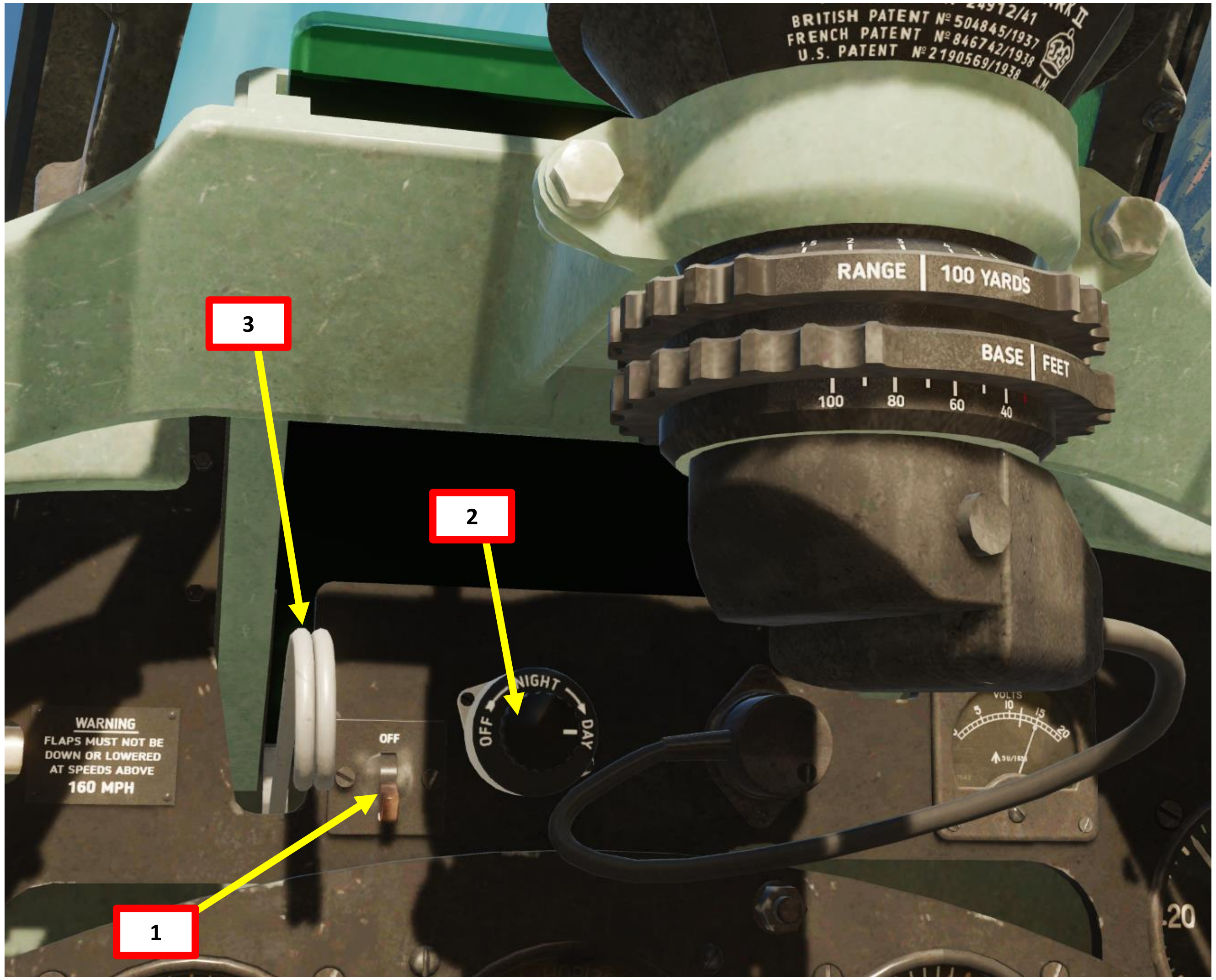


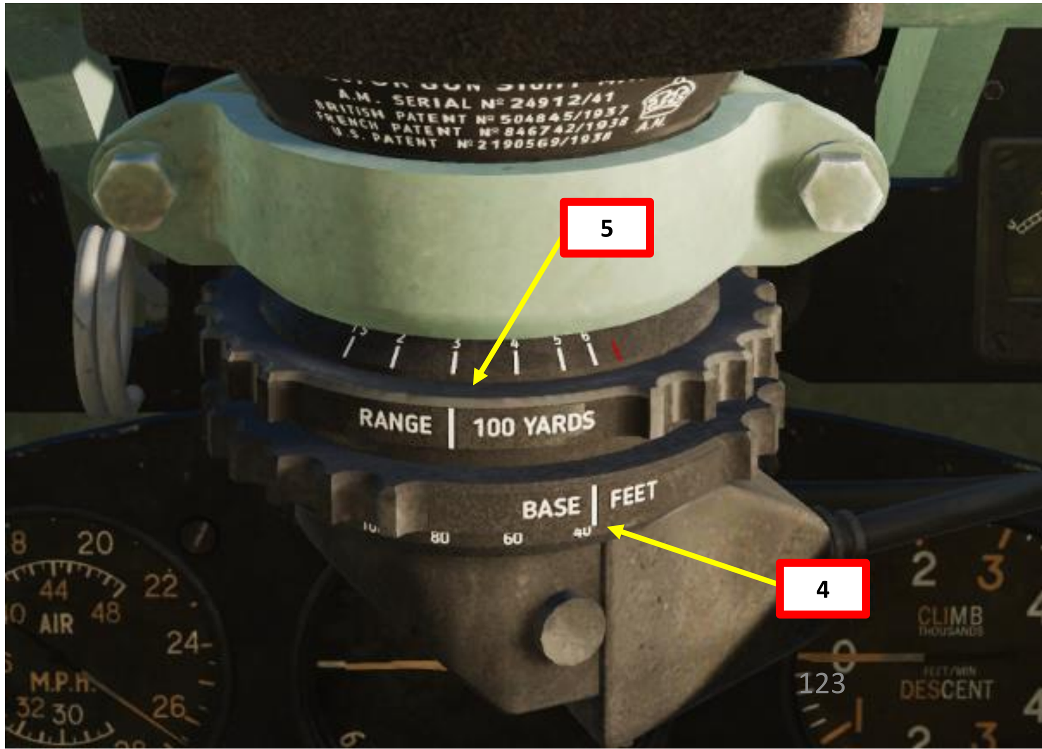
Now… how do we interpret the gunsight to estimate the range of a target?

1. We know the **reticle diameter** is 118 mil (118 thousandths of a radian, or 6° 44' in degrees).
2. We calculated that when the wingspan of a target fits within the diameter of the reticle, we are at a range of approx. 85 meters, which is way too close.
3. Using the **RANGE** and **BASE** gunsight settings, we can set the **inner reference marks** of the gunsight to a distance of 300 yards / 275 m (optimal firing range) adjusted for a wingspan of 10 m (32 ft).
4. When target wings fit within the **reticle inner reference marks**, we know we are at the optimal firing range of 300 yards. You may fire.

HISPANO 20 MM CANNONS & BROWNING 0.303 CAL MACHINEGUNS

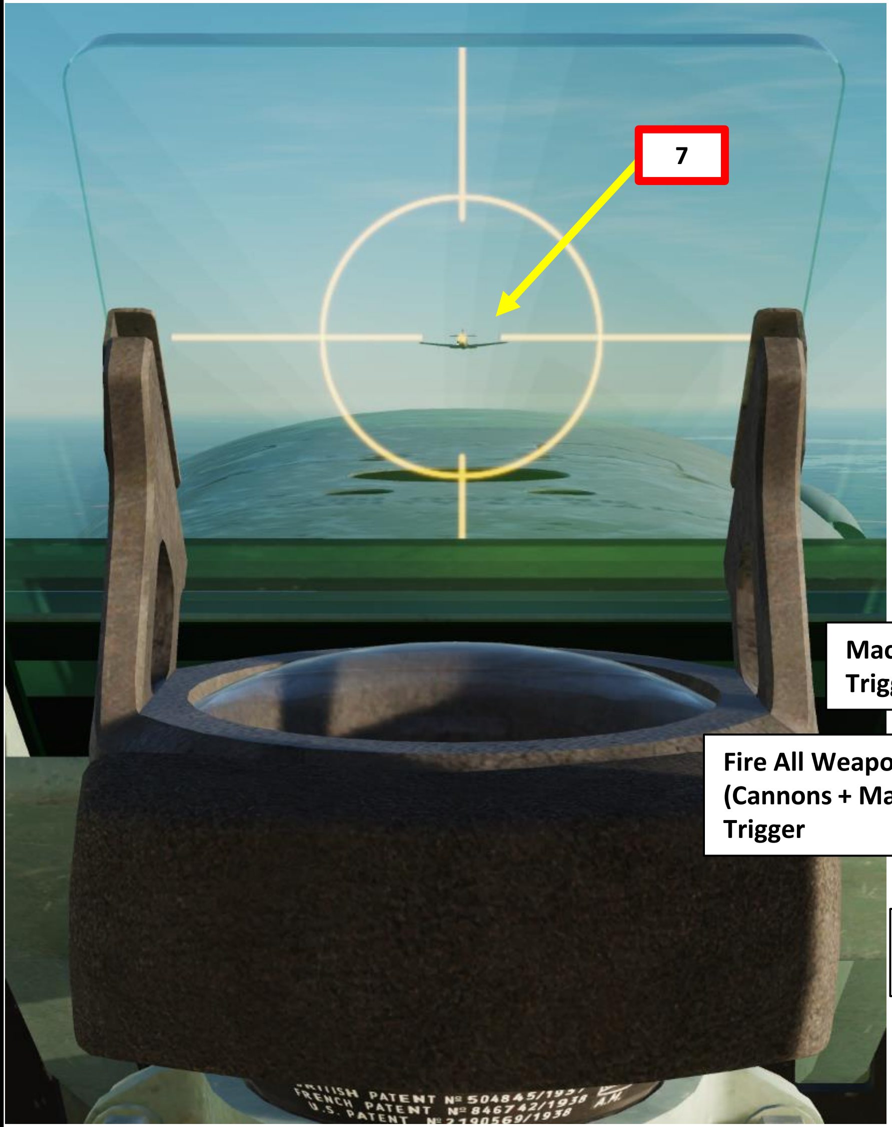
1. Set Reflector Power switch to ON (DOWN)
2. Adjust Gunsight brightness as required
3. Use Gunsight Reflector Tinted Screen if required
4. Set Gunsight Wingspan to 32 ft (typical FW190 and Bf.109 wingspan)
5. Set Gunsight Range to 300 yards (Typical Spitfire gun convergence was set to this value after the Battle of Britain).





HISPANO 20 MM CANNONS & BROWNING 0.303 CAL MACHINEGUNS

6. Remove gun safety by setting the Gun Safety Lever to OUT FIRE (LSHIFT+SPACEBAR)
7. When the wing of the target fits in your gunsight, you are now in the range set in previous step.
8. Fire by pressing the “FIRE MACHINEGUNS AND CANNONS” button (SPACEBAR key)



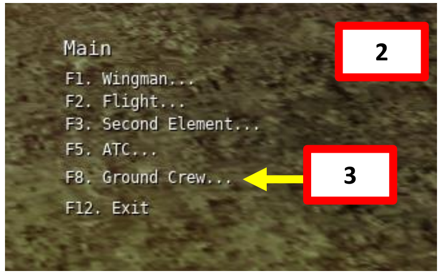
HISPANO 20 MM CANNONS & BROWNING 0.303 CAL MACHINEGUNS

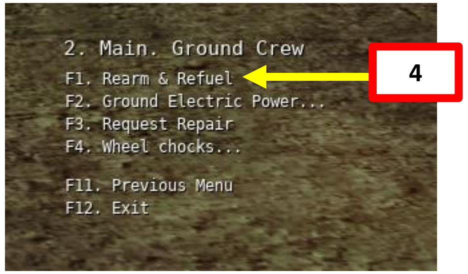
HISPANO 20 MM CANNONS & BROWNING 0.303 CAL MACHINEGUNS

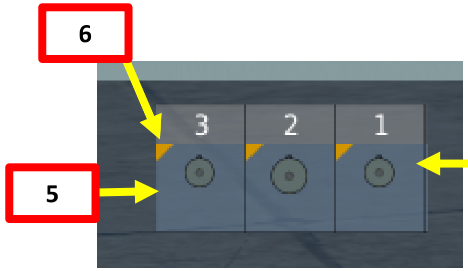
BOMB FUZES

To equip bombs with a fuze delay, contact the ground crew.

1. Open canopy
2. Press “RALT + \” (Communication Push-to-Talk)
3. Select ground crew by pressing “F8”
4. Select “Rearm & Refuel” by pressing “F1”.
5. Equip bomb on desired pylon.
6. Click on the yellow triangle on the bomb to set fuze type and delay.
7. Set fuze type and delay.
8. Click OK on the Fuze panel.
9. Repeat for each individual bomb.
10. Click OK on the Re-Arming panel.

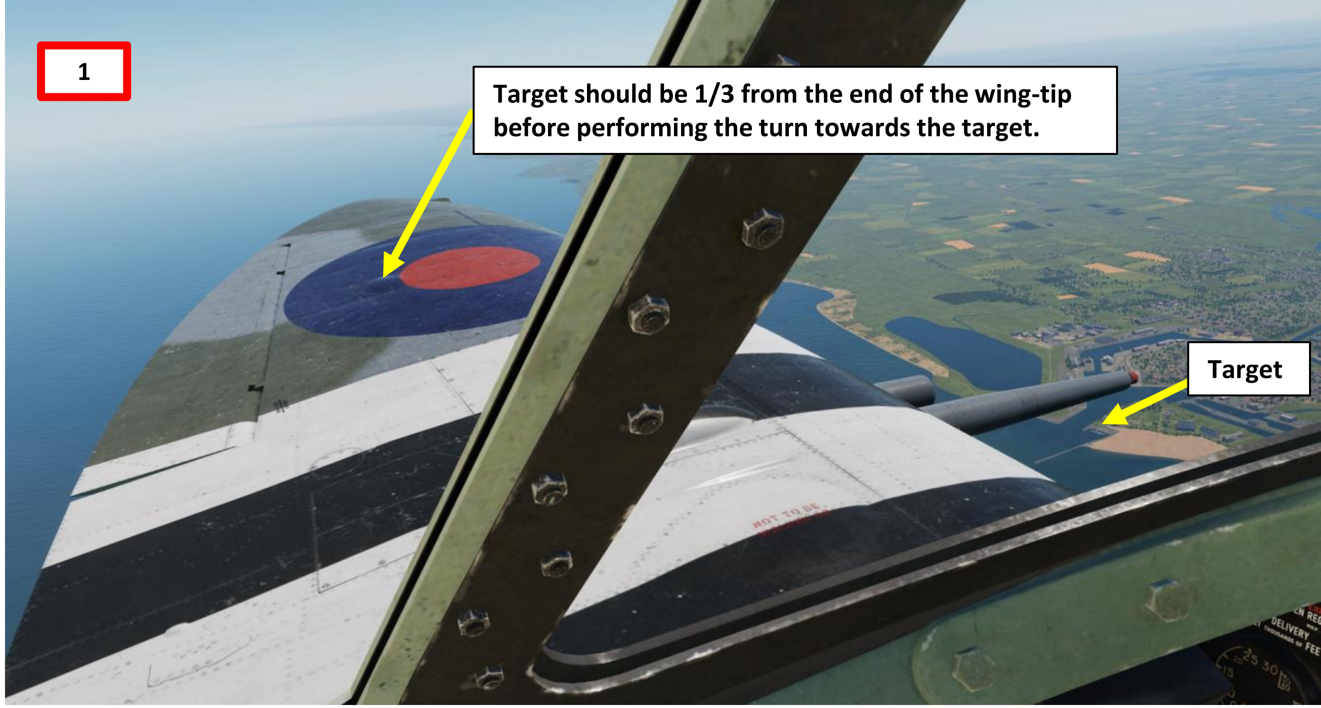


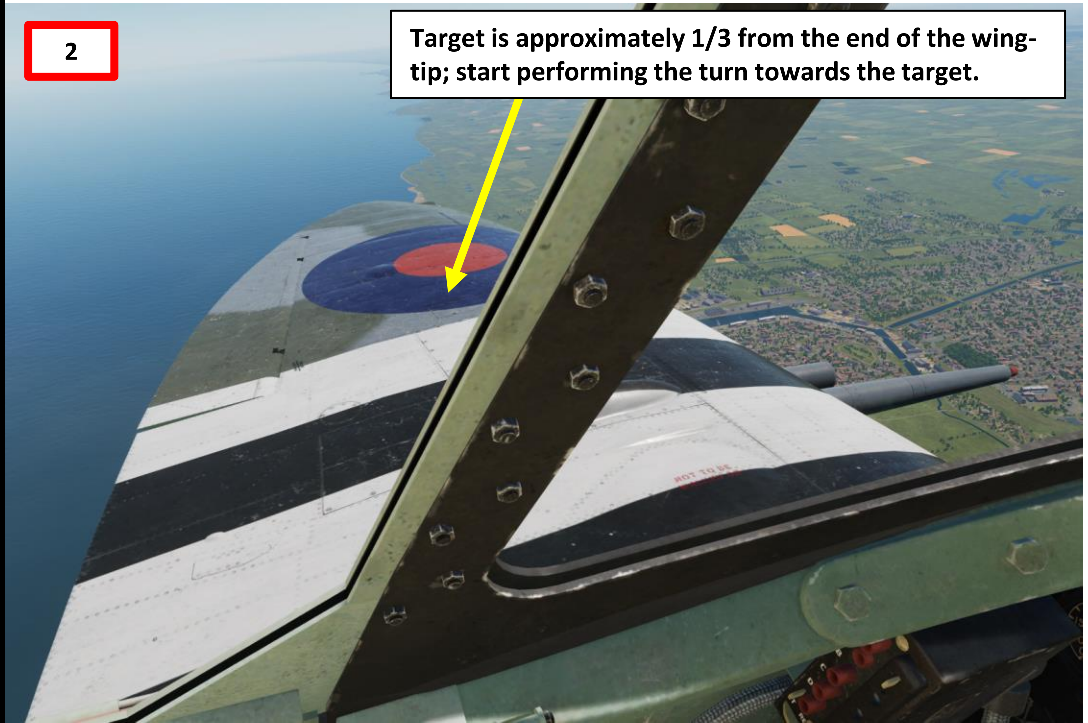




BOMBS

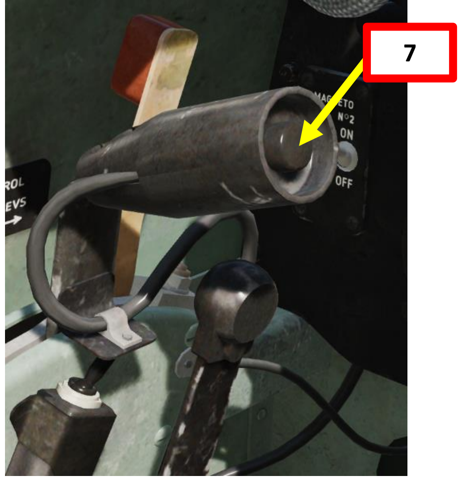
1. Approach the target by flying level at an altitude between 6000 and 8000 ft, with an airspeed between 220 and 230 mph.
2. When the target disappears under the wing on a line of about 1/3 from the end of the wing-tip, perform a gentle turn under the horizon in the direction of the target.
3. While turning, regulate speed so that the target remains visible. This turn has to be very steady and made without excessive use of the rudder.

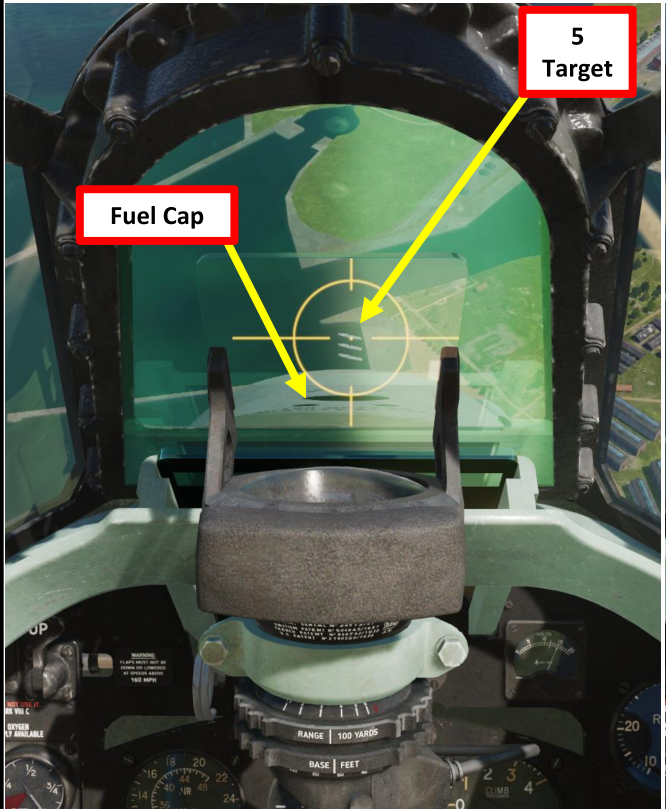


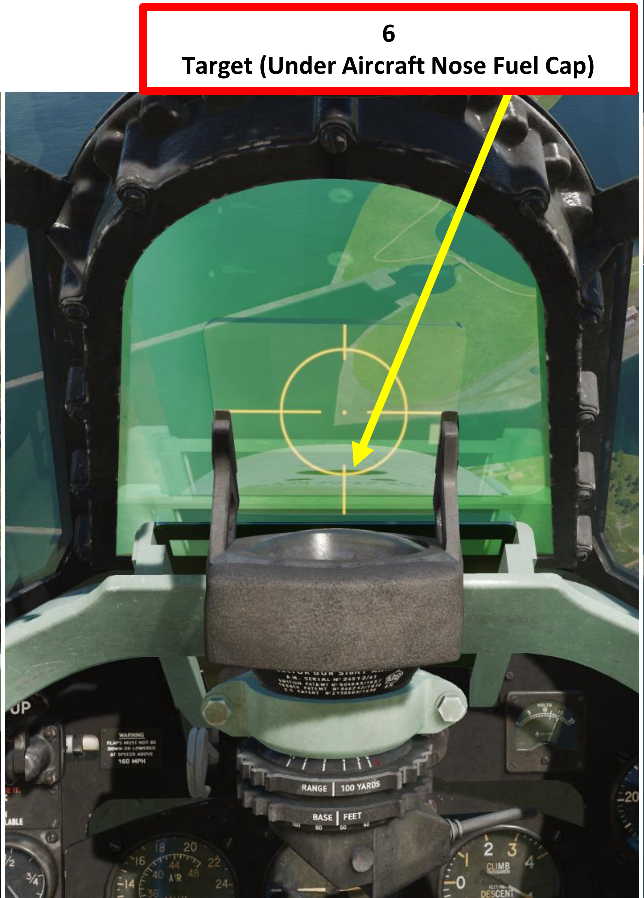


BOMBS

4. Throttle back at idle power and perform a dive between 45 and 60 degrees. The steeper the dive angle the better precision you will have.
5. Line up the target with the center of the gunsight reticle.
6. Pull lead to bring the target slightly under the fuel cap located on the aircraft nose.
7. When target is lined up under the aircraft nose (fuel cap) and aircraft is at an altitude of 3000 ft, release bombs by pressing the Bomb Drop button on the throttle (“RSHIFT+SPACEBAR” binding). All bombs equipped will drop simultaneously.





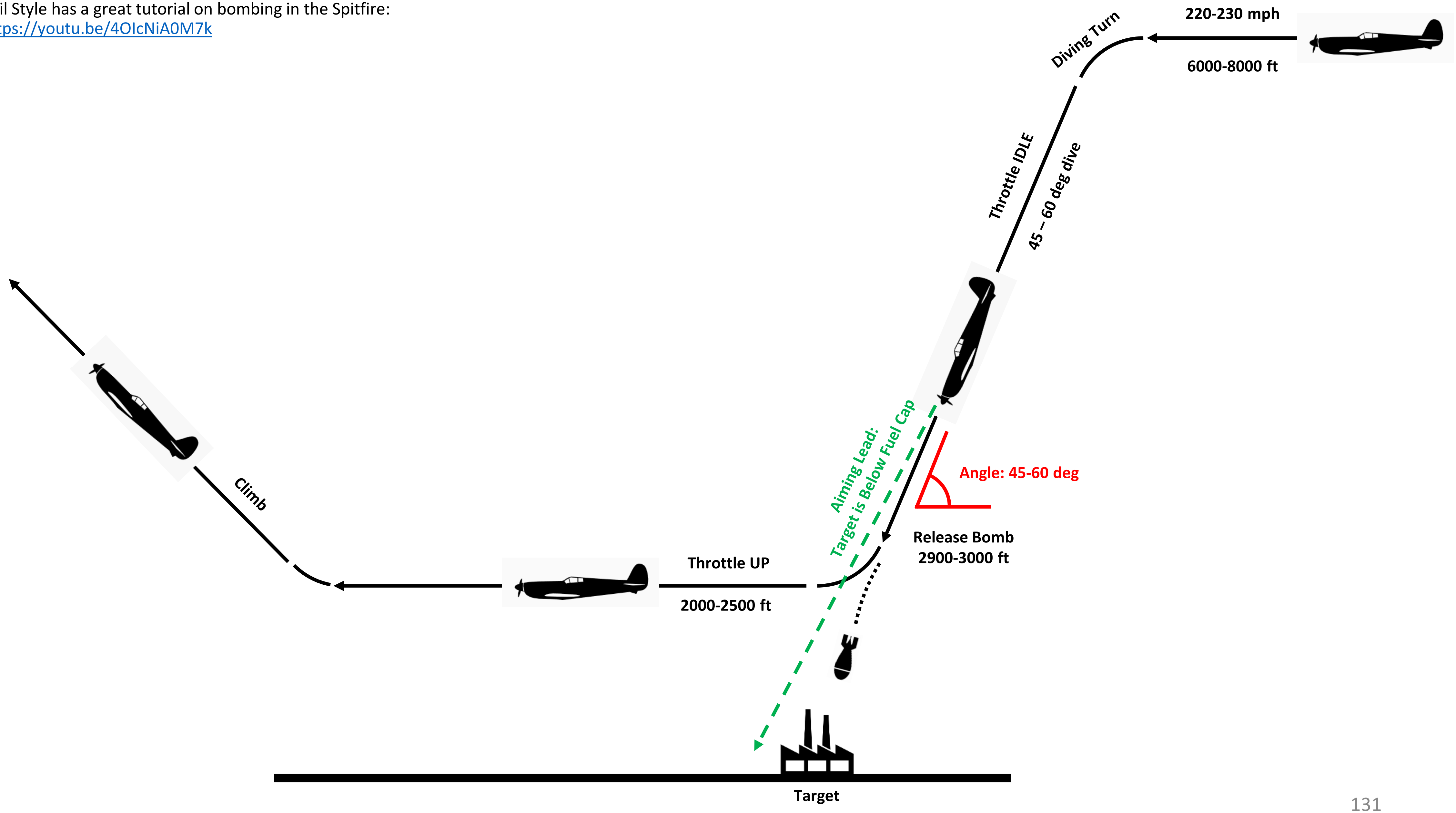


BOMBS

8. Apply full power and pull away from the blast while maintaining level flight. This will allow you to get out as quickly as possible from the orbit of enemy flak.
9. After having travelled enough distance, start climbing. Climbing immediately after the release of bombs was one of the most common mistakes and resulted in:
    - Unnecessary danger to the pilot from the enemy flak
    - Black-out
    - Wing wrinkling

BOMBS

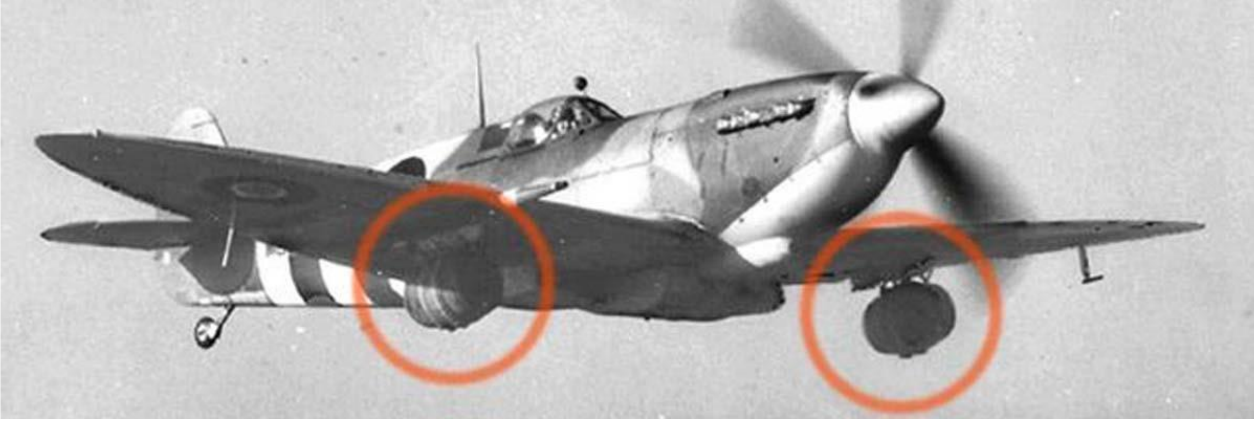
Phil Style has a great tutorial on bombing in the Spitfire:
https://youtu.be/4OIcNiA0M7k



BEER KEGS FOR BOMBS?

In WWII, Spitfire squadrons sometimes carried beer to front line units by strapping kegs underneath the wings on ordnance hardpoints. These events probably only occurred on a few occasions for some good public relations and/or morale boosting, but there are a few well-known photographs of a Spitfire in flight "armed" with beer kegs as a result.

Eagle Dynamics added “beer bombs” for the Spitfire module as a nice Easter egg with no real practical application… but they certainly have earned style points from me!



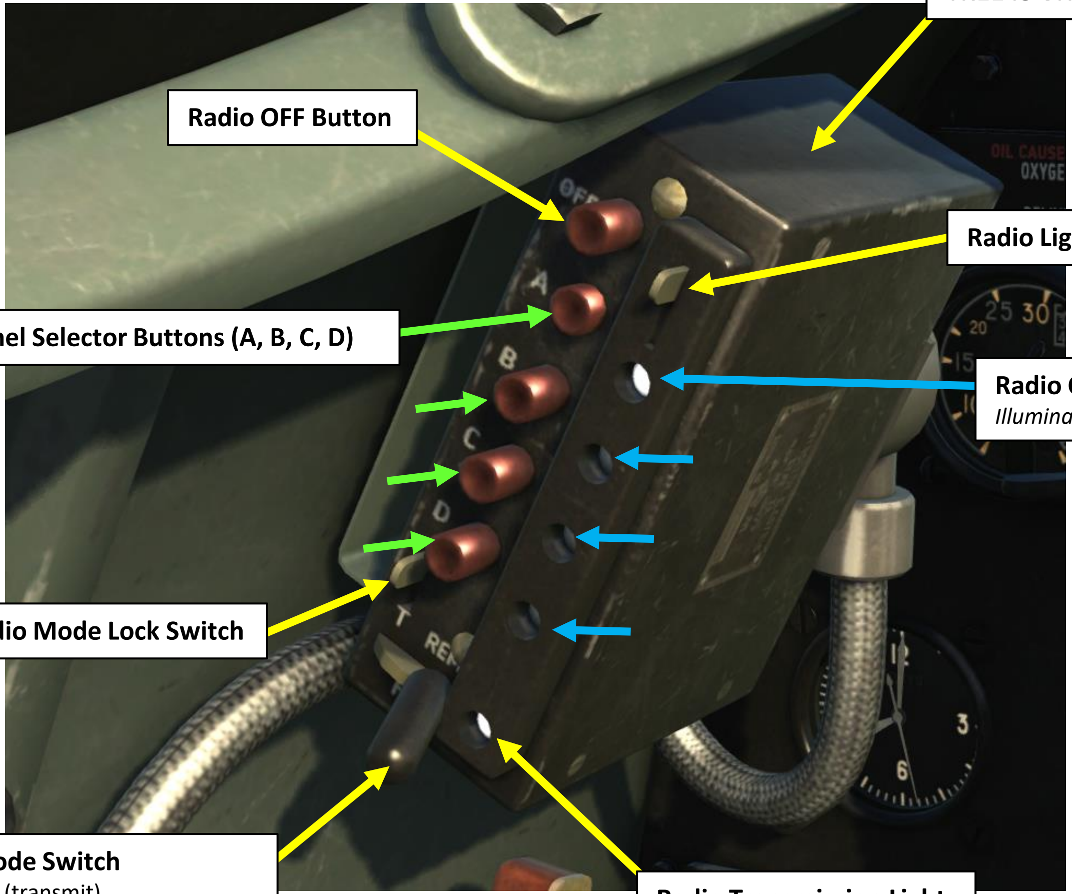
TR1143 VHF RADIO

The Spitfire Mk IX is equipped with an TR1143 type VHF radio. Radio frequencies are preset in the mission editor in 4 different channels and cannot be tuned manually during flight; you have to use these 4 preset frequencies.

Maximum Radio Range

Altitude, Feet	Range, Miles
1000	30
3000	70
5000	80
10000	120
15000	150
20000	180

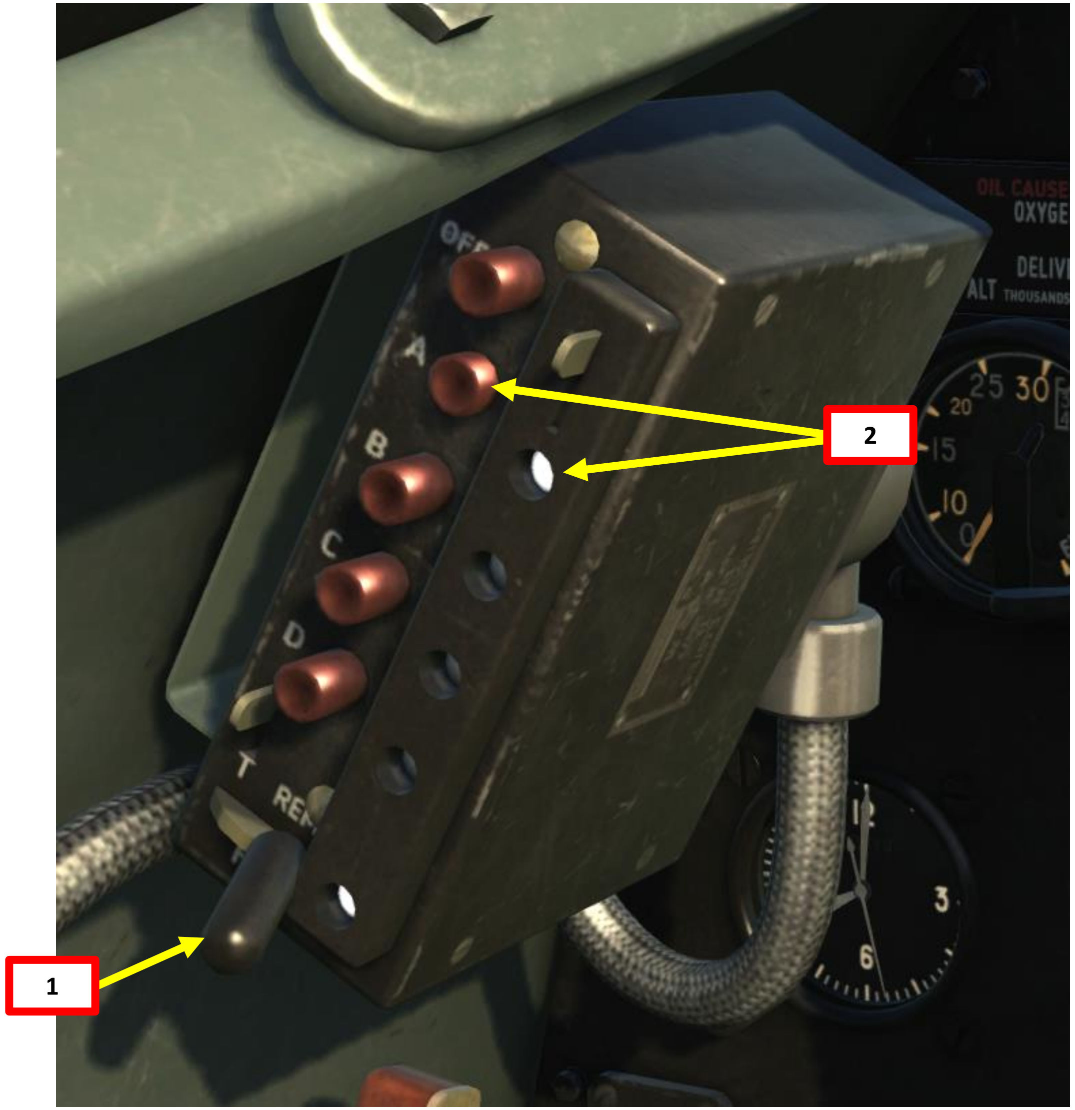
RADIO FREQUENCY RANGE: 100 - 156 MHz

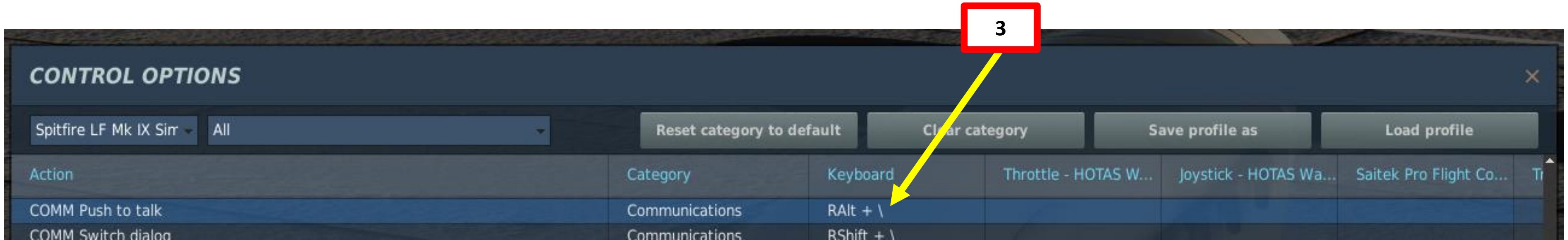


TR1143 VHF RADIO

To use the radio:

1. Set the radio transmit-receive switch to REM (Remote Operation)
2. Select desired channel (A, B, C or D)
3. Press the “COMM – Push to Talk” binding “RALT+ /” to transmit.

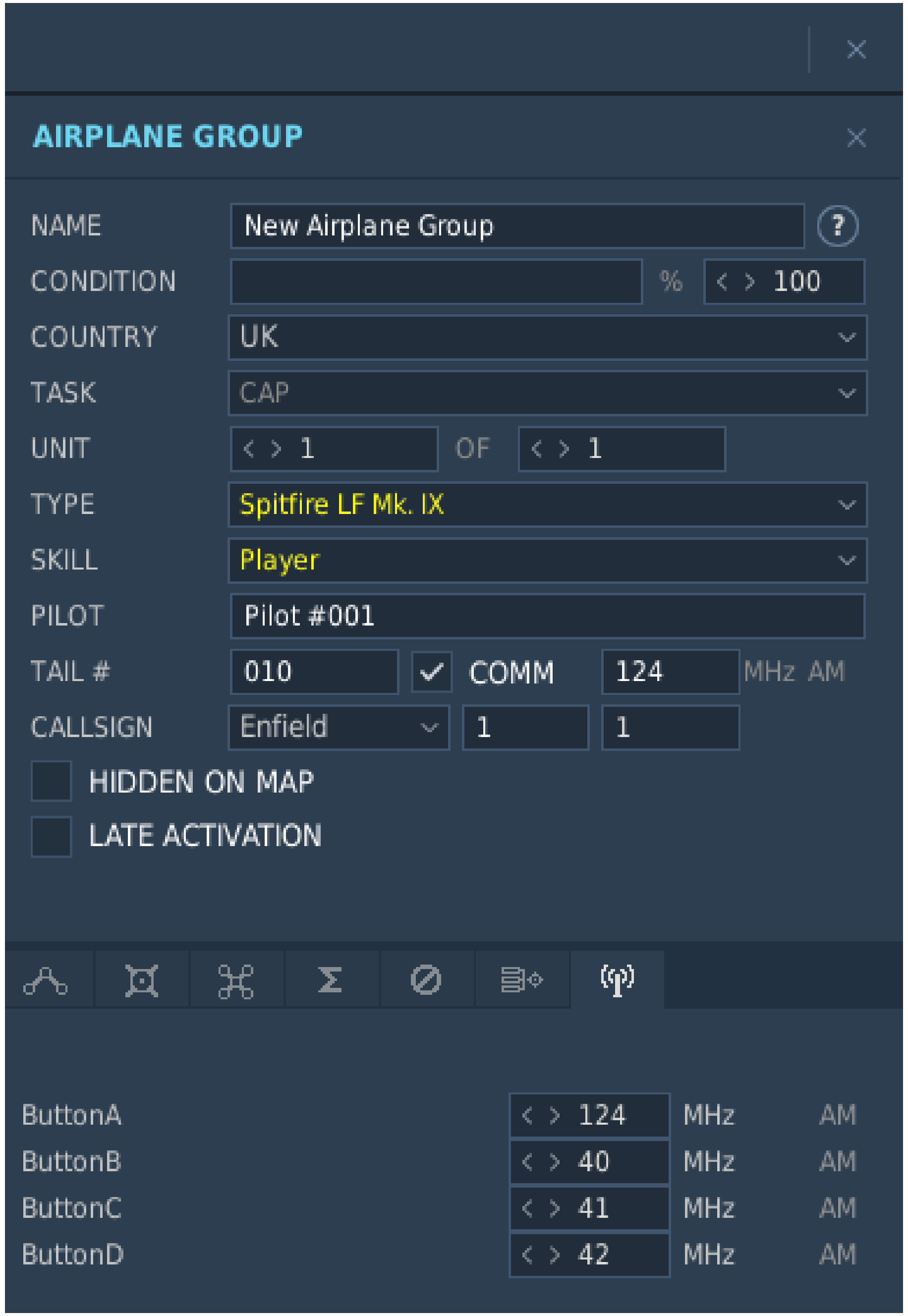




A FEW NOTES ON THE SPITFIRE RADIO

The Spitfire variant modelled in DCS does not specifically explain the real life radio transmission procedure, nor could I find any relevant information about it. Radio transmission worked differently throughout Spitfire variants. For the Spitfire Mk IX variant we have in DCS, here are a few plausible guesses:

- **Guess #1**: Transmission was done by pressing and holding the Radio Mode Switch to T (Transmit), which is sprung back when released.
- **Guess #2**: Transmission was done by setting the Radio Mode Switch to REM (Remote) and then using a Push-to-Talk button installed on the throttle certain Spitfire variants, which is not modelled on our variant.
- **Guess #3 (most likely):** Transmission was done with a throat microphone (also called “laryngophone”), which is a type of contact microphone that absorbs vibrations directly from the wearer's throat by way of single or dual sensors worn against the neck. Transmission was done simply by talking, and the sensors would pick up the voice and transmit it on the selected channel.



RADIO FREQUENCIES – AIRFIELDS

LOCATION	FREQUENCY (MHz)
Anapa	121.0
Batumi	131.0
Beslan	141.0
Gelendzhik	126.0
Gudauta	130.0
Kobuleti	133.0
Kutaisi	134.0
Krasnodar Center	122.0
Krasnodar Pashkovsky	128.0
Krymsk	124.0
Maykop	125.0
Mineral'nye Vody	135.0
Mozdok	137.0
Nalchik	136.0
Novorossiysk	123.0
Senaki	132.0
Sochi	127.0
Soganlug	139.0
Sukhumi	129.0
Tblisi	138.0
Vaziani	140.0

Channel A:

- Plane-to-plane communication on local flights
- Communication with controller in your own region.

Channel B:

- Common to all VHF-equipped control towers. It is normally used to contact the control tower for takeoff and landing instructions

Channel C:

- Frequently used in contacting homing stations

Channel D:

- Plane-to-plane contact between a pilot practicing fighter instrument flying and his safety pilot.
- Normally used for plane-to-ground contact with D/F (Directional Finding) stations. The pip-squeak (contactor), used in conjunction with the D/F fixing provides controllers and intercepts officers with an accurate minute-by-minute position report of your plane. The contactor clock consists of a dial and two switches.

P8 COMPASS OVERVIEW

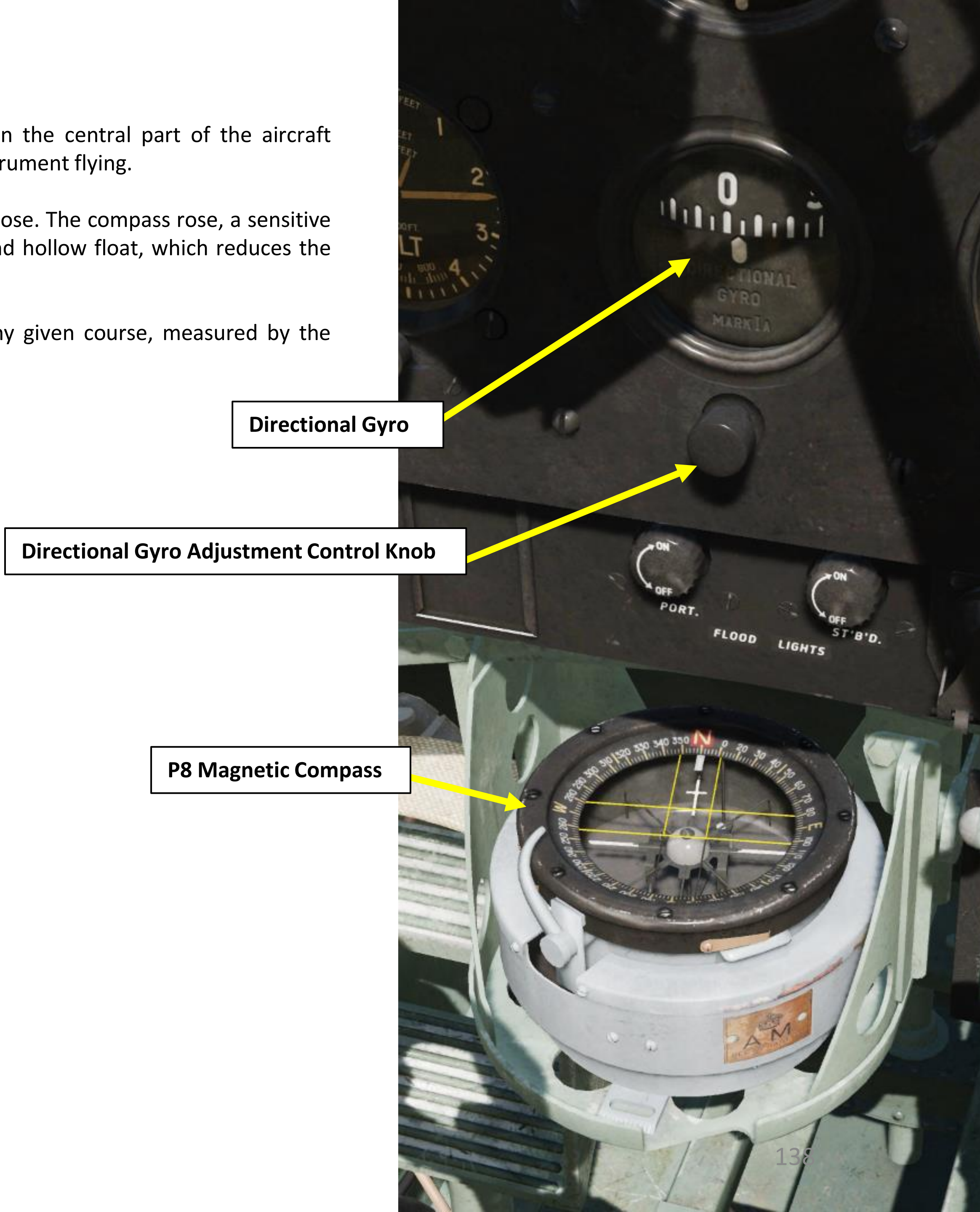
The aircraft's navigation equipment consists of the P.8.M (6A/726) magnetic compass installed on the central part of the aircraft dashboard's lower section, as well as the Mk.1A (6A/1298) gyroscope on the instrument panel for instrument flying.

The main part of the compass is a magnetic compass system, which bears the name of the compass rose. The compass rose, a sensitive element consisting of a system of magnets, antennae, damping wires, a compass cap, centre-pin and hollow float, which reduces the weight of the compass rose in the liquid.

The gyroscope does not automatically indicate course and instead indicates the deviation from any given course, measured by the magnetic compass P8. It requires re-calibration after a few minutes of flight.

Here are two great video tutorials on the P8 compass:

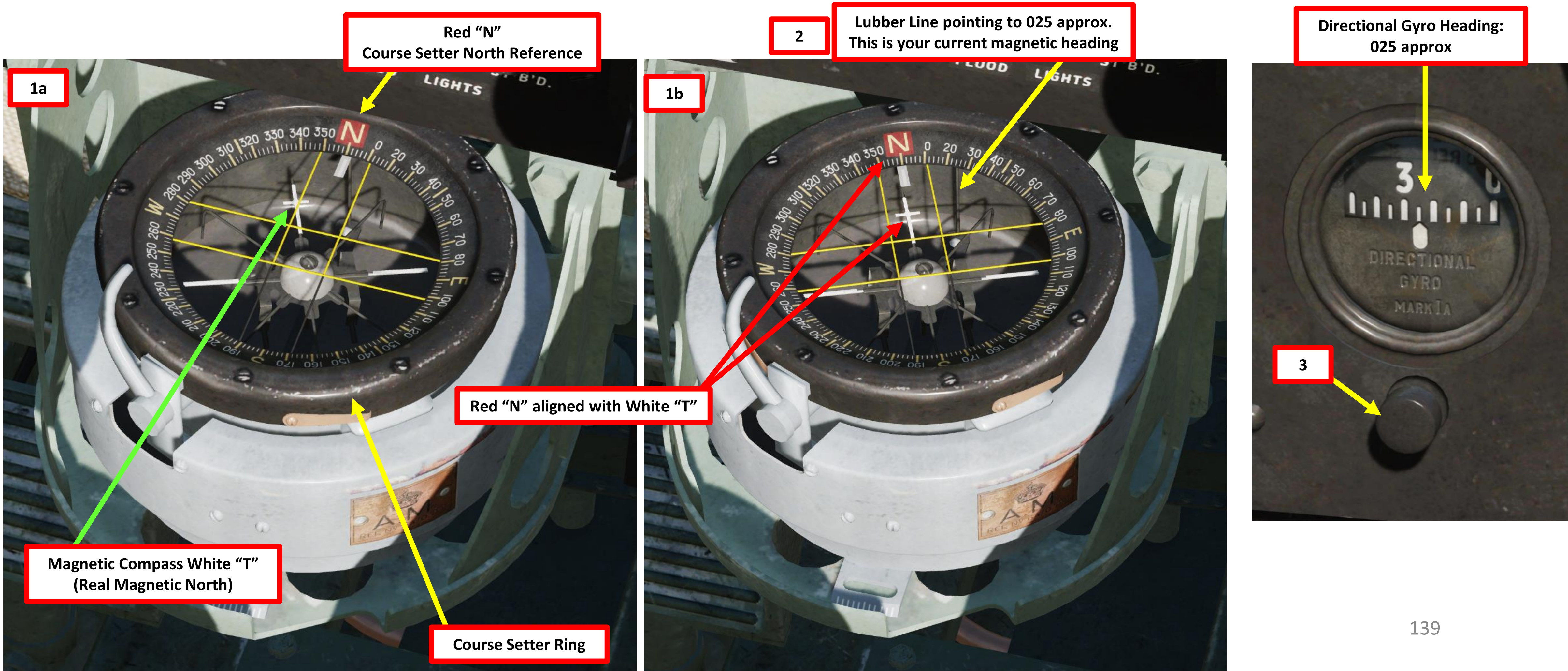
- Dreamsofwings Spitfire P8 Tutorial: https://youtu.be/YdDvh5zPUWI
- RAF Low Flying Navigation: https://youtu.be/NQWZEVaoFKQ



P8 COMPASS TUTORIAL

1. Turn the Course Setter ring of the P8 Magnetic Compass (scroll mousewheel on course setter ring) to align the red “N” (North Reference of the course setter) with the white “T” cross (real magnetic North of the compass).
2. The lubber line will display your current heading.
3. Turn the Directional Gyro adjustment knob to match the heading of the directional gyro with the one shown by the magnetic compass’ lubber line.
4. You may now use the Directional Gyro heading as a reference. You may need to re-align it with the magnetic compass after hard manoeuvers.

Note: High-G manoeuvers can decalibrate your gyro and give you a wrong reading. Be aware that once you start a dogfight, your gyro can give you readings that don’t make sense. It’s normal: it is one of the real-life drawbacks of this navigation system. The same issue is also recurrent in today’s civilian acrobatic prop planes.



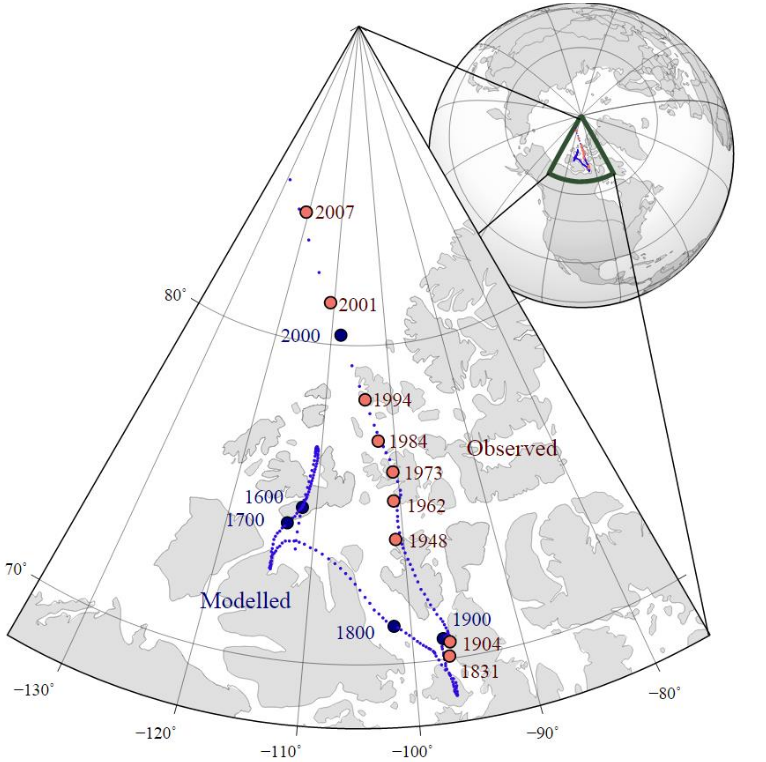
MAGNETIC VARIATION

The direction in which a compass needle points is known as magnetic north. In general, this is not exactly the direction of the North Magnetic Pole (or of any other consistent location). Instead, the compass aligns itself to the local geomagnetic field, which varies in a complex manner over the Earth's surface, as well as over time. The local angular difference between magnetic north and true north is called the magnetic variation. Most **map coordinate** systems are based on **true north**, and magnetic variation is often shown on map legends so that the direction of true north can be determined from north as indicated by a compass. This is the reason why in DCS the course to a runway needs to be "adjusted" to take into account this magnetic variation of the magnetic North pole (actually modelled in the sim, which is pretty neat).

True Heading = Magnetic Heading + Magnetic Variation

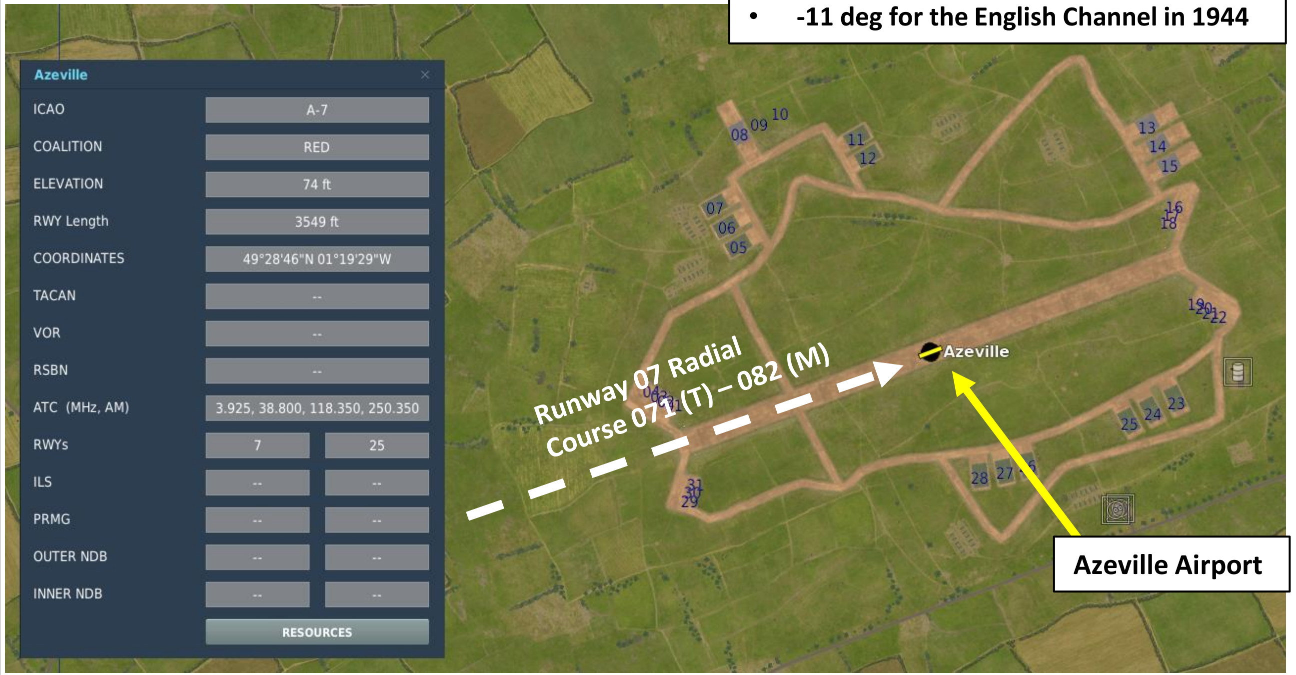
As an example, if the runway heading that you read on the F10 map in Azeville is 071 (True Heading), then the direction you should take with your magnetic compass course should be 071 subtracted with the Magnetic Variation (-11 degrees), or 082. In other words, you would need to use a course of 082 (M) with your compass.

Magnetic variation varies from place to place, but it also changes with time. This means this value will be highly dependent on the mission time and map.

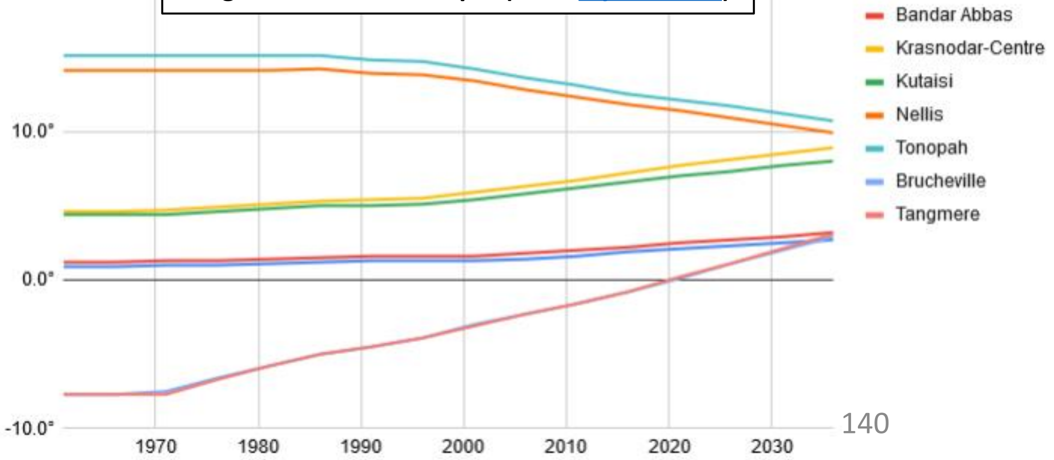


The movement of Earth's north magnetic pole across the Canadian arctic, 1831–2007.

Magnetic Variation:
- **-11 deg for Normandy in 1944**
- **-11 deg for the English Channel in 1944**

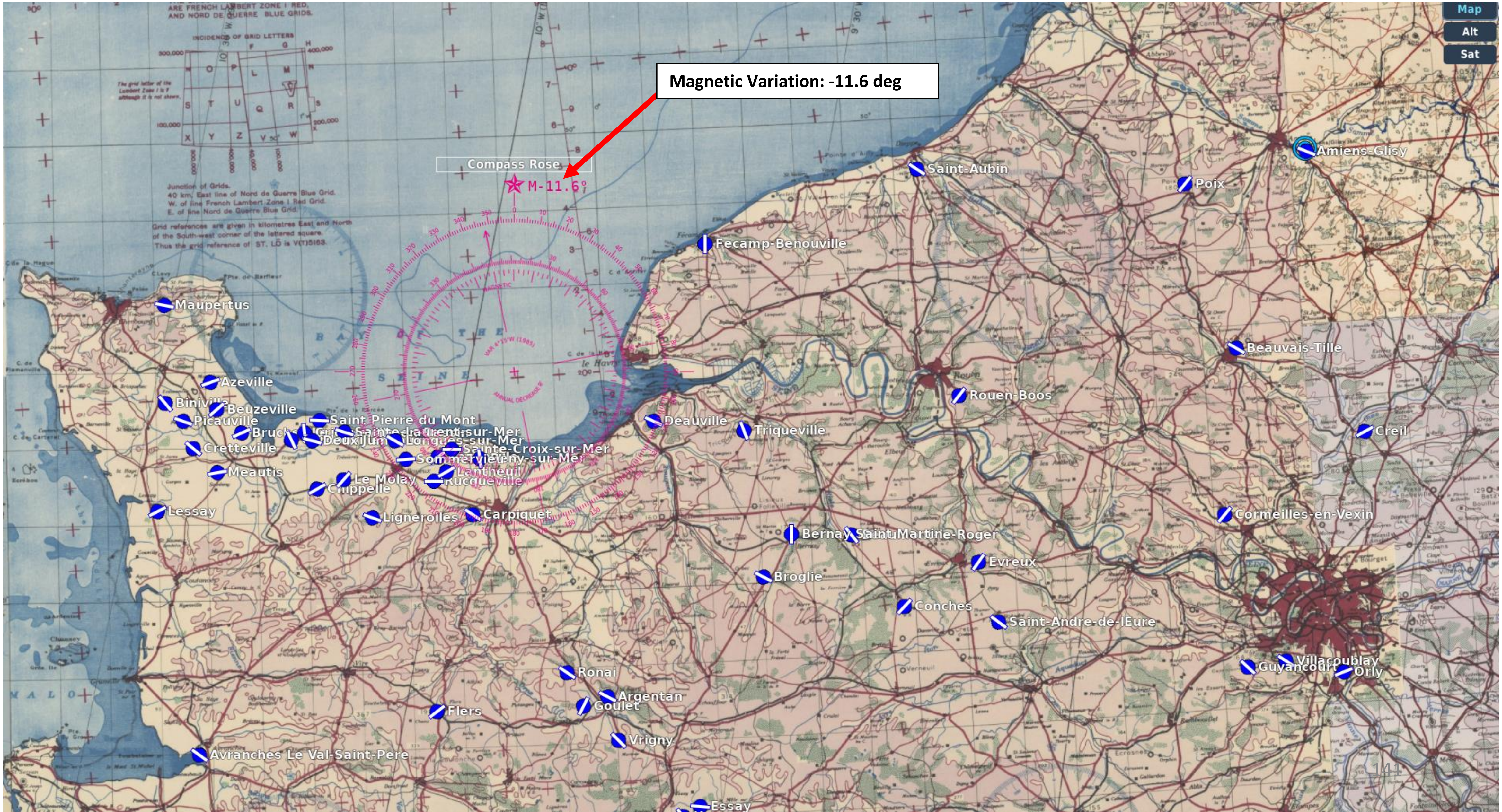


MagVar Evolution Sample (from FlyAndWire)



MAGNETIC VARIATION

Checking the magnetic variation is now very easy: you can access it directly from the F10 map, shown with the Compass Rose.



SPITFIRE MK IX

PART 11 – NAVIGATION

AIRPORT DATA NORMANDY 1944

By Minsky
https://www.digitalcombatsimulator.com/en/files/3312200/

AD Normandy 2.0, Part 1

Average magvar: -9° (1944) / +1° (2023)
The magnetic headings below are valid from 1942 to 1950

DimOn

England

ID	Name / Coordinates	ELEV. FEET / METERS	VHF / UHF	HF / FM		MAG HDG / 3500 ft (1000 m) OR LESS — DOT - PRIMARY / LENGTH, feet / GRASS RWY
71	Biggin Hill N51°19'38/.646 E00°01'57/.954	568 173	134.80 253.45	5.475 41.85	BROKEN SPAWNS	033° ~~XX~~ 4800 ~~XX~~ 213° 053° ~~XX~~ 2500 ~~XX~~ 233° 113° ~~XX~~ 2800 ~~XX~~ 293°
27	Chailey N50°57'08/.149 W00°02'50/.844	95 29	119.15 251.05	4.275 39.50		082° 07 4200 25 262° 161°•15 3500 33•341°
54	Deanland N50°53'03/.059 E00°09'40/.680	72 22	120.60 252.50	5.000 40.95	RWY 34: HUGE BUMP	063° ~~22~~ 3800 ~~34~~ 243°
73	Detling N51°18'20/.346 E00°36'05/.092	593 181	118.45 253.55	5.525 41.95		051° 04 3700 22 231°
52	Farnborough N51°16'43/.722 W00°46'28/.480	246 75	120.50 252.40	4.950 40.85	17 06 28	071° 06 4700 24 251° 116° 10 3000 28 296° 182°•17 4000 35•002°
31	Ford N50°49'05/.085 W00°35'26/.443	29 9	119.40 251.30	4.400 39.75		067° 05 5600 23 247° 153°•14 4500 32•333°
53	Friston N50°45'42/.704 E00°10'17/.289	309 94	120.55 252.45	4.975 40.90		069° 06 3700 24 249°
29	Funtington N50°52'05/.088 W00°52'08/.144	125 38	119.25 251.15	4.325 39.60		095° 08 6700 26 275° 160°•15 5000 33•340°
66	Gravesend N51°25'04/.079 E00°23'48/.802	232 71	121.25 253.15	5.325 41.55	UNEVEN	187° 18 5000 36 007°
50	*Heathrow* N51°28'39/.657 W00°27'12/.216	89 27	CLOSED, NO ATC			098° 12 8700 30 278°
43	Kenley N51°18'14/.240 W00°05'47/.794	561 171	120.05 251.95	4.725 40.40	RWY 30: NO LAND	031° 02 3000 20 211° 131°•~~02~~ 2100 30•311°
37	Lymington N50°45'44/.748 W01°30'51/.863	20 6	119.70 251.60	4.550 40.05		068° 06 4200 24 248° 147°•12 3500 30•327°
74	Lympne N51°04'58/.969 E01°01'10/.178	225 68	NO ATC			028° 02 3500 20 208° 119°•~~07~~ 3000 ~~25~~•290°
72	Manston N51°20'32/.539 E01°20'46/.769	157 48	118.25 253.50	5.500 41.90		060° 05 5000 23 240° 107°•~~XX~~ 8700 ~~XX~~•287°
28	Needs Oar Point N50°46'17/.299 W01°26'04/.071	20 6	119.20 251.10	4.300 39.55		071°•06 4200 24•251° 180° 17 4700 35 000°
39	Odiham N51°14'03/.065 W00°56'30/.504	366 112	119.80 251.70	4.600 40.15		105° 10 5100 28 285°
58	Stoney Cross N50°54'40/.667 W01°39'29/.486	384 117	120.80 252.70	5.100 41.15		073°•06 5800 24•253° 192° 18 4800 36 012°
30	Tangmere N50°50'44/.744 W00°42'06/.113	48 15	119.35 251.25	4.375 39.70		072° 06 5700 24 252° 162°•~~03~~ 4400 ~~21~~•332°
41	West Malling N51°16'13/.221 E00°24'16/.281	305 93	119.95 251.85	4.675 40.30		074° ~~15~~ 5700 ~~33~~ 254°

DEG° MIN'SEC/.DCML

IMPROPERLY NAMED RUNWAYS ARE IN STRIKETHROUGH

Adjust the above magnetic headings when flying in the following years (expect 1-2 degrees of error):
1935-1941 +1° 1951-1959 -1° 1960-1971 -2° 1972-1979 -3° 1980-1985 -4° 1986-1995 -5°
1996-2001 -6° 2002-2009 -7° 2010-2016 -8° 2017-2020 -9° 2021-2026 -10°

AD Normandy 2.0, Part 2

Average magvar: -9° (1944) / +1° (2023)
The magnetic headings below are valid from 1942 to 1950

DimOn

France A—Deauv

ID	Name / Coordinates	ELEV. FEET / METERS	VHF / UHF	HF / FM		MAG HDG / 3500 ft (1000 m) OR LESS — DOT - PRIMARY / LENGTH, feet / GRASS RWY
75	Abbeville Drucat N50°08'16/.274 E01°50'17/.295	217 66	121.55 253.60	5.550 42.00		027° 02 5000 20 207° 093° 09 5000 27 273° 135°•13 5200 31•315°
59	Amiens-Glisy N49°52'17/.290 E02°23'30/.513	216 66	120.85 252.75	5.125 38.40		049° 04 5100 22 229° 120°•11 5100 29•300°
32	Argentan N48°46'07/.126 W00°01'49/.826	640 195	119.45 251.35	4.425 39.80	AERODROME LOCATED IN THE WESTERN CLUSTER	127° 12 3800 30 307°
65	Avranches Le Val-Saint-Pere N48°40'05/.091 W01°22'50/.837	47 14	121.20 253.10	5.300 41.50		137° 13 3800 31 317°
15	Azeville A-7 N49°28'51/.859 W01°19'03/.057	75 23	118.50 250.40	3.950 38.85		080° 07 3600 25 260°
34	Barville N48°28'48/.807 E00°18'50/.837	463 141	119.55 251.45	4.475 39.90		105° 10 4000 28 285° 156°•15 4100 33•336°
20	Bazenville B-2 N49°18'14/.236 W00°33'53/.884	200 61	118.80 250.70	4.100 39.15		063° 05 5400 23 243°
67	Beaumont-le-Roger N49°05'46/.780 E00°47'48/.814	489 149	121.30 253.20	5.350 41.60		060° 04 2900 22 240° 092° 07 2400 25 272° 150°•13 2600 31•330°
44	Beauvais-Tille N49°27'14/.249 E02°06'47/.792	331 101	120.10 252.00	4.750 40.45		046° 04 5500 22 226° 128°•12 5300 30•308°
21	Beny-sur-Mer B-4 N49°17'52/.878 W00°25'35/.597	199 61	118.90 250.80	4.150 39.25		181° 17 4200 35 001°
69	Bernay Saint Martin N49°06'15/.264 E00°35'54/.905	512 156	121.40 253.30	5.400 41.70	MESH ISSUES	189° 18 3500 36 009°
14	Beuzeville A-6 N49°25'13/.231 W01°17'54/.913	114 35	118.40 250.35	3.925 38.80		059° 05 4300 23 239°
10	Biniville A-24 N49°26'12/.202 W01°28'08/.138	107 32	118.15 250.15	3.825 38.60		150° 14 3500 32 330°
68	Broglie N49°00'56/.939 E00°29'55/.932	595 181	121.35 253.25	5.375 41.65		127° 12 3700 30 307°
5	Brucheville A-16 N49°22'06/.111 W01°12'58/.976	46 14	120.90 252.80	5.150 41.20		076° 07 4800 28 256°
19	Carpiquet B-17 N49°10'30/.507 W00°27'16/.268	187 57	118.70 250.60	4.050 39.05		133° 12 5100 30 313°
11	Cardonville A-3 N49°21'03/.060 W01°03'03/.060	102 31	118.20 250.20	3.850 38.65		164° 15 4800 33 344°
13	Chippelle A-5 N49°14'30/.513 W00°58'17/.299	125 38	118.35 250.30	3.900 38.75		070° 06 4900 24 250°
40	Conches N48°56'05/.086 E00°57'40/.676	541 165	119.90 251.80	4.650 40.25		052° 04 5100 22 232°
45	Cormeilles-en-Vexin N49°05'35/.594 E02°02'07/.124	312 95	120.15 252.05	4.775 40.50		048°•04 5300 22•228° 122° 11 5200 29 302°
46	Creil N49°15'12/.208 E02°31'08/.136	269 82	120.20 252.10	4.800 40.55		069°•~~15~~ 7600 ~~33~~•249° 138° 13 4000 31 318°
3	Cretteville A-14 N49°20'11/.194 W01°22'45/.761	95 29	119.85 251.75	4.625 40.20		140° 13 4800 31 320°
7	Cricqueville-en-Bessin A-2 N49°21'52/.872 W01°00'24/.414	81 25	121.70 253.75	5.625 42.15		183° 17 4900 35 003°
62	Deauville N49°21'51/.855 E00°09'26/.434	459 140	121.05 252.95	5.225 41.35	DAMAGED, LANDABLE	125° 12 3500 30 305°

IMPROPERLY NAMED RUNWAYS ARE IN STRIKETHROUGH

Adjust the above magnetic headings when flying in the following years (expect 1-2 degrees of error):
1935-1941 +1° 1951-1959 -1° 1960-1971 -2° 1972-1979 -3° 1980-1985 -4° 1986-1995 -5°
1996-2001 -6° 2002-2009 -7° 2010-2016 -8° 2017-2020 -9° 2021-2026 -10°

AIRPORT DATA NORMANDY 1944

By Minsky
https://www.digitalcombatsimulator.com/en/files/3312200/

AD Normandy 2.0, Part 3

Average magvar: −9° (1944) / +1° (2023)
The magnetic headings below are valid from 1942 to 1950
DimOn

France — Deux–R

ID	Name / Coordinates	ELEV. FEET / METERS	VHF / UHF	HF / FM		MAG HDG / 3500 ft (1000 m) OR LESS; DOT - PRIMARY / LENGTH, feet / GRASS RWY
12	Deux Jumeaux A-4 N49°20'50/.838 W00°58'50/.849	124 38	118.30 250.25	3.875 38.70		115° 10 4800 28 295°
49	Dinan-Trelivan N48°26'36/.602 W02°06'11/.187	377 115	120.35 252.25	4.875 40.70		081° 07 2800 25 261°
35	Essay N48°31'14/.235 E00°15'27/.461	507 155	119.60 251.50	4.500 39.95		104° 09 3500 27 284°
26	Evreux N49°01'25/.426 E01°12'47/.789	423 129	119.10 251.00	4.250 39.45		044°•~~21~~ 4800 ~~35~~•224° 173° 16 5000 34 353°
51	Fecamp-Benouville N49°44'46/.776 E00°21'21/.365	295 90	120.45 252.35	4.925 40.80		189° 18 3600 36 009°
64	Flers N48°44'57/.952 W00°35'44/.737	661 202	121.15 253.05	5.275 41.45	BUMPY, UNEVEN	063° 05 3800 23 243°
33	Goulet N48°44'58/.979 W00°06'41/.688	617 188	119.50 251.40	4.450 39.85		036° ~~21~~ 3700 ~~35~~ 216°
47	Guyancourt N48°45'31/.523 E02°04'47/.794	525 160	120.25 252.15	4.825 40.60		051° 04 2900 22 231° 082° 07 2400 25 262° 142°•13 2600 31•322°
36	Hauterive N48°29'59/.995 E00°12'00/.004	476 145	119.65 251.55	4.525 40.00		151° ~~15~~ 3700 32 331°
25	Lantheuil B-9 N49°16'17/.286 W00°32'18/.304	175 53	119.05 250.95	4.225 39.40		070° 06 3800 24 250°
17	Le Molay A-9 N49°15'41/.691 W00°52'54/.900	105 32	118.60 250.50	4.000 38.95		051° 04 4400 22 231°
8	Lessay A-20 N49°12'05/.096 W01°30'07/.133	66 20	121.75 253.80	5.650 42.20		073°•06 4800 24•253° 134° 12 5800 30 314°
2	Lignerolles A-12 N49°10'30/.513 W00°47'21/.361	405 123	119.30 251.20	4.350 39.65		120° 11 4800 29 300°
18	Longues-sur-Mer B-11 N49°20'34/.573 W00°42'21/.357	225 69	118.65 250.55	4.025 39.00		130° 12 4300 30 310°
48	Lonrai N48°28'03/.060 E00°02'14/.242	515 157	120.30 252.20	4.850 40.65		069° 06 4700 24 249°
4	Maupertus A-15 N49°38'59/.987 W01°28'01/.017	441 134	120.40 252.30	4.900 40.75		111° 10 4800 28 291°
6	Meautis A-17 N49°16'59/.990 W01°18'00/.014	83 25	121.45 253.35	5.425 41.75		090° 08 4400 26 270°
77	Merville Calonne N50°37'13/.233 E02°39'12/.205	131 40	121.65 253.70	5.600 42.10		042° 03 4900 21 222° 082°•~~XX~~ 4900 ~~XX~~•262° 145° 14 5100 32 325°
57	Orly N48°44'06/.108 E02°23'30/.508	272 83	120.75 252.65	5.075 41.10		022° 01 3600 19 202° 076°•07 3600 25•256°
16	Picauville A-8 N49°23'46/.782 W01°24'40/.669	73 22	118.55 250.45	3.975 38.90		120° 11 4400 29 300°
56	Poix N49°49'07/.130 E01°58'38/.636	547 167	120.70 252.60	5.050 41.05		047°•04 5100 22•227° 098° 09 5100 27 278°
60	Ronai N48°49'24/.403 W00°09'40/.673	860 262	120.95 252.85	5.175 41.25		083° 07 4100 25 263° 134°•12 4500 30•314°
61	Rouen-Boos N49°23'13/.232 E01°10'44/.737	493 150	121.00 252.90	5.200 41.30		047° 04 3500 22 227°
23	Rucqueville B-7 N49°15'05/.085 W00°34'49/.819	193 59	118.95 250.85	4.175 39.30		100° 09 4700 27 280°

IMPROPERLY NAMED RUNWAYS ARE IN STRIKETHROUGH

Adjust the above magnetic headings when flying in the following years (expect 1-2 degrees of error):
1935-1941 +1° 1951-1959 -1° 1960-1971 -2° 1972-1979 -3° 1980-1985 -4° 1986-1995 -5°
1996-2001 -6° 2002-2009 -7° 2010-2016 -8° 2017-2020 -9° 2021-2026 -10°

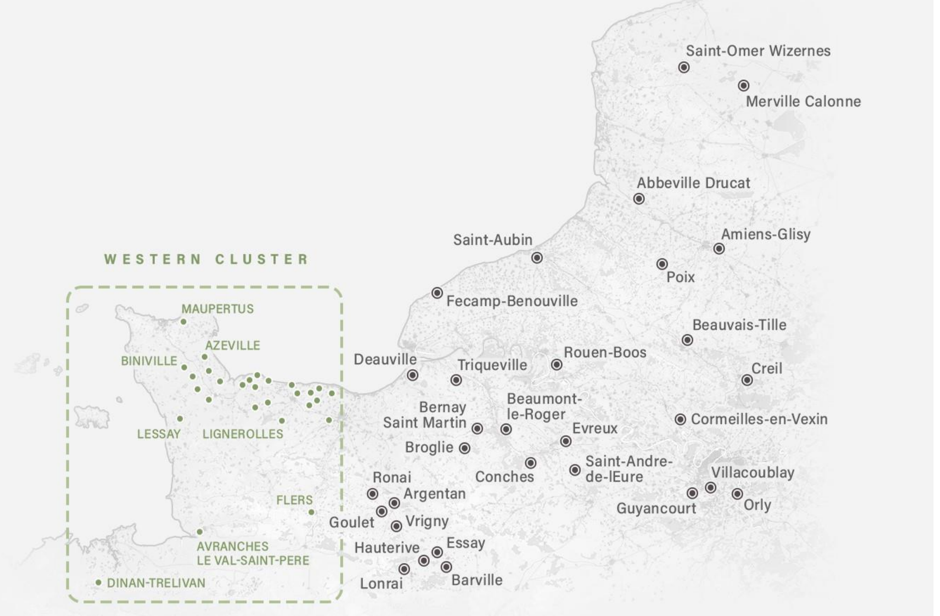
AD Normandy 2.0, Part 4

Average magvar: −9° (1944) / +1° (2023)
The magnetic headings below are valid from 1942 to 1950
DimOn

France — S–V

ID	Name / Coordinates	ELEV. FEET / METERS	VHF / UHF	HF / FM		MAG HDG / 3500 ft (1000 m) OR LESS; DOT - PRIMARY / LENGTH, feet / GRASS RWY
1	Saint Pierre du Mont A-1 N49°23'25/.430 W00°57'25/.425	103 31	118.75 250.65	4.075 39.10		102° 09 4900 27 282°
70	Saint-Andre-de-lEure N48°53'28/.475 E01°16'05/.099	473 144	121.50 253.40	5.450 41.80		058° 05 5000 23 238° 136°•13 5000 31•316°
63	Saint-Aubin N49°53'06/.100 E01°04'/49.825	312 95	121.10 253.00	5.250 41.40	DAMAGED, LANDABLE	133° 12 3500 ~~31~~ 313°
76	Saint-Omer Wizernes N50°43'43/.729 E02°13'55/.932	213 65	121.60 253.65	5.575 42.05		039° 03 1700 21 219° 099°•~~XX~~ 2000 ~~XX~~•279°
21	Sainte-Croix-sur-Mer B-3 N49°19'13/.216 W00°31'02/.035	160 49	118.85 250.75	4.125 39.20		100° 09 4500 27 280°
9	Sainte-Laurent-sur-Mer A-21 N49°21'52/.867 W00°52'24/.409	62 19	121.80 253.85	5.675 42.25		117° 11 4800 29 297°
24	Sommervieu B-8 N49°18'00/.013 W00°40'15/.257	187 57	119.00 250.90	4.200 39.35		096° 09 4500 27 276°
55	Triqueville N49°20'10/.172 E00°27'29/.496	404 123	120.65 252.55	5.025 41.00		168° ~~15~~ 3800 34 348°
42	Villacoublay N48°46'02/.040 E02°12'18/.300	558 170	120.00 251.90	4.700 40.35		131° 12 3900 30 311°
38	Vrigny N48°40'20/.336 W00°00'07/.129	581 180	119.75 251.65	4.575 40.10		145° 14 3800 32 325°

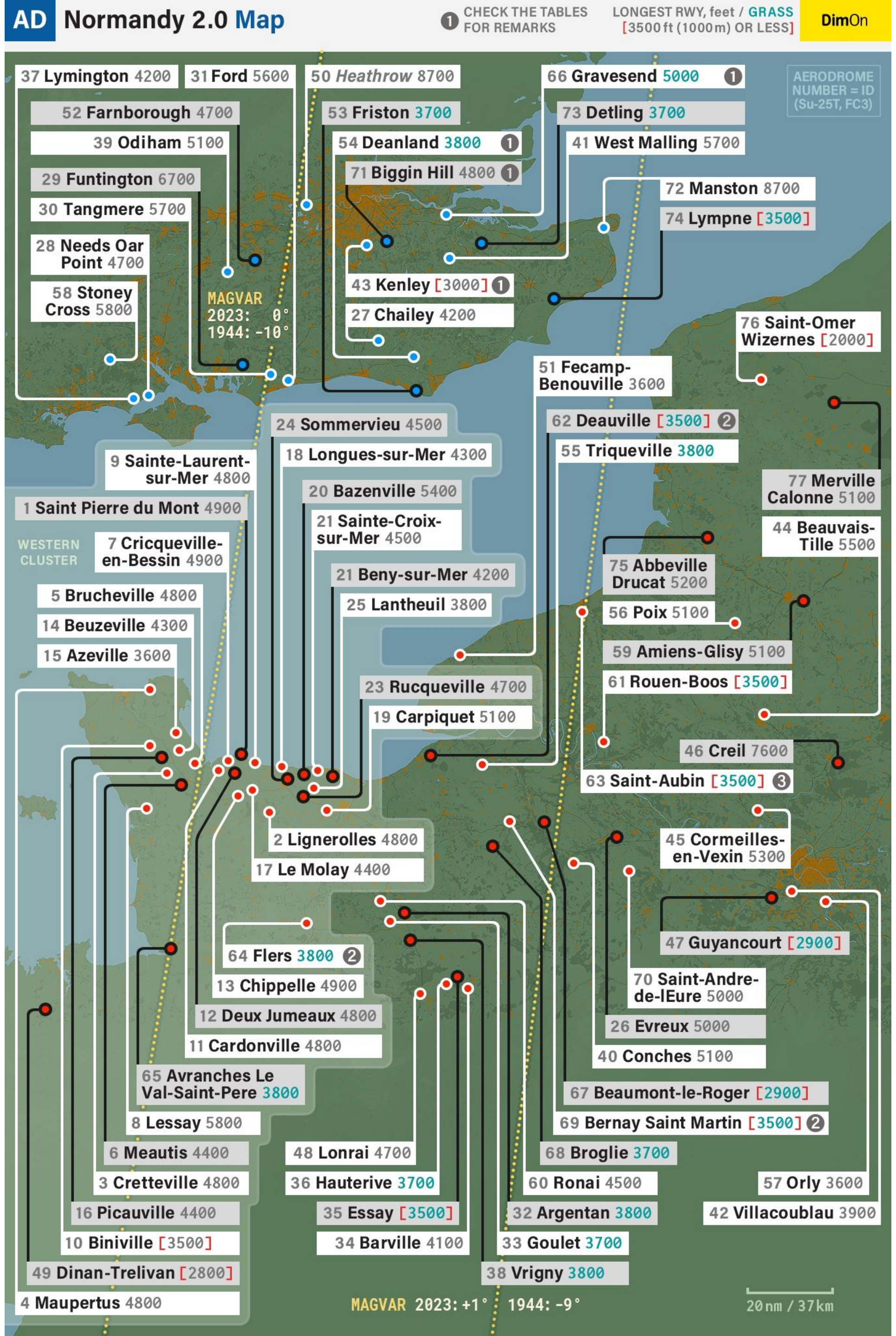
IMPROPERLY NAMED RUNWAYS ARE IN STRIKETHROUGH



Adjust the above magnetic headings when flying in the following years (expect 1-2 degrees of error):
1935-1941 +1° 1951-1959 -1° 1960-1971 -2° 1972-1979 -3° 1980-1985 -4° 1986-1995 -5°
1996-2001 -6° 2002-2009 -7° 2010-2016 -8° 2017-2020 -9° 2021-2026 -10°

AIRPORT DATA NORMANDY 1944

By Minsky
https://www.digitalcombatsimulator.com/en/files/3312200/



AIRPORT DATA ENGLISH CHANNEL 1944

By Minsky
https://www.digitalcombatsimulator.com/en/files/3312200/

AD The Channel

Average magvar: −11° (1944) / +1° (2023)
The magnetic headings below are valid from 1938 to 1950

DimOn

ID	England / DEG° MIN'SEC/.DCML	ELEV. FEET / METERS	VHF / UHF	HF / FM	MAG HDG / 3500 ft (1000 m) OR LESS — DOT - PRIMARY / LENGTH, feet / GRASS RWY
1	**Biggin Hill** N51°19'36/.602 E00°01'51/.866	553 169	118.20 250.20	3.850 38.60	040° 04 4700 22 220° 059°•05 2300 23•239° 119° 12 2500 30 299°
8	**Detling** N51°18'18/.302 E00°35'59/.991	623 190	118.60 250.60	4.050 39.00	058° 05 3700 23 238°
9	**Eastchurch** N51°23'24/.408 E00°50'48/.814	40 13	118.05 250.05	3.775 38.45	034° 02 3100 20 214° 109°•10 3500 28•289°
6	**Hawkinge** N51°06'42/.714 E01°09'36/.615	525 160	118.50 250.50	4.000 38.90	011°•01 2500 19•191° 050° 05 3100 23 230°
11	**Headcorn** N51°10'57/.956 E00°41'22/.369	115 35	118.15 250.15	3.825 38.55	024° 02 3800 20 204° 104°•10 4100 ~~29~~•284°
10	**High Halden** N51°07'17/.298 E00°41'37/.624	105 32	118.10 250.10	3.800 38.50	042° 04 4300 22 222° 113°•11 3900 29•293°
7	**Lympne** N51°04'50/.839 E01°01'01/.022	351 107	118.55 250.55	4.025 38.95	031° 02 2600 20 211° 145°•13 3200 31•325° 169° 16 3500 34 349°
5	**Manston** N51°20'31/.518 E01°20'46/.768	161 50	118.45 250.45	3.975 38.85	067° ~~04~~ 4800 ~~22~~ 247° 113°•10 9000 28•293°
	France				
1	**Abbeville Drucat** N50°08'36/.607 E01°49'55/.916	184 56	118.25 250.25	3.875 38.65	034°•02 5100 20•214° 100° 09 5100 27 280° 142° 13 5100 31 322°
4	**Dunkirk Mardyck** N51°01'46/.777 E02°15'08/.147	16 5	118.40 250.40	3.950 38.80	091° 08 2000 26 271°
2	**Merville Calonne** N50°37'10/.170 E02°38'17/.287	52 16	118.30 250.30	3.900 38.70	048° 04 5100 22 228° 088° 08 5100 26 268° 149°•14 5000 32•329°
3	**Saint Omer Longuenesse** N50°43'43/.721 E02°13'54/.915	220 67	118.35 250.35	3.925 38.75	040° 03 1600 21 220° 097°•08 2000 26•277°

IMPROPERLY NAMED RUNWAYS ARE IN STRIKETHROUGH

Adjust the above magnetic headings when flying in the following years (expect about 1 degree of error):

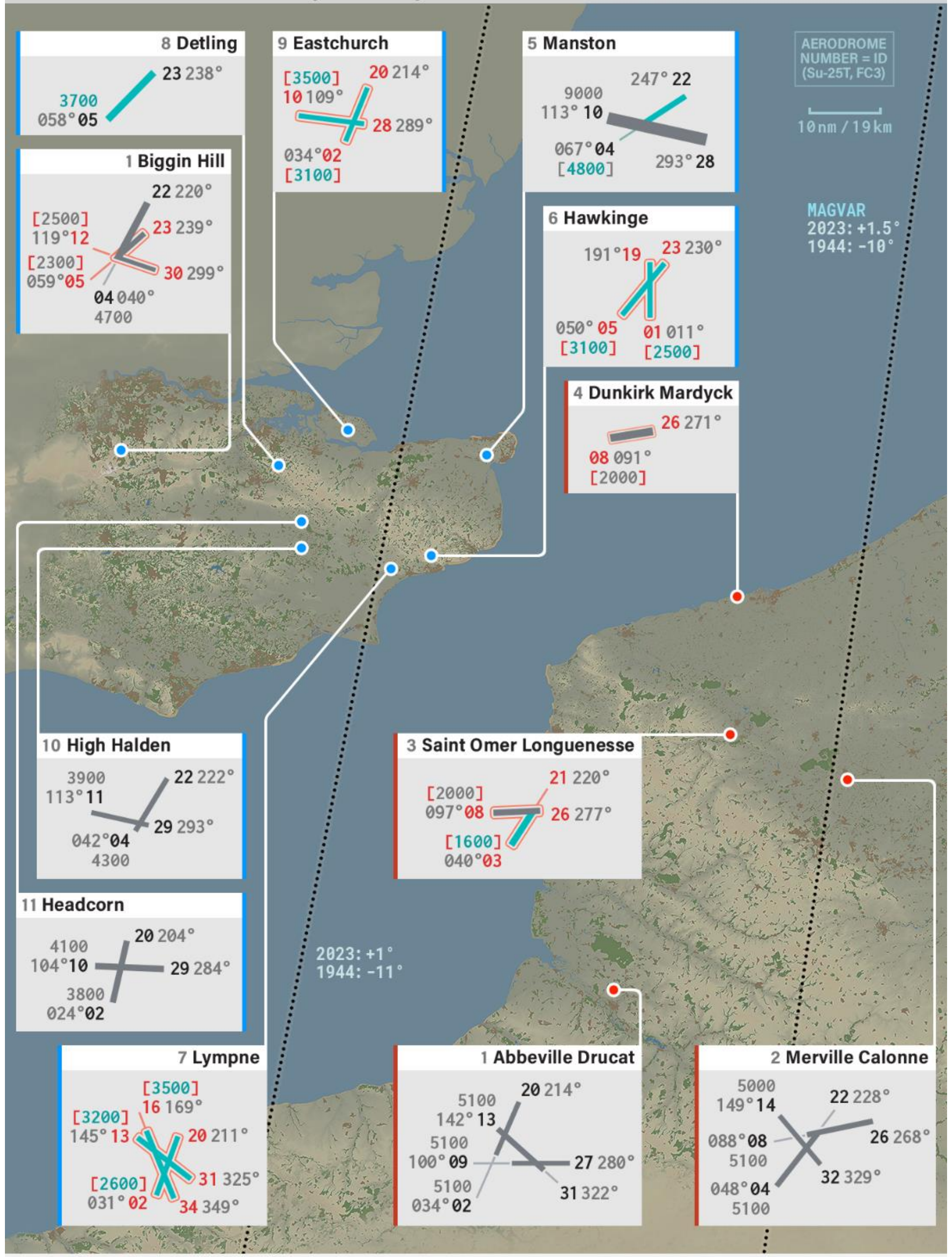
1951-1954 -1°	1955-1961 -2°	1962-1967 -3°	1968-1972 -4°	1973-1979 -5°	1980-1987 -6°
1988-1995 -7°	1996-2001 -8°	2002-2009 -9°	2010-2015 -10°	2016-2021 -11°	2022-2026 -12°

AD The Channel Map

RUNWAY LENGTH, feet / GRASS
[3500 ft (1000 m) OR LESS]

DimOn

The magnetic headings below are valid from 1938 to 1950



Adjust the above magnetic headings when flying in the following years (expect about 1 degree of error):
1951-1954 -1° 1955-1961 -2° 1962-1967 -3° 1968-1972 -4° 1973-1979 -5° 1980-1987 -6°
1988-1995 -7° 1996-2001 -8° 2002-2009 -9° 2010-2015 -10° 2016-2021 -11° 2022-2026 -12°

SPITFIRE VARIANTS

The basic airframe of the Spitfire proved to be extremely adaptable, capable of taking far more powerful engines and far greater loads than its original role as a short-range interceptor had allowed for. This would lead to 24 marks of Spitfire, and many sub-variants within the marks, being produced throughout the Second World War and beyond, in continuing efforts to fulfill Royal Air Force requirements and successfully combat ever-improving enemy aircraft.

The Mk I and Mk II were famous for their role in the Battle of Britain, being qualified as great “turn fighters”. However, these variants suffered from engine cut-out during negative Gs due to the way the carburetor was designed.

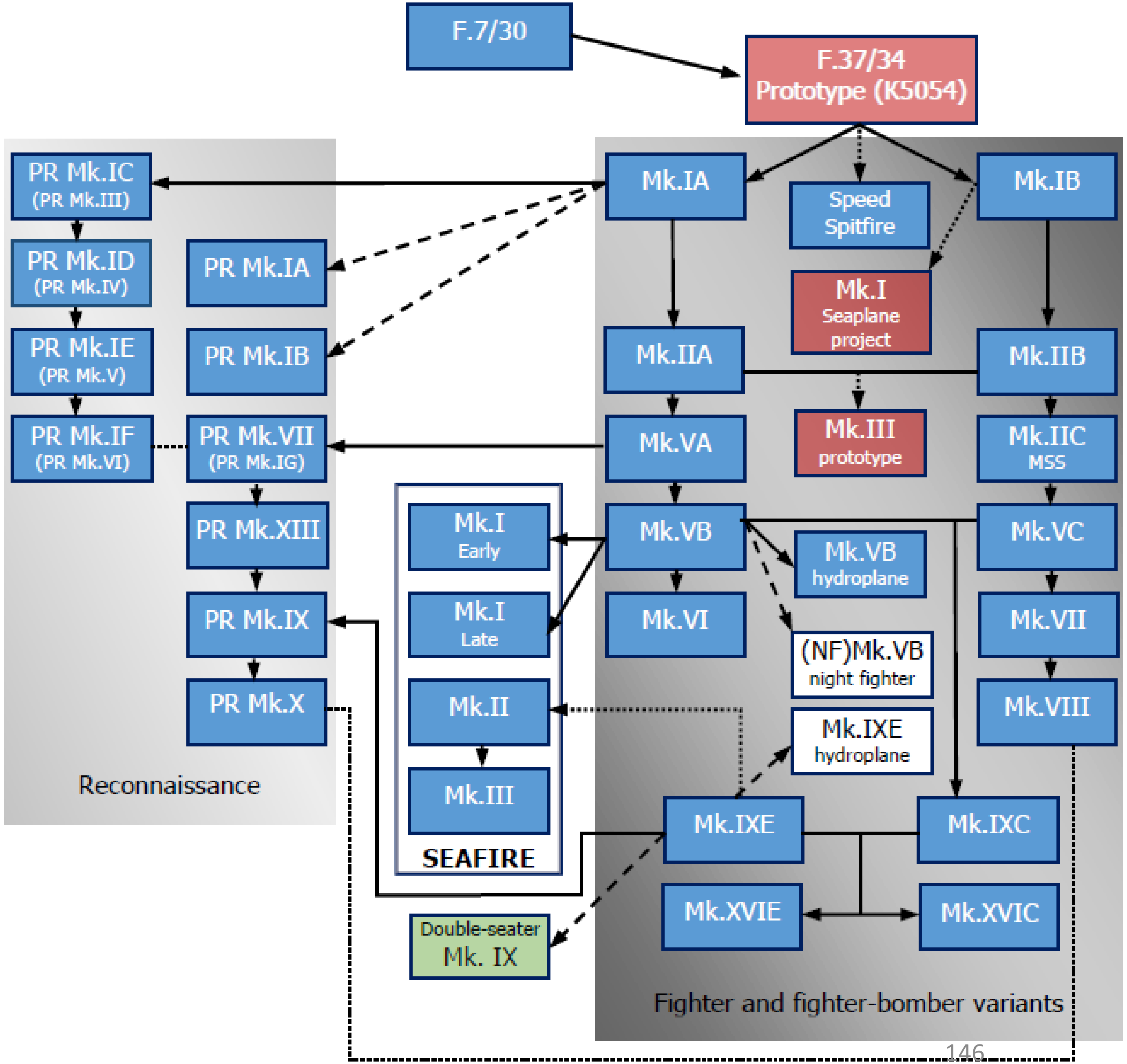
The Mk V followed and eventually added 20 mm Hispano cannons. This variant was widely used in the Mediterranean following the Battle of Britain and retained much of the aerodynamic properties of the early Mk I.

The Focke-Wulf FW190 forced the engineers at Supermarine to rethink the design of the Mk V since this variant was completely outclassed.

There was much pressure to get Spitfires into production using the new two-stage supercharged Merlin 61 engine, which eventually culminated in the creation of the Mk IX as a response to the Butcher Bird. The performance increase was described by Jeffrey Quill (Supermarine test pilot) as a "quantum leap" over that of the Mk VB. The first AFDU (Air Fighting Development Unit) report on the Mk IX in 1942 stated:

“The performance of the Spitfire IX is outstandingly better than the Spitfire V especially at heights above 20,000 feet. On the level the Spitfire is considerably faster and climb is exceptionally good. It will climb easily to 38,000 feet and when levelled off there can be made to climb in stages to above 40,000 feet by building up speed on the level and a slight zoom. Its manoeuvrability is as good as a Spitfire V up to 30,000 feet and above is very much better. At 38,000 feet it is capable of a true speed of 368mph and is still able to manoeuvre well for fighting.”

Although the Mk IX's airframe did not have the aerodynamic and strength improvements, or the modified control surfaces of the Mk VII and VIII, the Mk IX still proved to be an effective counter to the FW190 by 1943, which is the variant we have in DCS.



VARIANT (MARK) NOMENCLATURE – ENGINE RATING

F, LF or HF refer to the **engine rating**

- **F** (Medium Altitude Fighter) refers to the early Spitfire IX model with a Merlin 61 engine in it

- **LF** (Low Altitude Fighter) refers to the slightly later Spitfire IX model with a Merlin 66 engine that was tuned to switch to the second supercharger stage (the Merlin 60 series introduced a two-stage supercharger) at higher altitudes. In the cockpit on the lower right side of the main panel there is a switch and a light that indicate which stage the supercharger is at (its automatically engaging). The red light will appear above 16,000 ft or so. The reason for the LF modification was to match the Spitfire IX's top speed to be better than the FW190A at all altitudes.

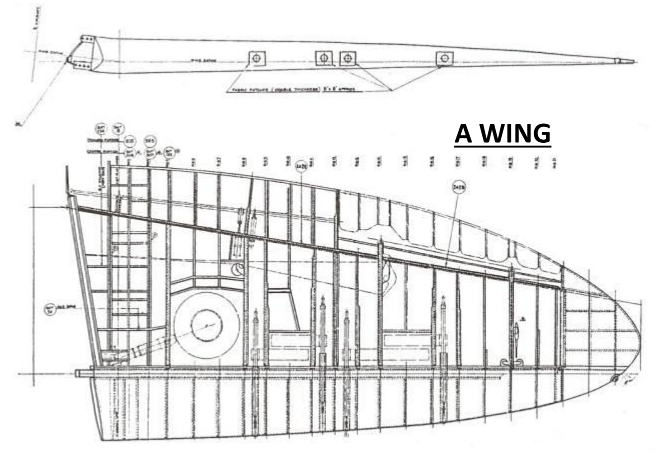
- **HF** (High Altitude Fighter) **r**efers to a very rare Spitfire IX model using a Merlin 70 engine. It is the exact opposite of the Merlin 66, meaning that its supercharger stage kicks in at a much higher altitude. The HF is slower than the LF model until about 24,000 ft where it outperforms it significantly. Most Spitfires employed in high altitude operations were used against high flying German reconnaissance aircraft and thus were not really meant for fighter combat but instead for interceptor operations at higher altitudes.

Note:
- **FR** refers to Fighter Reconnaissance (armed reconnaissance, usually low altitude)
- **PR** refers to Photo Reconnaissance (unarmed reconnaissance, usually high altitude)

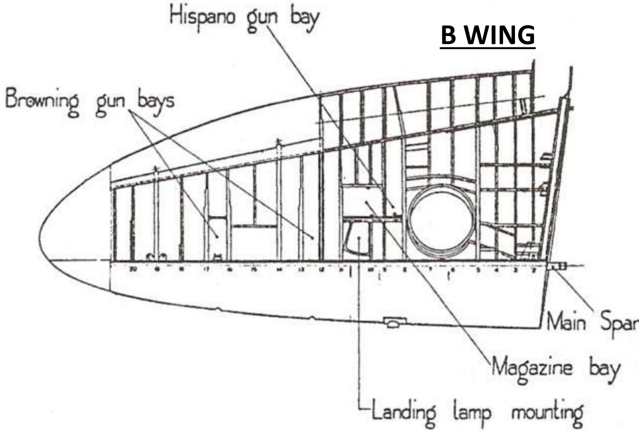
VARIANT (MARK) NOMENCLATURE – WING TYPE

A, B, C, D or E refer to the **wing type**

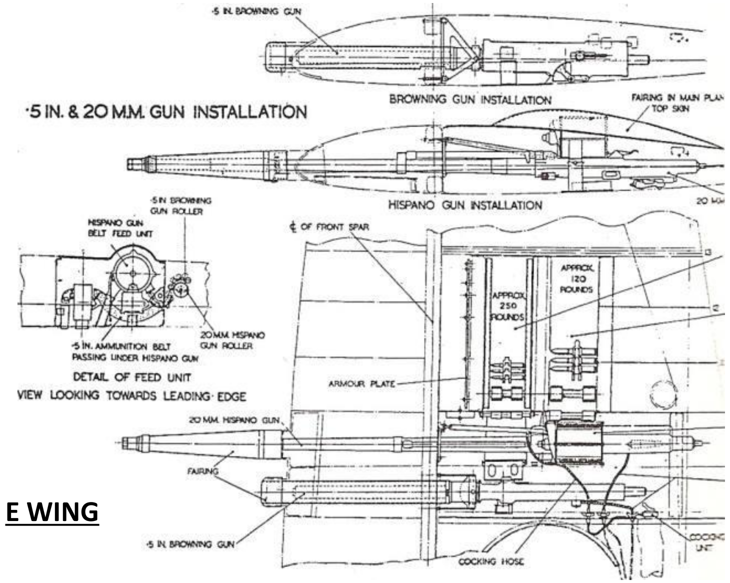
- **A** refers to the original wing design, the basic structure of which was unchanged until the arrival of C type wing in 1942. The only armament able to be carried was eight .303-calibre Browning machine guns with 300 rounds per gun.
    - *Armament: 4x .303 machineguns per wing.*
- **B** refers to the A type wing modified to carry a 20mm Hispano cannon. One type of armament could be fitted, comprising two 20 mm-calibre Hispano Mk II cannon, fed from drum magazines with the capacity of 60 rounds/gun, and four .303 Browning machine guns with 350 rounds per gun.
    - *Armament: 2x .303 machineguns and 1x 20mm cannon per wing.*
- **C** refers to the “universal wing”. This wing was structurally modified to reduce labour and manufacturing time and allow mixed armament options; A or B type armament or a new, yet heavier combination of four 20 mm Hispano cannon.
    - *Armament: 2x .303 machineguns and 1x 20mm cannon per wing OR 2x 20mm cannon per wing.*
- **D** refers to the unarmed long-range wing for reconnaissance versions. Space for substantial amount of additional fuel was provided in the space ahead of the wing spar, which together with the reinforced skin of the wing’s leading edge formed a rigid torsion box.
    - *Armament: None.*
- **E** refers to a structurally unchanged form of the C wing, but the outer machine gun ports were eliminated. Although the outer machine gun bays were retained, their access doors were devoid of empty shell case ports and shell deflectors. The inner gun bays allowed for two weapon fits two 20 mm Hispano Mk II cannon with 120 rounds/gun in the outer bays and two American .50 calibre M2 Browning machine guns, with 250 rounds per gun in the inner bays. Alternatively, four 20 mm Hispano cannon with 120 rounds per gun could be carried as per original C-wing production standard.
    - *Armament: 2 x 20mm cannons OR 1 x 20mm cannon and 2x .50 cal machineguns.*



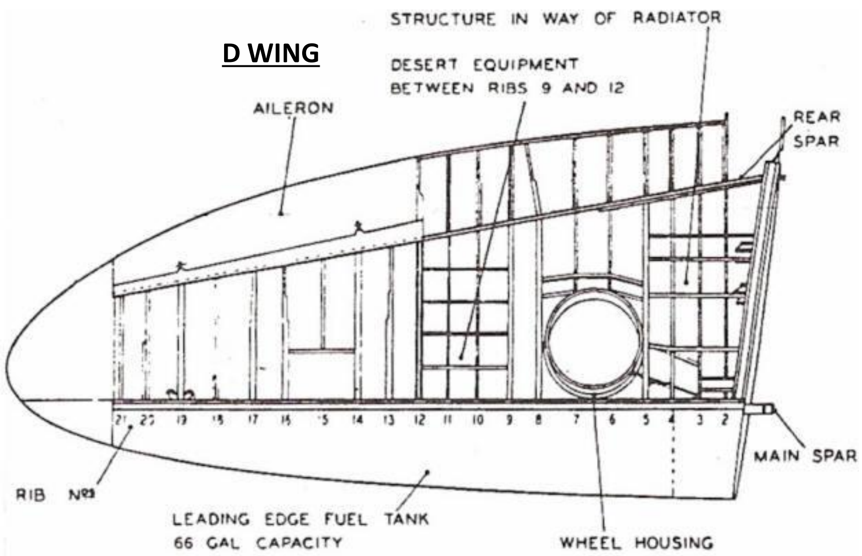
A WING



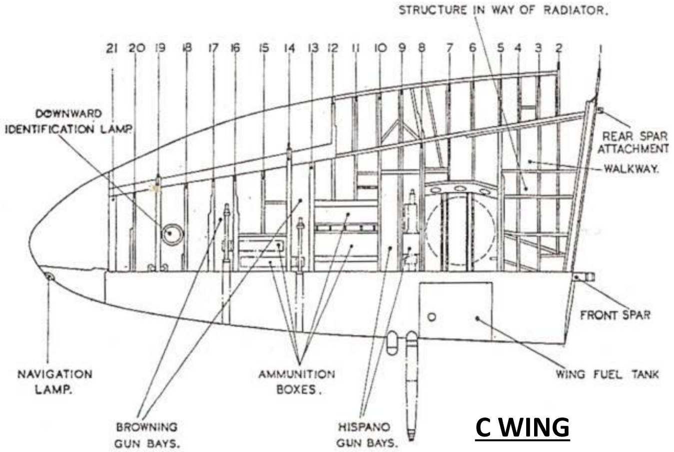
B WING



E WING



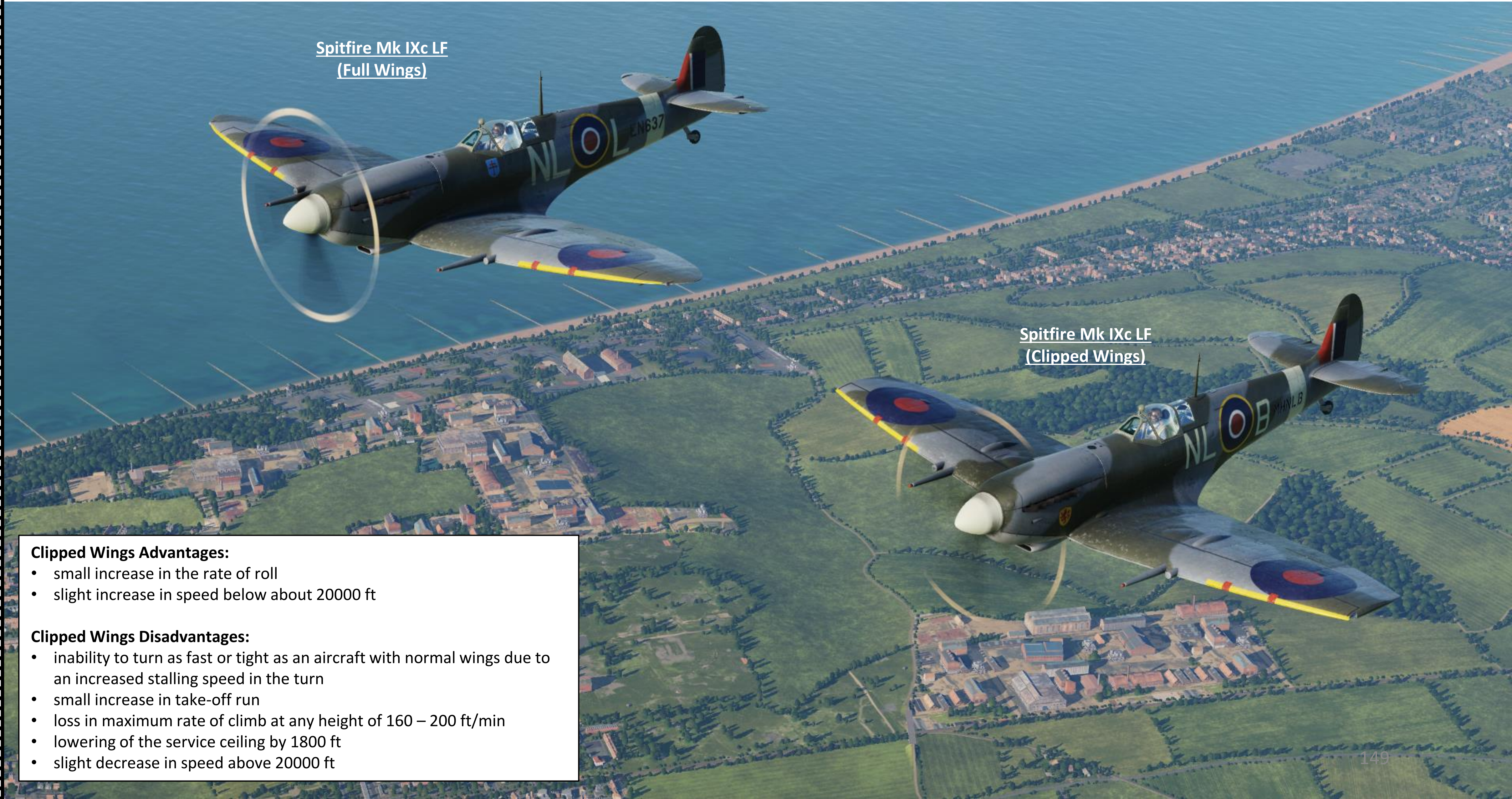
D WING



C WING

AVAILABLE VARIANTS: FULL WING & CLIPPED WING MK IXC

The Spitfire was the result of many design iterations by trial and error. The variants available in DCS are the Mk IXc LF with both a "full wings" and "clipped wings" configurations.



Clipped Wings Advantages:
- small increase in the rate of roll
- slight increase in speed below about 20000 ft

Clipped Wings Disadvantages:
- inability to turn as fast or tight as an aircraft with normal wings due to an increased stalling speed in the turn
- small increase in take-off run
- loss in maximum rate of climb at any height of 160 – 200 ft/min
- lowering of the service ceiling by 1800 ft
- slight decrease in speed above 20000 ft

Dogfighting in the Spitfire is an art that is difficult against a pilot who knows what he is doing.

You may have read countless articles on the Spitfire stating how much of a "turn and burn" fighter it is. The Spitfire's incredible turn rate is useful for defensive fights but tight turns often come at the price of losing valuable energy (airspeed). "Turning and burning" energy may be useful circumstantially, but accepting a defensive fight means that you lose the initiative and needlessly puts you in a vulnerable position. The design philosophy between the Mk I and the Mk IX radically changed: the Mk I was meant to be a superb turner, while the Mk IX was a stopgap measure to counter the FW.190A's vastly superior climb rate. Aircraft design is always a matter of trade-offs: gaining a better climb rate will often come at a cost in terms of turning performance. The Mk IX was such a compromise, meaning that while it could better keep up with the 190s in terms of airspeed and climb rate, it was slowly losing that turning advantage. Most pilots preferred this kind of compromise over the shortcomings of the Mk V that had become obsolete by late 1943.

The best Spitfire pilots used their aircraft offensively by using the combat tactics pioneered by the German *experten* throughout the war. Using "Boom and Zoom" techniques ensure a much higher survivability and offensive capabilities, therefore I recommend that you use your Spitfire as an energy fighter. The Spitfire is best used at altitudes of 25,000 ft and higher. This is where it will have the greatest performance advantage over the Bf.109 and the FW190. However, most dogfights occurring in multiplayer servers happen at lower altitudes between 5,000 and 15,000 ft, which is where the Messerschmitts and Focke-Wulfs will dominate in terms of climb rate and diving speed. Turning tightly will be of no use if you can't catch an opponent that dictates when, where and how fights will occur. If you happen to be forced to fight on the 109's terms down low, you are at a serious disadvantage from the very beginning. Try to avoid that.

During dogfights, I would advise you to keep your energy state (airspeed and altitude) high at all times. These principles apply to every single aircraft, but particularly to the Spitfire. The Spitfire's flaps can be used as an airbrake but are more or less impractical during a dogfight since they are used to slow the Spitfire down to a crawl for landing, which is closer to a death sentence than a proper dogfighting technique.

If you want to survive against experienced Bf.109 or FW.190 pilots, you must:

- Always fly with a wingman
- Always fly with a high energy state (high airspeed and altitude)
- Do not attempt to outclimb or outdive a 109 or 190 unless you have a serious energy advantage
- Bring the fight to high altitudes if you can to fly your plane in the combat environment it was designed for
- Master your aircraft: know your engine limits and airspeed limits by heart and practice manoeuvers to avoid stalls and spins.

Following the end of the Battle of Britain, RAF Fighter Command moved from defensive to offensive operations where they would engage German fighters on the other side of the Channel; the operational instructions were ready by December 1940.

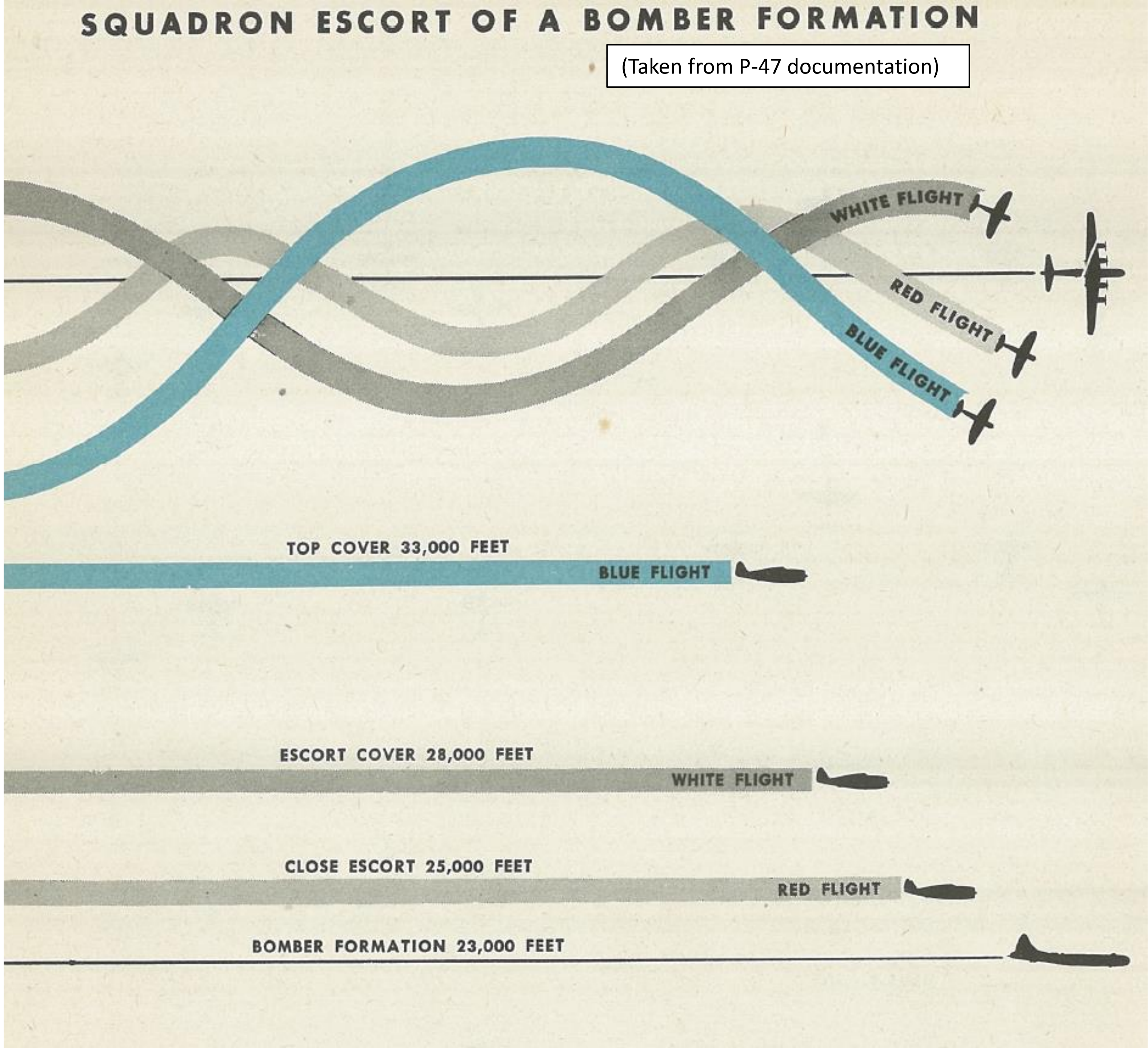
There would be two types of offensive operation:

- "**Rhubarb**" (initially called Mosquito) in which small patrols would cross under cover of cloudy conditions and engage any aircraft they found and on clear weather days
- "**Circus**" which would send several squadrons - possibly with a few bombers - in sweeps of northern France. Circus came to mean an operation with bombers.

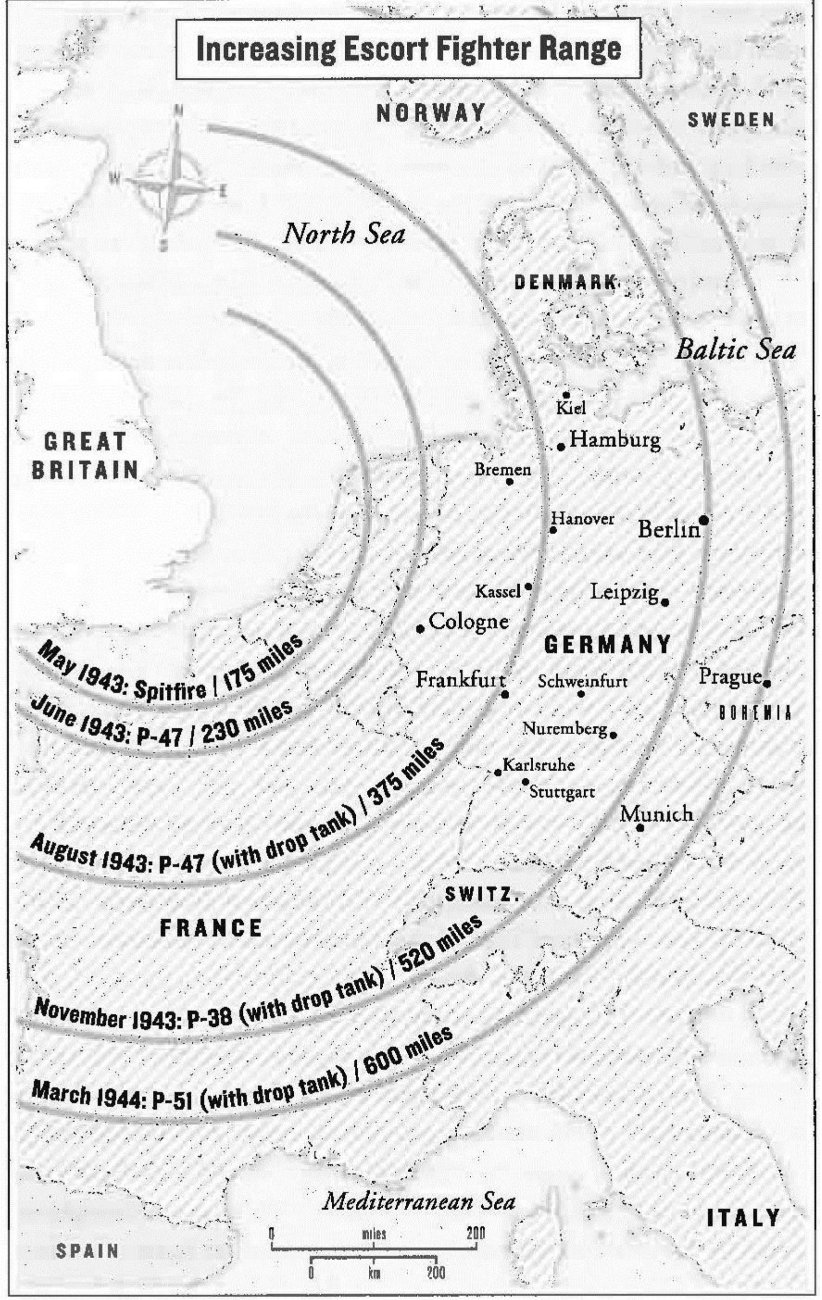
Rhubarb patrols began in December 1940; while the pilots were allowed to attack ground targets if any presented itself their primary objective was to bring down German aircraft. By mid-June 1941, Fighter Command had flown 149 Rhubarb patrols (336 sorties) claiming seven enemy aircraft brought down for loss of eight pilots on the British side. Circus operations with bombers began in January and eleven had been carried out by June, the targets including docks on the French coast and airfields. More than forty sweeps without bombers had been made in the same period.

While Fighter Command's priority was the German fighters, Bomber Command concentrated on destroying the ground targets. At higher level in the RAF it was felt that the effects on the war by damage that could be inflicted by the bombers would be minimal; the commanders of Bomber and Fighter Commands held a conference that agreed that the **purpose of a Circus was to force German fighters into combat in circumstances that favoured the British and to that end the bombers had to do enough damage that the Luftwaffe could not ignore the attacks**.

The Spitfire participated in a significant number of Rhubarb and Circus operations. It also took part in short-range "**Ramrod**" operations, which were similar to Circus but with destroying a target being the principal aim. The Spitfire was primarily a short-range interceptor and ill-suited for long-range bomber escort, but in the scope of DCS it is still a viable role since the target range rarely exceeds 150 nm in the English Channel or Normandy maps. I still suggest you try out some escort missions if you want to experience a very different way to fly in the Spitfire.



(Taken from P-47 documentation)



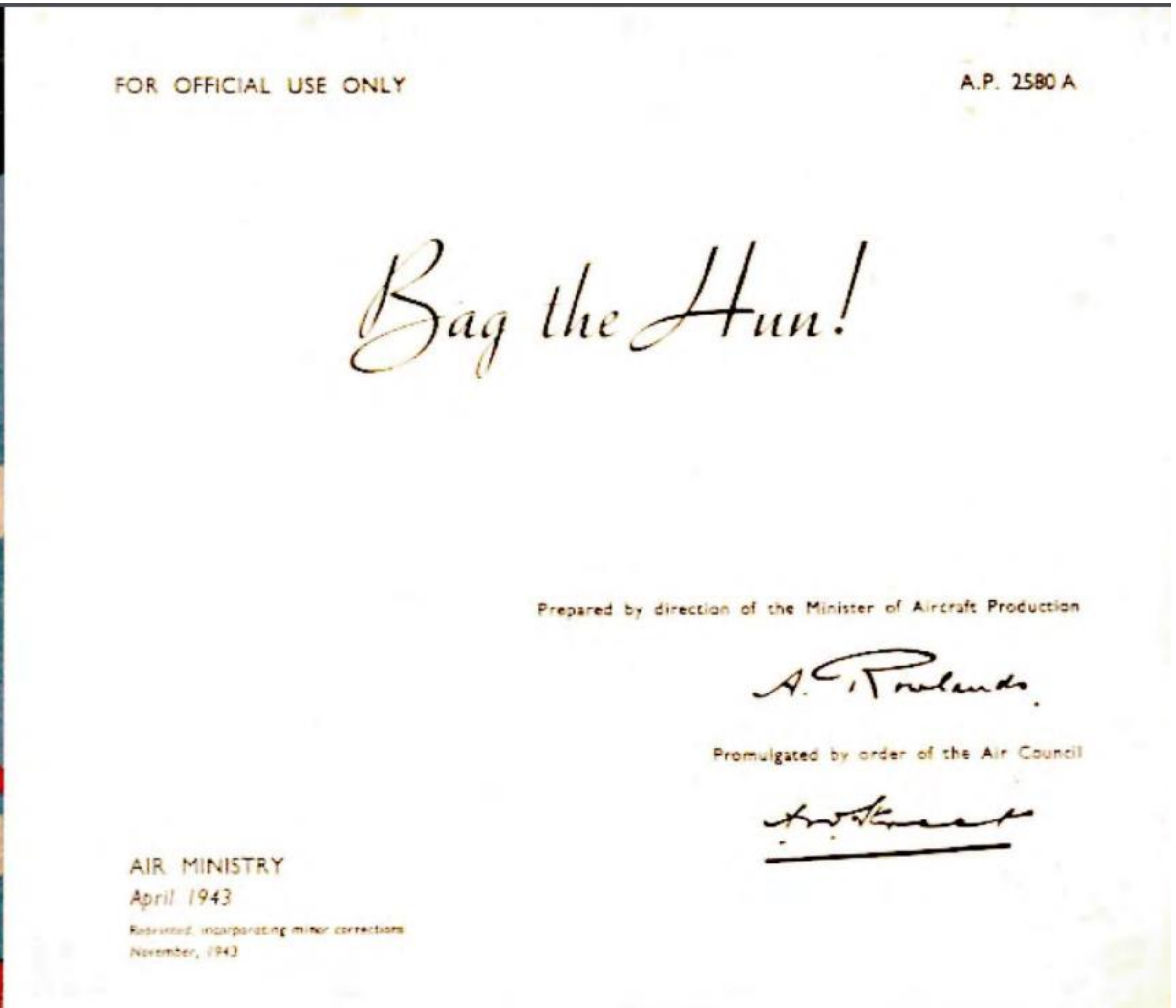
Increasing Escort Fighter Range

Providing long-range fighter escorts in daytime for the American heavy bombers was the critical component in gaining air supremacy between 1943 and 1944.

BAG THE HUN

One of the best resources for "bagging those huns" is actually a document of the same name.

Here is a link to a pdf scan of this manual: https://drive.google.com/open?id=0B-uSpZROuEd3V25mRlE2TDMzcXc


FOR OFFICIAL USE ONLY A.P. 2580 A

Bag the Hun!

Prepared by direction of the Minister of Aircraft Production

Promulgated by order of the Air Council

AIR MINISTRY
April 1943
Reprinted, incorporating minor corrections
November, 1943

Taming taildraggers is much more difficult than meets the eye, especially during the takeoff and landing phase. Here is a useful and insightful essay on the art of flying taildraggers wonderfully written by *Chief Instructor*. I highly recommend you give it a read.

Link: https://drive.google.com/open?id=0B-uSpZROuEd3V3Jkd2pfa0xRRW8

TAMING TAILDRAGGERS

Essay by Chief Instructor (CFI)

PART 1

Why taildraggers are tricky and how to overcome it

What do I know about it? Well, I have spent a significant proportion of my professional flying career teaching both experienced and novice pilots how to fly and handle tail-dragging aircraft. This amounts to several thousand hours of tailwheel training alone, though who's counting! These aircraft include among them modern high performance aerobatic aircraft and a variety of more vintage types from DH Tiger Moths, to Harvards. I can't recall off the top of my head exactly how many students I've worked with over the years, but it's well over 200! Best of all, they have all gone on to fly extensive tailwheel ops in a variety of types and to the best of my knowledge, only 2 of them have crashed anything since!

As a significant number of pilots here are expressing difficulties with tailwheel handling,

USEFUL RESOURCES

Reflected Simulations Spitfire Tutorials (Youtube)

- Start-Up, Takeoff, Combat & Landing: https://youtu.be/7Xpbk-6Fa2U
- RAF Lingo & Codewords Explained: https://youtu.be/S1JItKfoNlg

DCS digital combat series
Chuck_Owl
SPITFIRE
L.F.Mk.IX
MH777
R FN
INSTANT ACTION
CREATE FAST MISSION
MISSION
CAMPAIGN
MULTIPLAYER
LOGBOOK
ENCYCLOPEDIA
TRAINING
REPLAY
MISSION EDITOR
CAMPAIGN BUILDER
EXIT
A-10C 1.5.5
Bf 109 K-4 1.5.5
C-101 1.5.5 Beta
CA 1.5.5
F-5E 1.5.5
F-86F 1.5.5
FC3 1.5.5
Fw 190 D-9 1.5.5
Hawk 1.5.5 Beta
Ka-50 1.5.5
L-39 1.5.5
M-2000C 1.5.5 Beta
MI-8MTV2 1.5.5
MiG-15bis 1.5.5
MiG-21bis 1.5.4
P-40F 1.5.4 Beta
P-51D 1.5.5
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