DCS GUIDE
P-51D MUSTANG

By Chuck

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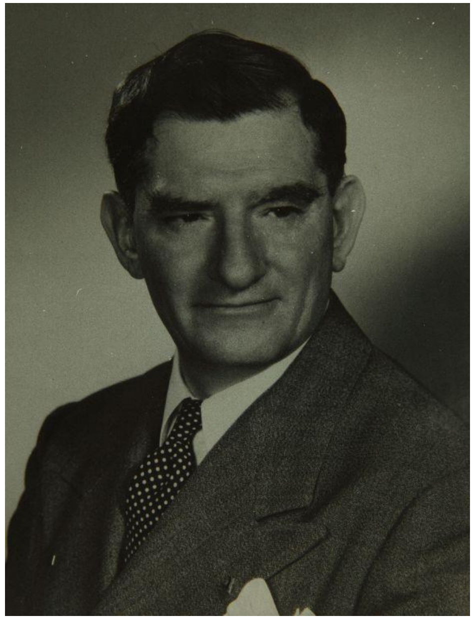
Special thanks to Paul "Goldwolf" Whittingham for creating the guide icons.

The **North American Mustang** is an American long-range, single-seat fighter and fighter-bomber used during World War II, the Korean War and other conflicts. The P-51 was the first aircraft of the war to be built entirely on the basis of combat experience. The Mustang was designed in 1940 by North American Aviation (NAA) in response to a requirement of the British Purchasing Commission. The Purchasing Commission approached North American Aviation to build Curtiss P-40 fighters under license for the Royal Air Force (RAF). Rather than build an old design from another company, North American Aviation proposed the design and production of a more modern fighter. The P-51 Mustang was a solution to the need for an effective bomber escort. It used a common, reliable engine and had internal space for a huge fuel load. With external fuel tanks, it could accompany the bombers from England to Germany and back.

The Mustang, which was designed by a team led by lead engineer Edgar Schmued, followed the best conventional practice of the era, but included several new features. One was a wing designed using laminar flow airfoils which were developed co-operatively by North American Aviation and the National Advisory Committee for Aeronautics (NACA). These airfoils generated very low drag at high speeds. During the development of the NA-73X, a wind tunnel test of two wings, one using NACA 5-digit airfoils and the other using the new NAA/NACA 45–100 airfoils, was performed in the University of Washington Kirsten Wind Tunnel. The results of this test showed the superiority of the wing designed with the NAA/NACA 45–100 airfoils.



Edgar O. Schmued
(1899-1985)

The Mustang was originally designed to use the Allison V-1710 engine, which, in its earlier variants, had limited high-altitude performance. The first operational Mustangs were delivered to the Royal Air Force (RAF) in October of 1941 as Mustang Mark-I's. These aircraft saw their initial action in the summer of 1942. Armed with two .50 caliber and four .30 caliber machine guns and limited in high altitude performance, they were used primarily for reconnaissance and 'rhubarb' missions – for zooming in at low altitudes and strafing trains, troops, and enemy installations. The addition of the Rolls-Royce Merlin to the P-51B/C model transformed the Mustang's performance at altitudes above 15,000 ft, allowing the aircraft to compete with Luftwaffe's fighters.

The definitive version, the P-51D, was powered by the Packard V-1650-7, a license-built version of the Rolls-Royce Merlin 66 two-stage two-speed supercharged engine, and was armed with six .50 caliber (12.7 mm) M2 Browning machine guns. The Packard engine delivers approximately 1490 horsepower at sea level. It has a critical altitude of approximately 14,000 feet in low blower supercharger mode and a critical altitude of approximately 27,000 feet in high blower mode. The maximum altitude is approximately 40,000 feet. The supercharger ratios are approximately 6 to 1 in low blower mode and 8 to 1 in high blower mode.

The P-51D version of the Mustang retained all of the great features of its predecessor, with important added improvements. Chief among these are the increased visibility for the pilot in a new "bubble" canopy, more convenient cockpit arrangement, and heavier firepower. The 'D' also featured a new dorsal fin to improve directional stability problems encountered when the rear fuselage area of the previous models was reduced to increase rear visibility from the cockpit. The fuselage is a semi-monocoque, all-metal structure. The all-metal wings are built in two halves which are joined at the aircraft center line and are of full cantilever structure. The airfoil is of laminar-flow design, which provides low drag even at high speed. The tail section is metal with fabric-covered elevator and rudder control surfaces. The aircraft is flush-riveted throughout – another factor contributing to its great speed. Two fuel tanks with a total capacity of 184 U.S. gallons are located inside the wing and an additional 85 gallon fuselage fuel tank is located aft of the cockpit.

From late 1943, P-51Bs and P-51Cs (supplemented by P-51Ds from mid-1944) were used by the USAAF's Eighth Air Force to escort bombers in raids over Germany, while the RAF's Second Tactical Air Force and the USAAF's Ninth Air Force used the Merlin-powered Mustangs as fighter-bombers, roles in which the Mustang helped ensure Allied air superiority in 1944. The P-51 was also used by Allied air forces in the North African, Mediterranean, Italian and Pacific theaters.

Becoming the definitive model of the Mustang during World War II, over 8,000 P-51D airframes were produced. As the war drew to a close, P-51s were active not only in the European theatre, but also in the Mediterranean and in the Far East, where, like in Europe, the aircraft's long range and superior performance made it the ideal escort for bombers running missions into the heart of Japan.

The Mustang has been flown by many renowned squadrons throughout the war. One of the most famous ones became known as the “Red Tails” of the 332nd Fighter Group. These “Tuskegee Airmen” were not only the first African-American military aviators in the United States, but were also considered to be some of the best pilots in the U.S. Army Air Forces due to a combination of pre-war experience and the personal drive of those accepted for training. During World War II, black Americans in many U.S. states were still subject to the Jim Crow laws and the American military was racially segregated, as was much of the federal government, which made the candidates for the Tuskegee Experiment subject to discrimination, both within and outside the army… despite their stellar track record at escorting bombers over Europe.

In air combat, the top-scoring P-51 units (both of which exclusively flew Mustangs) were the 357th Fighter Group of the 8th Air Force with 565 air-to-air combat victories and the 9th Air Force's 354th Fighter Group with 664, which made it one of the top-scoring fighter groups. The top Mustang ace was the USAAF's George E. “Ratsy” Preddy Jr, whose final tally stood at 26.83 victories (a number that includes shared one half- and one third victory credits), 23 of which were scored with the P-51. Preddy was shot down and killed by friendly fire on Christmas Day 1944 during the Battle of the Bulge.

**Top P-51 Mustang Ace
Major George E. Preddy Jr.**

Tuskegee Airmen

For me, flying the DCS Mustang was love at first sight. I crashed it so many times, seized countless engines, entered too many nasty spins… yet the Mustang truly is the Cadillac of the skies. Its cockpit is well laid out, and proper training will make it a real joy to fly. I learned so much about taildraggers with the Mustang, I cannot recommend this aircraft enough if you are interested in the second world war in the slightest.

The versatility of the P-51 will bring you hundreds of hours of different kinds of missions. Hopefully, you will enjoy it as much as I did since 2012.

WHAT YOU NEED MAPPED

War Emergency Power
(hidden grey button on right hand side)

↑ Trim Elevator DOWN
→ Trim Rudder RIGHT
↓ Trim Elevator UP
← Trim Rudder LEFT

↑ Gunsight Range to Target Decrease
→ Gunsight Target Span Decrease
↓ Gunsight Range to Target Increase
← Gunsight Target Span Increase

Weapon Release Button

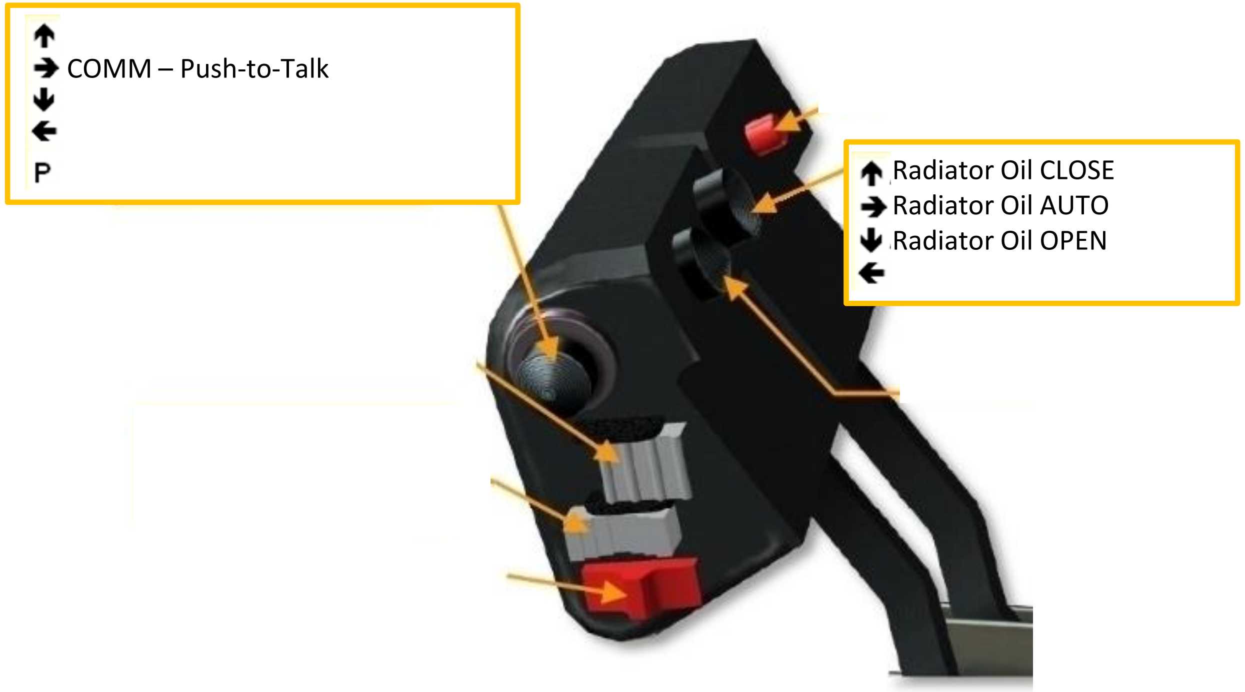
↑ Zoom In Slow
→
↓ Zoom Out Slow
←

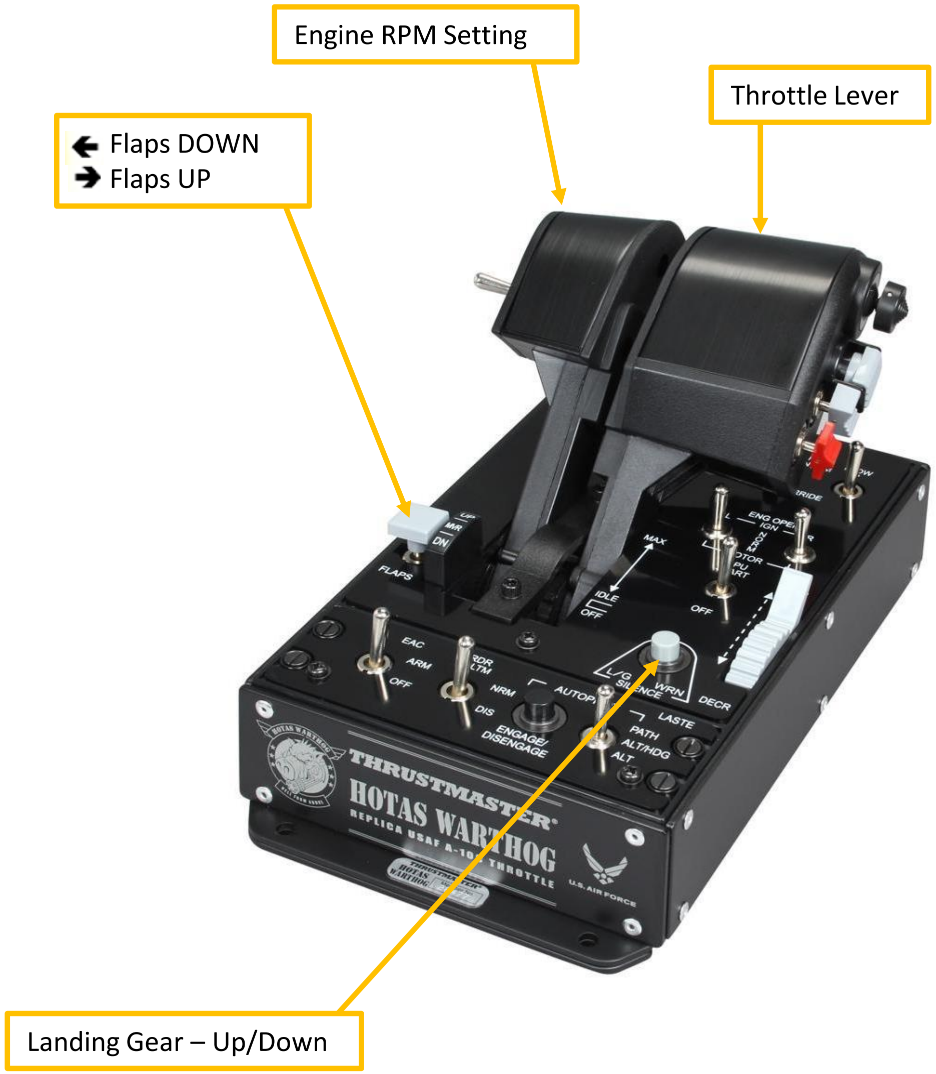
Gun Fire Trigger
(Machineguns)

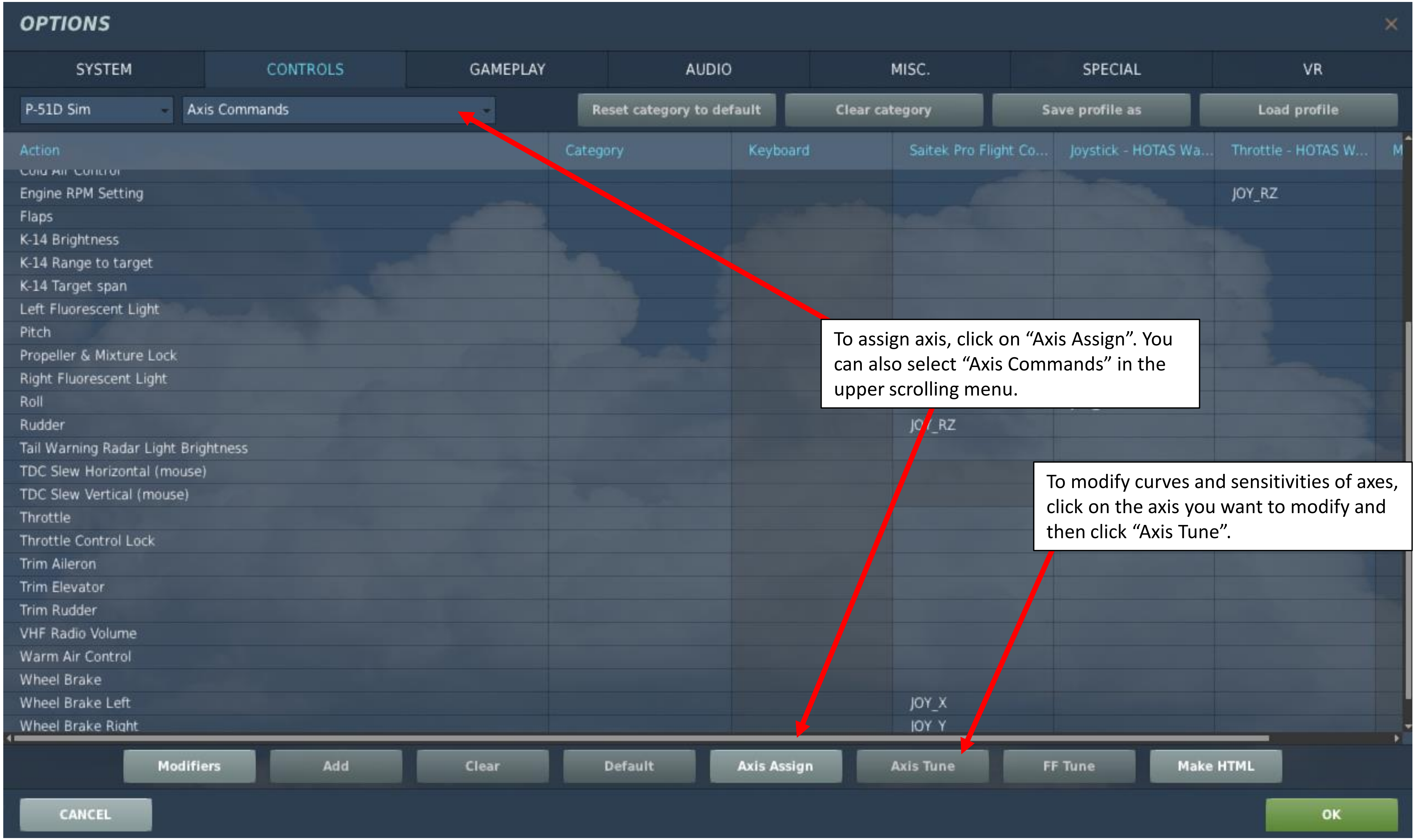
↑ Radiator Coolant Open
→
↓ Radiator Coolant Close
←
P Radiator Coolant Auto

+ TOE BRAKES (MAPPED ON PEDALS)

WHAT YOU NEED MAPPED





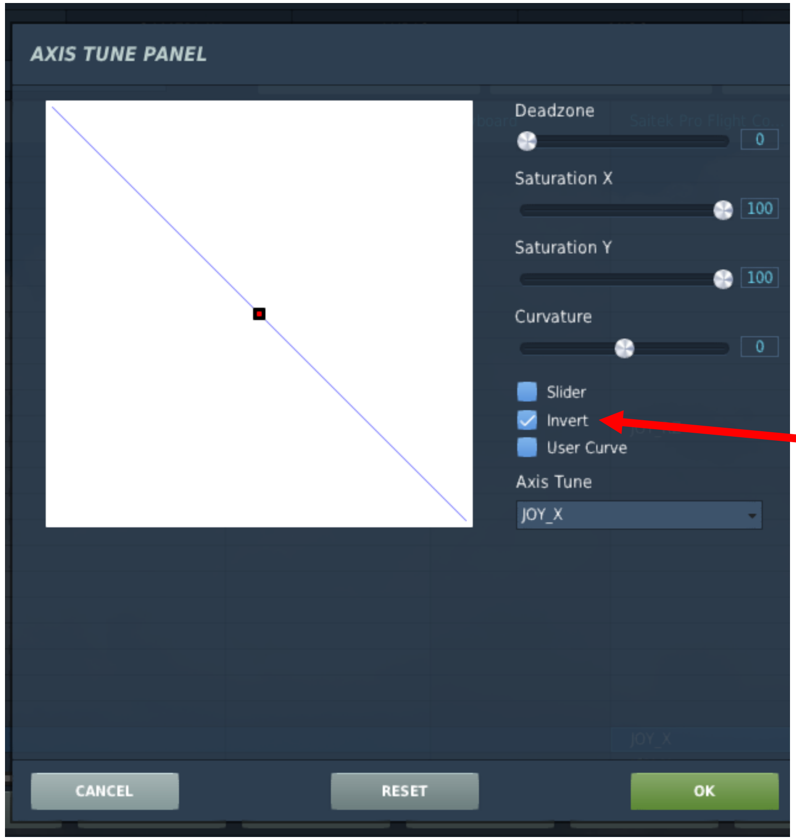


To assign axis, click on “Axis Assign”. You can also select “Axis Commands” in the upper scrolling menu.

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

Bind the following axes:

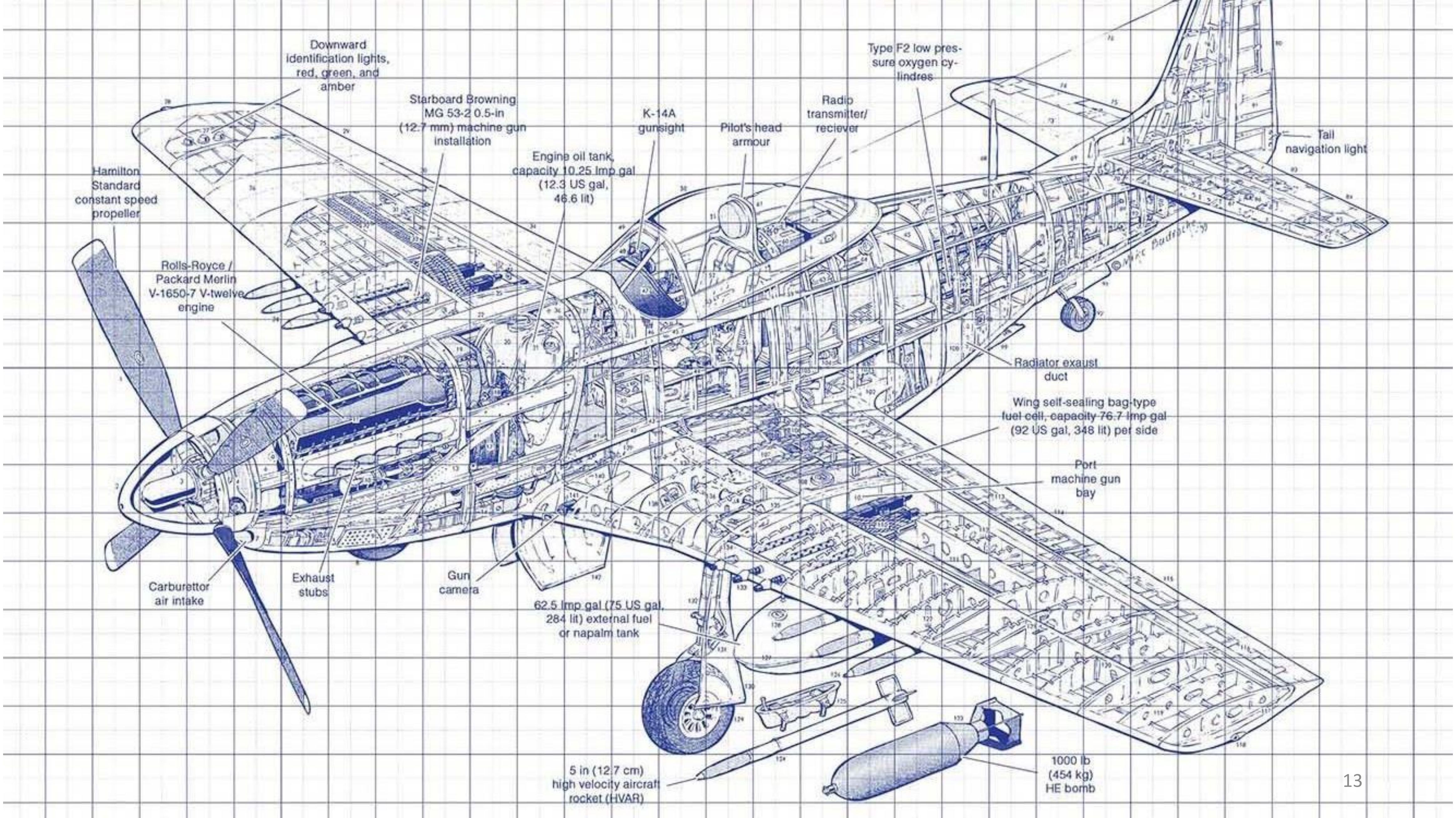
- Pitch, Roll, Rudder (Deadzone at 0, Saturation X at 100, Saturation Y at 100, Curvature at 0)
- Engine RPM Setting – Controls RPM
- Throttle – Controls Manifold Pressure
- Wheel Brake Left
- Wheel Brake Right

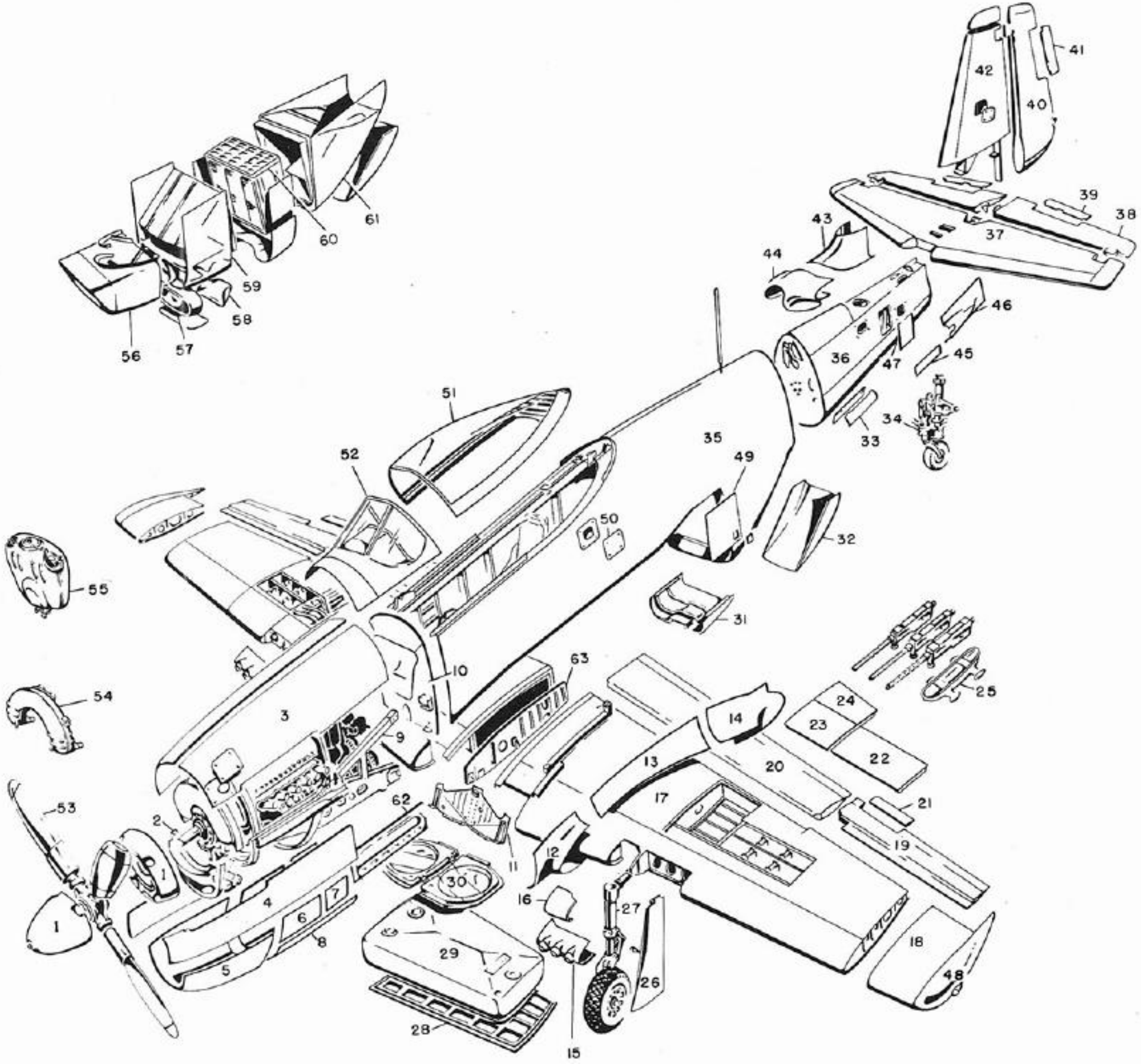


When setting wheel brake axis, they are not set to "INVERT" by default. You need to click on INVERT in the Axis Tune menu for each wheel brake.


NO
HAND HOLD

NORTH AMERICAN P-51D MUSTANG





1. Propeller Spinner
2. Engine Mount Front Flame
3. Engine Top Cowling
4. Engine Intermediate Cowling
5. Engine Bottom Cowl Forward
6. Engine Bottom Cowl Center
7. Engine Bottom Cowl Rear
8. Engine Bottom Cowl Aft
9. Engine Mount Assembly
10. Firewall Assembly
11. Wing Center Bulkhead
12. Wing Fillet Forward
13. Wing Fillet Intermediate
14. Wing Fillet Rear
15. Gun Nose Assembly
16. Landing Gear Access Door
17. Outer Wing Panel
18. Wing Tip Assembly Inner
19. Aileron Assembly
20. Flap Assembly
21. Aileron Trim Tab Assembly
22. Ammunition Bay Door
23. Gun Bay Door Forward
24. Gun Bay Door Rear
25. Wing Bomb Rack
26. Strut Fairing
27. Landing Gear Strut
28. Fuel Tank Door
29. Fuel Cell
30. Wheel Fairing Door
31. Coolant Radiator Access Cover
32. Radiator Air Scoop Rear
33. Tail Wheel Doors
34. Tail Wheel Assembly
35. Fuselage Assembly Front Covered
36. Fuselage Assembly Rear Covered
37. Horizontal Stabilizer
38. Elevator
39. Elevator Trim Tab
40. Rudder
41. Rudder Trim Tab
42. Fin
43. Fin Fillet Forward
44. Empennage Fillet, Forward
45. Empennage Fillet, Lower
46. Stabilizer Fillet Rear
47. Cover Assembly
48. Wing Tip Assembly Outer
49. Cover Assembly
50. Cover Assembly
51. Canopy
52. Windshield Assembly
53. Propeller Blade
54. Cool. Header Tank Complete
55. Oil Tank
56. Radiator Air Scoop Forward
57. Oil Cooler
58. Oil Cooler Outlet Door
59. Radiator Air Duct Forward
60. Radiator Assembly
61. Air Duct Aft
62. Stack Fairing
63. Rib, Wing Center

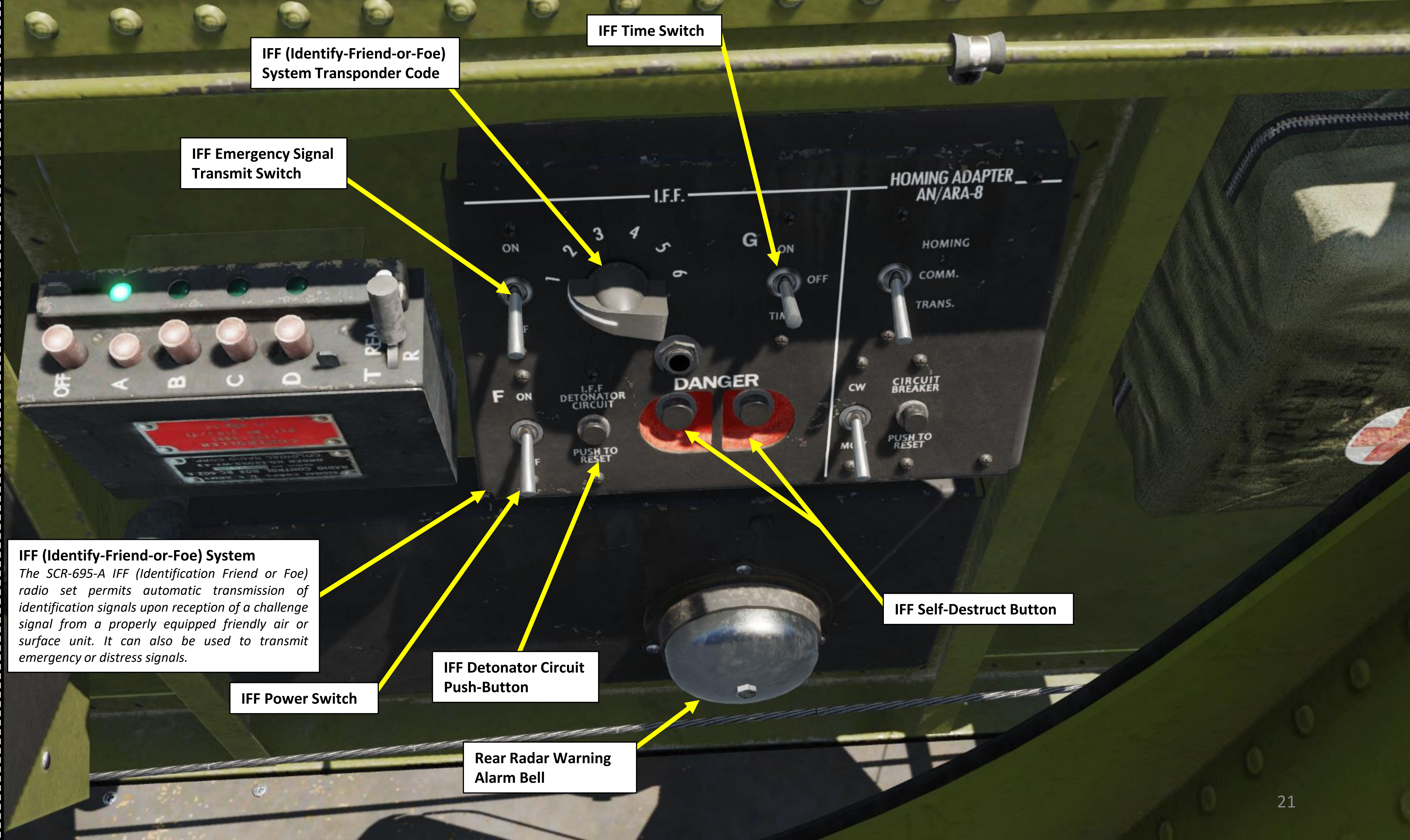
Tip: Pilot body can be toggled ON/OFF with "RSHIFT+P"


HO


THIS IS A MILITARY TYPE AIRCRAFT AND UNDER THE CIVIL AIR REGULATIONS SHALL NOT BE USED FOR THE CARRIAGE OF PASSENGERS OR CARGO FOR COMPENSATION OR HIRE
ENGINE LIMITATIONS
TAKE-OFF CONDITIONS
U.S. ARMY AIR CORPS
BLINKER
OXYGEN FLOW INDICATOR
AN/APS-13

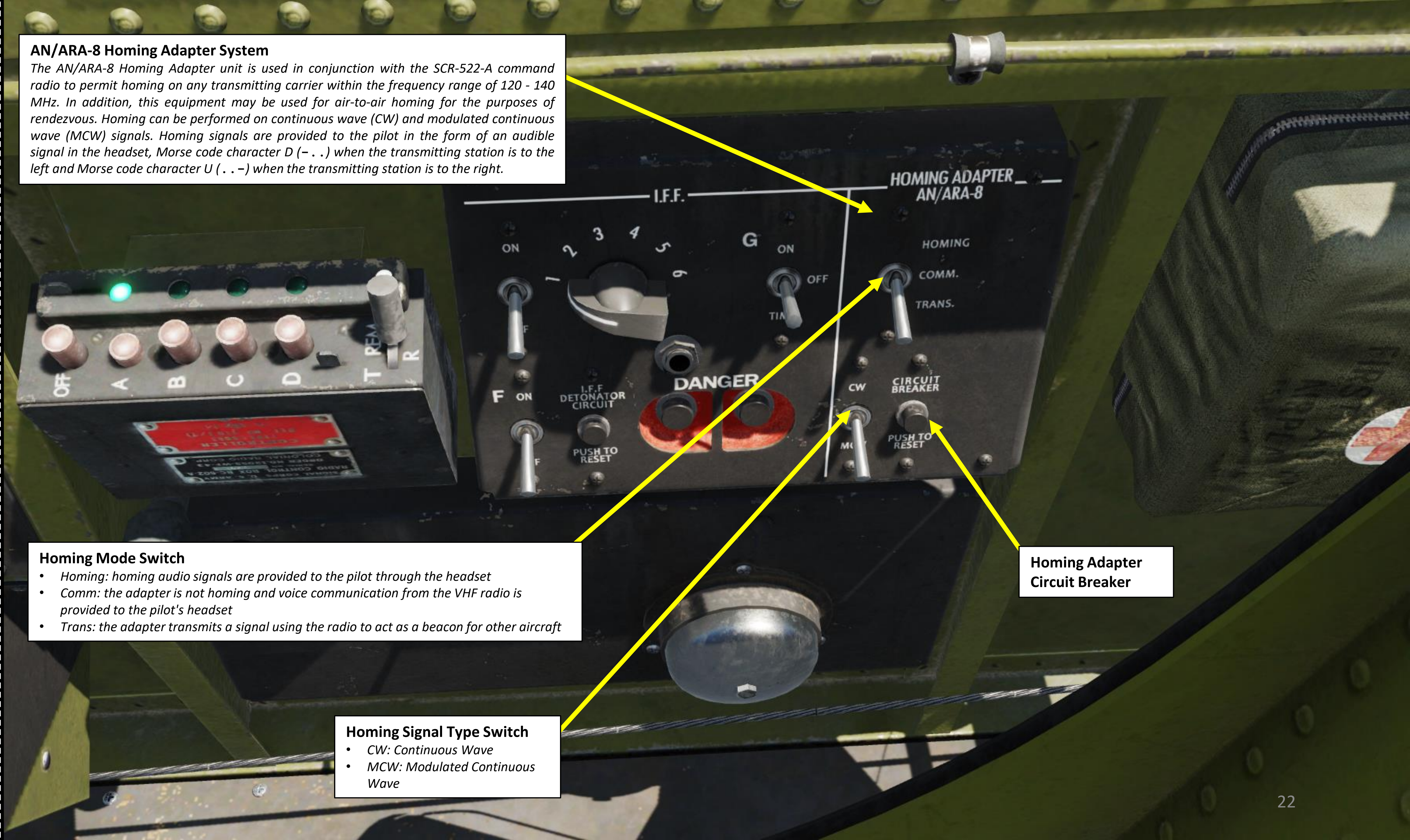

Medical Pack
ENGINE LIMITATIONS
PACKARD V 1650-7
FUEL: 100 OCT.
TAKE OFF CONDITIONS
THIS IS A MILITARY TYPE AIRCRAFT AND UNDER THE CIVIL AIR REGULATIONS SHALL NOT BE USED FOR THE CARRIAGE OF PASSENGERS OR CARGO FOR COMPENSATION OR HIRE
U.S.ARMY AIR CORPS
HOMING ADAPTER AN/ARA-8
I.F.F.
DANGER


IFF (Identify-Friend-or-Foe) System
(Not Functional)
Radio System
Homing Adapter System
(Not Functional)
Detrola Radio Range Receiver
(Not Functional)



IFF (Identify-Friend-or-Foe) System

The SCR-695-A IFF (Identification Friend or Foe) radio set permits automatic transmission of identification signals upon reception of a challenge signal from a properly equipped friendly air or surface unit. It can also be used to transmit emergency or distress signals.



AN/ARA-8 Homing Adapter System

The AN/ARA-8 Homing Adapter unit is used in conjunction with the SCR-522-A command radio to permit homing on any transmitting carrier within the frequency range of 120 - 140 MHz. In addition, this equipment may be used for air-to-air homing for the purposes of rendezvous. Homing can be performed on continuous wave (CW) and modulated continuous wave (MCW) signals. Homing signals are provided to the pilot in the form of an audible signal in the headset, Morse code character D (– . .) when the transmitting station is to the left and Morse code character U (. . –) when the transmitting station is to the right.

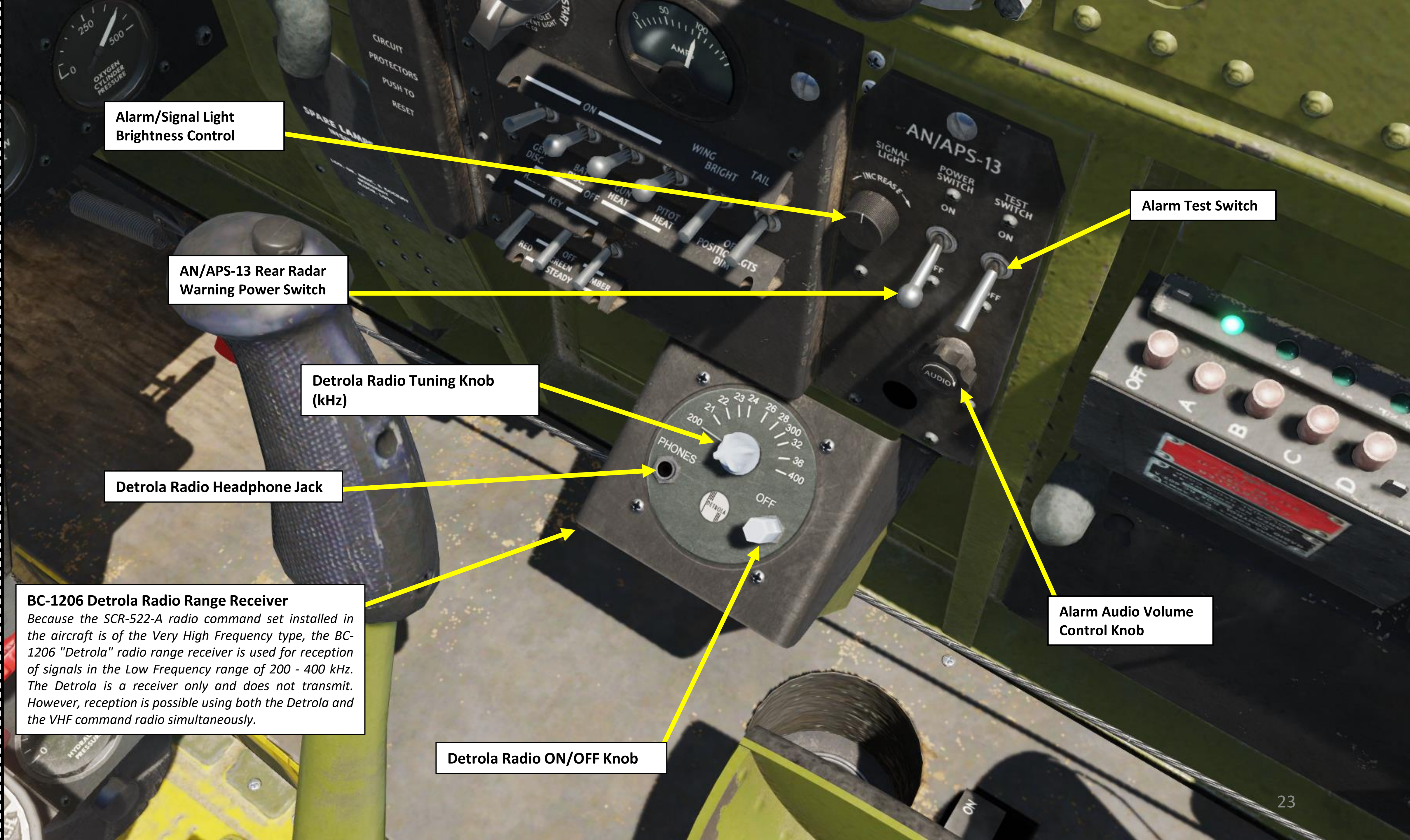
Homing Mode Switch

- *Homing: homing audio signals are provided to the pilot through the headset*
- *Comm: the adapter is not homing and voice communication from the VHF radio is provided to the pilot's headset*
- *Trans: the adapter transmits a signal using the radio to act as a beacon for other aircraft*

Homing Adapter Circuit Breaker

Homing Signal Type Switch

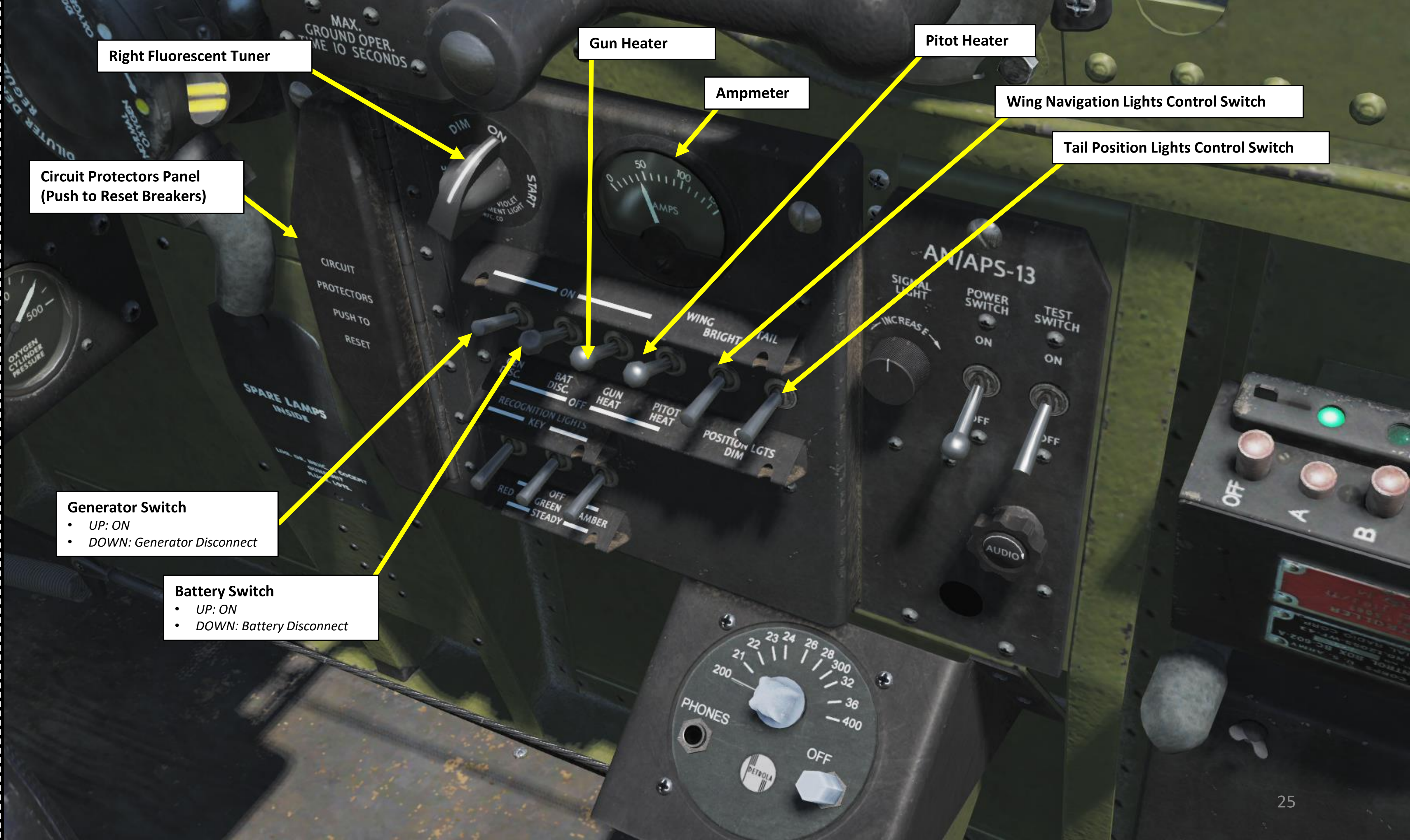
- *CW: Continuous Wave*
- *MCW: Modulated Continuous Wave*



BC-1206 Detrola Radio Range Receiver

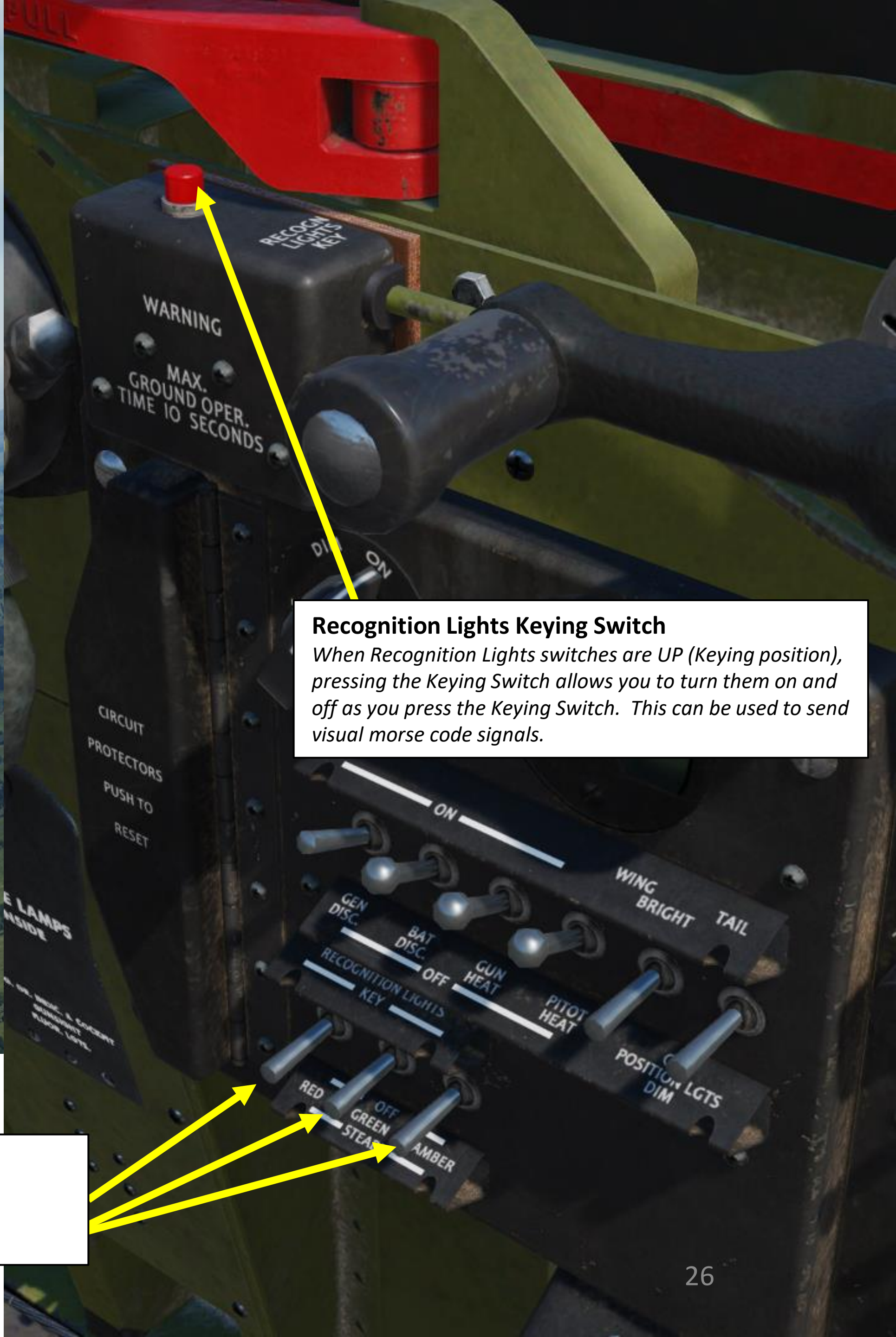
Because the SCR-522-A radio command set installed in the aircraft is of the Very High Frequency type, the BC-1206 "Detrola" radio range receiver is used for reception of signals in the Low Frequency range of 200 - 400 kHz. The Detrola is a receiver only and does not transmit. However, reception is possible using both the Detrola and the VHF command radio simultaneously.


Canopy Handle
RELEASE UNLOCKED IF RED INDICATOR SHOWS.
THIS IS A MILITARY TYPE AIRCRAFT AND UNDER THE CIVIL AIR REGULATIONS SHALL NOT BE USED FOR THE CARRIAGE OF PASSENGERS OR CARGO FOR COMPENSATION OR HIRE
ENGINE LIMITATIONS
PACKARD V 1650-7
FUEL: 100 OCT.
TAKE OFF CONDITIONS
AN/APS-13
I.F.F.
DANGER
HOMING ADAPTER AN/ARA-8
HOMING
COMM.
TRANS.
CIRCUIT BREAKER
PUSH TO RESET
PHONES
OFF


Right Fluorescent Tuner
Gun Heater
Pitot Heater
Ampmeter
Wing Navigation Lights Control Switch
Tail Position Lights Control Switch
Circuit Protectors Panel (Push to Reset Breakers)
Generator Switch
• UP: ON
• DOWN: Generator Disconnect
Battery Switch
• UP: ON
• DOWN: Battery Disconnect
MAX. GROUND OPER. TIME 10 SECONDS
DIM
ON
START
CIRCUIT PROTECTORS PUSH TO RESET
SPARE LAMPS INSIDE
AMPS
WING
BRIGHT
TAIL
BAT DISC.
GUN HEAT
PITOT HEAT
OFF
POSITION LGTS
DIM
RECOGNITION LIGHTS
KEY
RED
GREEN
STEADY
AMBER
AN/APS-13
POWER SWITCH
TEST SWITCH
ON
INCREASE
AUDIO
PHONES
OFF
OXYGEN CYLINDER PRESSURE
A
B

Red, Green & Amber Recognition Lights

NOTE:
Do not operate the recognition lights for over 10 seconds continuously on the ground. This may result in melting the plastic lens due to heat.



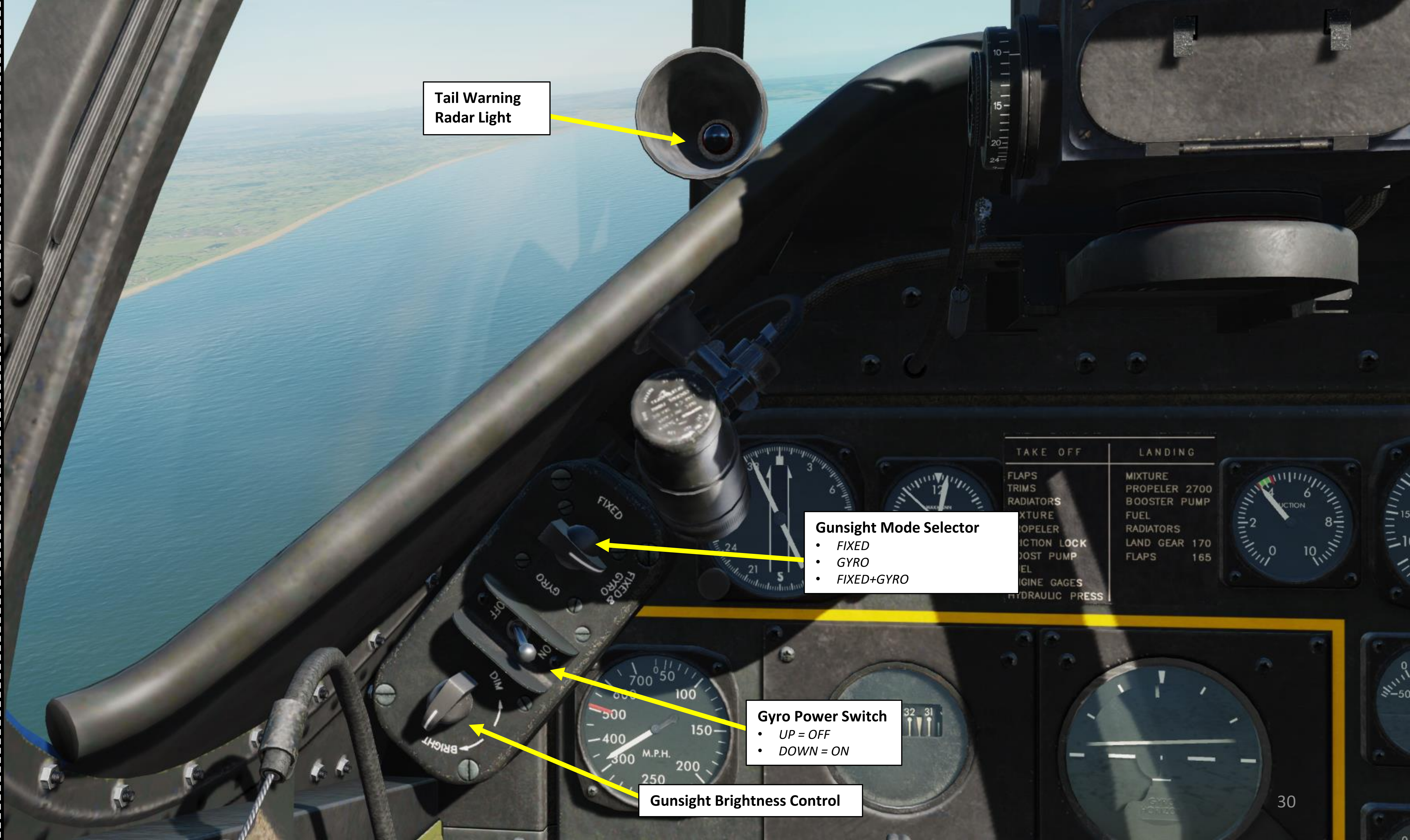
Recognition Lights Keying Switch
When Recognition Lights switches are UP (Keying position), pressing the Keying Switch allows you to turn them on and off as you press the Keying Switch. This can be used to send visual morse code signals.

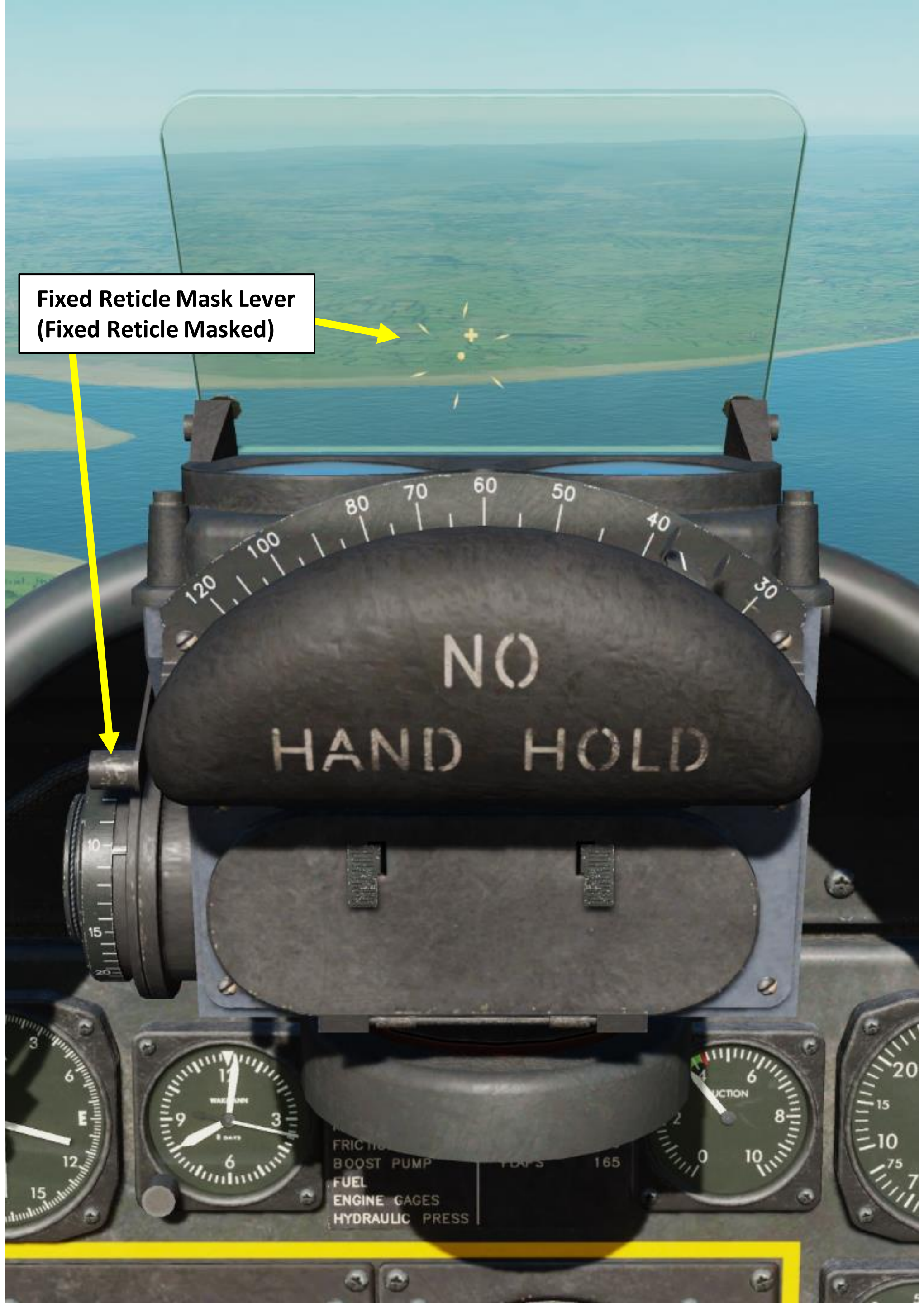
Red, Green & Amber Recognition Lights Switches
- *UP: Key position (ON when the keying switch is being pressed)*
- *MIDDLE: OFF*
- *DOWN: Steady glow (ON)*


Canopy Jettison Lever
Recognition Lights Key
Oxygen Emergency Bypass Valve
Oxygen Mix Selector
• Yellow bars indicate what is selected
• NORMAL Oxygen
• 100 % Oxygen
WARNING
DO NOT INCREASE THROTTLE ABOVE 40" M.P. STICK FULL BACK WITHOUT TAIL OF AIRPLANE BEING LASHED DOWN.
EMERGENCY PULL
CAUTION EMERG. RELEASE UNLOCKED IF RED INDICATOR SHOWS.
WARNING
MAX. GROUND OPER. TIME 10 SECONDS
AN/APS-13
THIS IS A MILITARY TYP
UNDER THE CIVIL AIR REGU
BE USED FOR THE CARRIAG
OR CARGO FOR COMPENS


Gyro Gunsight
Fixed Gunsight
NO
HAND HOLD
MANIFOLD PRESSURE
FUEL
ENGINE GAGES
HYDRAULIC PRESS
WARNING

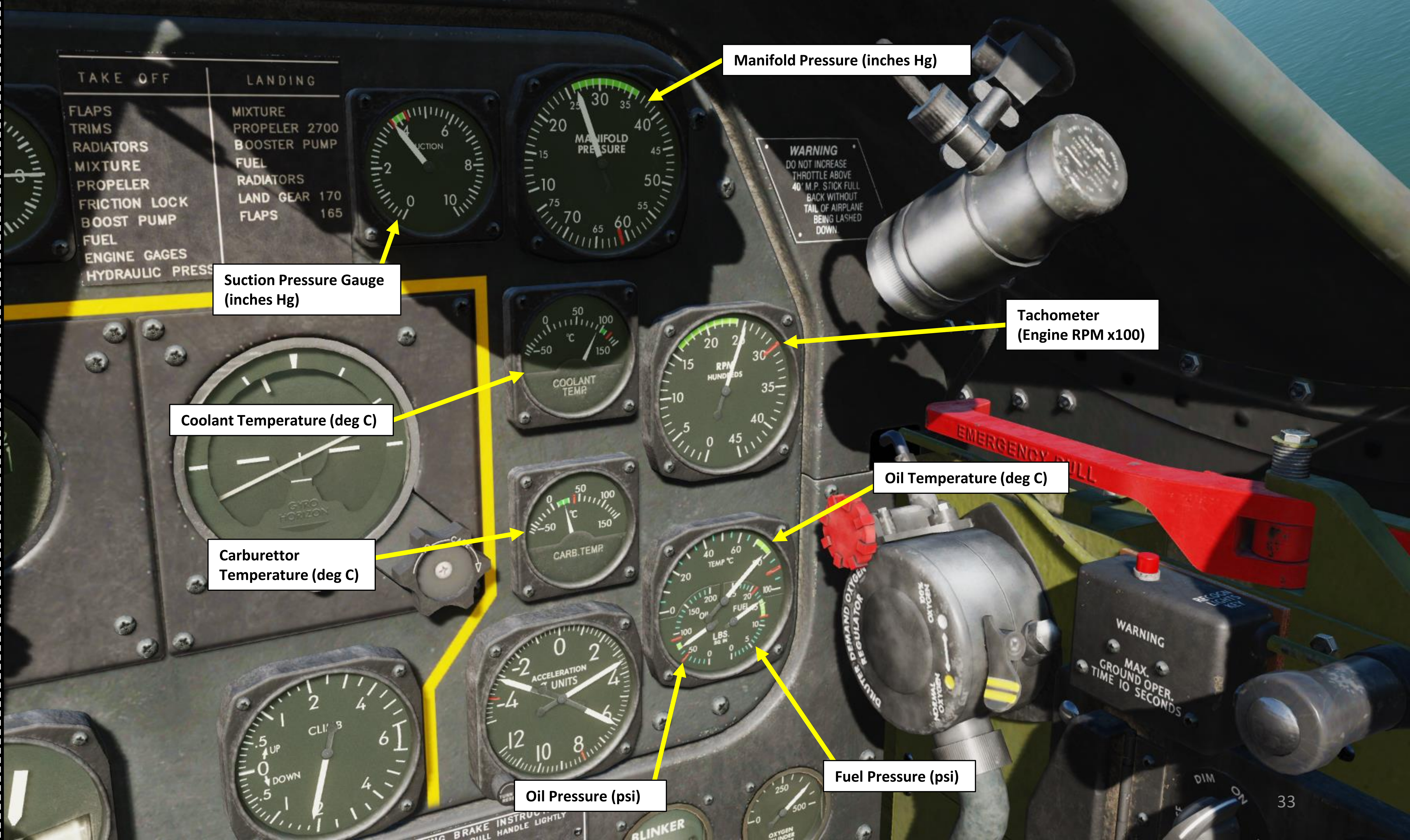

Gunsight Wingspan Scale (ft)
Gunsight Wingspan Selector
Gunsight Range (x100 ft)
NO
HAND HOLD
WARNING
DO NOT INCREASE THROTTLE ABOVE 40" M.P. STICK FULL BACK WITHOUT TAIL OF AIRPLANE BEING LASHED DOWN.

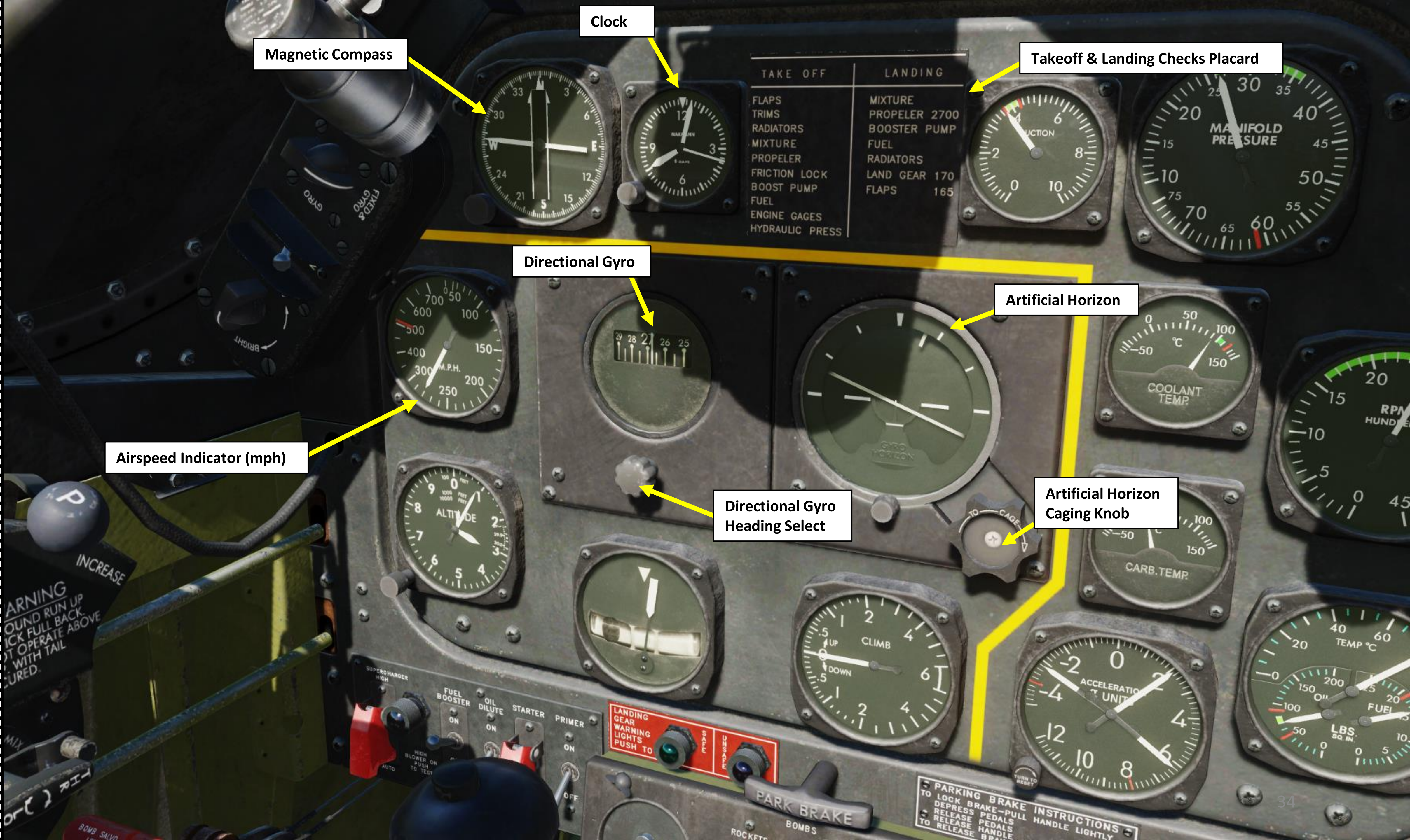

Tail Warning Radar Light
Gunsight Mode Selector
• FIXED
• GYRO
• FIXED+GYRO
Gyro Power Switch
• UP = OFF
• DOWN = ON
Gunsight Brightness Control

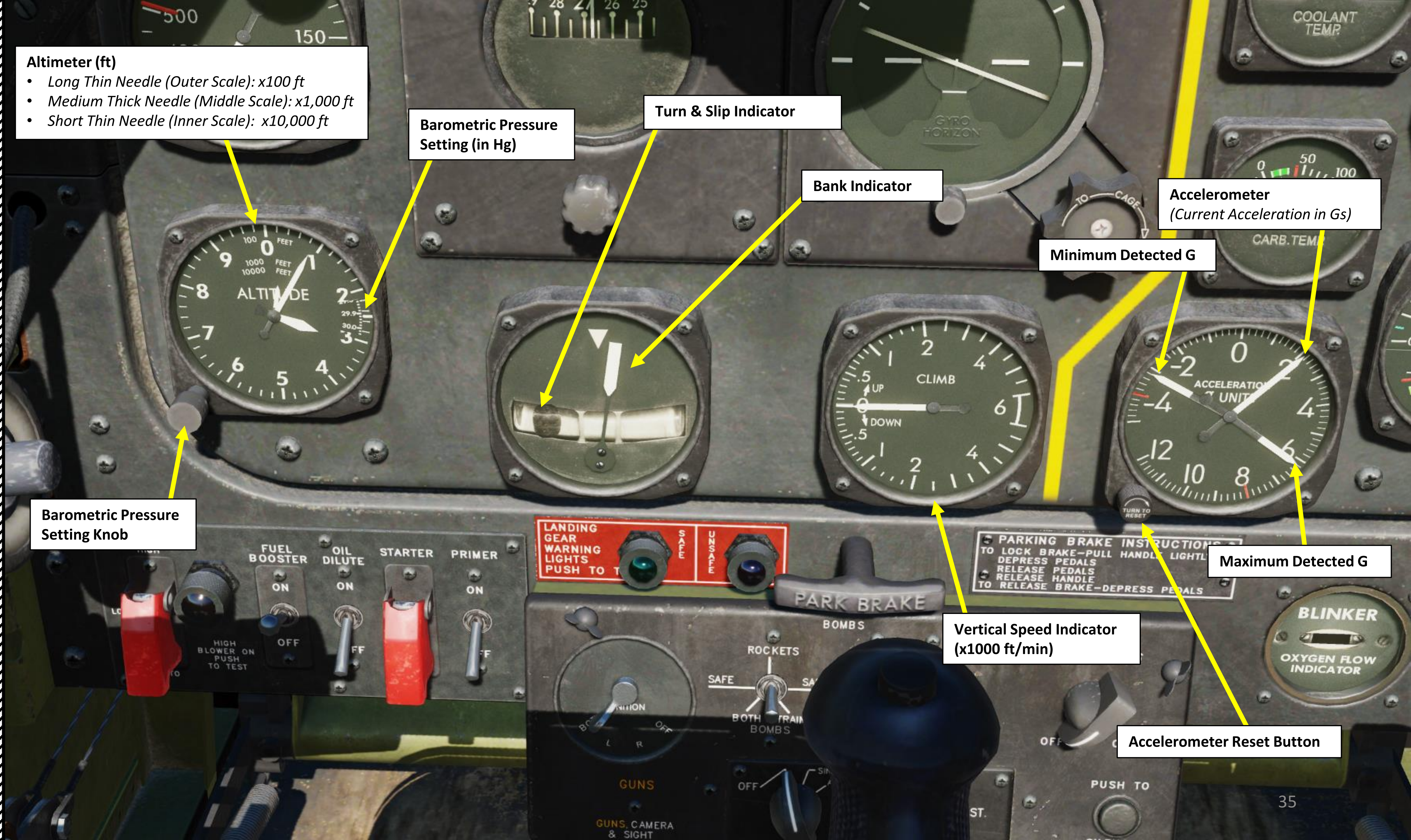

Fixed Reticle Mask Lever
(Fixed Reticle Masked)
NO
HAND HOLD

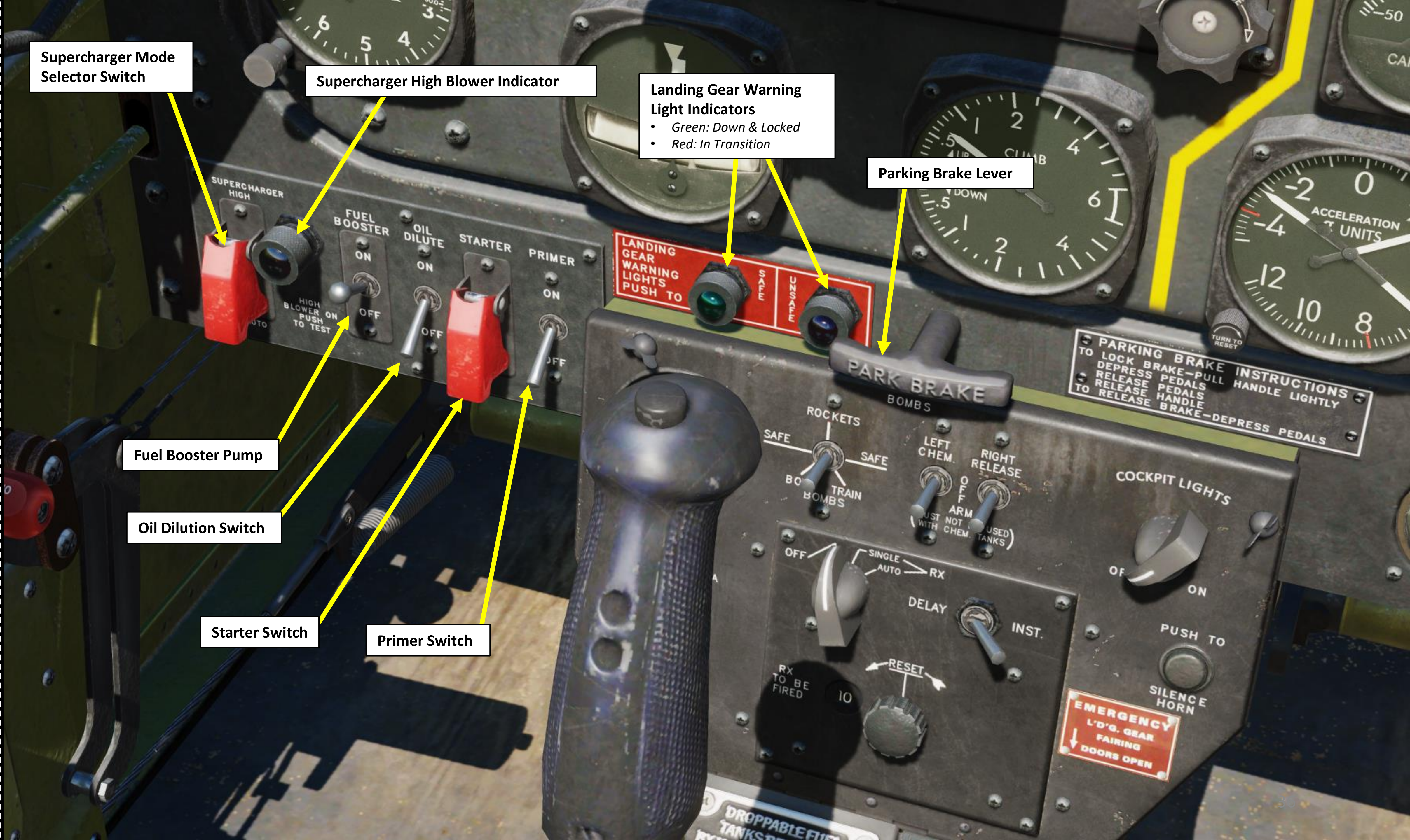

Fixed Reticle Mask Lever
(Fixed Reticle Not Masked)
NO
HAND HOLD

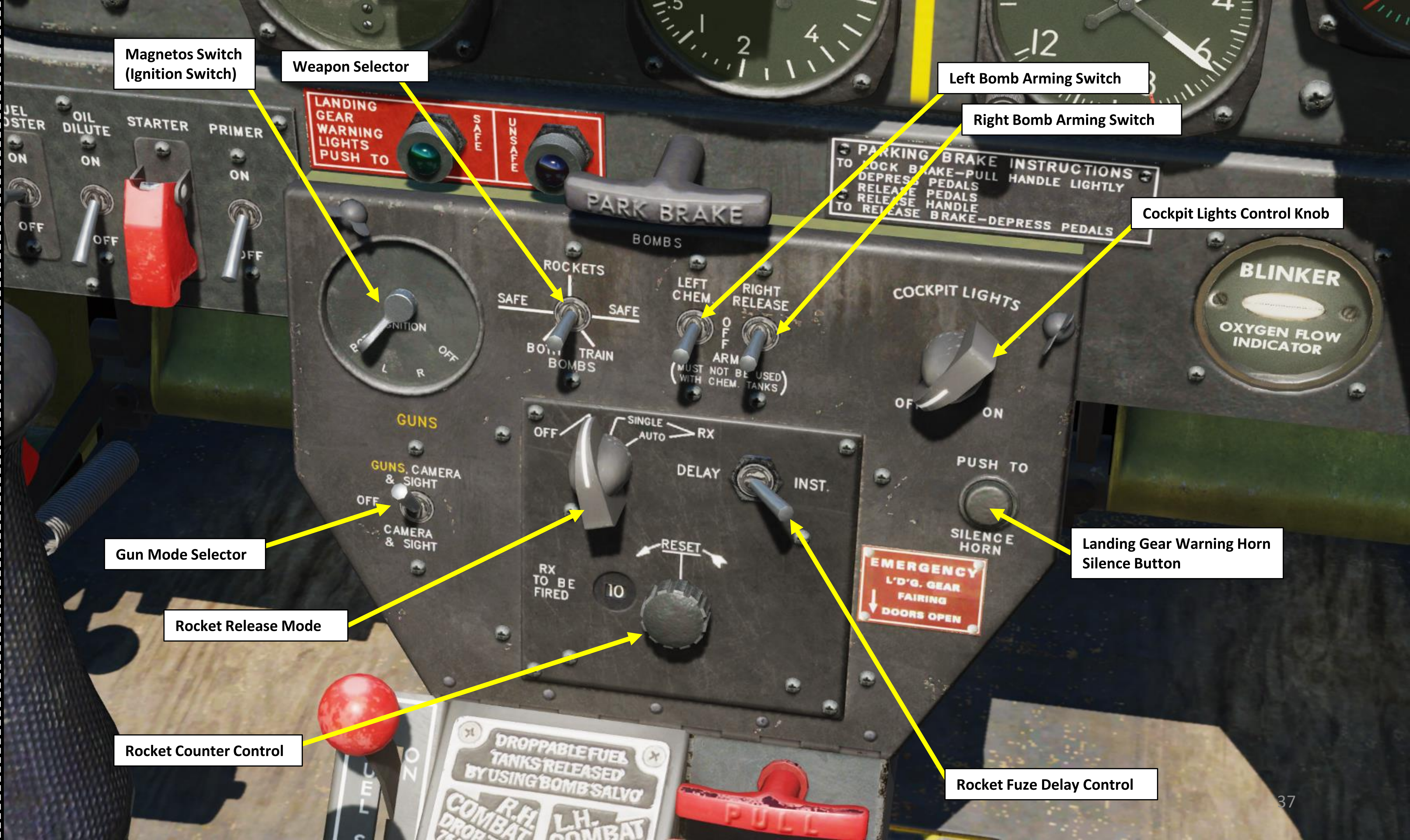

Oxygen Pressure (psi)
Oxygen Flow Indicator (Blinker)
EMERGENCY PULL
CARB. TEMP.
BLINKER
OXYGEN FLOW INDICATOR
OXYGEN CYLINDER PRESSURE
WARNING
MAX. GROUND OPER. TIME 10 SECONDS
RECOGN LIGHTS KEY
CIRCUIT PROTECTORS PUSH TO RESET
PARKING BRAKE INSTRUCTIONS
COCKPIT LIGHTS

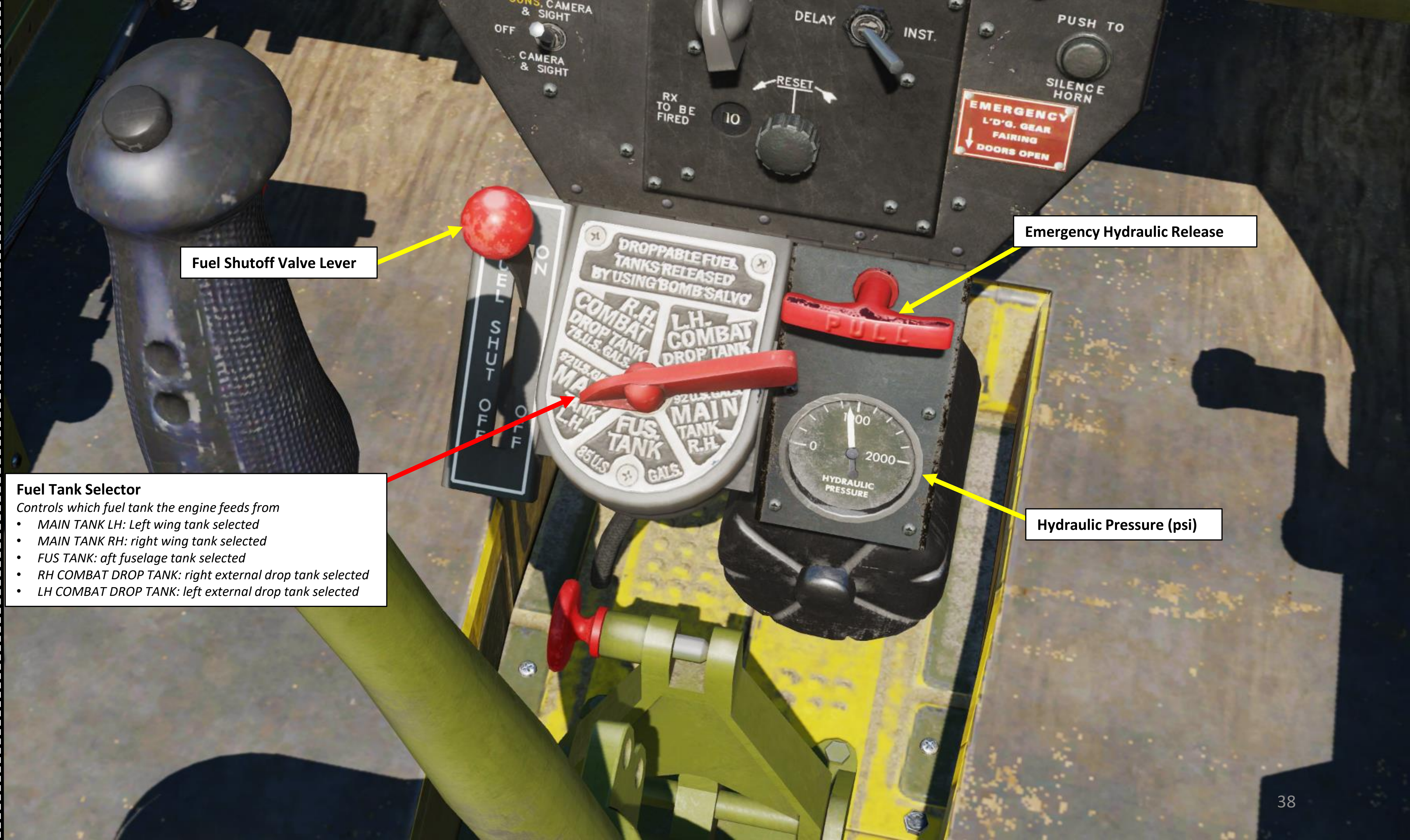

Manifold Pressure (inches Hg)
Suction Pressure Gauge (inches Hg)
Tachometer (Engine RPM x100)
Coolant Temperature (deg C)
Carburettor Temperature (deg C)
Oil Temperature (deg C)
Fuel Pressure (psi)
Oil Pressure (psi)
TAKE OFF
FLAPS
TRIMS
RADIATORS
MIXTURE
PROPELER
FRICTION LOCK
BOOST PUMP
FUEL
ENGINE GAGES
LANDING
MIXTURE
PROPELER 2700
BOOSTER PUMP
FUEL
RADIATORS
LAND GEAR 170
FLAPS 165
WARNING
DO NOT INCREASE THROTTLE ABOVE 40" M.P. STICK FULL BACK WITHOUT TAIL OF AIRPLANE BEING LASHED DOWN
WARNING
MAX. GROUND OPER. TIME 10 SECONDS


Clock
Magnetic Compass
Takeoff & Landing Checks Placard
TAKE OFF
FLAPS
TRIMS
RADIATORS
MIXTURE
PROPELER
FRICTION LOCK
BOOST PUMP
FUEL
ENGINE GAGES
HYDRAULIC PRESS
LANDING
MIXTURE
PROPELER 2700
BOOSTER PUMP
FUEL
RADIATORS
LAND GEAR 170
FLAPS 165
Directional Gyro
Artificial Horizon
Airspeed Indicator (mph)
Directional Gyro Heading Select
Artificial Horizon Caging Knob


Altimeter (ft)
• Long Thin Needle (Outer Scale): x100 ft
• Medium Thick Needle (Middle Scale): x1,000 ft
• Short Thin Needle (Inner Scale): x10,000 ft
Barometric Pressure Setting (in Hg)
Turn & Slip Indicator
Bank Indicator
Accelerometer (Current Acceleration in Gs)
Minimum Detected G
Barometric Pressure Setting Knob
Vertical Speed Indicator (x1000 ft/min)
Maximum Detected G
Accelerometer Reset Button


Supercharger Mode Selector Switch
Supercharger High Blower Indicator
Landing Gear Warning Light Indicators
• Green: Down & Locked
• Red: In Transition
Parking Brake Lever
Fuel Booster Pump
Oil Dilution Switch
Starter Switch
Primer Switch
SUPERCHARGER HIGH
FUEL BOOSTER
OIL DILUTE
STARTER
PRIMER
HIGH BLOWER ON PUSH TO TEST
LANDING GEAR WARNING LIGHTS PUSH TO
SAFE
UNSAFE
PARK BRAKE
BOMBS
ROCKETS
PARKING BRAKE INSTRUCTIONS
TO LOCK BRAKE–PULL HANDLE LIGHTLY
DEPRESS PEDALS
RELEASE PEDALS
RELEASE HANDLE
TO RELEASE BRAKE–DEPRESS PEDALS
COCKPIT LIGHTS
PUSH TO SILENCE HORN
EMERGENCY L'D'G. GEAR FAIRING DOORS OPEN
DELAY
INST.
RESET
RX TO BE FIRED
ACCELERATION UNITS
CLIMB
DROPPABLE FUEL TANKS

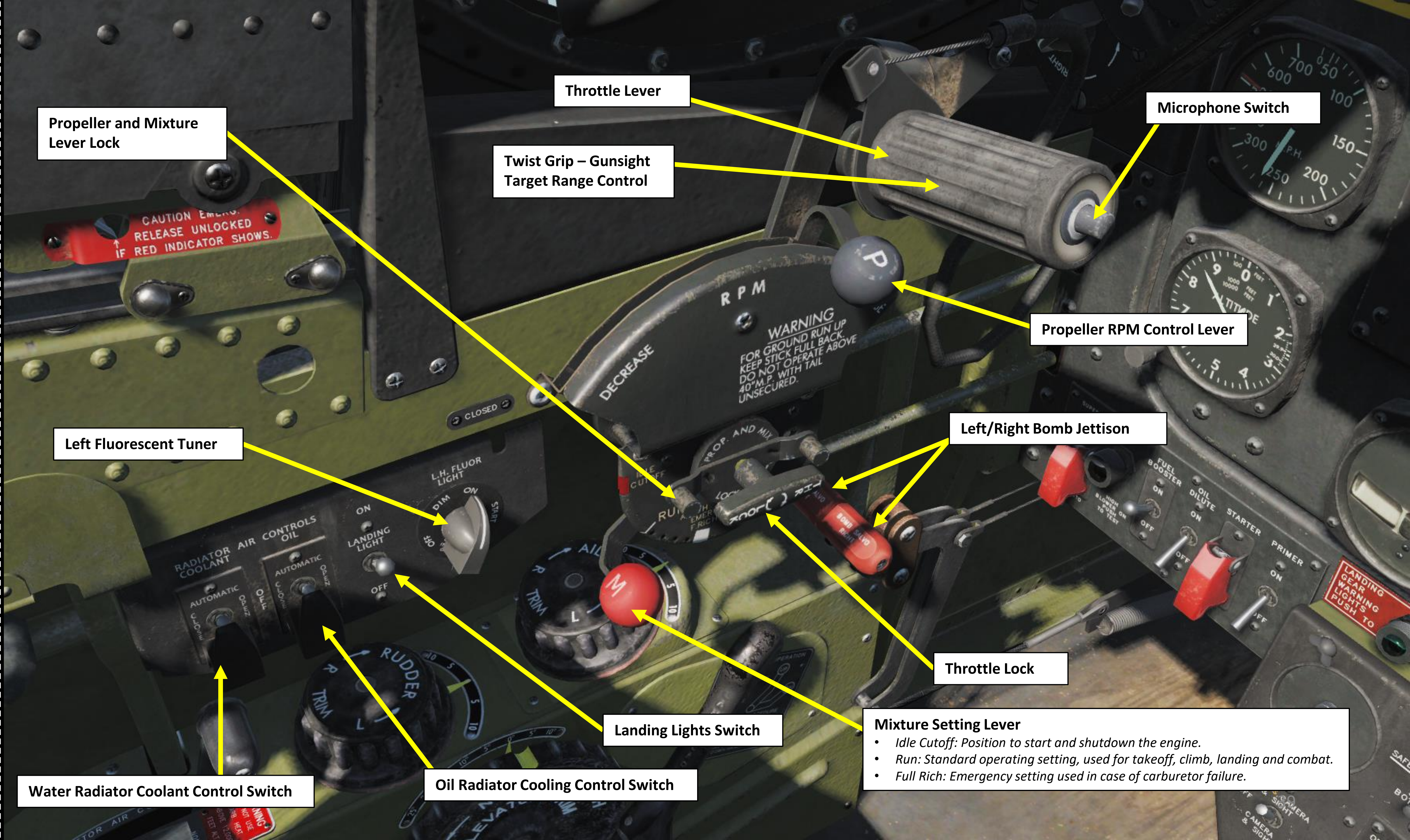

Magnetos Switch (Ignition Switch)
Weapon Selector
Left Bomb Arming Switch
Right Bomb Arming Switch
Cockpit Lights Control Knob
Gun Mode Selector
Rocket Release Mode
Rocket Counter Control
Landing Gear Warning Horn Silence Button
Rocket Fuze Delay Control

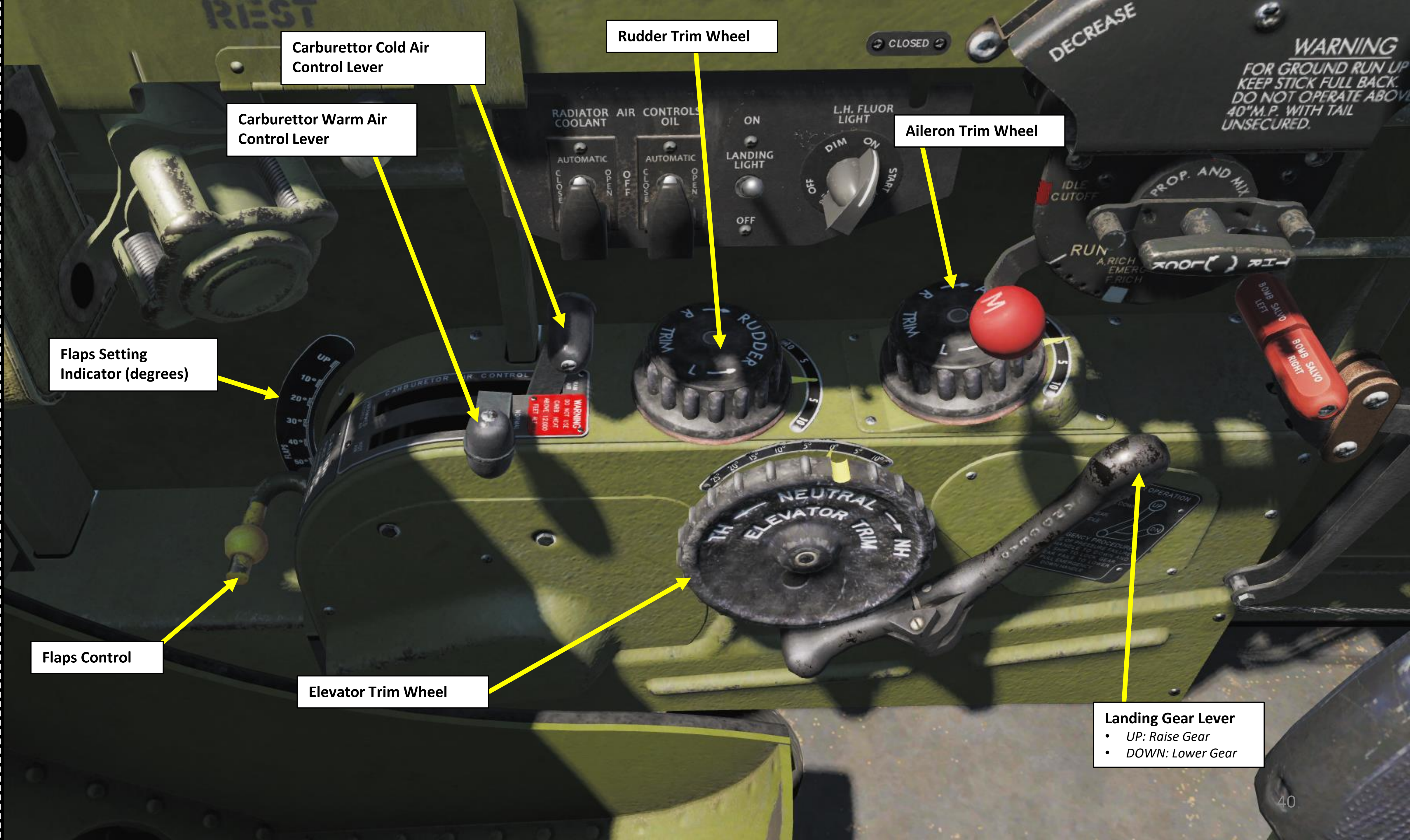


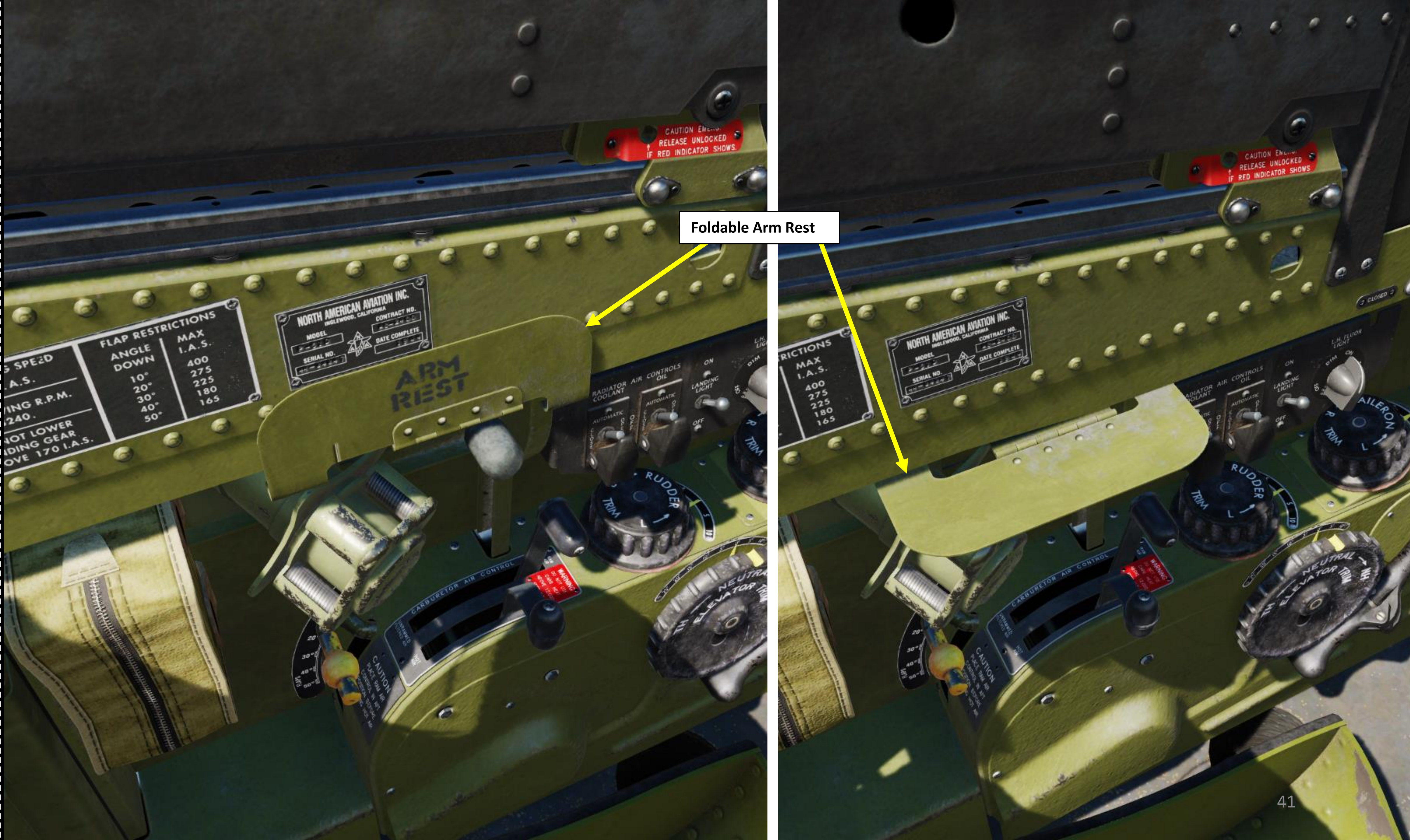
Fuel Tank Selector

Controls which fuel tank the engine feeds from

- *MAIN TANK LH: Left wing tank selected*
- *MAIN TANK RH: right wing tank selected*
- *FUS TANK: aft fuselage tank selected*
- *RH COMBAT DROP TANK: right external drop tank selected*
- *LH COMBAT DROP TANK: left external drop tank selected*

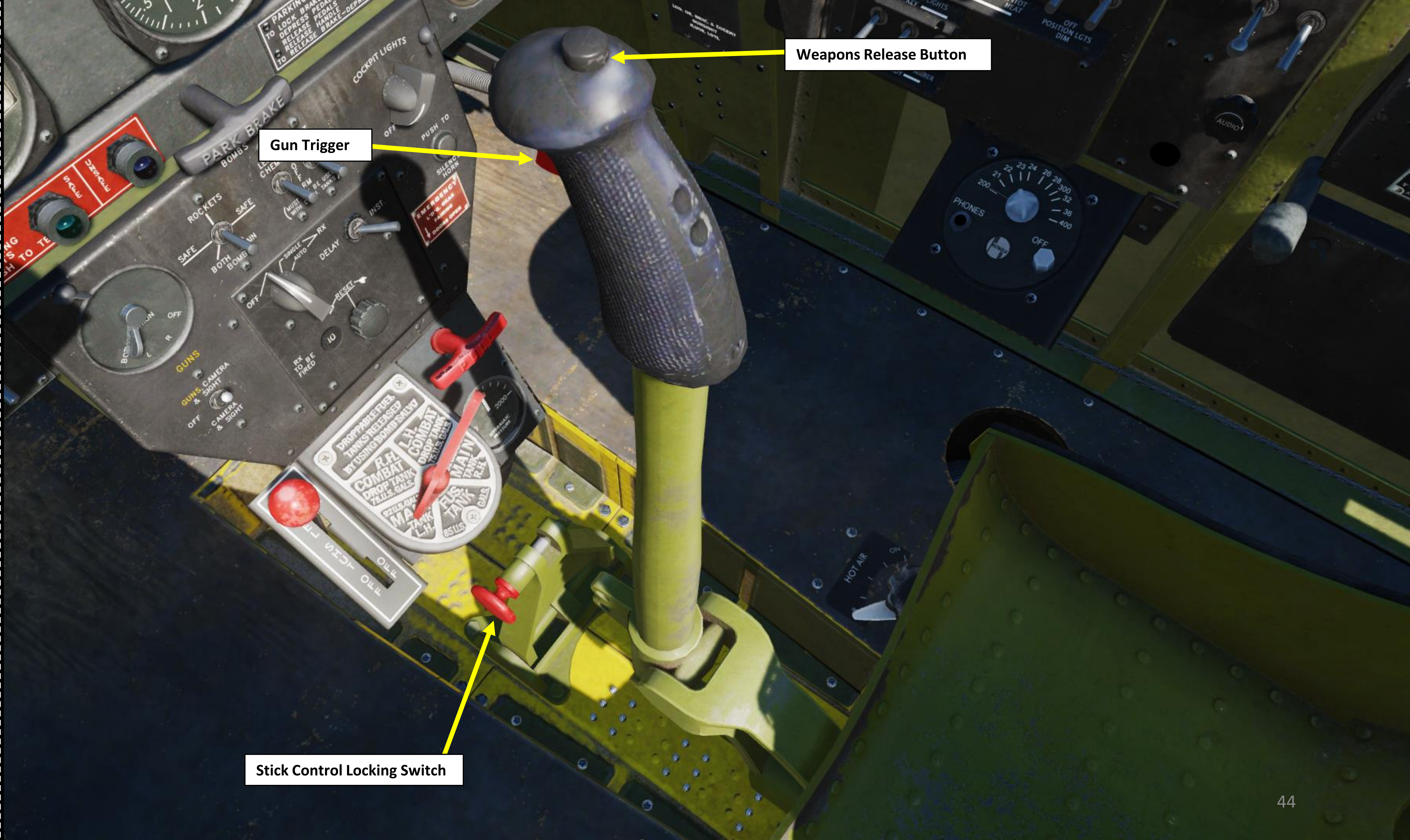

Throttle Lever
Microphone Switch
Propeller and Mixture Lever Lock
Twist Grip – Gunsight Target Range Control
Propeller RPM Control Lever
Left/Right Bomb Jettison
Left Fluorescent Tuner
Throttle Lock
Landing Lights Switch
Mixture Setting Lever
• Idle Cutoff: Position to start and shutdown the engine.
• Run: Standard operating setting, used for takeoff, climb, landing and combat.
• Full Rich: Emergency setting used in case of carburetor failure.
Water Radiator Coolant Control Switch
Oil Radiator Cooling Control Switch


Carburettor Cold Air Control Lever
Rudder Trim Wheel
Carburettor Warm Air Control Lever
Aileron Trim Wheel
Flaps Setting Indicator (degrees)
Flaps Control
Elevator Trim Wheel
Landing Gear Lever
• UP: Raise Gear
• DOWN: Lower Gear
WARNING
FOR GROUND RUN UP
KEEP STICK FULL BACK.
DO NOT OPERATE ABOVE
40"M.P. WITH TAIL
UNSECURED.
RADIATOR AIR CONTROLS
COOLANT
OIL
LANDING LIGHT
L.H. FLUOR LIGHT
NEUTRAL
ELEVATOR TRIM

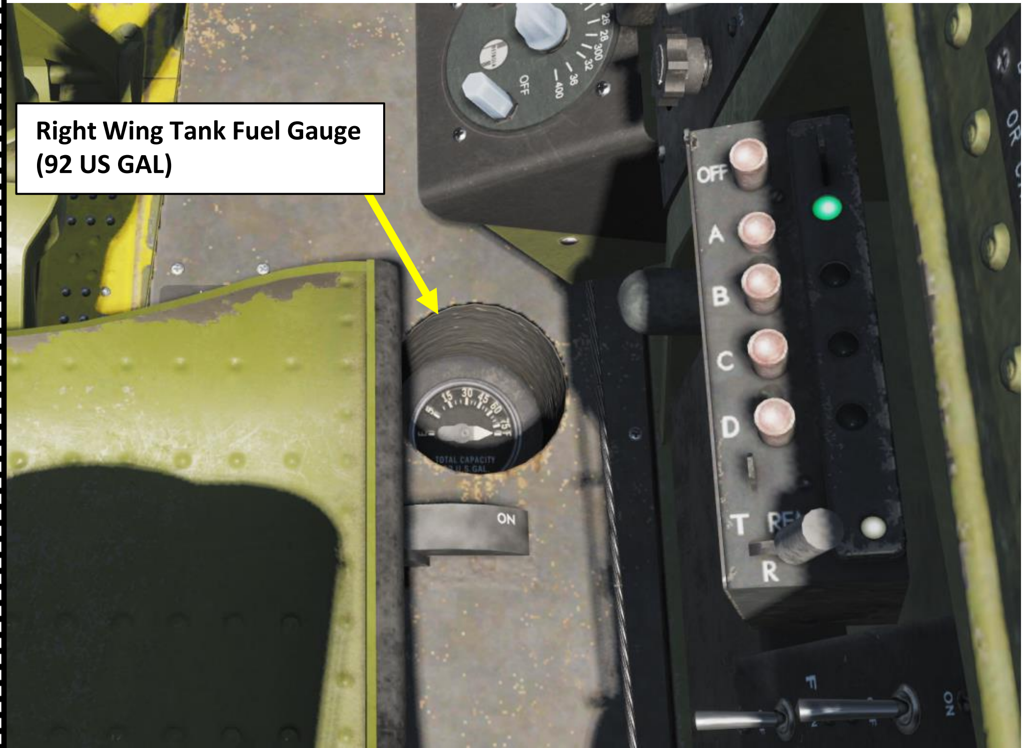

Foldable Arm Rest
ARM REST
FLAP RESTRICTIONS
NORTH AMERICAN AVIATION INC.
CAUTION EMERG. RELEASE UNLOCKED IF RED INDICATOR SHOWS.
RUDDER TRIM
AILERON TRIM
RADIATOR COOLANT
OIL
AIR CONTROLS
LANDING LIGHT
CARBURETOR AIR CONTROL


ARM REST
NORTH AMERICAN AVIATION INC.
FLAP RESTRICTIONS
ANGLE DOWN
MAX I.A.S.
10° 20° 30° 40° 50°
400 275 225 180 165
MAX. DIVING SPEED
505 I.A.S.
MAX. DIVING R.P.M.
3240
DO NOT LOWER
LANDING GEAR
ABOVE 170 I.A.S.
DECREASE
R P M
WARNING
ALTITUDE
FUEL BOOSTER
OIL DILUTE
STARTER
TRIM
M


Defroster Control
Hot Air Control
Cold Air Control
DEFROSTER
HOT AIR
ON
ELEVATOR TRIM
NEUTRAL
NH
BOMB SALVO RIGHT
PHONES
OFF

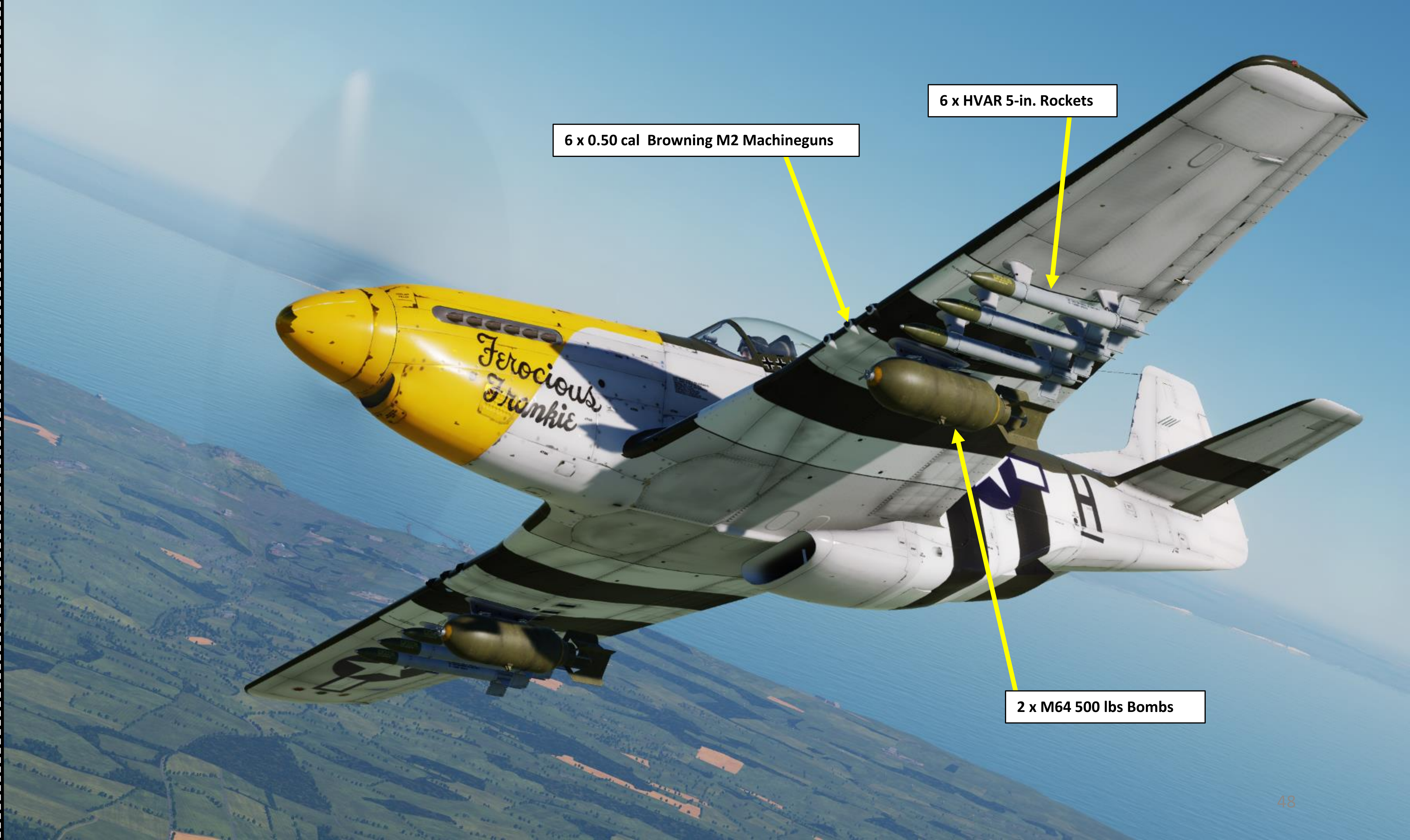

Weapons Release Button
Gun Trigger
Stick Control Locking Switch
PARK BRAKE
COCKPIT LIGHTS
ROCKETS
GUNS
PHONES
AUDIO
HOT AIR


Left Wing Tank Fuel Gauge
(92 US GAL)


Right Wing Tank Fuel Gauge
(92 US GAL)


TOTAL FUEL QUANTITY: 489 US GAL
(with 2 x 110 gal drop tanks installed)
Rear Fuselage Tank Fuel Gauge
(85 US GAL)


Mirror
NO HAND HOLD

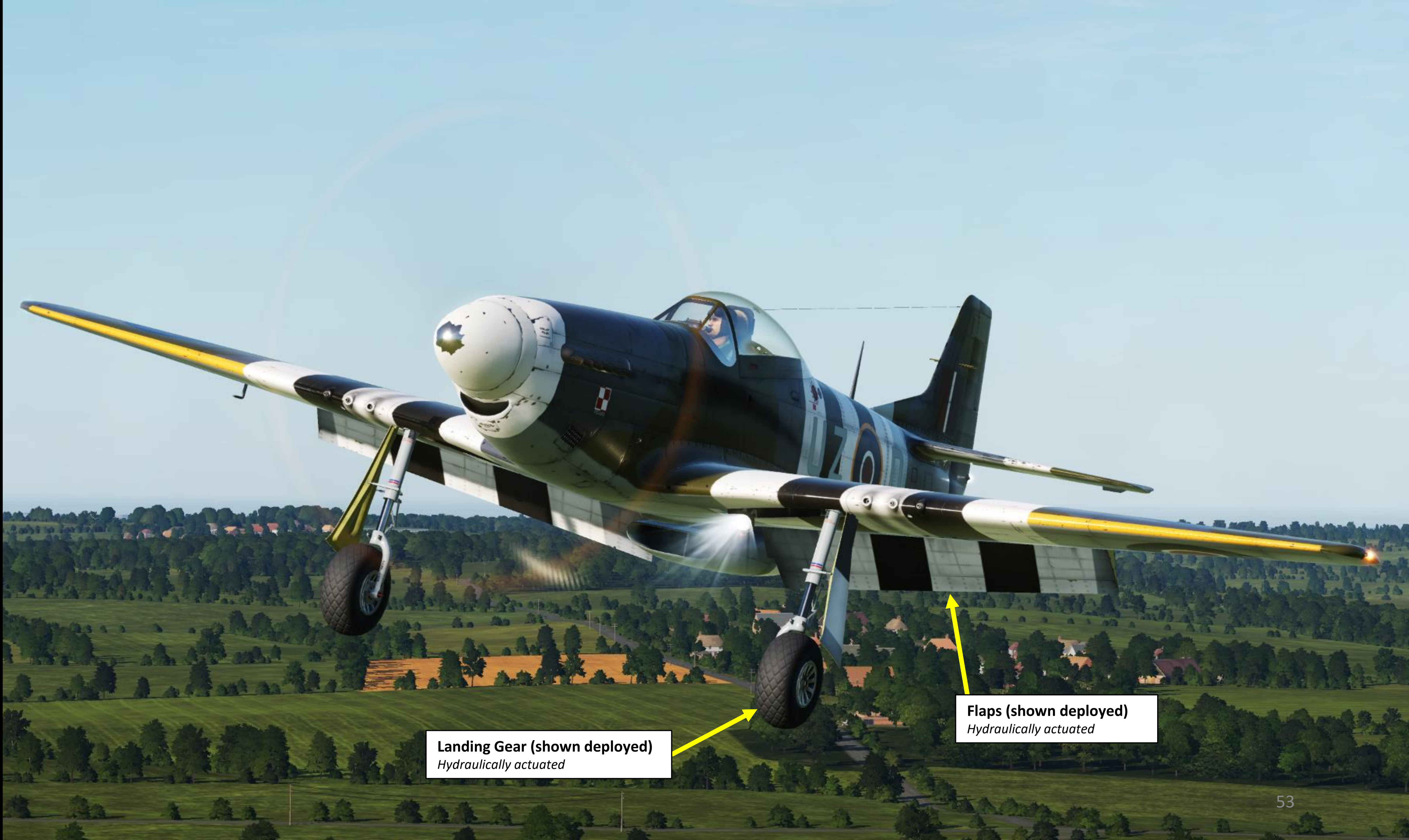

6 x HVAR 5-in. Rockets
6 x 0.50 cal Browning M2 Machineguns
Ferocious Frankie
2 x M64 500 lbs Bombs


Machinegun Cartridge Ejection Ports

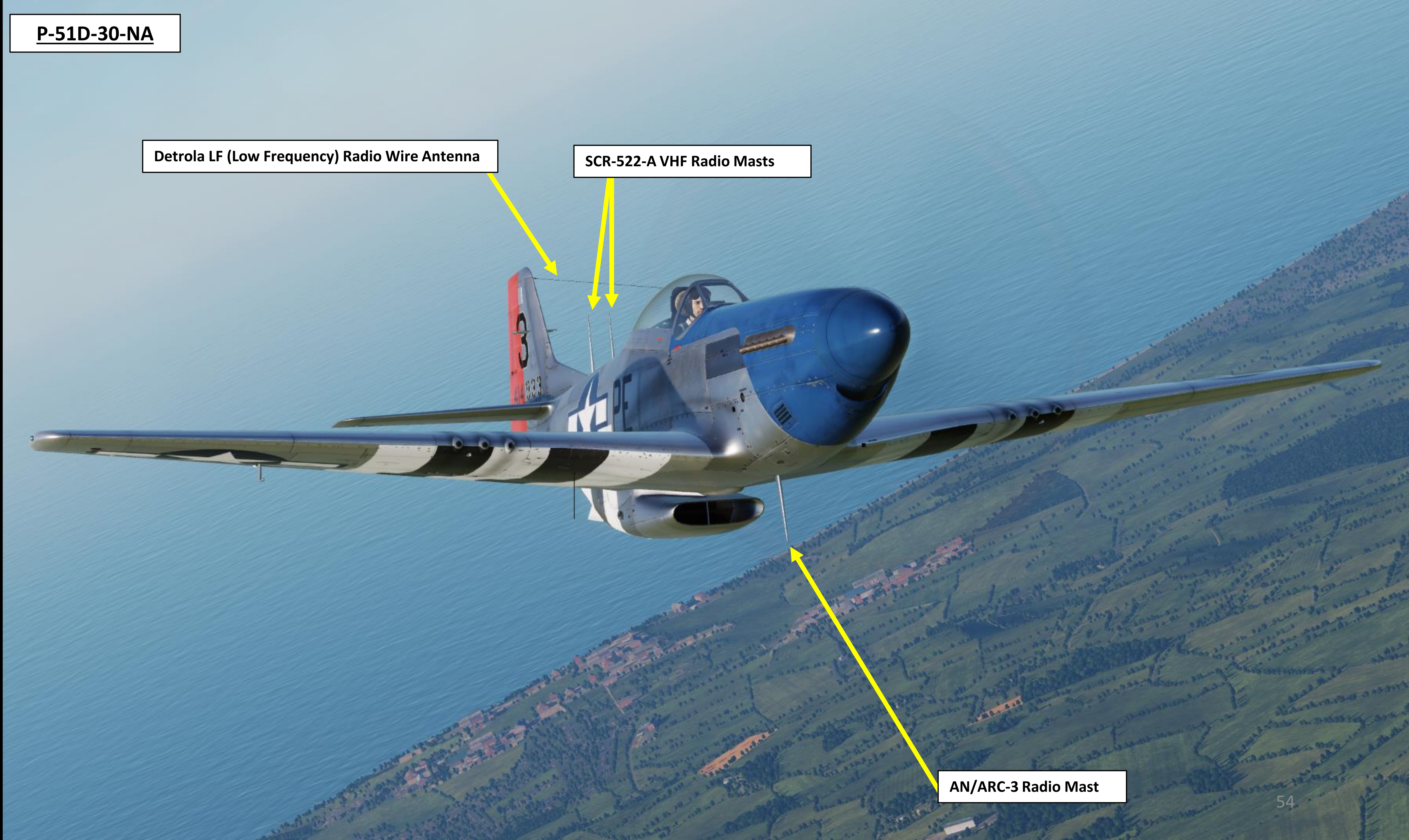

External Fuel Drop Tank
External Fuel Drop Tank


Pitot Tube
Radiator Coolant and Oil Radiator Air Intake
Carburetor Air Scoop (Ram Air)

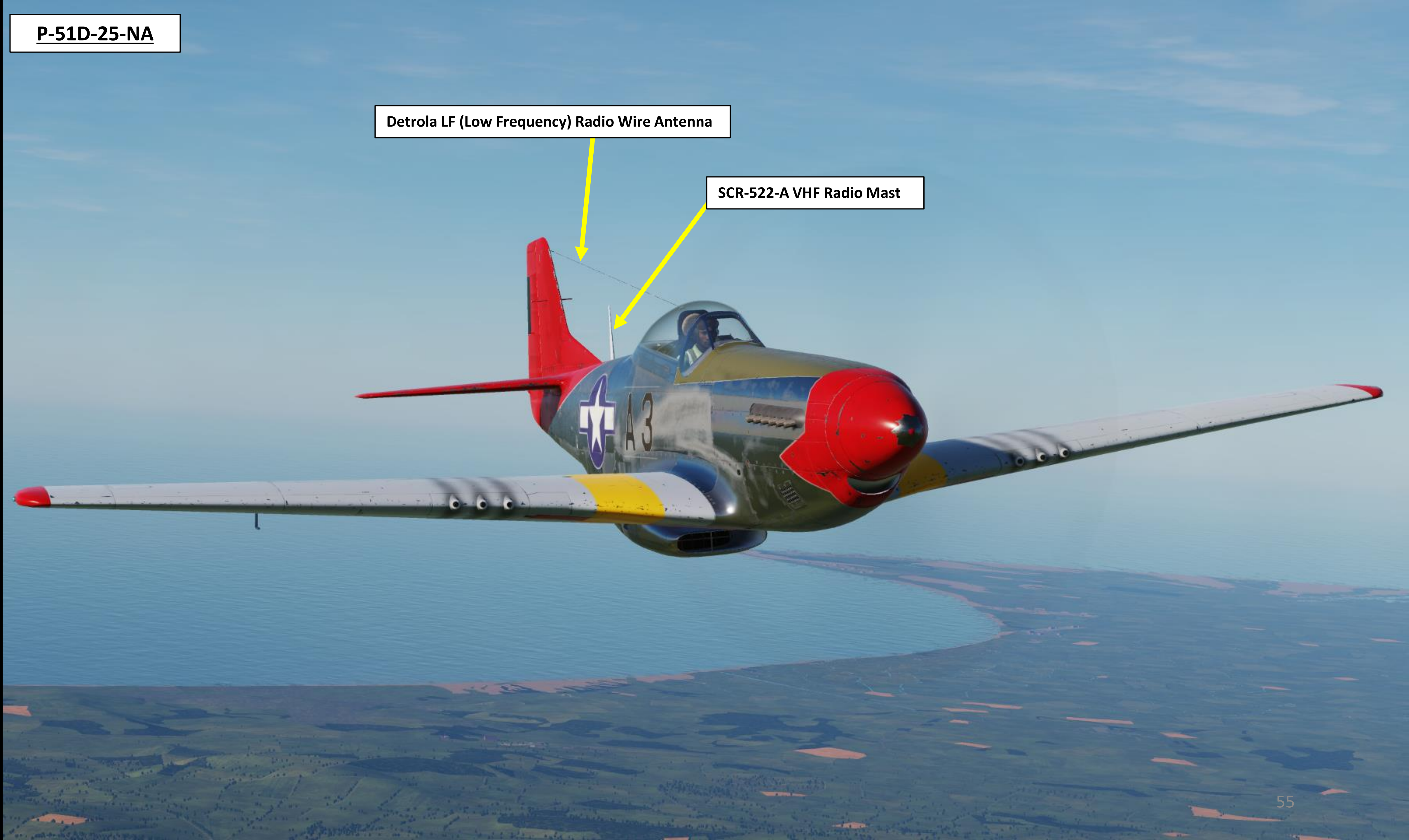

Aftercooler & Engine Coolant Radiator Outlet
Oil Radiator Outlet

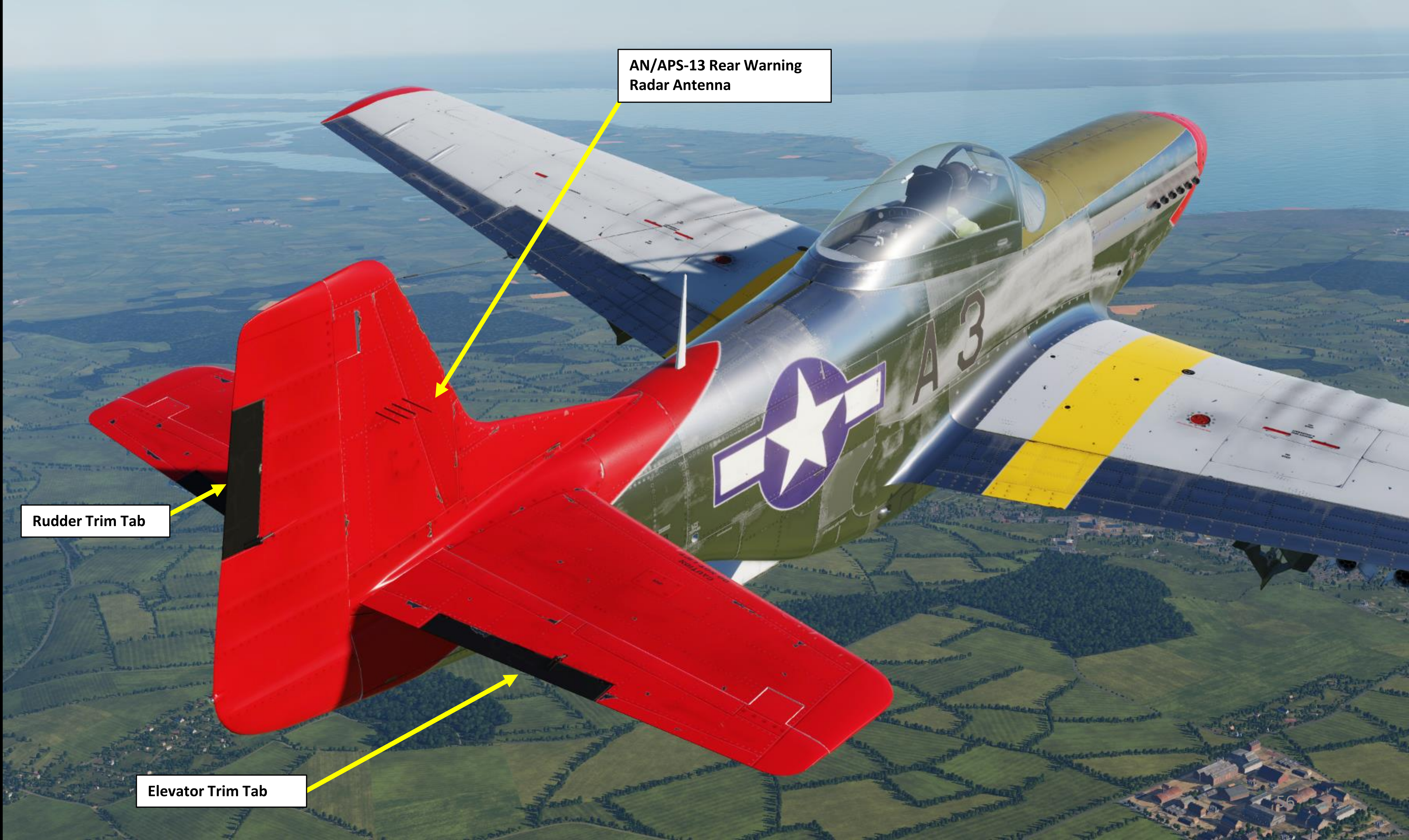

Landing Gear (shown deployed)
Hydraulically actuated
Flaps (shown deployed)
Hydraulically actuated

P-51D-30-NA


Detrola LF (Low Frequency) Radio Wire Antenna
SCR-522-A VHF Radio Masts
AN/ARC-3 Radio Mast

P-51D-25-NA


Detrola LF (Low Frequency) Radio Wire Antenna
SCR-522-A VHF Radio Mast
A3


AN/APS-13 Rear Warning Radar Antenna
Rudder Trim Tab
Elevator Trim Tab


Wing Navigation Lights Control Switch
Tail Position Lights Control Switch
Wing Navigation Light (Green)
Tail Navigation Light
Wing Navigation Light (Red)


Landing Light Control Switch
RADIATOR AIR CONTROLS
COOLANT
OIL
AUTOMATIC
CLOSE
OPEN
OFF
ON
LANDING LIGHT
OFF
L.H. FLUOR LIGHT
DIM
ON
OFF
Landing Light

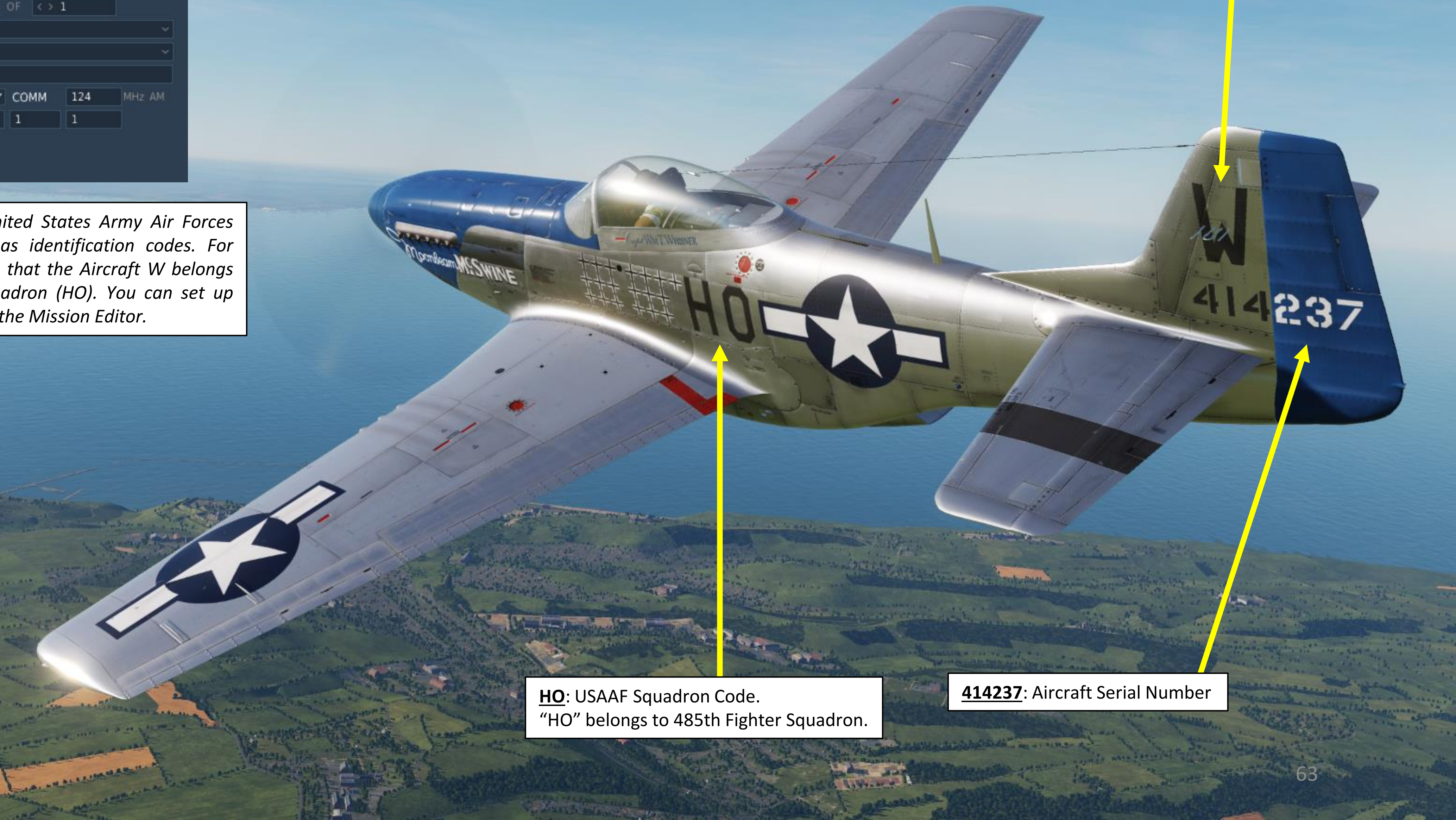

L.H. FLUOR LIGHT
DIM
ON
OFF
Left Fluorescent Tuner
DIM
ON
START
Right Fluorescent Tuner
NO HAND HOLD


Cockpit Utility Light
Cockpit Utility Light
Cockpit Lights Control Knob
COCKPIT LIGHTS
OFF
ON


Cockpit Utility Light
Cockpit Lights Control Knob
COCKPIT LIGHTS
OFF
ON
NORTH AMERICAN AVIATION INC.
INGLEWOOD, CALIFORNIA
RADIATOR COOLANT
AIR CONTROLS OIL
LANDING LIGHT
L.H. FLUOR LIGHT
RUDDER TRIM
AILERON TRIM
NEUTRAL
ELEVATOR TRIM
CARBURETOR AIR CONTROL
RPM
DECREASE
WARNING
FOR GROUND RUN UP KEEP STICK FULL BACK. DO NOT OPERATE ABOVE 40" M.P. WITH TAIL UNSECURED.


Cockpit Utility Light
Cockpit Lights Control Knob
COCKPIT LIGHTS
OFF
ON
AN/APS-13
SIGNAL LIGHT
POWER SWITCH
TEST SWITCH
CIRCUIT PROTECTORS PUSH TO RESET
SPARE LAMPS INSIDE
PHONES
OFF
THIS IS A MILITARY
UNDER THE CIVIL AIR RE
BE USED FOR THE CARR
OR CARGO FOR COMPE

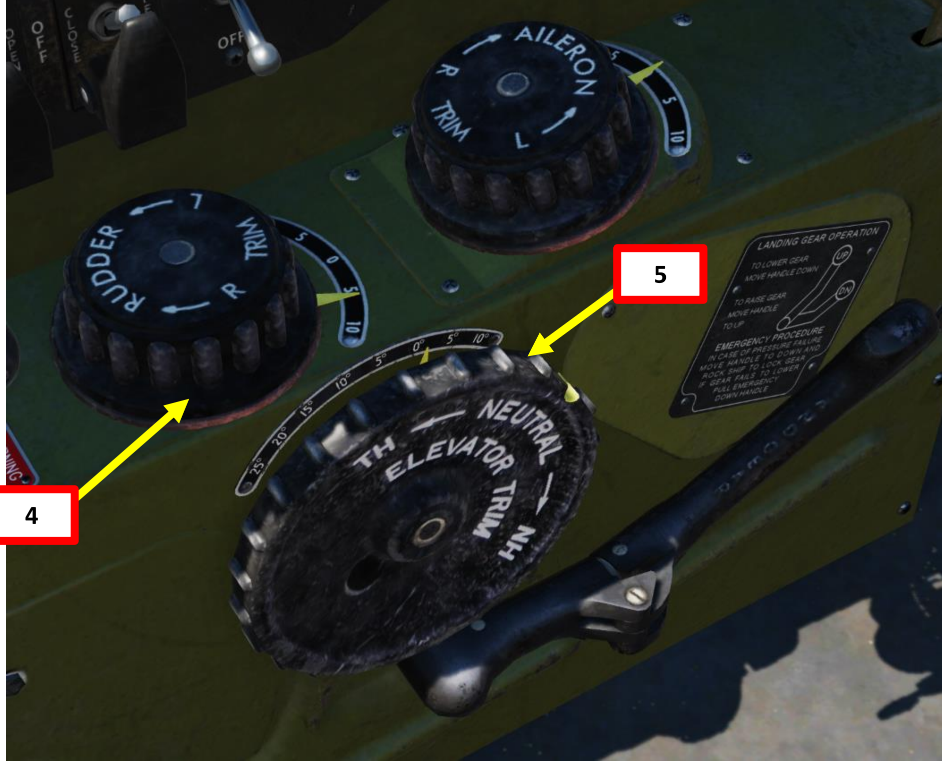
In World War 2, the United States Army Air Forces used aircraft markings as identification codes. For instance, "HO-W" means that the Aircraft W belongs to the 485th Fighter Squadron (HO). You can set up your aircraft markings in the Mission Editor.

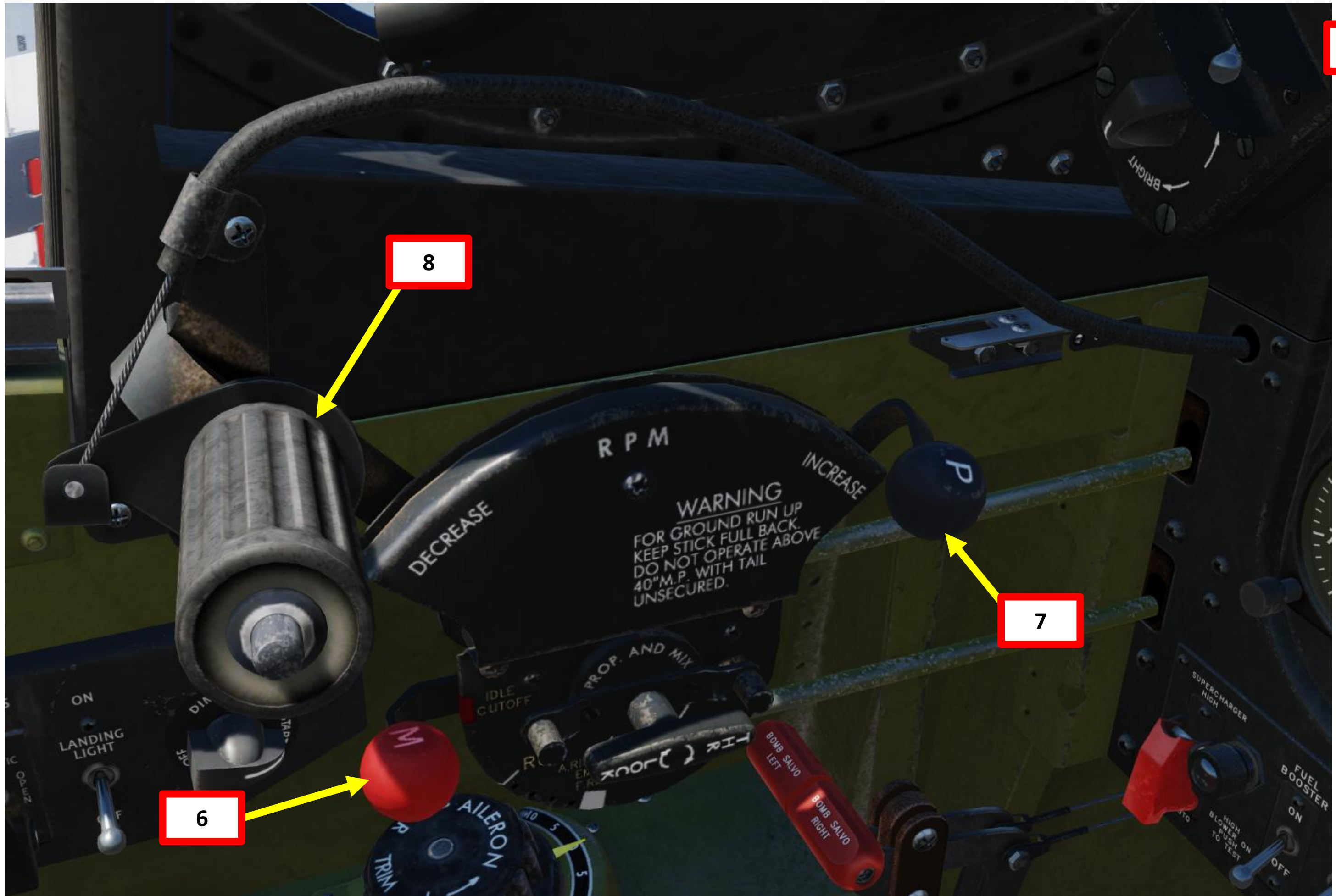


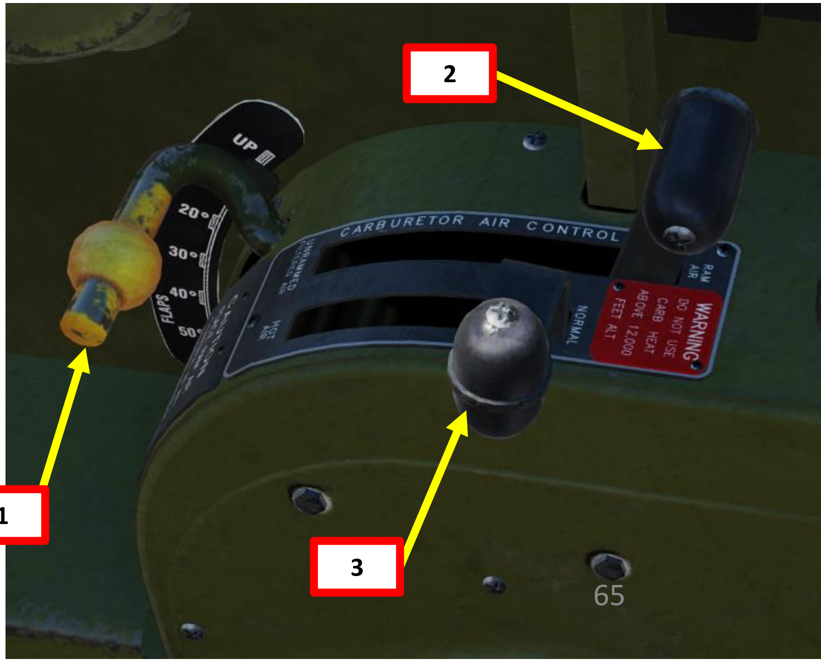
PART 4 – START-UP

PRE-FLIGHT

1. Flaps – UP
2. Carburettor Ram Air Control Lever – FORWARD (RAM AIR POSITION)
3. Carburettor Hot Air Control Lever – FORWARD (NORMAL POSITION)
4. Rudder Trim: 6 deg right
5. Elevator Trim: 2 deg nose heavy with no drop tanks, 4 deg nose heavy with drop tanks
6. Mixture Control Lever – IDLE CUT-OFF
7. Propeller Control Lever – FULLY FORWARD
8. Crack Throttle Open (advance throttle 1 inch forward)

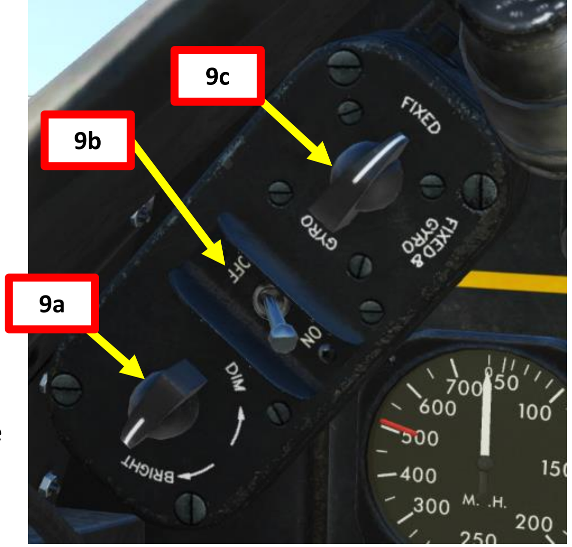


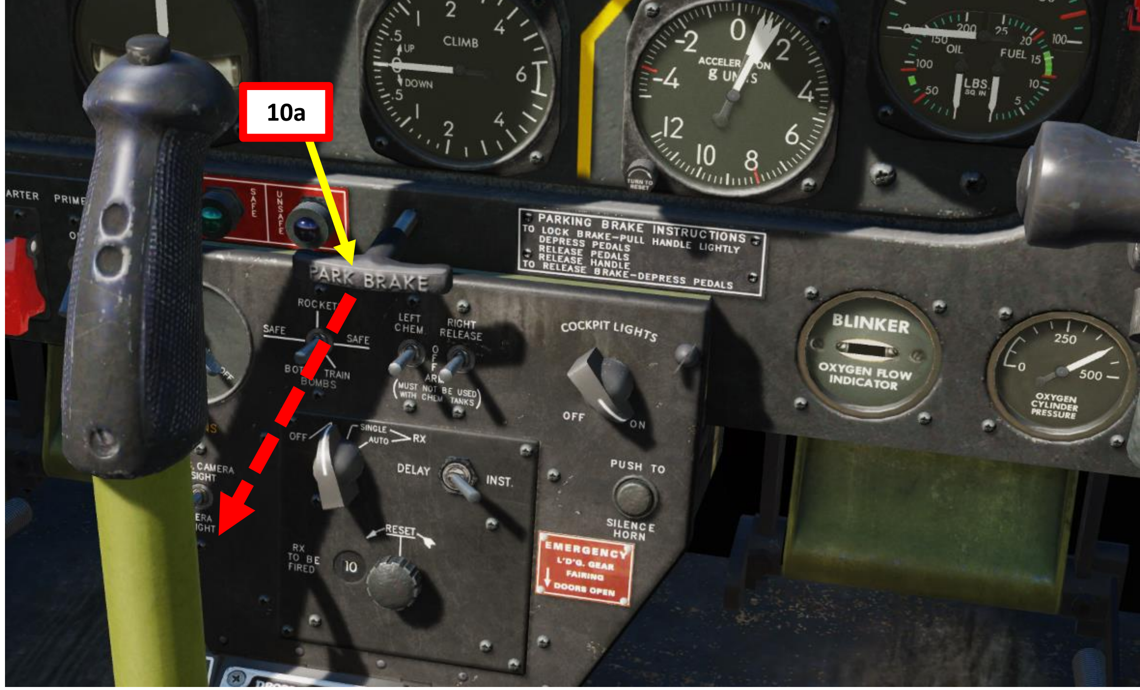


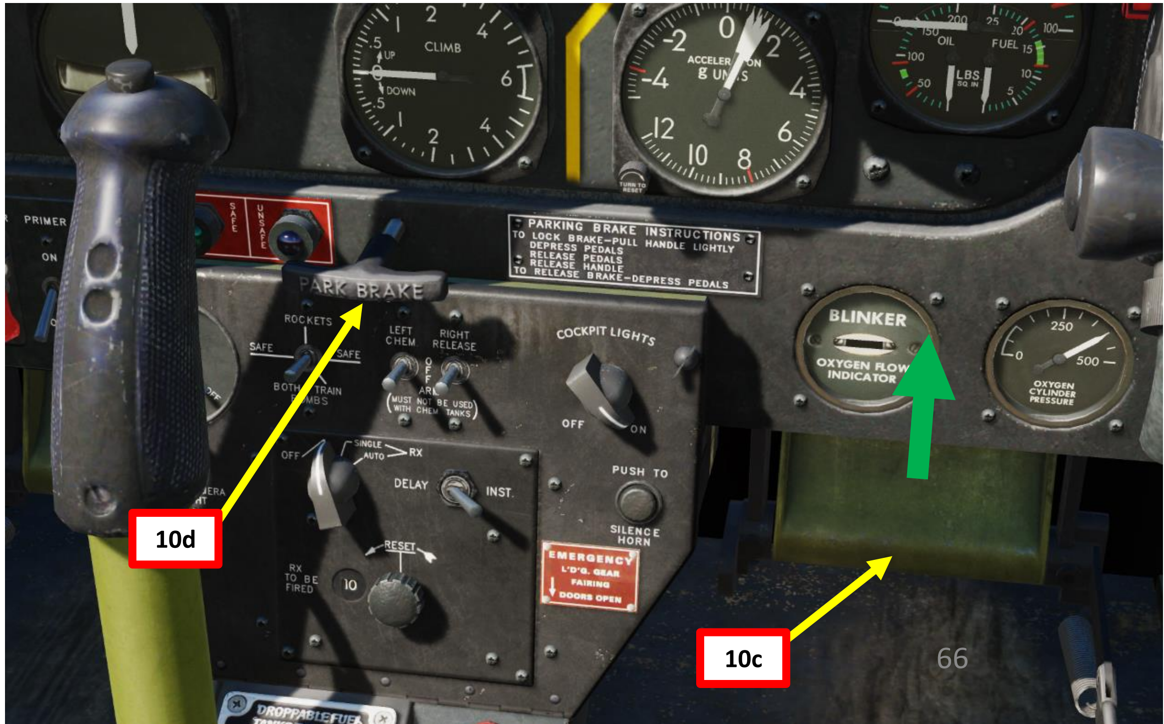


PRE-FLIGHT

9. Set Gunsight Selector-Dimmer Panel
    a) Brightness – BRIGHT
    b) Gyro Power – ON
    c) Gunsight Mode - FIXED
10. Set Parking Brake
    a) Click and Hold Parking Brake Handle (hold left mouse button)
    b) Press wheel brake pedals
    c) Release Wheel brake pedals
    d) Release Parking Brake Handle (release left mouse button)
    e) To release parking brake, tap your wheel brake pedals

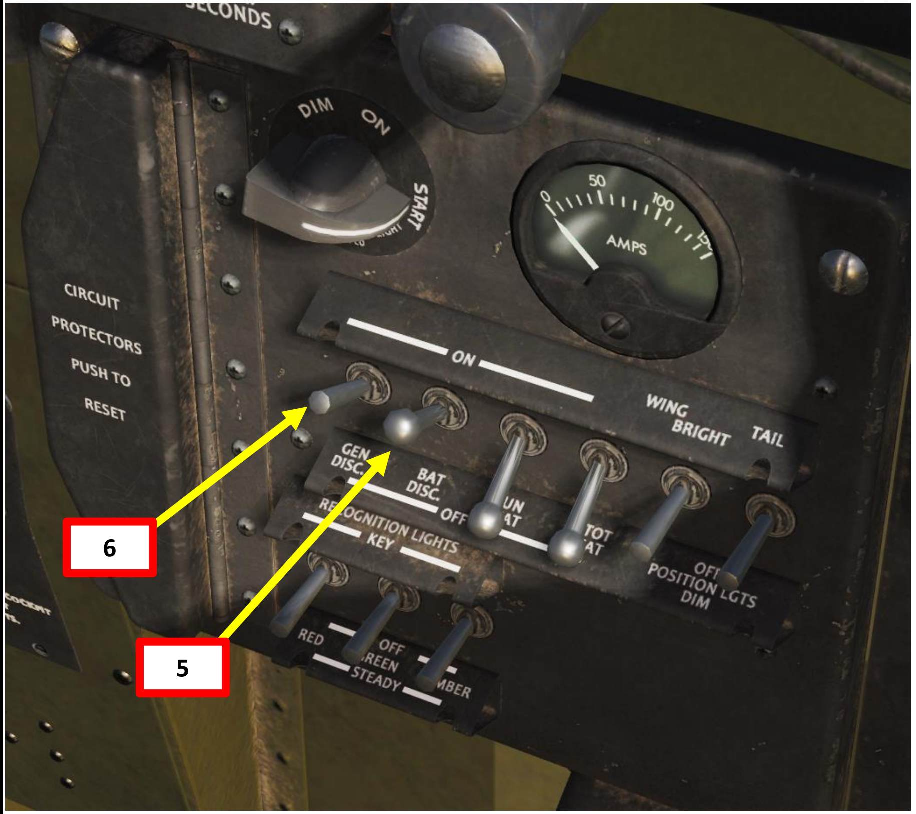


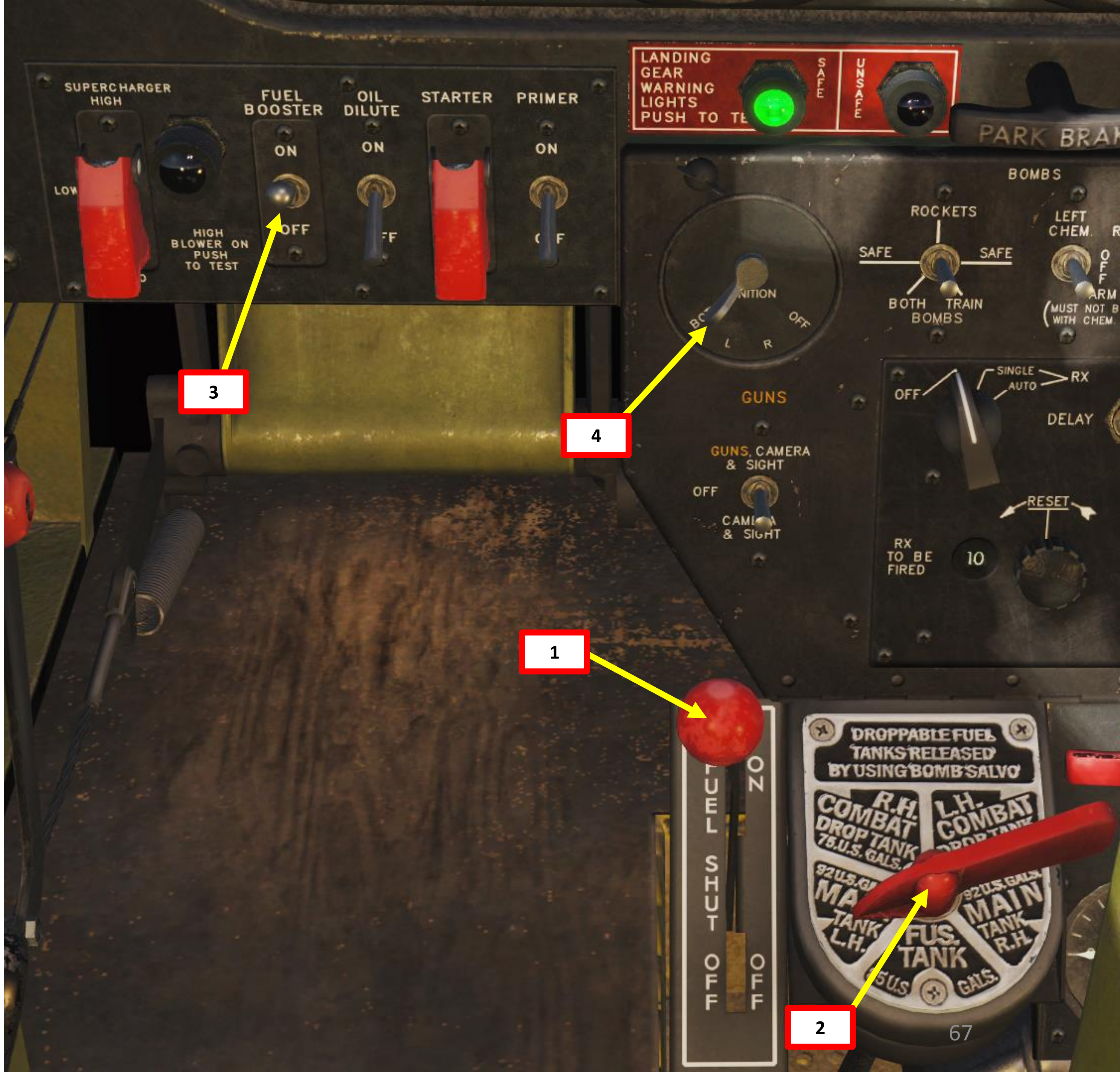




ENGINE START

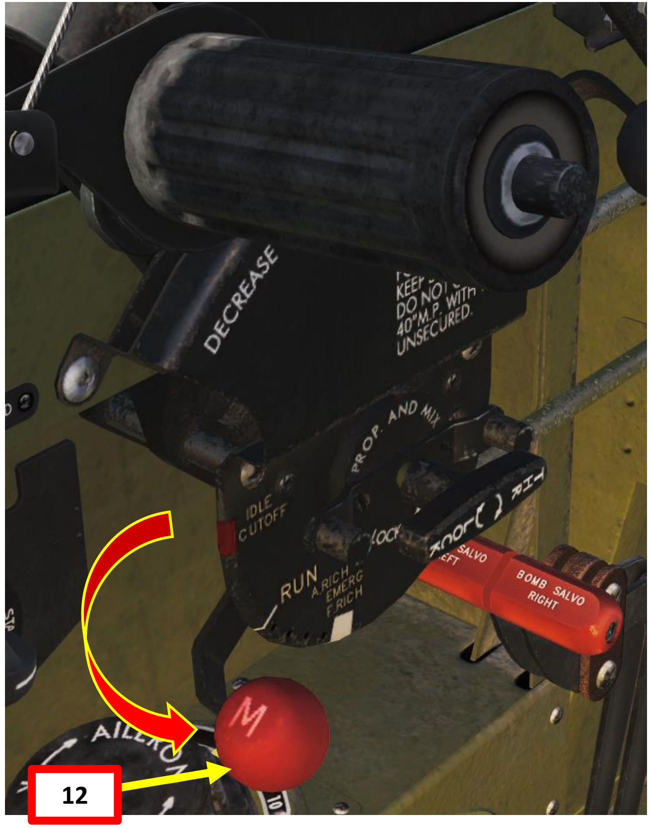
1. Fuel Shut-Off Valve – ON
2. Fuel Selector Valve – Set to MAIN TANK LEFT HAND SIDE
3. Fuel Booster – ON
4. Ignition (Magnetos) Switch – BOTH
5. Battery Switch – ON (UP)
6. Generator Switch – ON (UP)

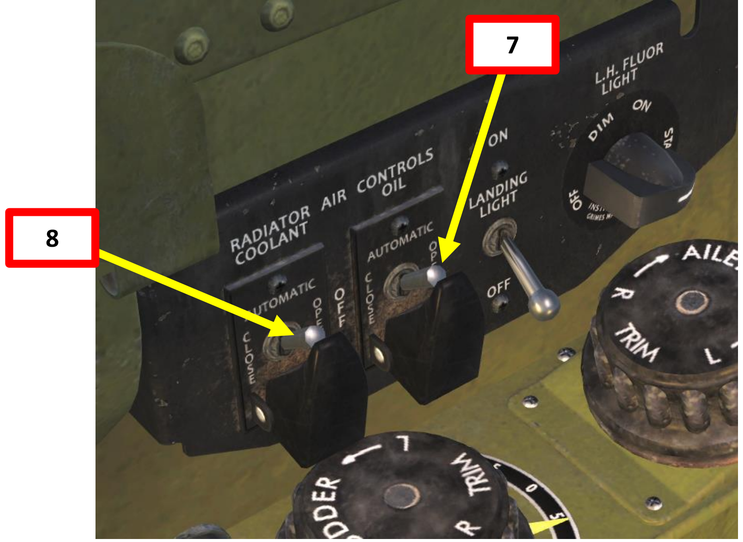


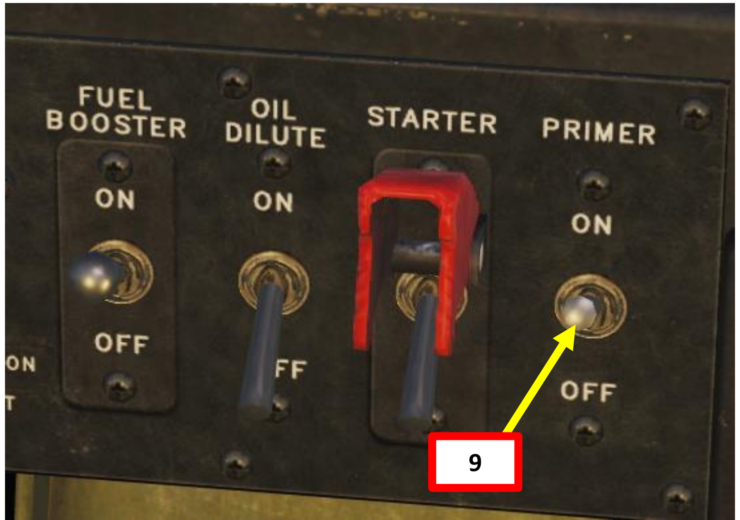


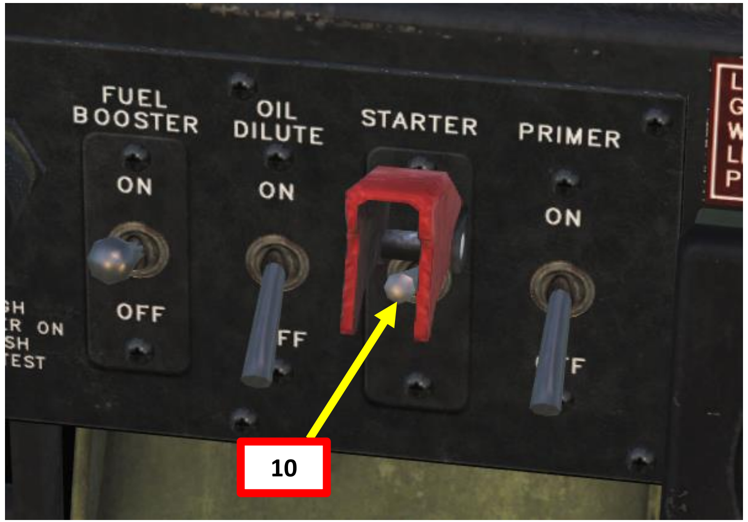
ENGINE START

7. Oil Radiator Flap Control Switch – AUTO (UP)
8. Coolant Radiator Flap Control Switch – AUTO (UP)
9. Hold Primer Switch for 3-4 seconds
10. Verify that the propeller is clear and command « Clear prop! » to warn people around you that you are about to start the engine. When ready, flip the Starter Switch cover and hold the Starter Switch.
11. Wait for the propeller to start spooling up (keep holding the starter switch) and hold the primer switch for 2-3 seconds again to prime the engine again to trigger the engine ignition.
    - **Note: do not engage starter switch for more than 15 seconds.**
12. When propeller spins and engine "coughs", set mixture to RUN by right-clicking on the red Mixture Lever.
    - **Do not open the mixture control until the engine is firing to prevent excess fuel in the induction system. If the engine has not started after 2 minutes of cranking, disengage the starter and allow it to cool for one minute before making another attempt.**
13. After Engine Start, release starter switch and throttle back to IDLE. As engine power increases, the hydraulics will kick in automatically, raising your flaps up gradually as hydraulic pressure increases.





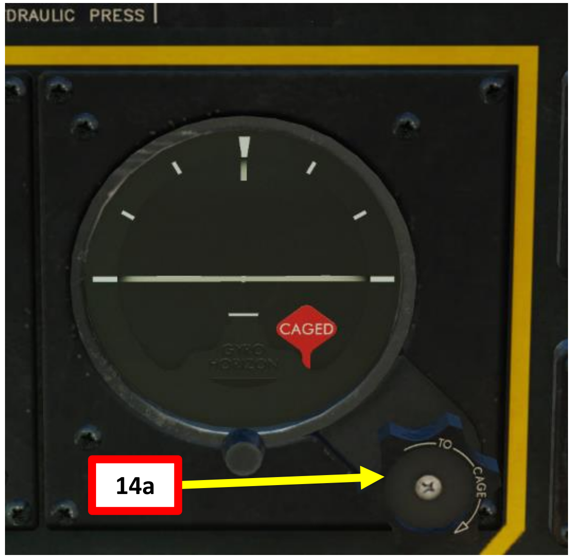


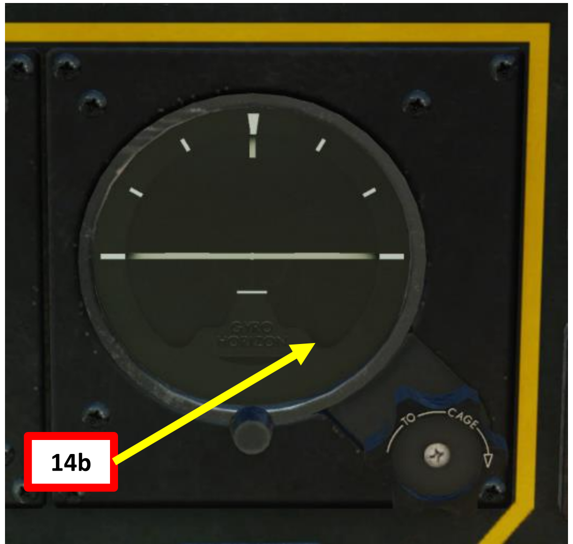


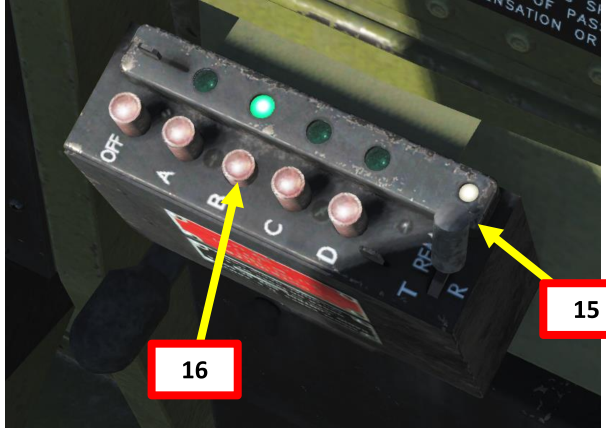
ENGINE START

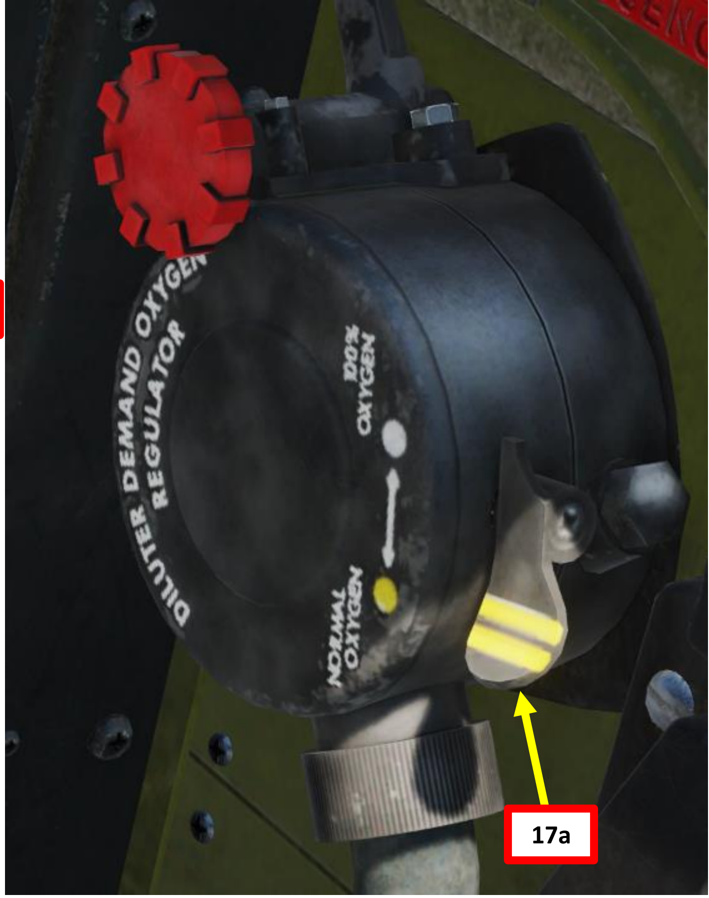
POST-START

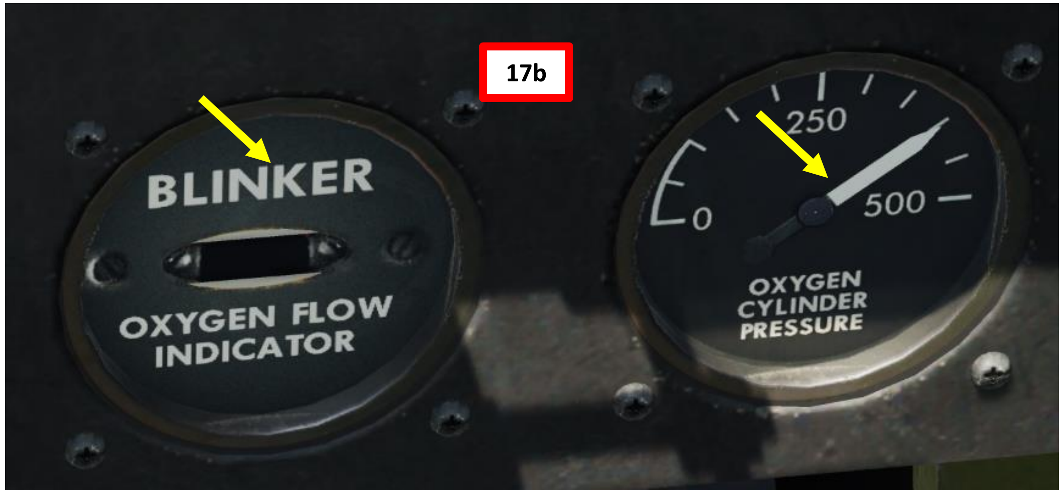
14. Uncage Attitude Indicator by scrolling mousewheel on caging knob
15. Set the radio Transmit-Receive switch to “REM” (Remote Operation)
16. Select desired channel (A, B, C or D)
17. Select Oxygen Mix switch to NORMAL (DOWN)
18. Verify that Oxygen Cylinder pressure is sufficient and that Oxygen Flow Indicator (Blinker) indicates oxygen flow (.

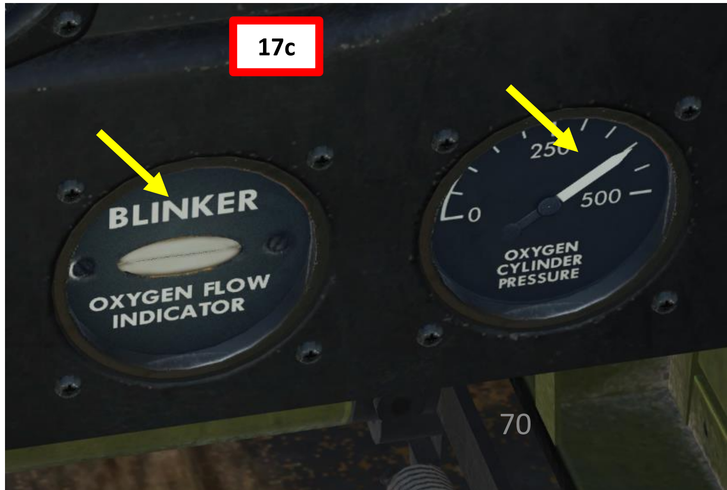












POST-START

19. As engine power increases, the hydraulics will kick in automatically, raising your flaps up gradually as hydraulic pressure increases.

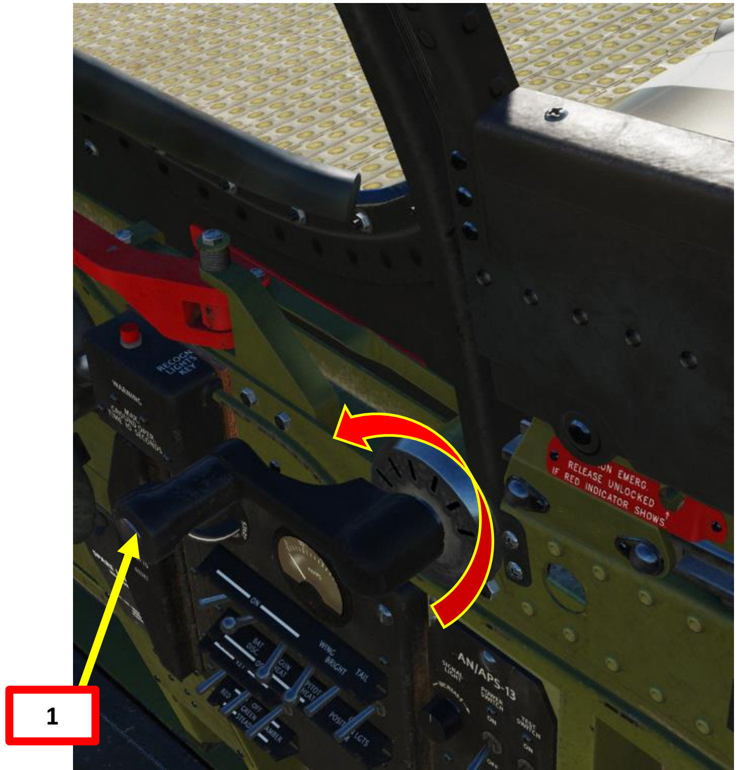
ENGINE WARM-UP

1. Ensure oil pressure is at least 60 psi.
   - If there is no oil pressure after 30 seconds running or if the pressure drops to 0 after a few minutes of ground operation, stop the engine immediately and investigate to prevent excess wear and damage.
2. Adjust throttle to reach a RPM between 1000 and 1200 (IDLE range).
3. Wait until engine oil warms up to at least 15 deg C and coolant temperature is at least 60 deg C.
4. Start taxiing when engine is warmed up by releasing the Parking Brake (tap wheel brakes).

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 this engine leaves no room for error when engine temperatures are concerned.*

TAXI PROCEDURE

1. Close canopy by turning the Canopy crank.
2. Taxi to the runway when ready. Be careful not to overheat your engine on the ground.

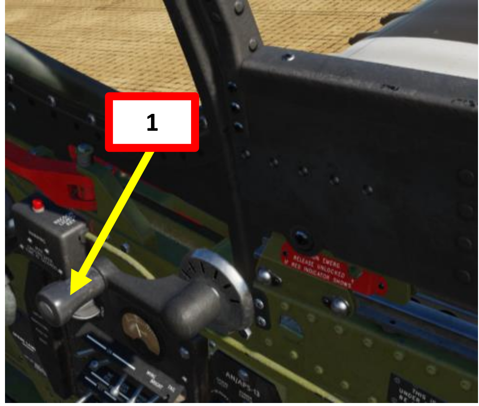


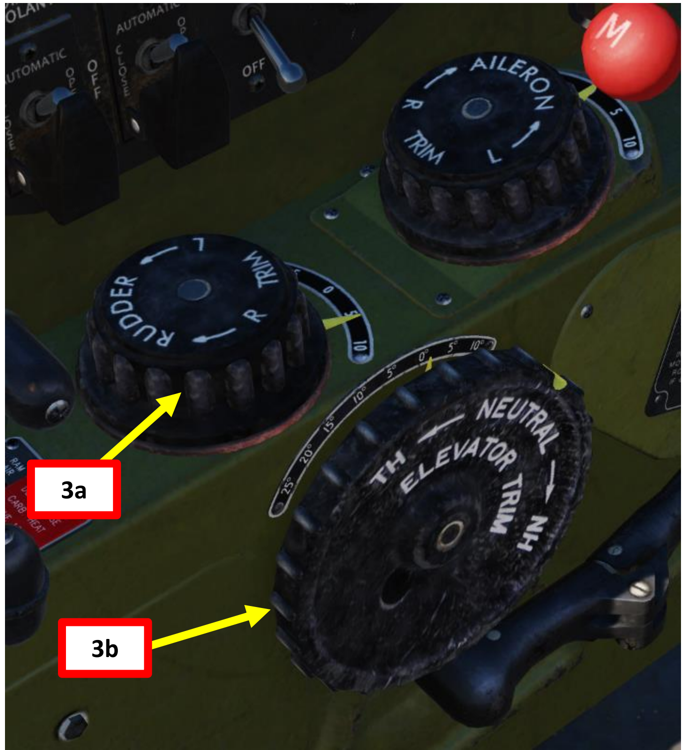
TAXI PROCEDURE

3. Tap toe brakes to release the parking brake. The disc-type wheel brakes are hydraulically-actuated.
4. Throttle up to gain forward motion. Taxiing should be done at 10-15 mph maximum.
5. The nose restricts forward visibility. This means that in taxiing, you must zig-zag (or "S-turn") continually. If you want to go straight, pull the stick fully back to lock the tailwheel in position.
6. To perform a turn, use differential braking by gently tapping the wheel brake pedal on the side you wish to turn.

TAKEOFF PROCEDURE

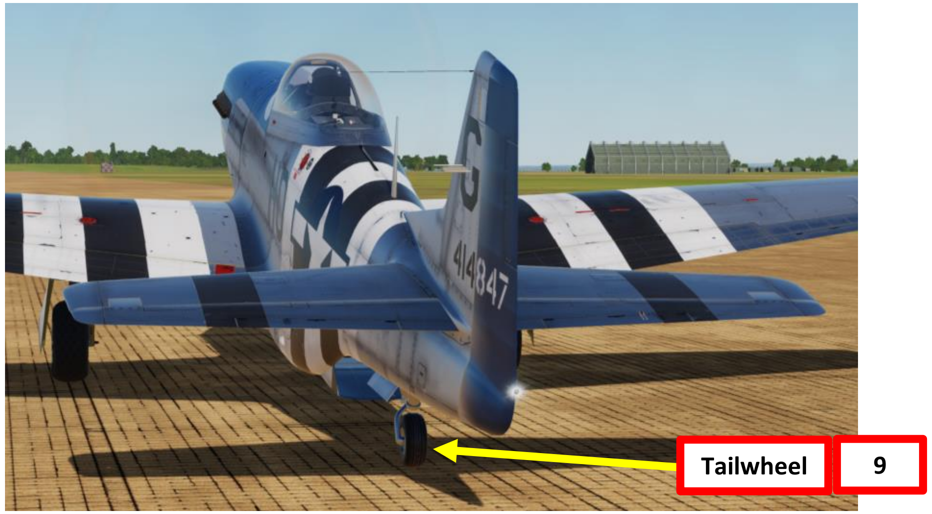
1. Line up on the runway and verify the canopy is closed.
2. Set Flaps Lever – UP for normal weight configurations, or 10-20 deg for heavy configurations (bombs/rockets).
3. Verify takeoff trim configuration:
   a) Rudder Trim: 6 deg right
   b) Elevator Trim: 2 deg nose heavy with no drop tanks, or 4 deg nose heavy with drop tanks
4. Set Propeller Pitch/RPM Control Lever Fully FWD to increase controlled RPM to 3000
5. Throttle up to move forward and ensure the tailwheel is straightened out. Then, pull your stick back to lock your tailwheel
6. Press and hold the Wheel Brakes Pedals
7. Smoothly increase throttle to 35 in Hg of Manifold Pressure (never jam the throttle forward).
8. When you reach 35 in Hg of Manifold Pressure, release brakes and gradually throttle up to 61 in Hg (Takeoff Power). A lower power setting of 55 in Hg may be used for formation takeoffs.





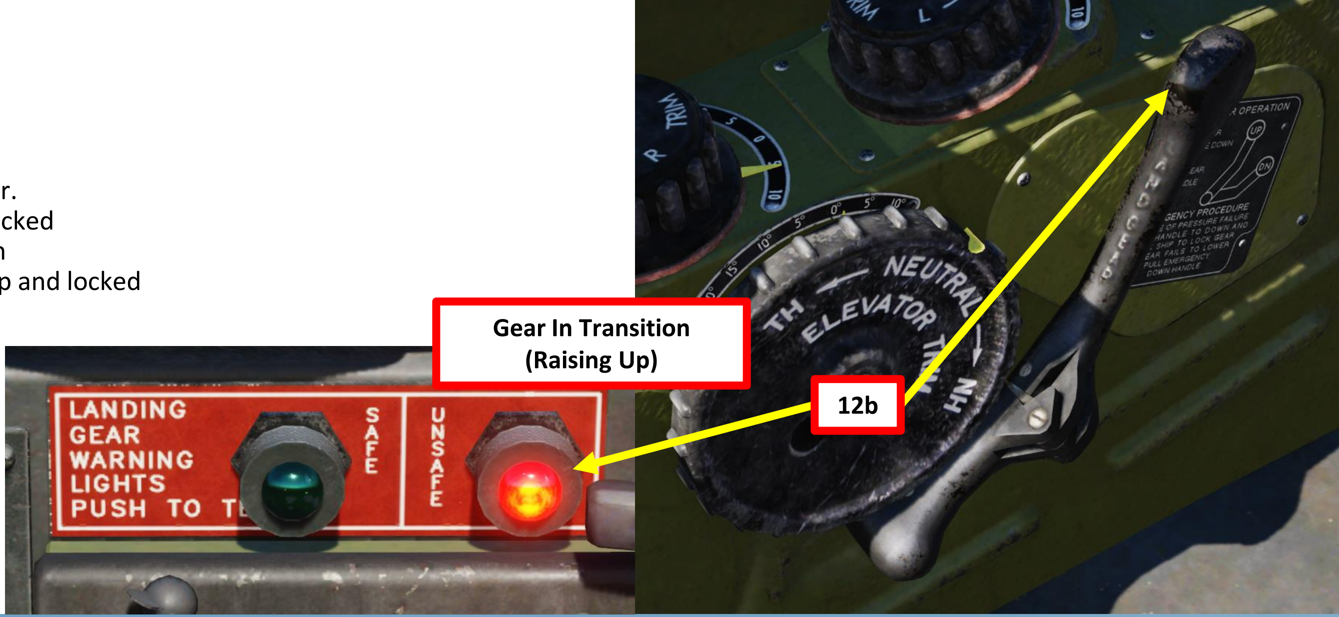
TAKEOFF PROCEDURE

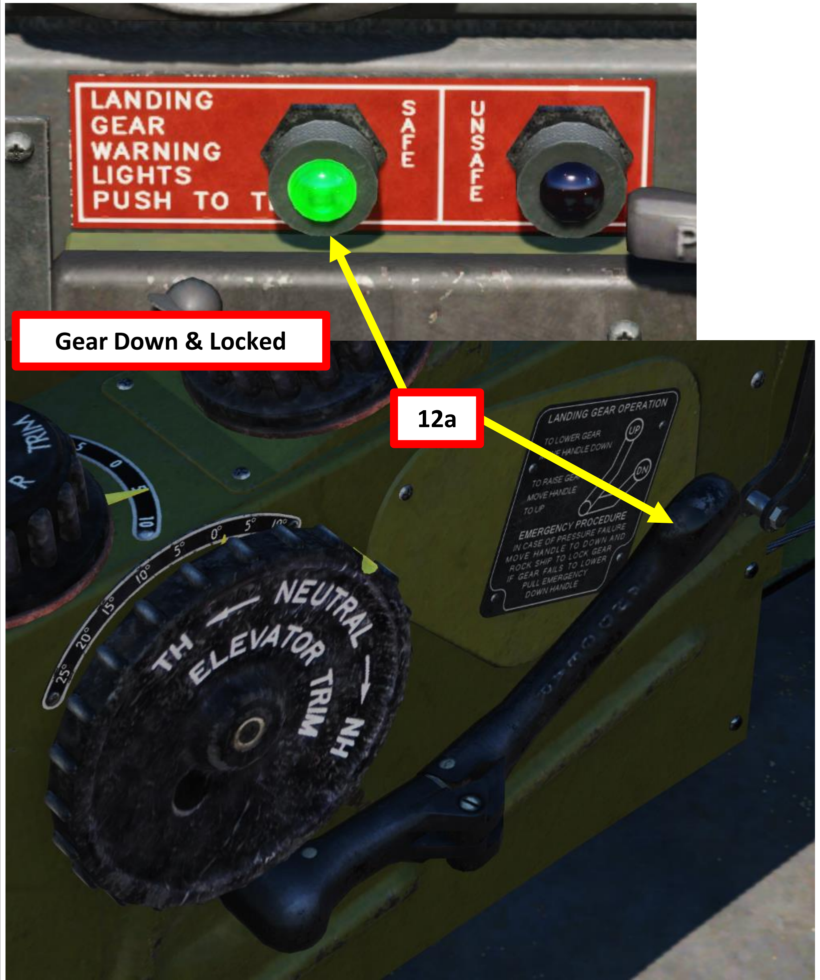
9. Do not use your brakes to steer your aircraft. Keep the stick pulled aft to keep the tailwheel straight.
10. Use your rudder to make small adjustments and counter engine torque.



TAKEOFF PROCEDURE

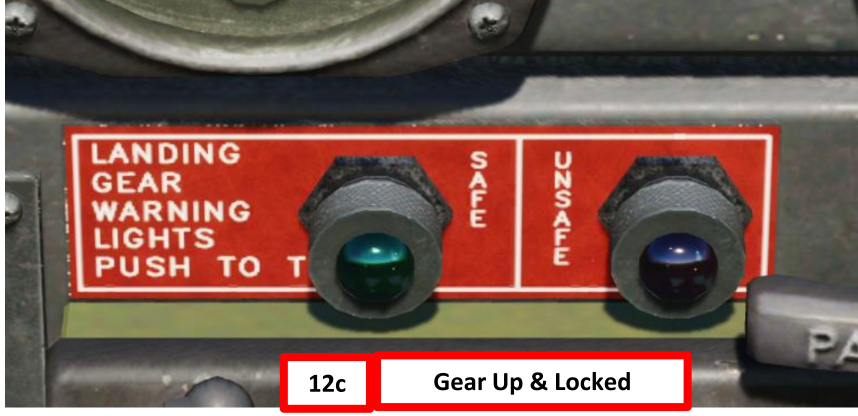
11. At 100 mph, center your control stick to allow you to pick up airspeed
12. At 120 mph, rotate and retract your landing gear by pulling up the Landing Gear lever.
    a) Landing Gear SAFE Warning light (green) illuminates when gear is down and locked
    b) Landing Gear UNSAFE Warning light (red) illuminates when gear is in transition
    c) Both Landing Gear SAFE and UNSAFE Warning lights extinguish when gear is up and locked



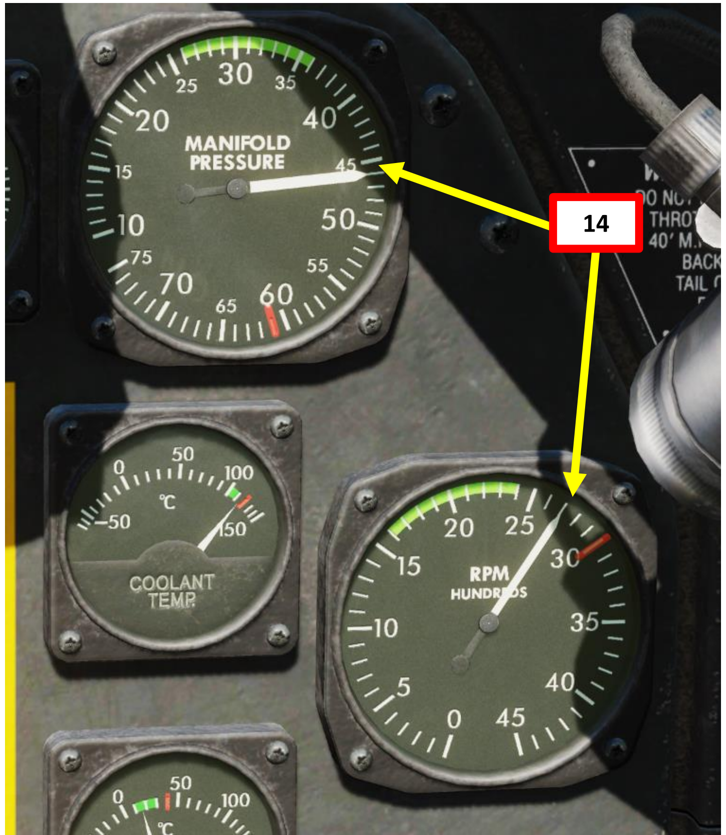


TAKEOFF PROCEDURE

12. At 120 mph, rotate and retract your landing gear by pulling up the Landing Gear lever.
    a) Landing Gear SAFE Warning light (green) illuminates when gear is down and locked
    b) Landing Gear UNSAFE Warning light (red) illuminates when gear is in transition
    c) Both Landing Gear SAFE and UNSAFE Warning lights extinguish when gear is up and locked
13. After takeoff, it's important to **avoid braking the wheels to stop them from turning**. If the brakes are hot from excessive ground use, they are likely to freeze/lock. The design of the gear and the wheel wells is such that under normal conditions the turning of the wheels has no harmful effect even after they have been retracted into the wheel wells.
14. When landing gear is up and locked, adjust manifold pressure to 46 in Hg with the throttle and reduce RPM to 2700 using the Propeller Pitch/RPM Control Lever (Maximum Continuous Power).
15. Start climbing.



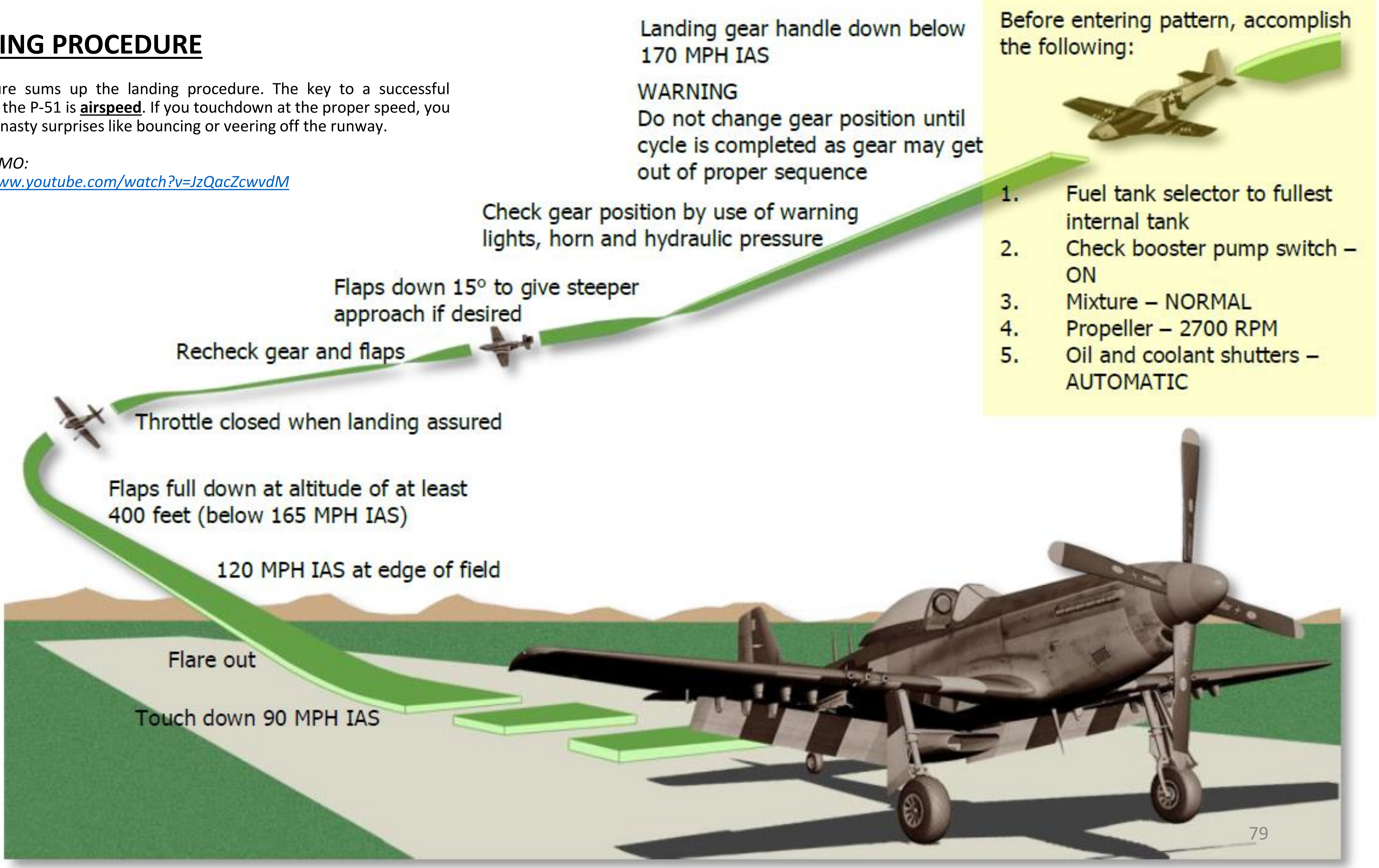
VIDEO DEMO:
https://www.youtube.com/watch?v=xdx8kVWL70M



LANDING PROCEDURE

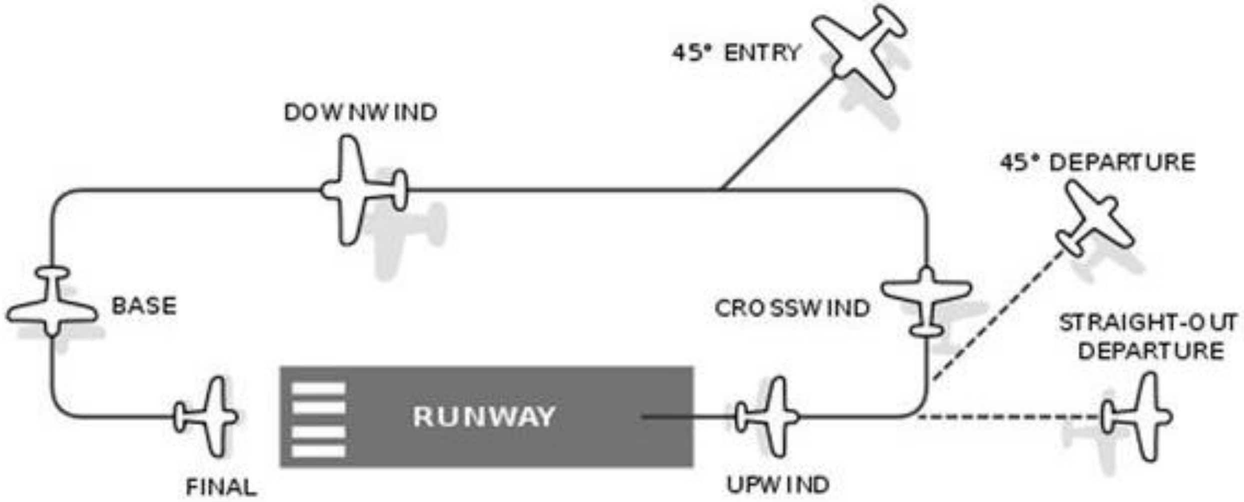
This picture sums up the landing procedure. The key to a successful landing in the P-51 is **airspeed**. If you touchdown at the proper speed, you will avoid nasty surprises like bouncing or veering off the runway.

VIDEO DEMO:
https://www.youtube.com/watch?v=JzQacZcwvdM



LANDING PROCEDURE

1. Fuel – select fullest internal tank for landing.
2. Set Propeller RPM control lever – 2700 RPM.
3. Enter downwind leg at 1000 ft altitude.

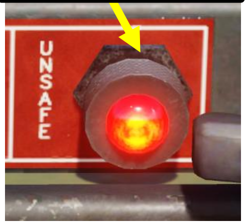


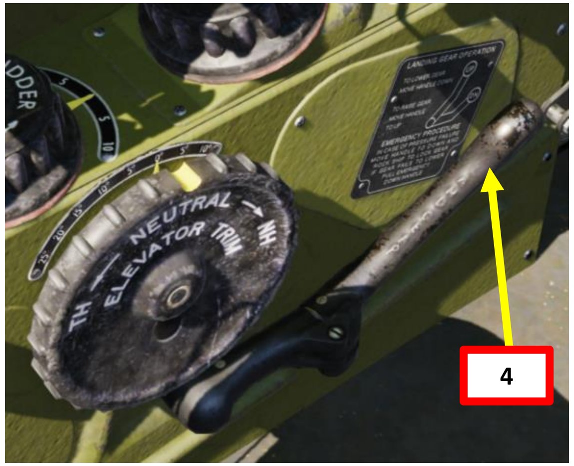
LANDING PROCEDURE

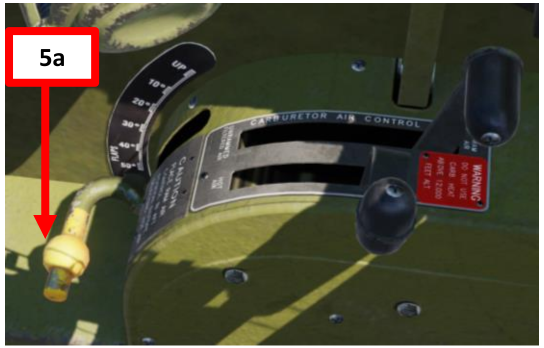
4. Landing gear – move lever to DOWN. Check indicator to see that the gear is down and locked. Note, the gear should be lowered below 170 mph.
5. Flaps – full down. Note, flaps are usually lowered for the turn to final approach. Only lower flaps below 165 mph.
6. Maintain approximately 150 mph IAS in the traffic pattern
7. When sure of a correct landing approach in final, close/cut the throttle.
8. Just before getting to the runway, break the glide with a controlled flare and approach so as to land within the first third of the runway in a 3-point attitude.
9. Hold the aircraft in the 3-point attitude just above the runway until flying speed is lost and the plane sets down at approximately 90 mph.
10. The tail wheel is locked when the stick is neutral or aft, so steering is limited after touchdown. Keep the stick held back until enough speed is lost and you are ready to turn off the runway and taxi.

- *Note: The* ***red Unsafe light*** *will turn on and a horn alert will sound in the cockpit when the throttle is retarded below the minimum cruise condition while the landing gear doors are closed and the gear is up and locked, or at any throttle position if the landing gear doors are open and the gear is down and unlocked or up and locked.*

Red Unsafe Light







Gear Up & Locked

Gear In Transition (Lowering Down)

Gear Down & Locked

LANDING PROCEDURE

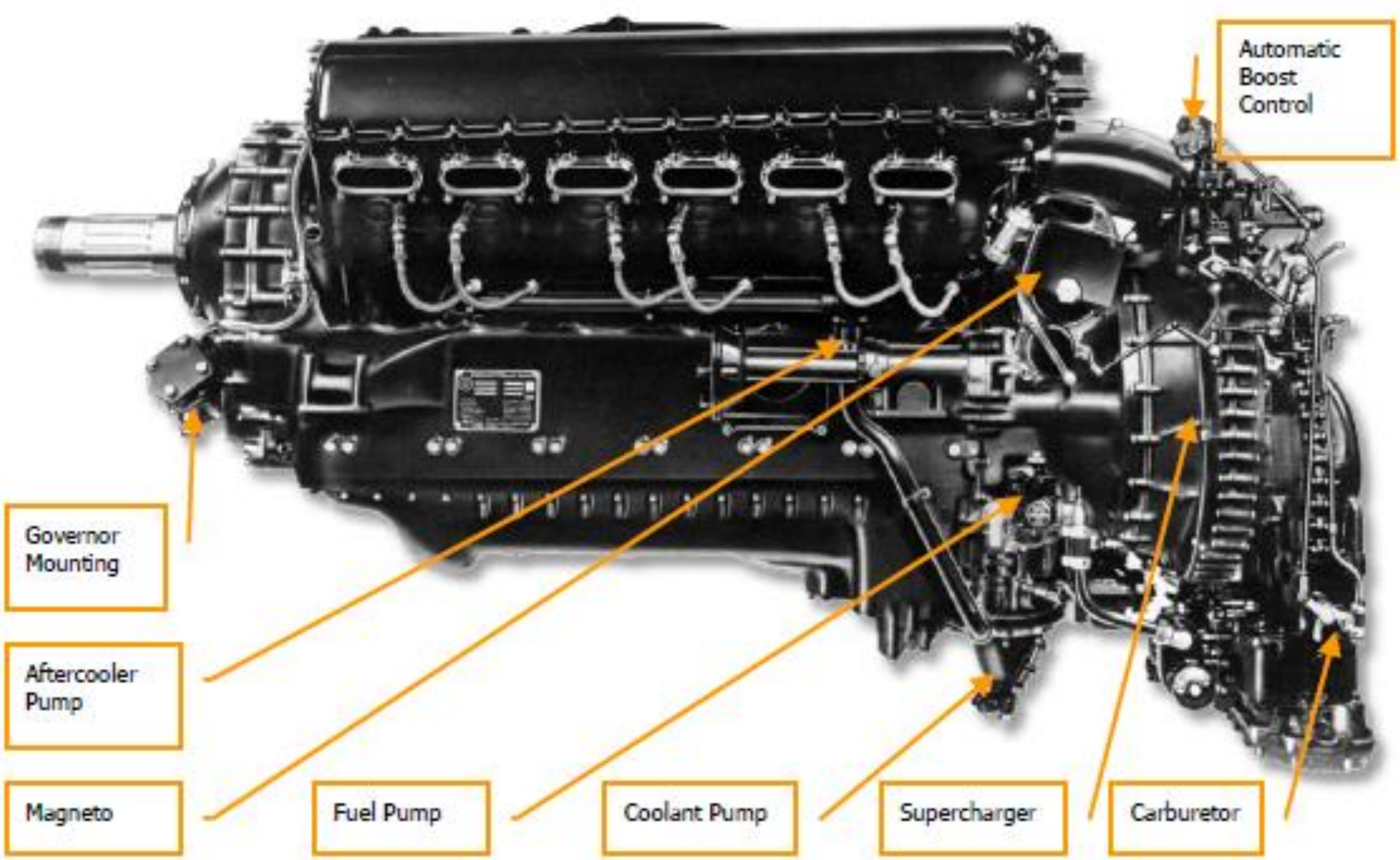
LANDING PROCEDURE

LANDING PROCEDURE

PACKARD V-1650 MERLIN ENGINE

The powerplant of the P-51D is a liquid-cooled, 12-cylinder Rolls-Royce Merlin V-1650-7, built in the U.S. by the Packard Motor Car Company. It is equipped with an injection-type carburetor, a two-speed, two-stage supercharger, and develops over 1400 hp on takeoff.

The P-51D has automatic radiator coolant and oil radiator controls, which can be overridden manually. The pilot can monitor engine RPM, manifold pressure, oil pressure, oil temperature, fuel pressure, carburetor temperature and coolant temperature. Each parameter has specific limitations that you should be aware of AT ALL TIMES. The engine limitations are listed in this section.

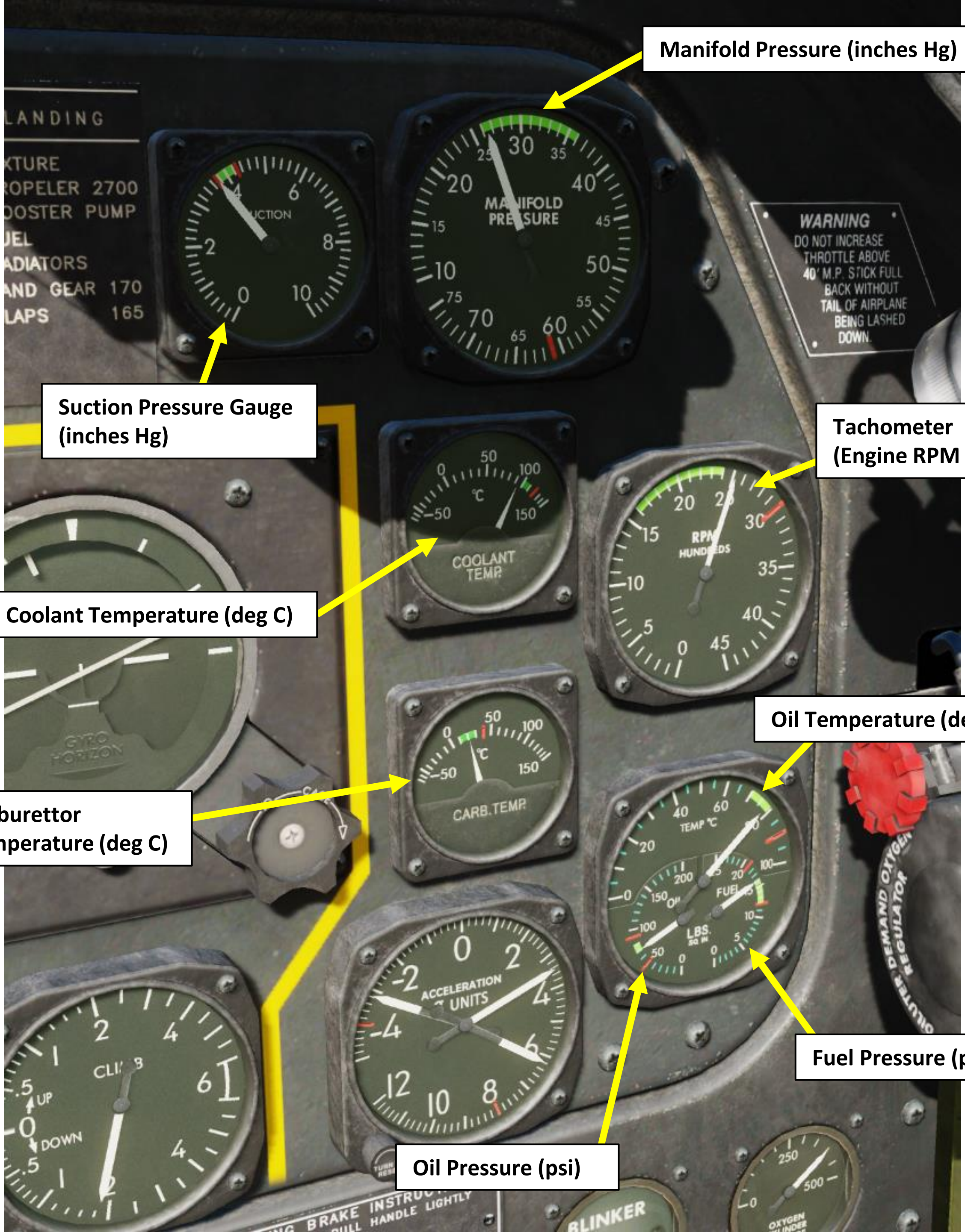


ENGINE INDICATIONS

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. The green range indicates normal operating RPM of 1600 - 2400. The red line indicates maximum normal RPM of 3000.
- **Manifold Pressure (in Hg)**: Manifold Pressure indicates the air pressure after the supercharger in inches of mercury. The green range indicates the normal operating range of 26-36 in Hg. The red line indicates full military power of 61 in Hg.
- **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.
- **Fuel Pressure Indicator (psi)**: indicates engine fuel pressure.
- **Suction Pressure Indicator (psi)**: indicates engine suction pressure.
- **Carburettor Temperature Indicator (deg C)**: indicates the temperature of the air running through the carburettor air scoop.
- **Supercharger High Blower Indicator Light**: indicates the supercharger is in second gear (high blower).

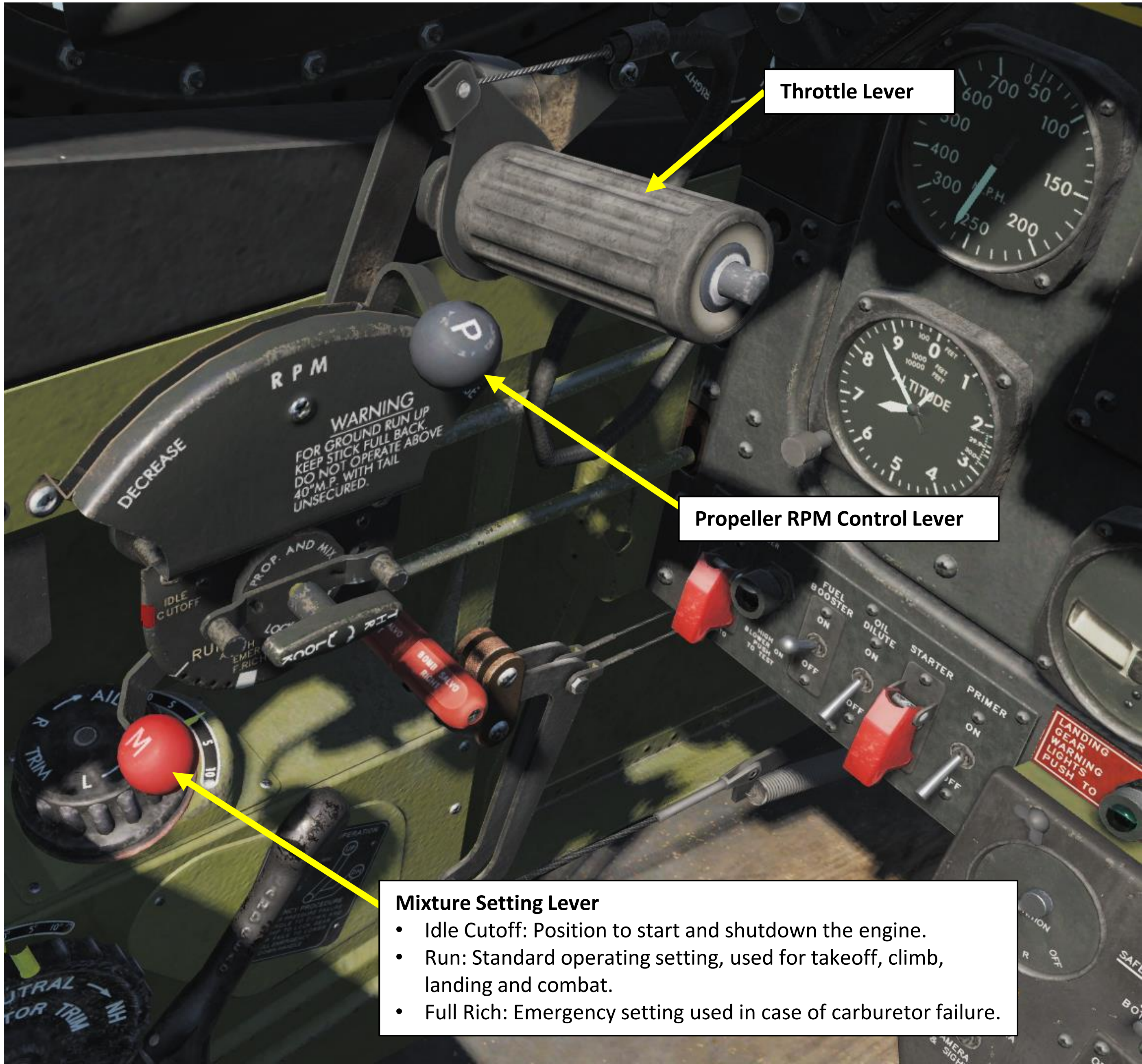
Redlines on the gauges show the value not to exceed of the engine parameter.



ENGINE CONTROLS

The main engine controls of the Mustang are:

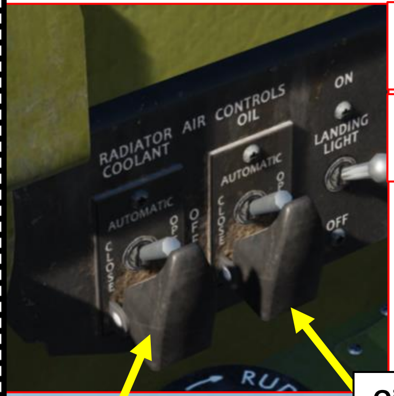
- **Throttle**: Controls manifold pressure.
- **RPM Control Lever**: Controls engine speed turning the constant speed propeller.
- **Mixture Setting Lever**: Controls mixture setting automatically if set to RUN, otherwise an emergency setting is available in case of carburetor failure (FULL RICH).
- **Supercharger Mode Selector**: Controls manual or automatic gear shifting of the supercharger at high altitudes.

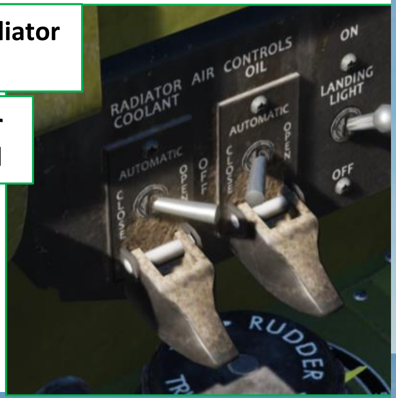


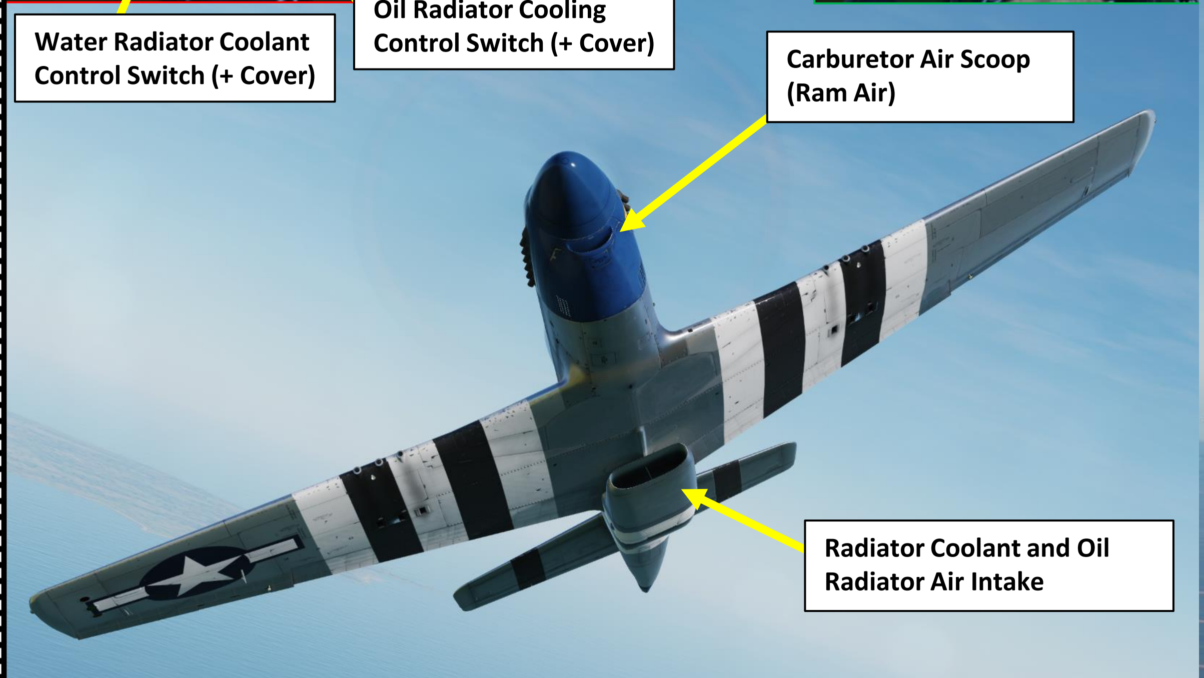
ENGINE CONTROLS

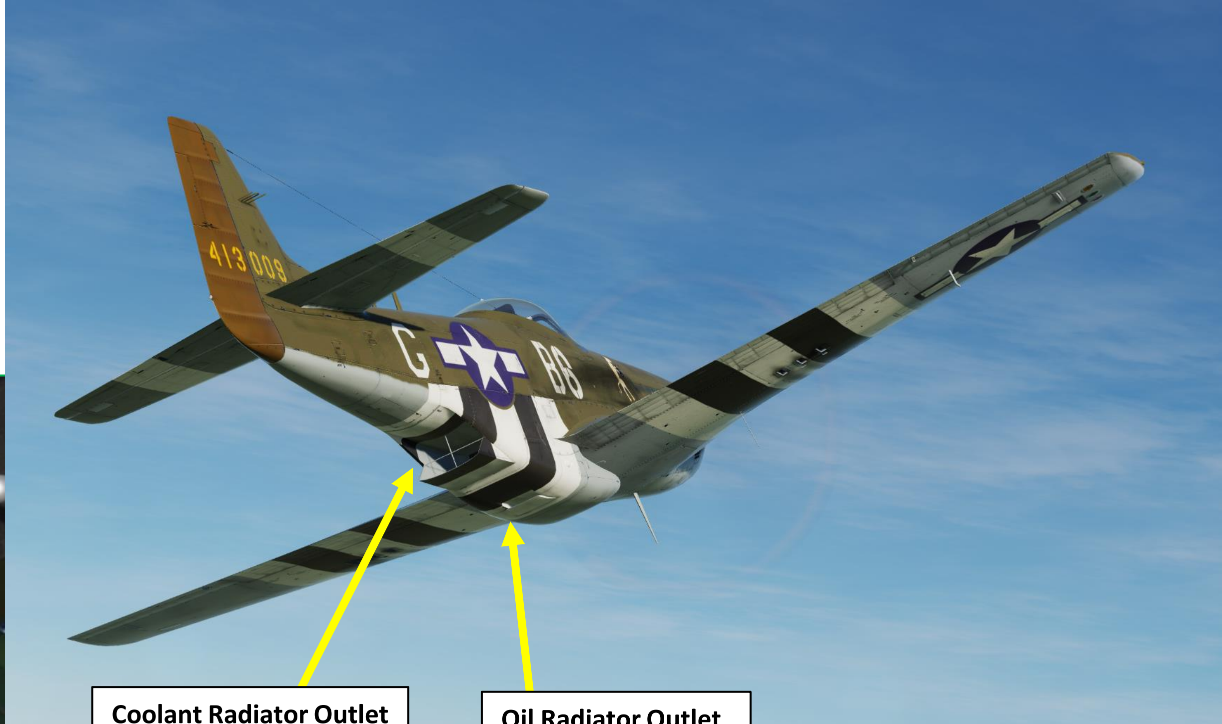
The main engine controls of the Mustang are:

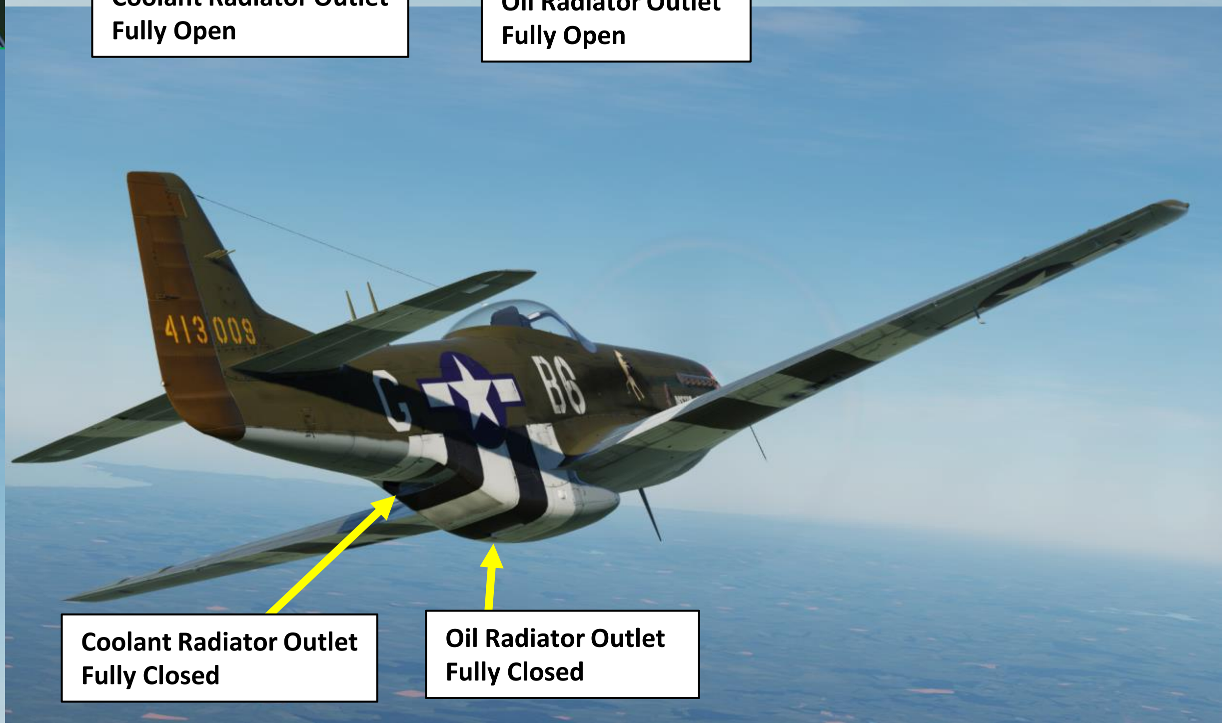
- **Radiator Coolant Control Switch**: Controls coolant radiator outlet door. Switch has 3 positions: automatic (UP), manually close (AFT), and manually open (FWD).
- **Oil Radiator Control Switch**: Controls oil cooler radiator outlet door. Switch has 3 positions: automatic (UP), manually close (AFT), and manually open (FWD).









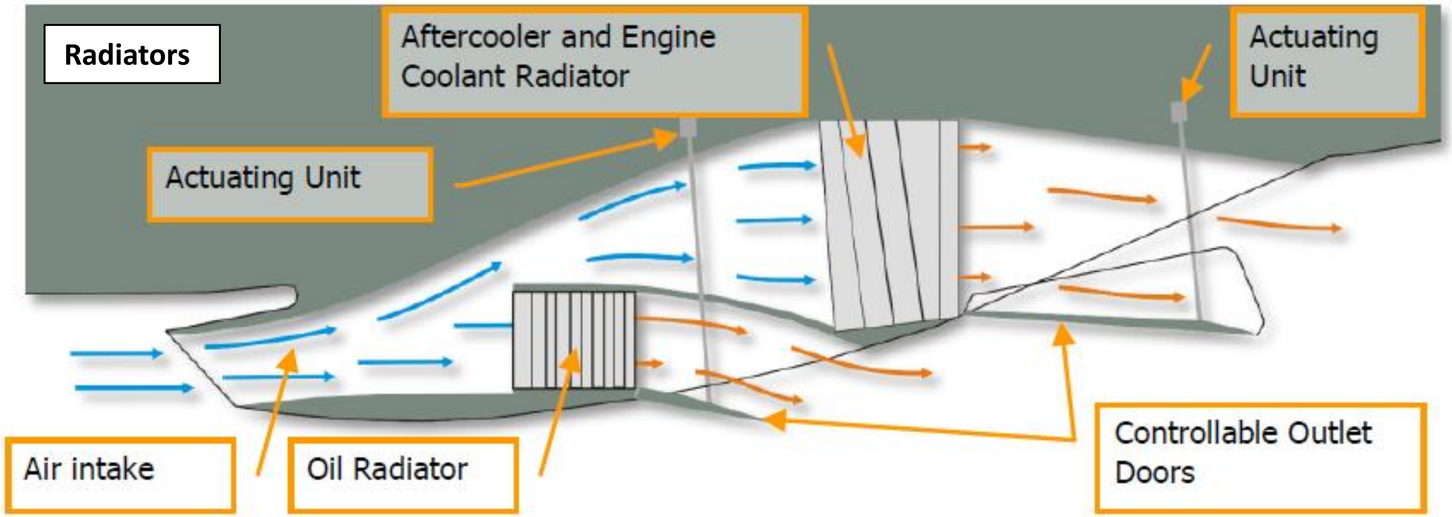


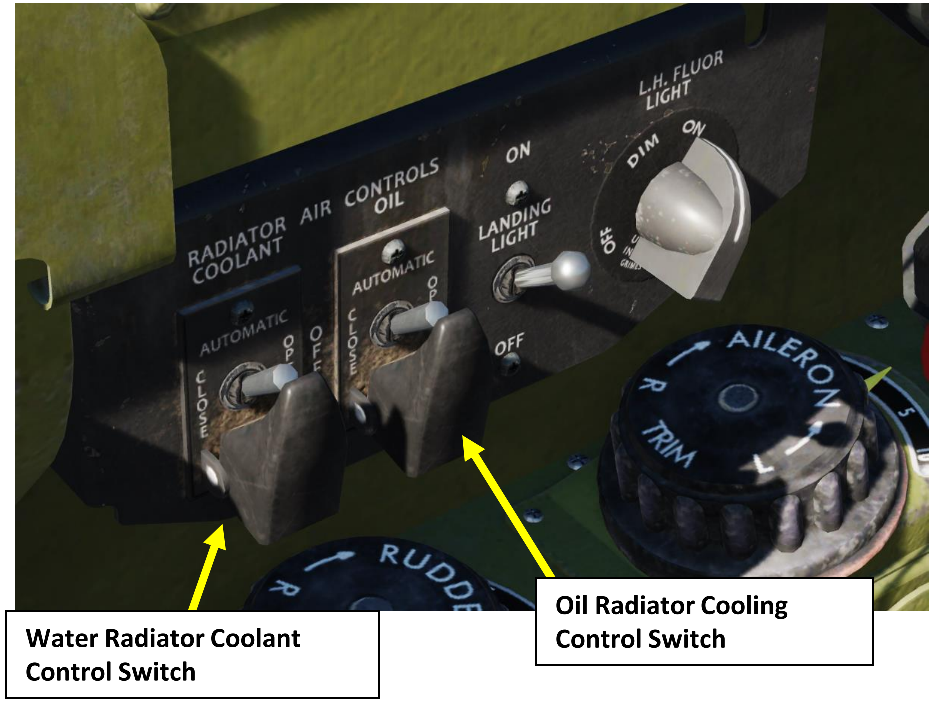
ENGINE CONTROLS

Note on Radiator Operation:

An outlet door on the bottom of the air scoop controls the oil temperature. Under ordinary conditions this door is operated automatically. However, it can be operated manually when running the engine on the ground or in case the automatic regulator fails in the air. This can be done by means of the Oil Radiator Air Control switch, located on the Radiator Air Control panel on the left side of the cockpit. The switch has three positions: AUTOMATIC, OPEN, and CLOSE.

The door can be set in any position by holding the toggle switch in the OPEN or CLOSE position for the necessary length of time (approximately 20 seconds), then returning the switch to neutral.





ENGINE CONTROLS

The main engine controls of the Mustang are:

- **Carburettor Cold Air Control Lever**: Controls cold air outlet.
- **Carburettor Warm Air Control Lever**: Controls hot air outlet.

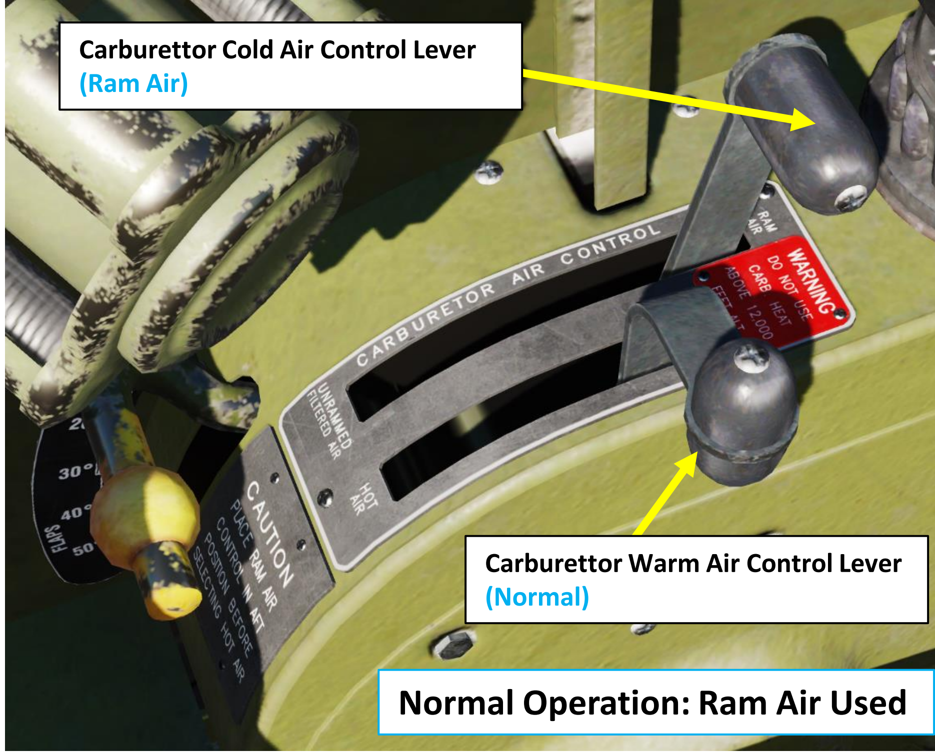
Carburetor air comes through a long carburetor air scoop directly under the engine. The aircraft's motion forces air at high speed (or rams it) directly into the carburetor. This is termed ram air.

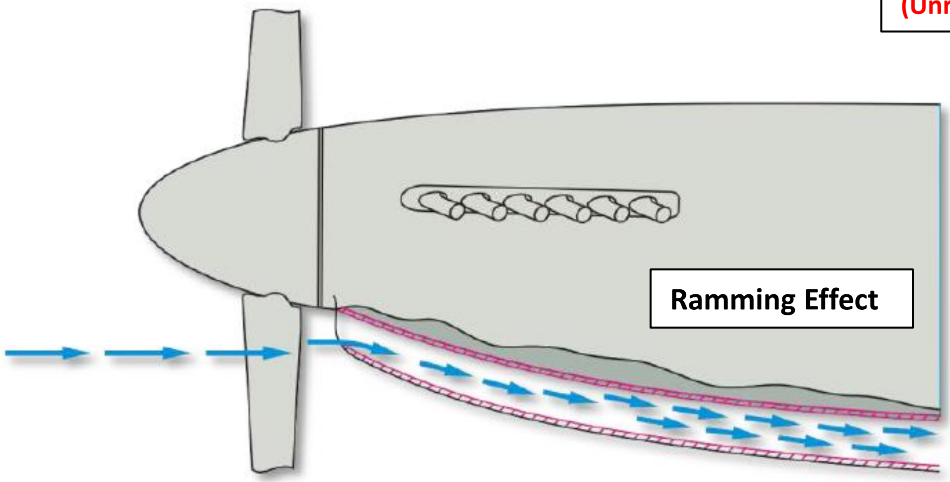
If the scoop becomes obstructed by ice or other foreign matter, a door in the air duct opens automatically to admit hot air from the engine compartment to the carburettor.

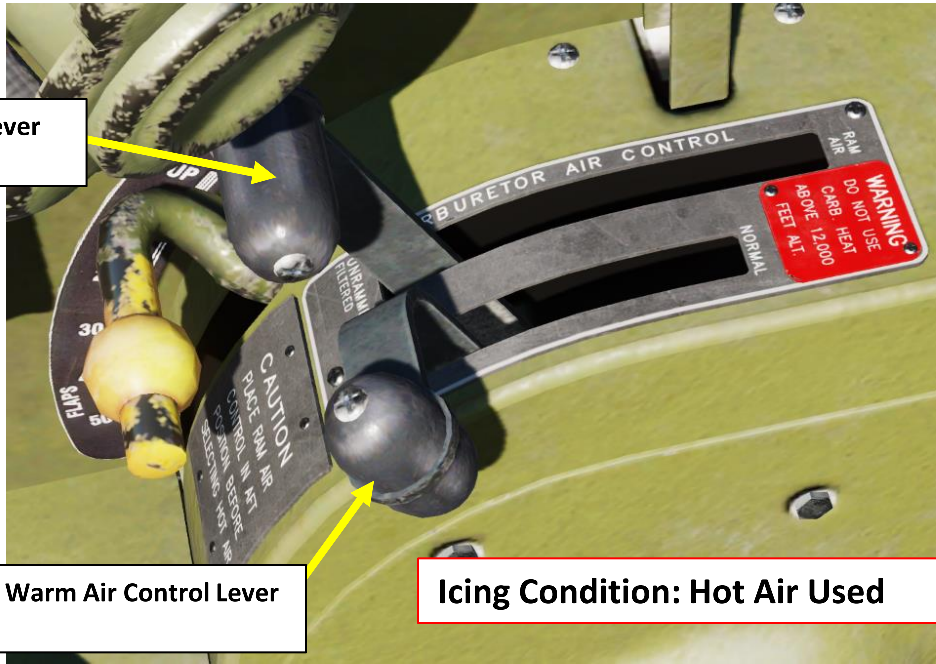
During normal operations, ram air is always used, but in the event of extreme icing or dust conditions, the carburettor air controls allow the pilot to select either unrammed filtered or, in later model aircraft, unrammed hot air for operation.

- In order to obtain hot air:
    - Hot Air control handle must be set to HOT
    - Cold Air control handle set to UNRAMMED FILTERED AIR.
- If the Cold Air control handle is set to RAM AIR, the hot air control will be ineffective.

Note: Hot air should not be used above 12,000 feet. At high altitudes its use affects the carburettor's altitude compensation and may result in an overly lean fuel mixture.







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.

Oil Dilution Switch

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 oil and coolant radiator switches to "MANUAL" mode and set them to the Maximal Open position

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

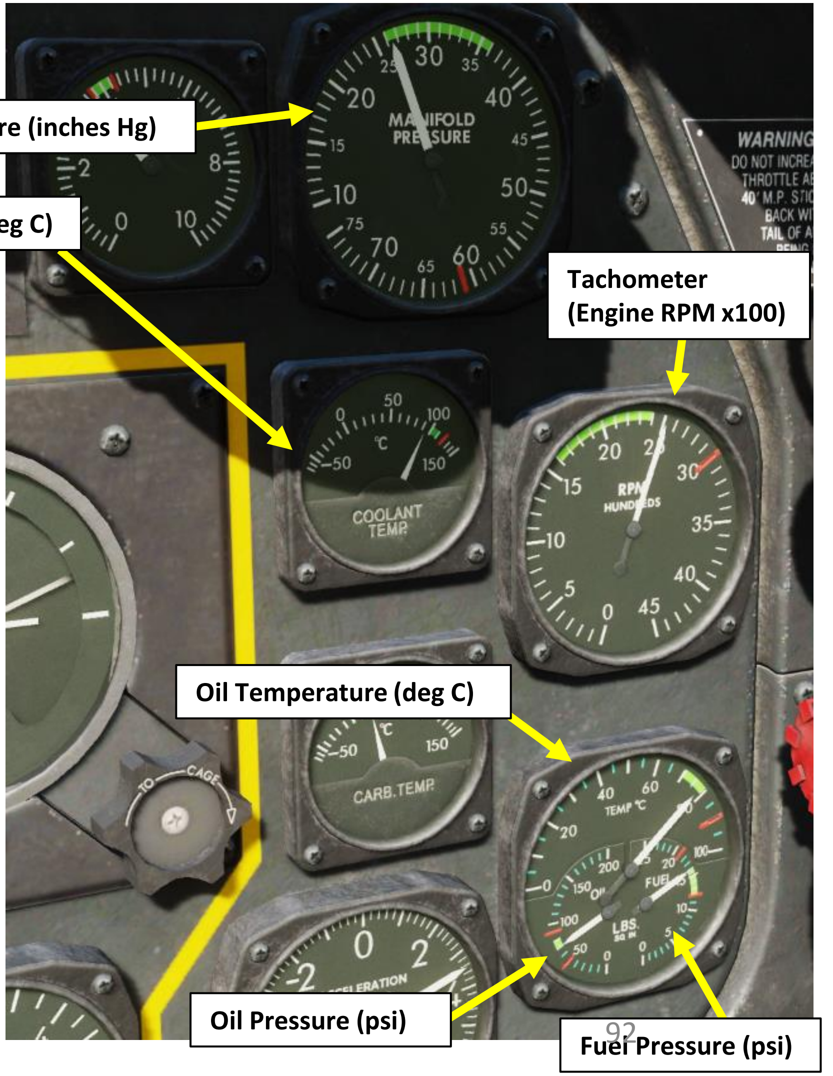


Table of Manifold Pressure & RPM Limits for Flight					
	Maximum Cruise	Maximum Continuous	Takeoff Maximum	Military Power	War Emergency
Manifold Pressure [in.]	42	46	61	61	67
RPM	2400	2700	3000	3000	3000

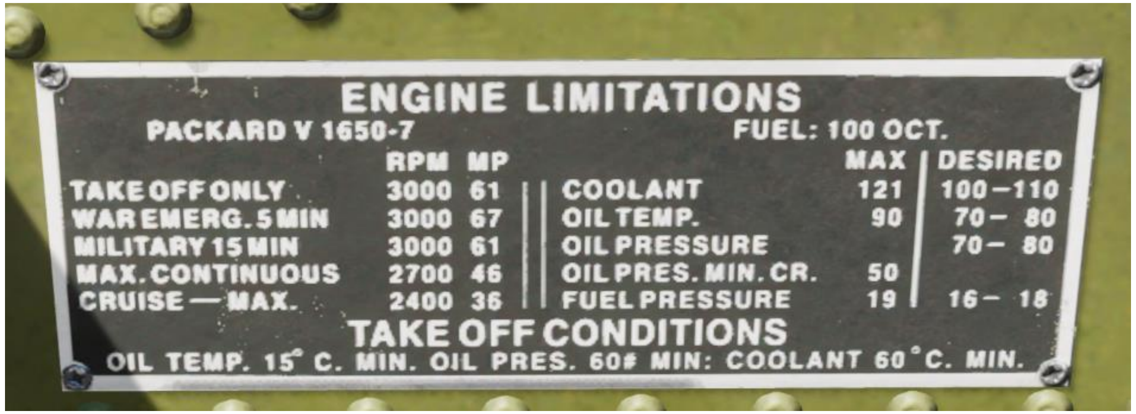
Table of Engine Instrument Limits				
	Coolant Temperature	Oil Temperature	Oil Pressure	Fuel Pressure
Minimum	-	-	50 PSI	14 PSI
Desired	100°-110°C	70°-80°C	70-80 PSI	16-18 PSI
Maximum	121°C	105°C	-	19 PSI

ENGINE OPERATION & LIMITS

Engine Ratings Table

Engine Ratings:

Operating Condition	RPM	MP	HP	Critical Altitude With Ram	Critical Altitude No Ram	Blower	Mixture Control Position	Fuel Flow (Gal/Hr/Eng.) U.S.	Maximum Duration (Minutes)
Take-Off	3000	61	1400	S.L.	S.L.	Low	Run/AR	150	5
War Emergency	3000	67	1595 1295	17,000 28,800	11,700 23,200	Low High	Run/AR Run/AR	166 160	5
Military	3000	61	1450 1190	19,800 31,200	13,700 25,600	Low High	Run/AR Run/AR	158 144	15
Maximum Continuous	2700	46	1120 940	20,500 34,400	17,500 29,500	Low High	Run/AR Run/AR	111 106	Cont.
Maximum Cruise	2400 2400	36 35	790 640	19,500 30,200	17,000 28,200	Low High	Run/AL Run/AL	70 70	Cont.

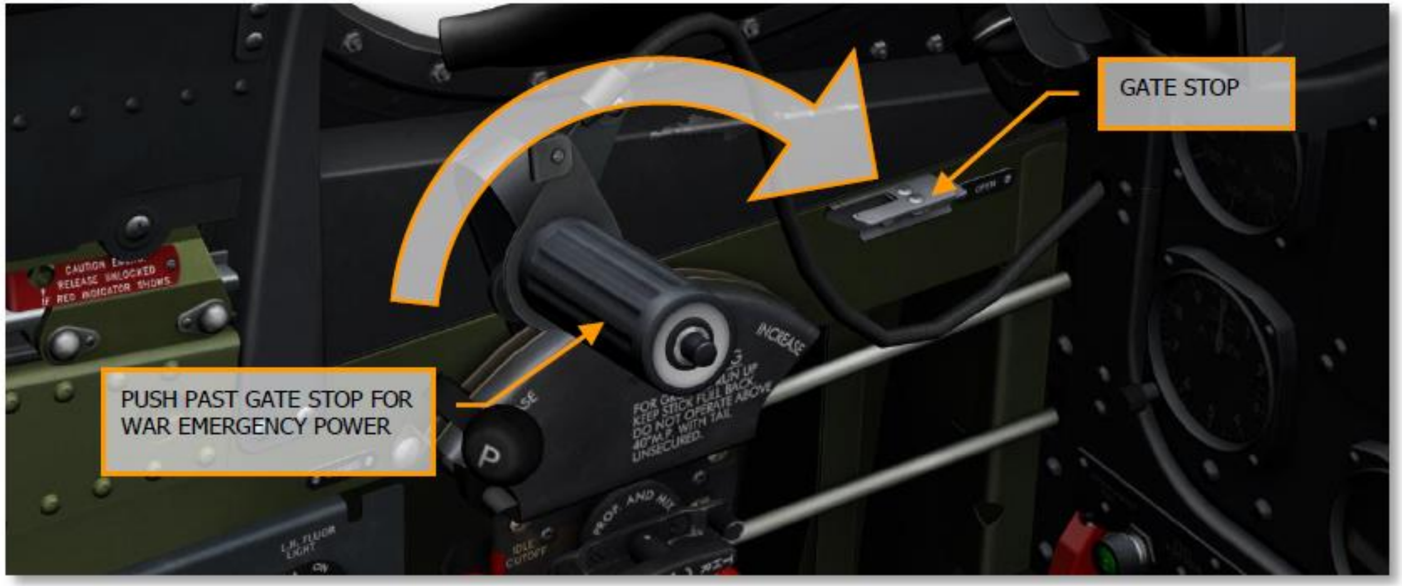


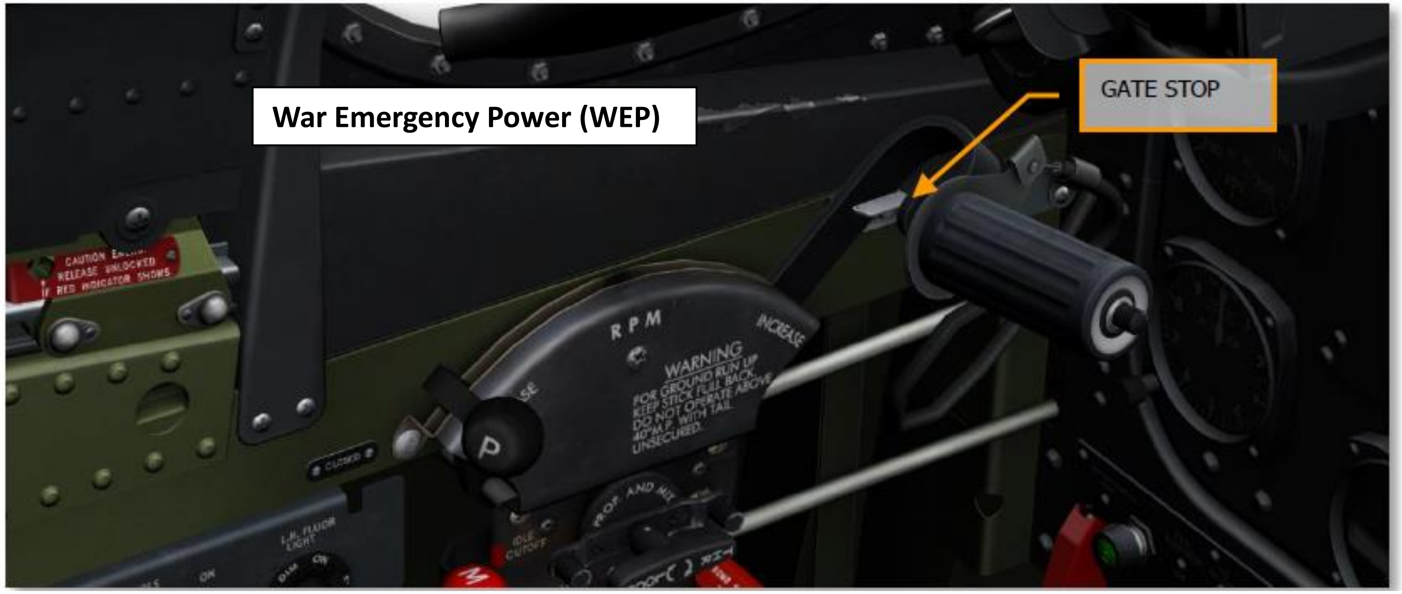
WAR EMERGENCY POWER (WEP)

In order to provide an extra boost to the engine in extreme situations, the throttle can be moved past the gate stop by the quadrant to break the safety wire. The engine will then be opened up to its absolute limit and will give approximately 6 in. of additional manifold pressure in excess of the normal full throttle setting of 61 in. (with mixture control set to RUN or AUTO RICH and prop set for 3000 RPM.) This throttle reserve is called War Emergency Power (WEP) and should be used only in extreme situations. If used for more than 5 minutes at a time, vital parts of the engine may be damaged.

WEP provides no benefit at altitudes below 5,000 feet. The throttle alone provides more than enough power to exceed the operating limits of the engine at these altitudes.

When running in War Emergency Power, the manifold pressure can be increased to a maximum of 67 inHg.





SUPERCHARGER BASICS

A **<u>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.</u>** 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 **<u>the air is less dense at the higher altitude</u>**. 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.

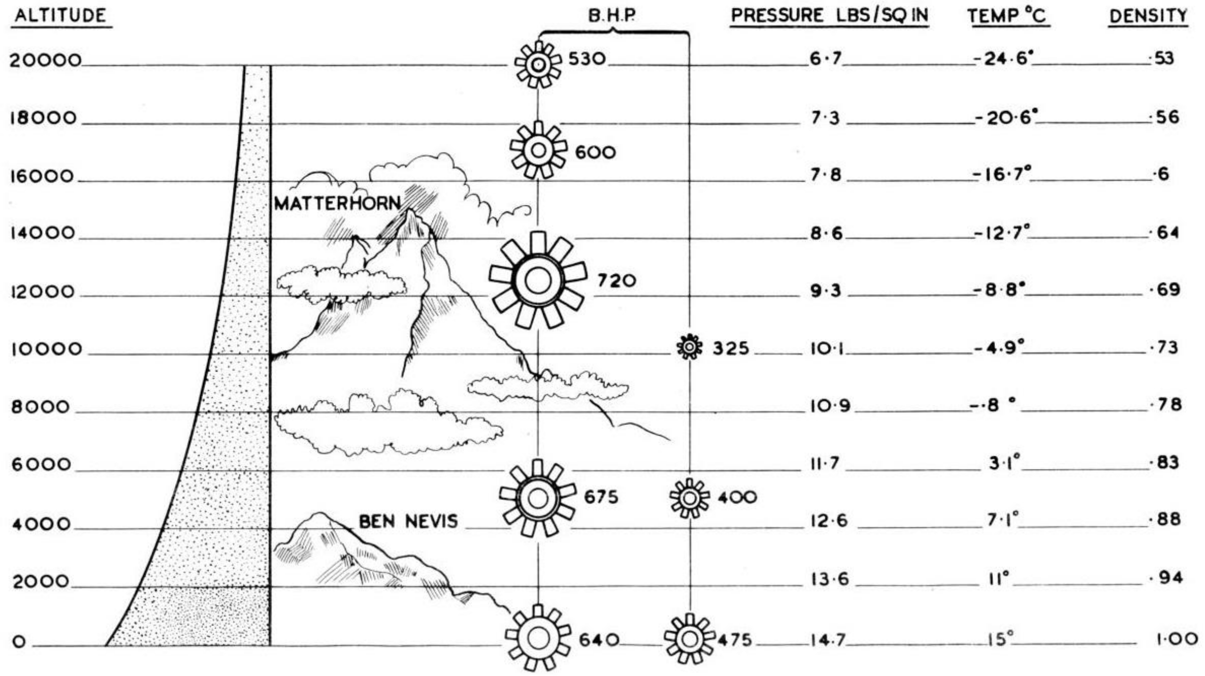
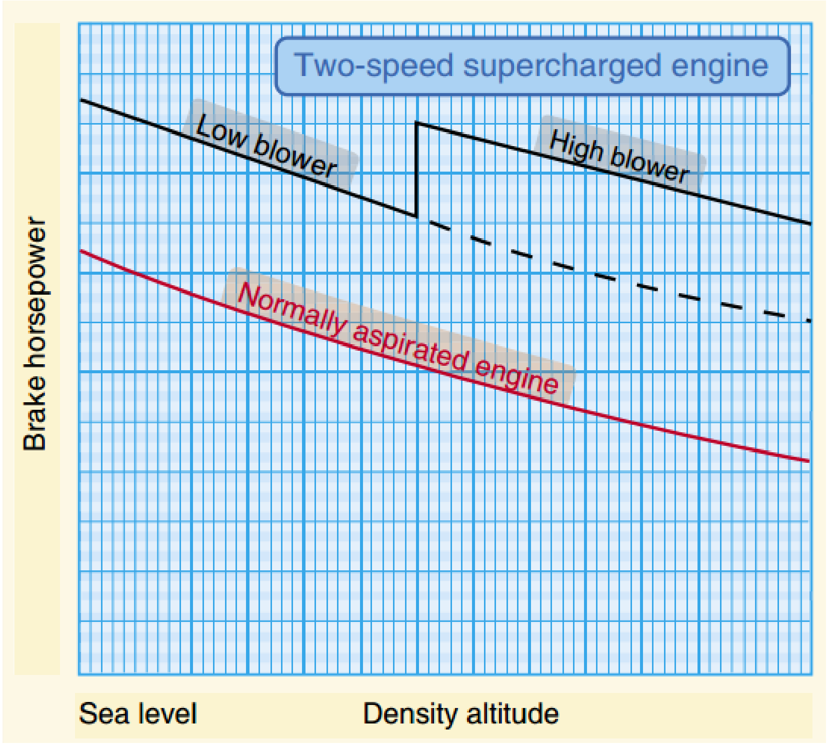


DIAGRAM SHOWING ATMOSPHERIC AND POWER VARIATIONS



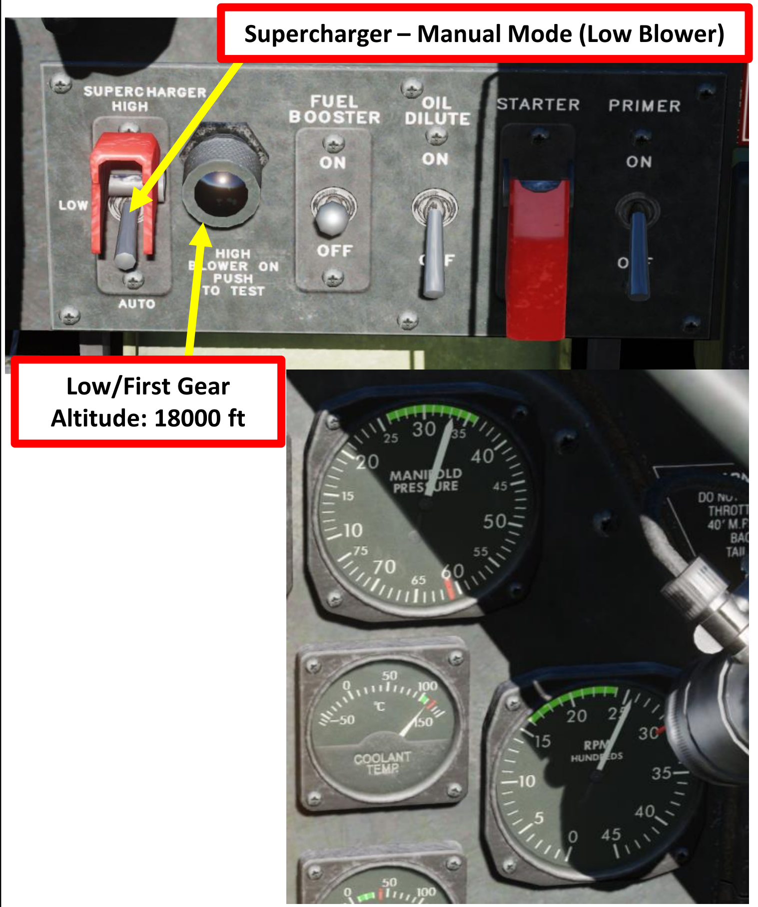
SUPERCHARGER OPERATION

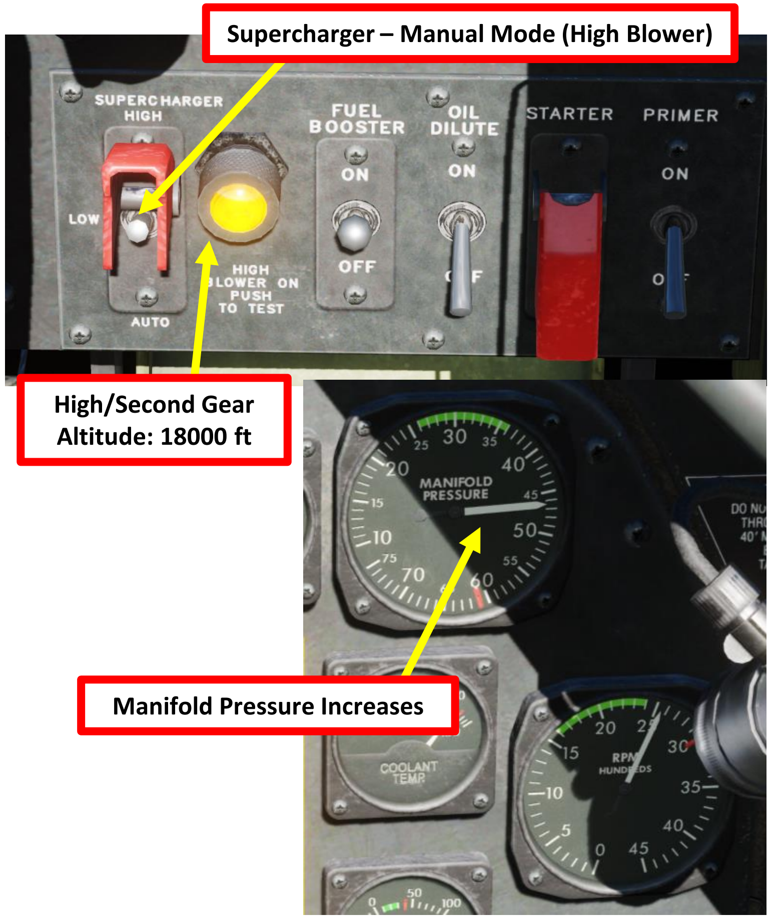
First Gear = Low Blower = Low Manifold Pressure = used between 0 and 14500 ft
Second Gear = High Blower = High Manifold Pressure = used at 14500 ft or higher

The supercharger installed on the Packard Merlin engine includes two compressor stages that deliver air from the carburetor intake to the pistons under much greater pressure than would be possible through direct aspiration, allowing a greater fuel-air mixture to be burned and increasing power output.

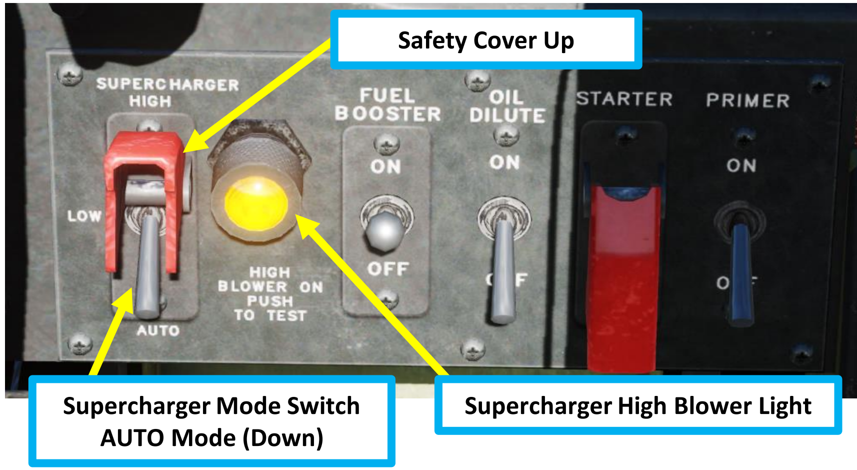
The supercharger works in either low or high blower mode, selection of which can be automatic or manually set by the pilot. In normal operations, high blower mode starts automatically from 14,500 to 19,500 feet, depending on the amount of ram air being delivered through the carburetor. The supercharger increases the blower-to-engine compression ratio from a low of 5.8 to 1 to a high of 7.35 to 1.

The supercharger can be controlled manually by a switch on the instrument panel. The switch has three positions – AUTOMATIC (DOWN), LOW (MIDDLE), and HIGH (UP). Usually, I would recommend that you set it to AUTO to avoid having to manage the supercharger.





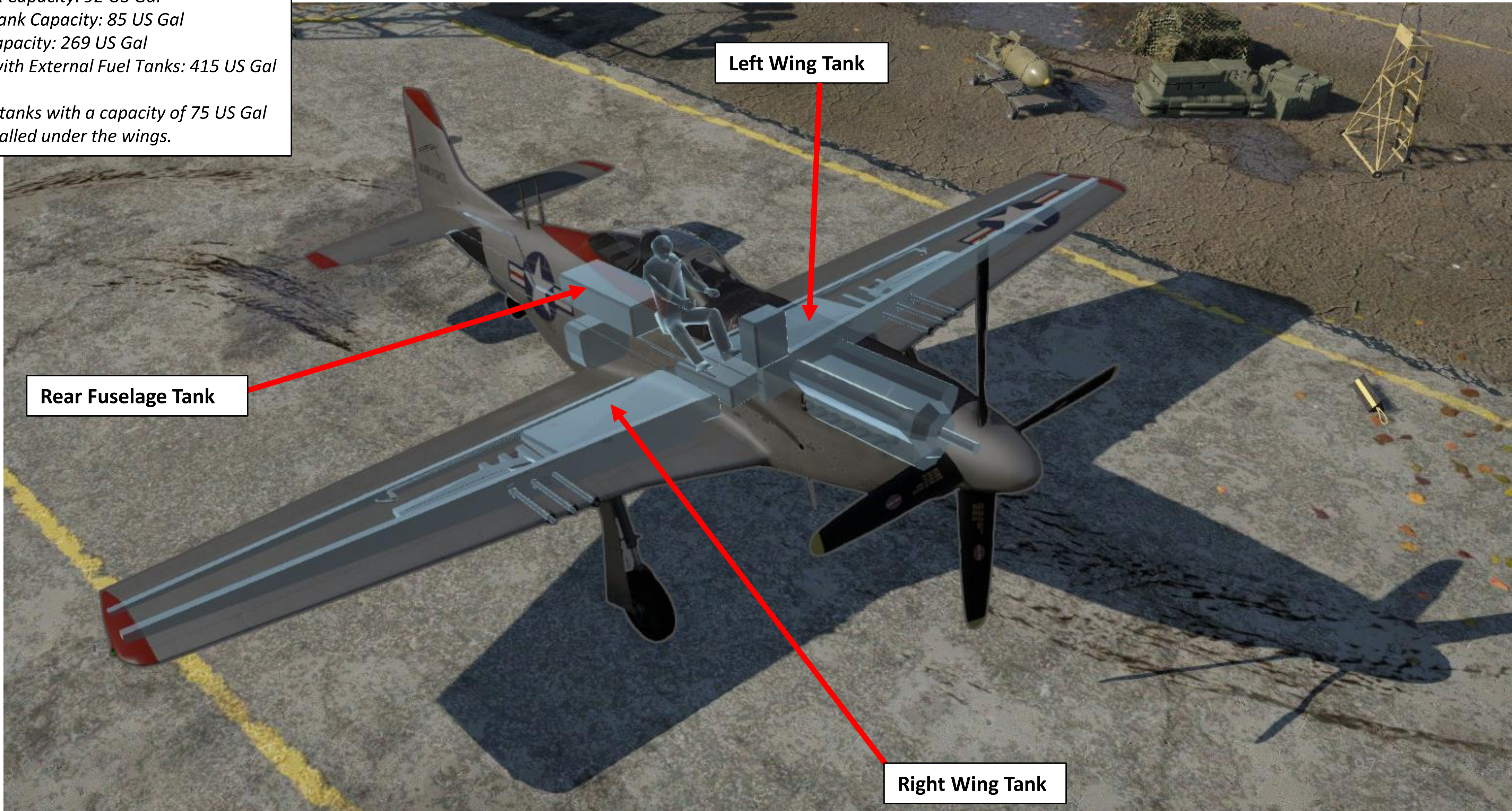
SUPERCHARGER IN AUTOMATIC MODE



FUEL TANKS

Fuel Capacity
Left Wing Tank Capacity: 92 US Gal
Right Wing Tank Capacity: 92 US Gal
Rear Fuselage Tank Capacity: 85 US Gal
Total Internal Capacity: 269 US Gal
Total Capacity with External Fuel Tanks: 415 US Gal

Note: Two drop tanks with a capacity of 75 US Gal each can be installed under the wings.



FUEL MANAGEMENT

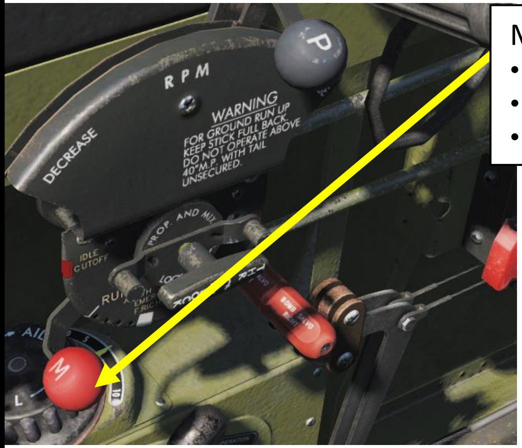
The tanks are not interconnected and it is necessary to switch from one tank to the other to maintain balance. The three booster pumps are controlled by a single switch on the front switch panel. Selection between the tanks is performed by turning the booster pump switch to ON, then turning the fuel selector valve to the desired tank.

Fuel capacity is monitored using the Fuel Gauges for the main and fuselage tanks. No gauges for drop tanks are available.

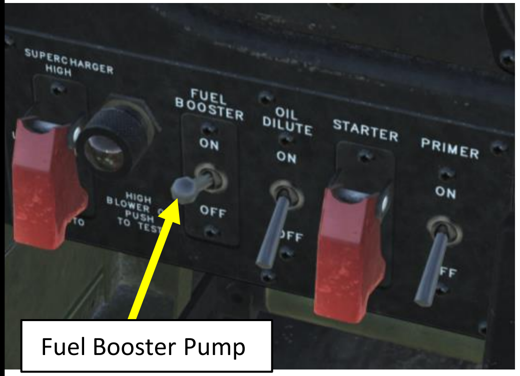
When changing tanks, don't stop the selector valve at an empty tank position, or at a droppable tank position if no droppable tanks are equipped. Starving the engine of fuel will result in engine failure. In such a case, perform the following steps immediately:

1. Turn the fuel selector to a loaded tank
2. Make sure that the booster pump switch is ON
3. As the engine takes hold, adjust the throttle setting as required.

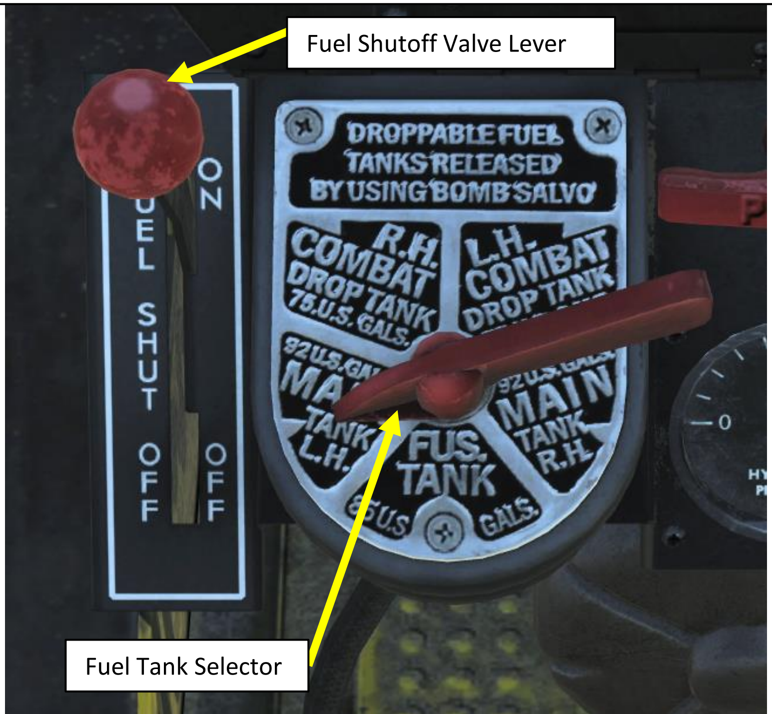
Rear Fuselage Tank Fuel Gauge (85 US GAL)



Mixture Setting Lever
- Idle Cutoff: Position to start and shutdown the engine.
- Run: Standard operating setting, used for takeoff, climb, landing and combat.
- Full Rich: Emergency setting used in case of carburetor failure.



Fuel Booster Pump



Fuel Shutoff Valve Lever

Fuel Tank Selector

Left Wing Tank Fuel Gauge (92 US GAL)

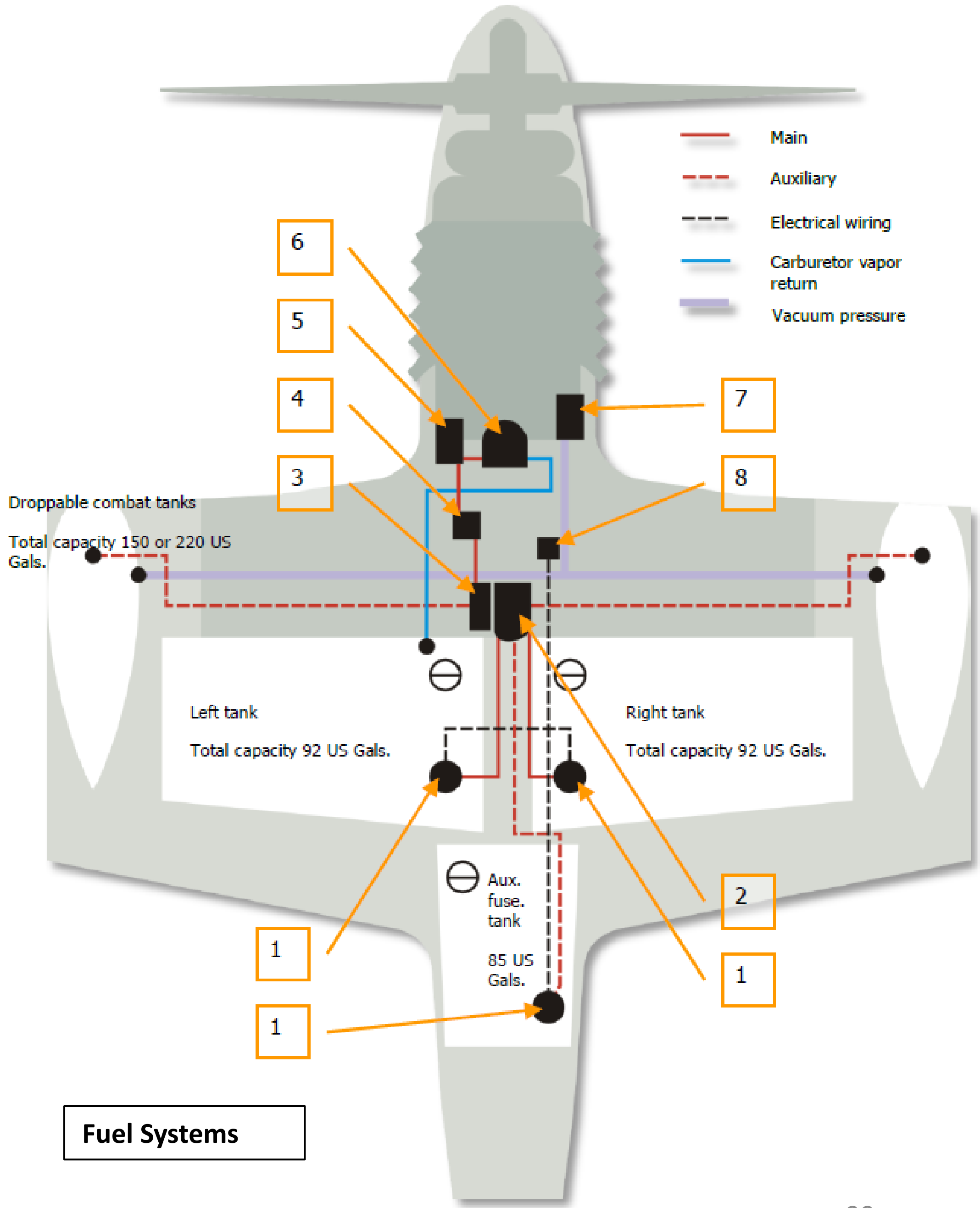
Right Wing Tank Fuel Gauge (92 US GAL)

FUEL MANAGEMENT

The fuel tanks are self-sealing and so are the fuel lines. The auxiliary drop tanks are not self-sealing. Fuel is forced to the carburetor by an engine-driven pump. In addition, there is an electrically powered booster pump in each internal tank.

The booster pumps prevent vapor lock at high altitudes, assure sufficient fuel supply under all flight conditions and, in case of engine-driven pump failure, provide enough fuel to the carburetor for normal engine operation. The droppable tanks do not have a booster pump. However, a constant and controlled pressure is maintained within the combat tanks by pressure obtained from a vacuum pump. This is in addition to the pressure obtained from the main engine fuel pump.

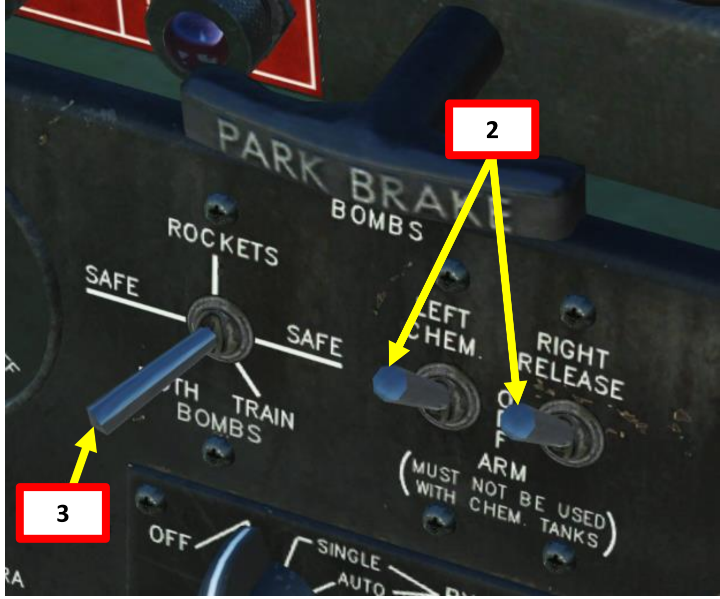
The carburetor is of the fuel injection type with a separate idle cut-off device and is equipped with a vapor return line that extends to the left fuel tank. The vapor vent line may become a fuel return line if the needle valve in the vapor eliminator sticks in the open position. The left fuel tank should always be used first to ensure availability of space for any returning fuel.

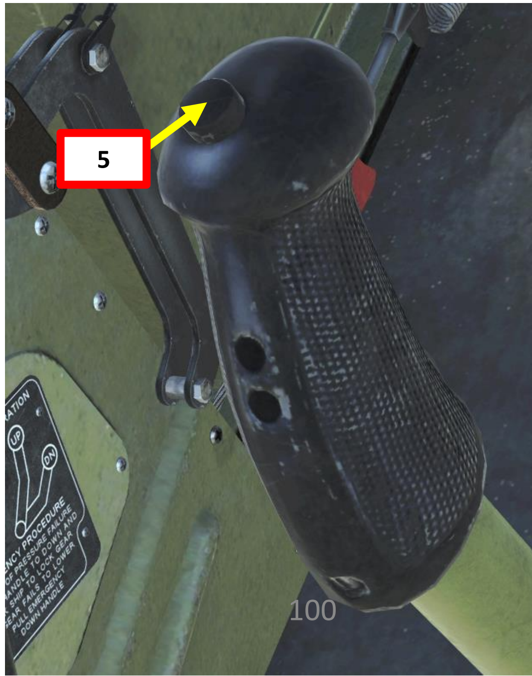


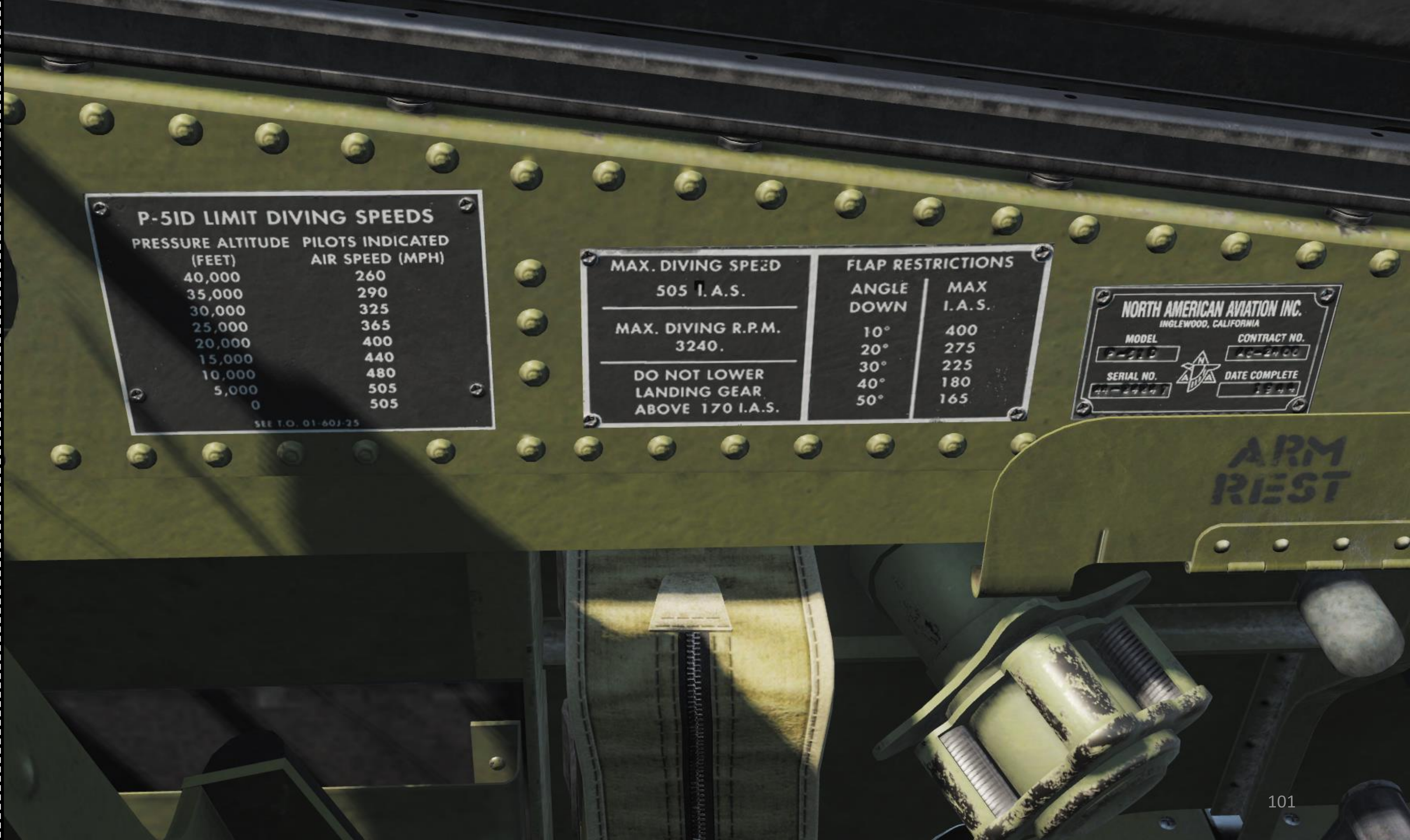
Fuel Systems

FUEL DROP TANK OPERATION

1. To consume fuel from your drop tanks, set Fuel Selector to either LH or RH COMBAT DROP TANKS
2. To jettison drop tanks, set arming switch in CHEM RELEASE position (UP)
3. Select drop tank release mode
   a) BOTH = 2 tank at the same time
   b) TRAIN = 1 tank at a time
4. Set Fuel Tank Selector to either MAIN TANK LH or MAIN TANK RH.
5. Release drop tanks by pressing "Weapons Release" button (RALT+SPACE).






P-51D LIMIT DIVING SPEEDS
PRESSURE ALTITUDE (FEET)
PILOTS INDICATED AIR SPEED (MPH)
40,000 260
35,000 290
30,000 325
25,000 365
20,000 400
15,000 440
10,000 480
5,000 505
0 505
SEE T.O. 01-60J-25
MAX. DIVING SPEED
505 I.A.S.
MAX. DIVING R.P.M.
3240.
DO NOT LOWER LANDING GEAR ABOVE 170 I.A.S.
FLAP RESTRICTIONS
ANGLE DOWN
MAX I.A.S.
10° 400
20° 275
30° 225
40° 180
50° 165
NORTH AMERICAN AVIATION INC.
INGLEWOOD, CALIFORNIA
MODEL
CONTRACT NO.
SERIAL NO.
DATE COMPLETE
ARM REST

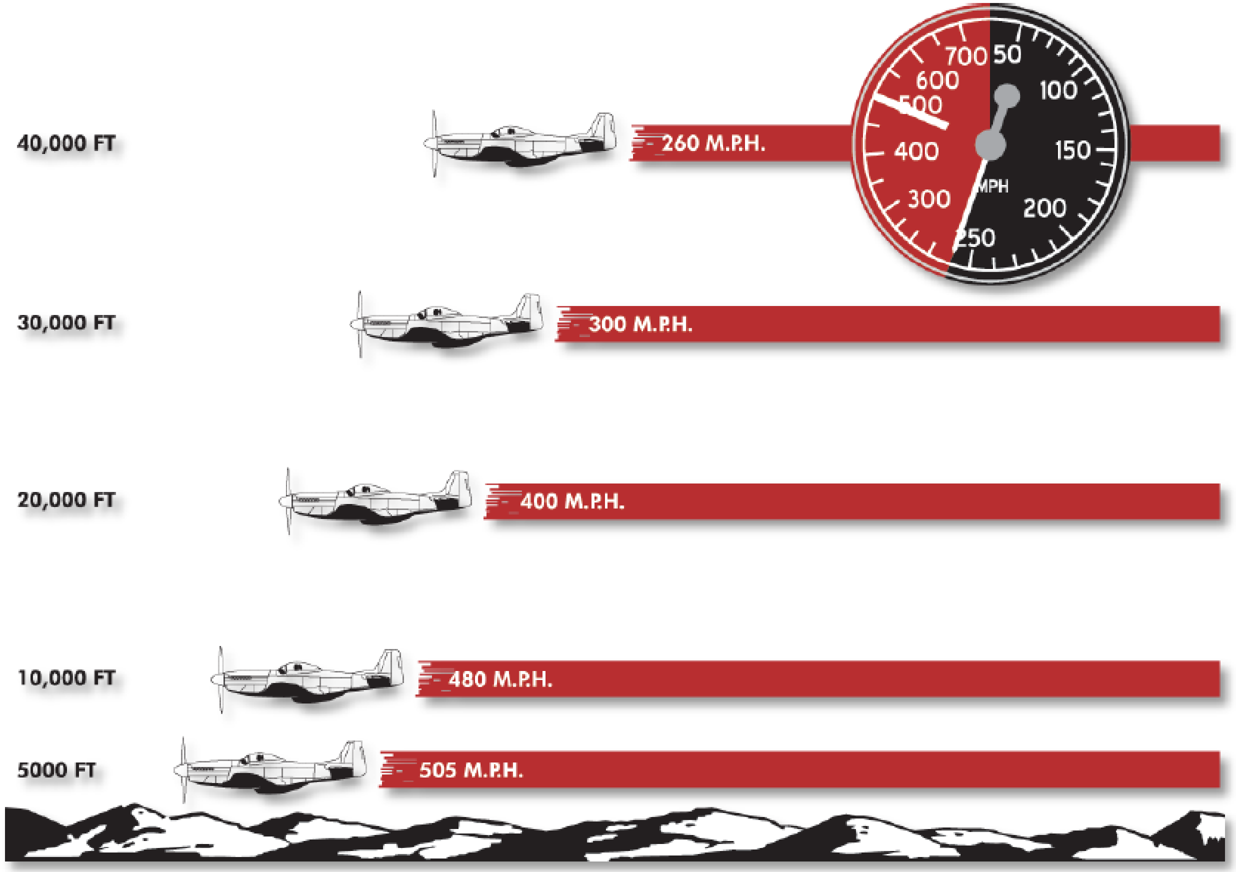
Stall Speeds Table (in mph)

	Gross weight (lbs)	Gear up Flaps up			Gear down Flaps 45° down		
		Level	30° bank	45° bank	Level	30° bank	45° bank
With Wing Racks Only	10,000	106	115	128	101	110	123
	9,000	101	109	121	94	103	116
	8,000	94	102	114	87	98	108
With Bombs, Drop Tanks, or Rockets	12,000	119	128	143	113	123	136
	11,000	113	122	137	107	117	131
	10,000	108	116	130	102	111	124
	9,000	102	110	123	95	105	117

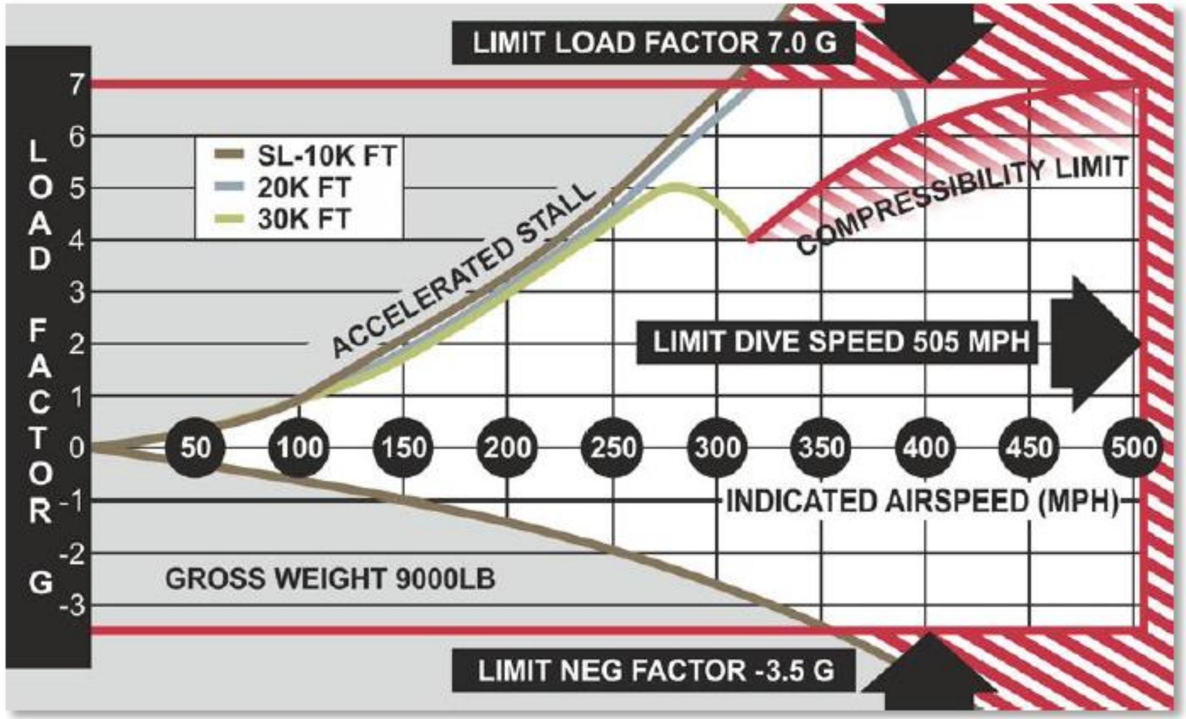
Maximum Allowable Speed for Flap Deployment

Flaps Down Angle [degrees]	Maximum IAS [mph]
10	400
20	275
30	225
40	180
50	165

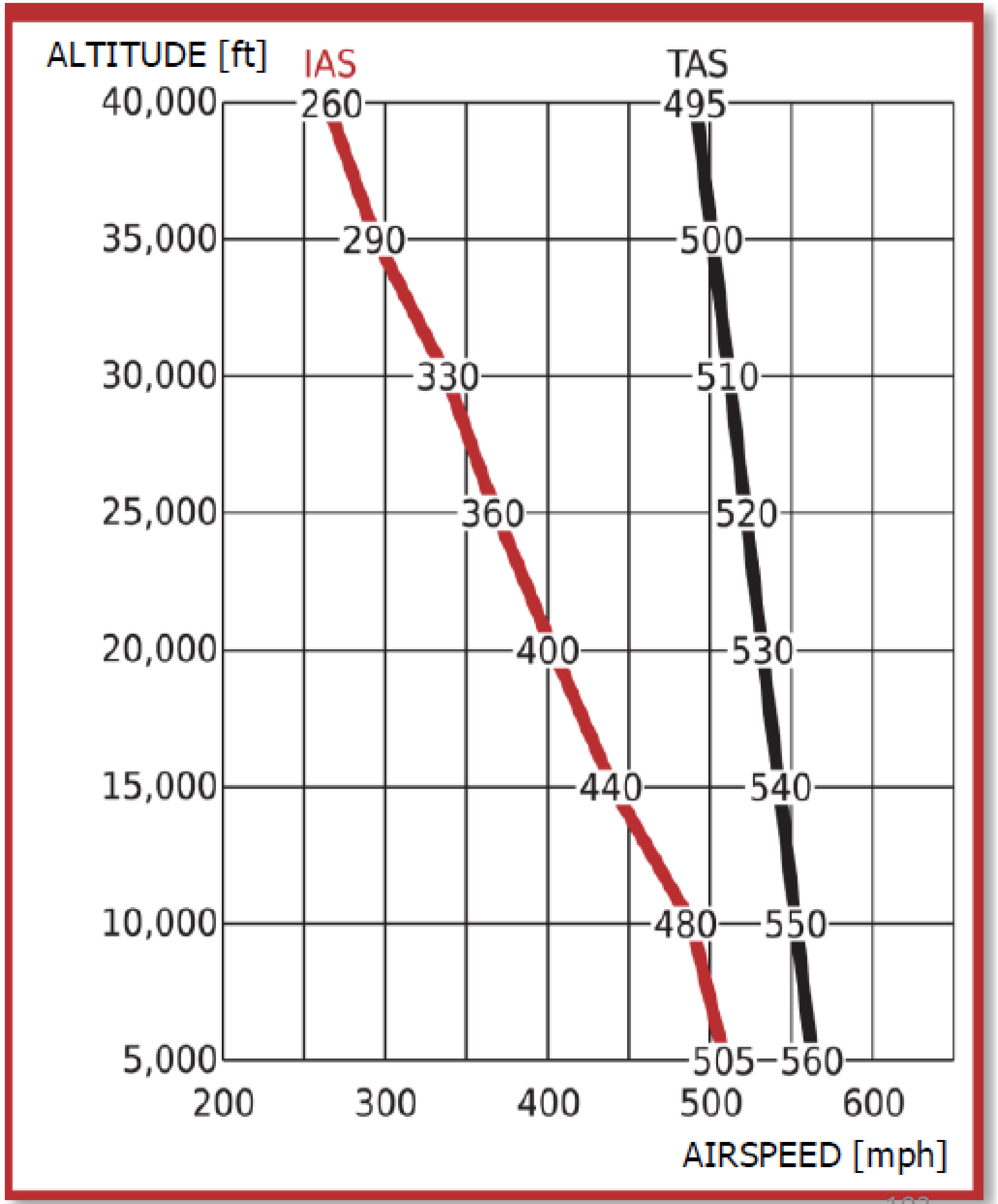
Maximum Indicated Airspeed



Load Factor Limitations



Maximum Allowable Dive Speeds



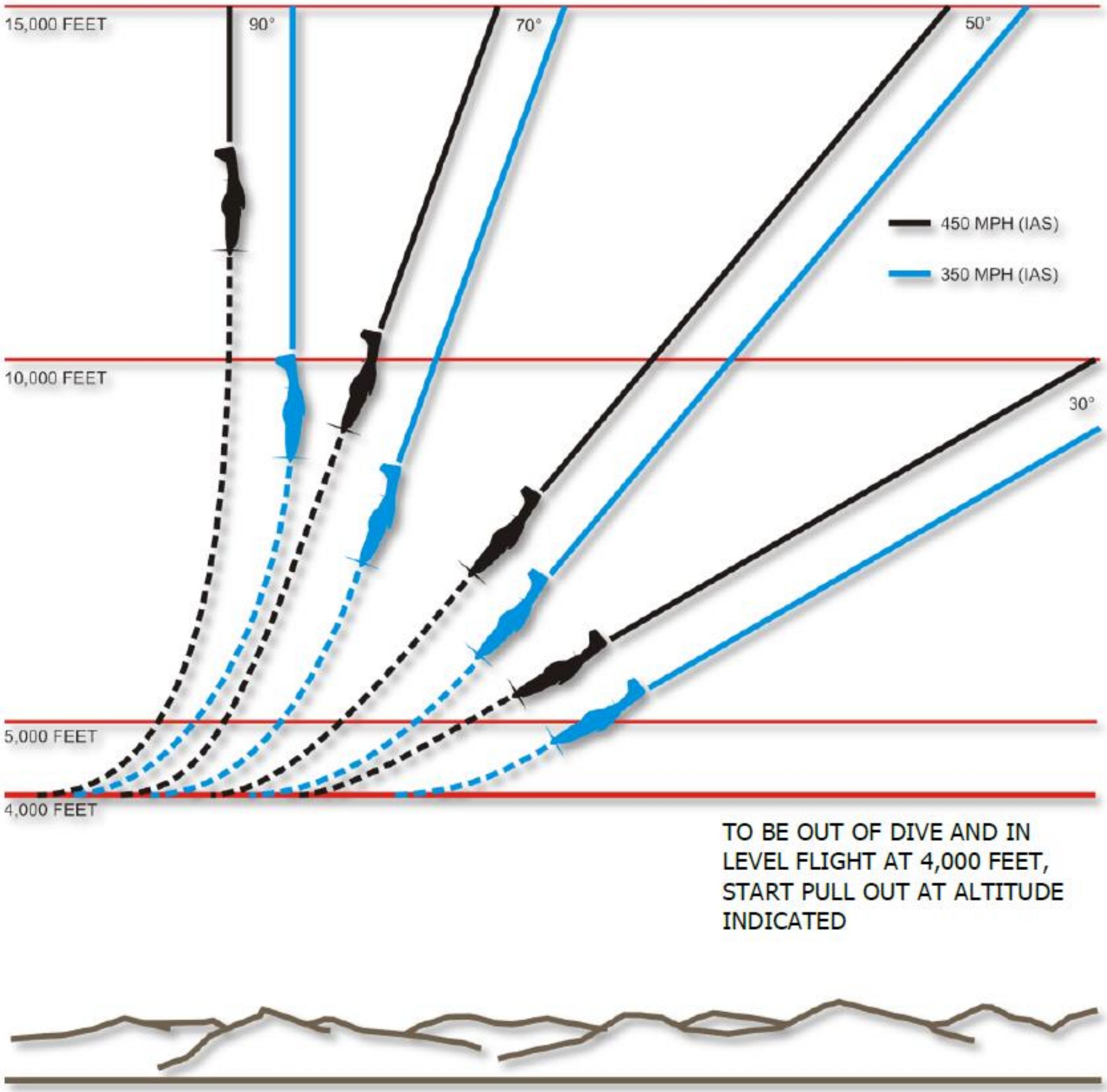
Oxygen Supply Duration

Altitude [ft]	Normal Oxygen	100% Oxygen	Emergency
40,000	11.4 Hrs.	11.4 Hrs.	12.6 Min.
35,000	8.1	8.1	12.6
30,000	6.0	6.0	12.6
25,000	6.0	4.9	12.6
20,000	7.1	3.3	9.0
15,000	8.1	2.7	9.0
10,000	10.2	2.1	9.0

TUC (Time of Useful Consciousness) once Oxygen Flow is Stopped

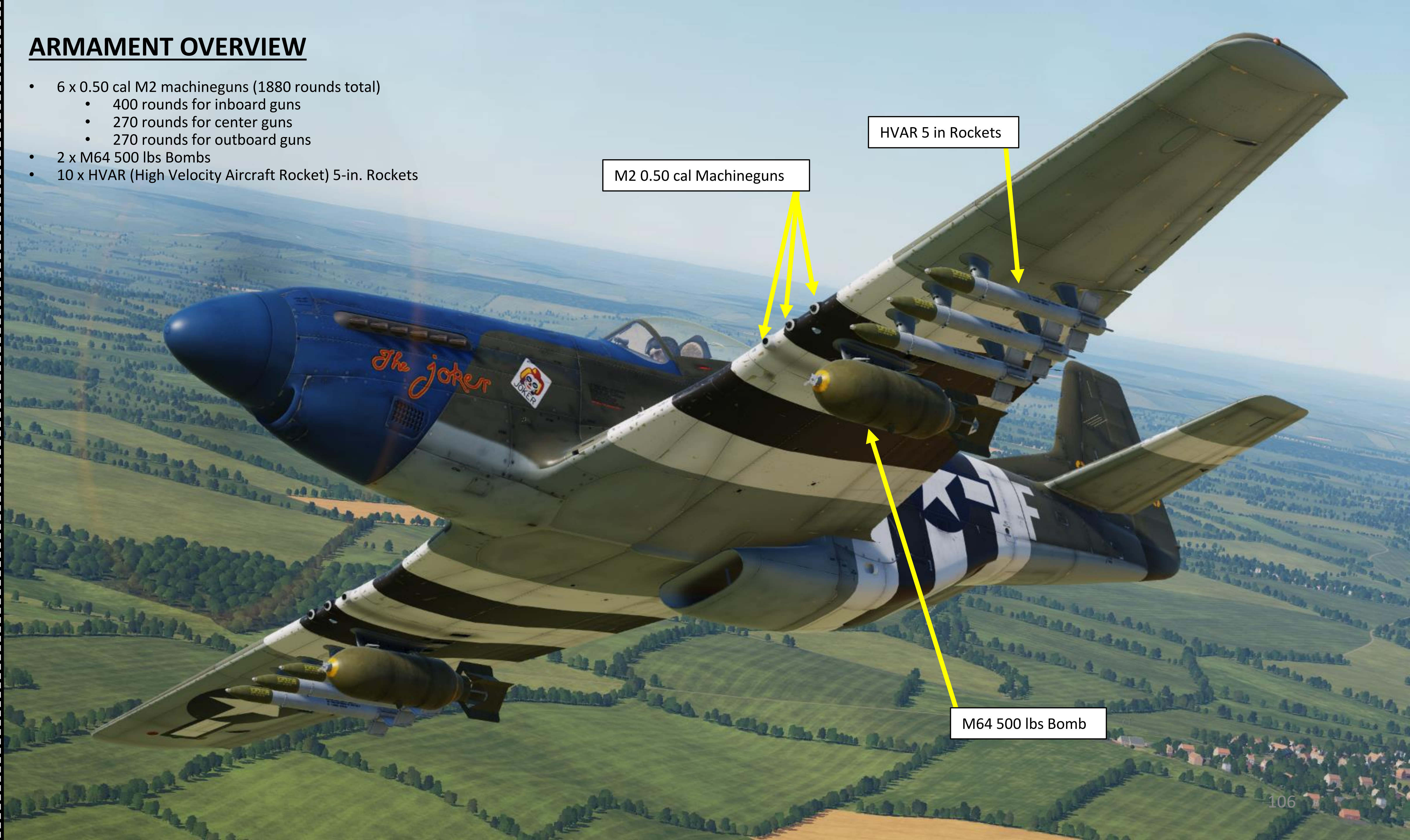
Altitude [ft]	TUC
15,000	30 min or more
18,000	20-30 minutes
22,000	5-10 minutes
25,000	3-5 minutes
28,000	2.5-3 minutes
30,000	1-3 minutes
35,000	30-60 seconds
40,000	15-20 seconds
45,000	9-15 seconds
50,000	6-9 seconds

Minimum Safe Altitude



ARMAMENT OVERVIEW

- 6 x 0.50 cal M2 machineguns (1880 rounds total)
    - 400 rounds for inboard guns
    - 270 rounds for center guns
    - 270 rounds for outboard guns
- 2 x M64 500 lbs Bombs
- 10 x HVAR (High Velocity Aircraft Rocket) 5-in. Rockets



ARMAMENT OVERVIEW

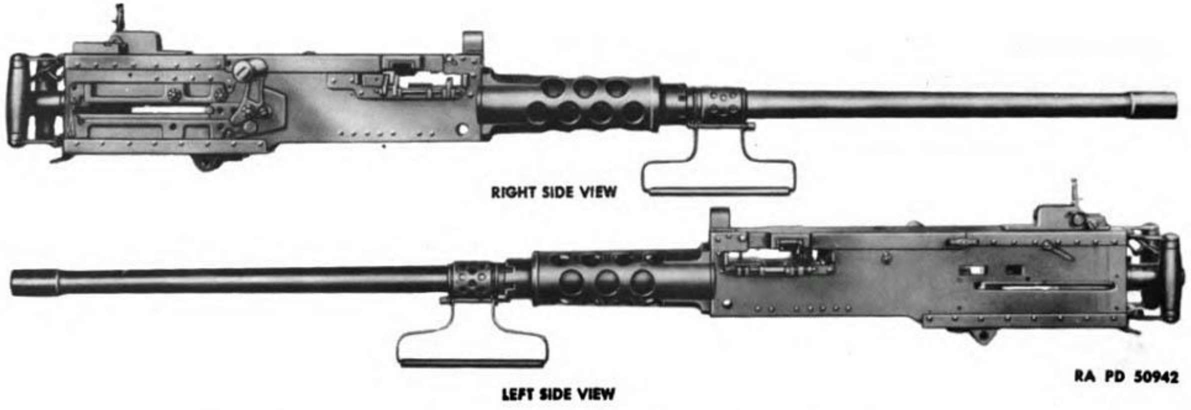
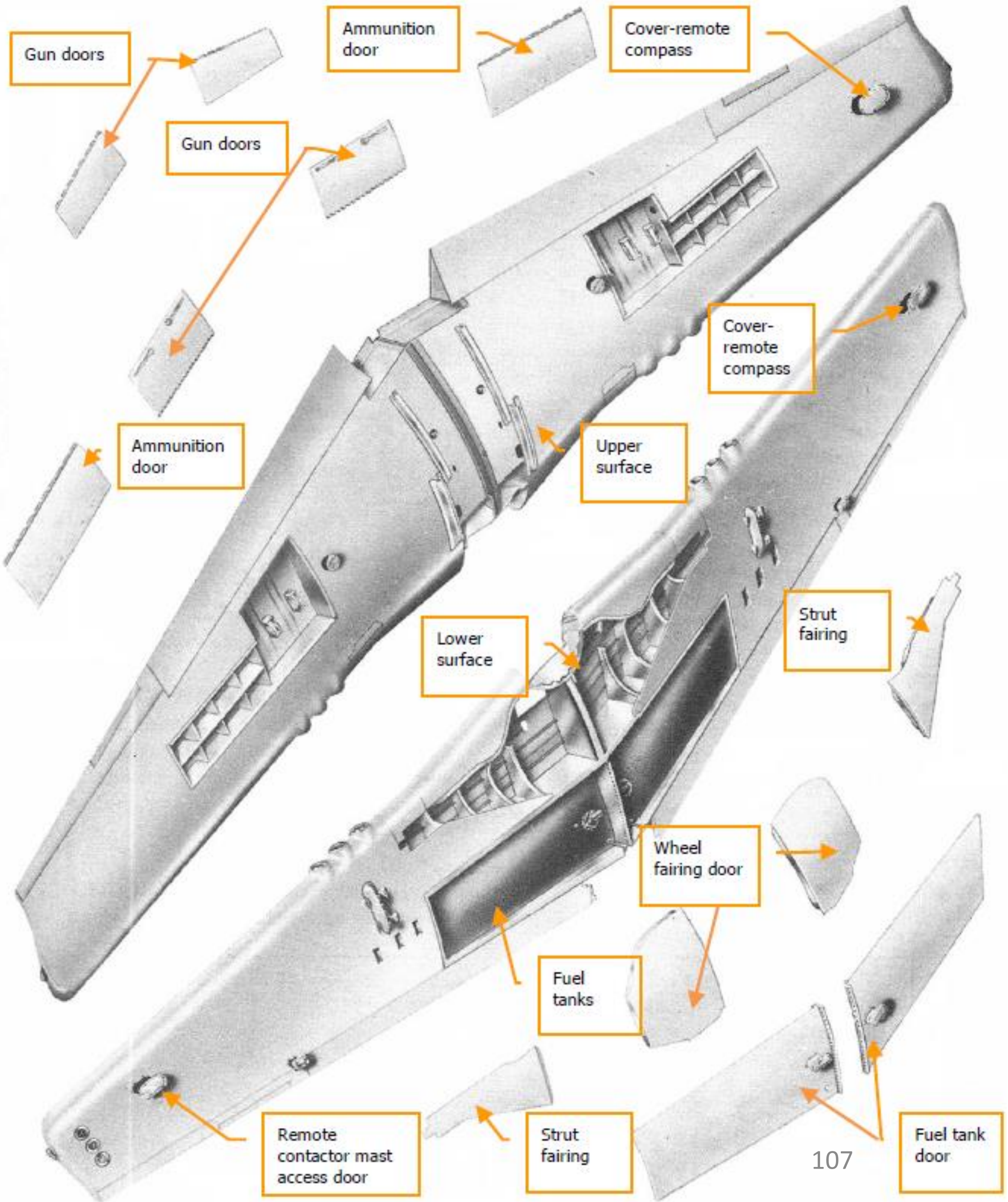
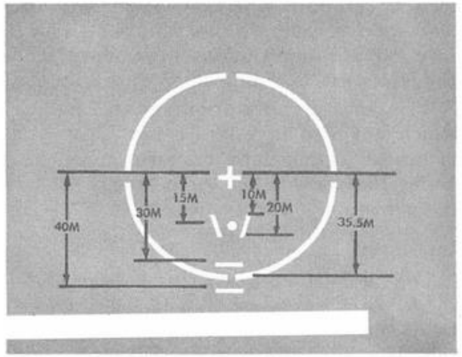


Figure 7—Browning Machine Gun, Cal. .50, M2, Heavy Barrel, Flexible

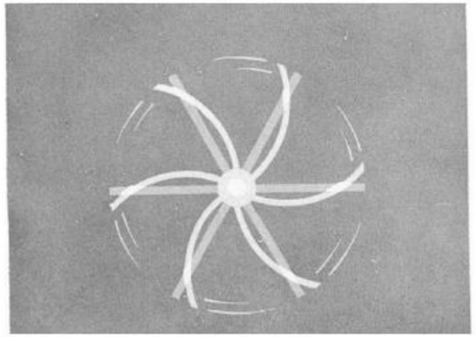


K-14 GYRO GUNSIGHT

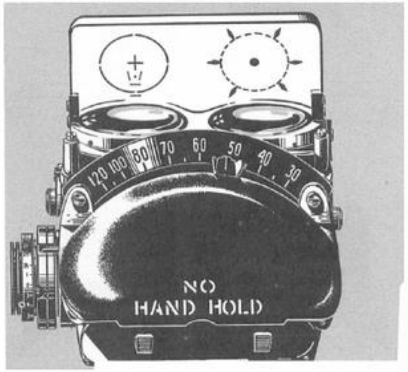
Your gunsight will show you where to shoot and when to shoot a target.

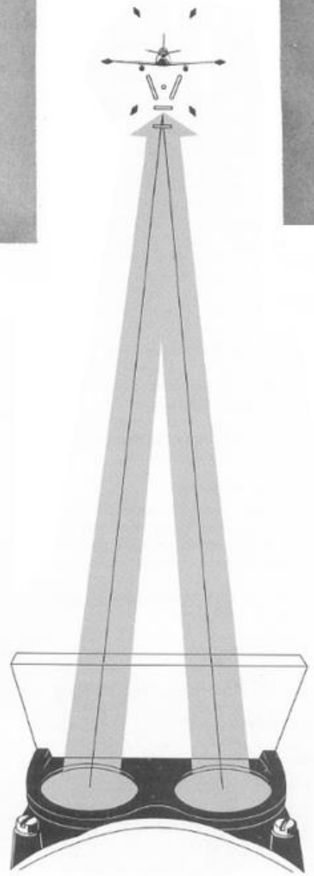


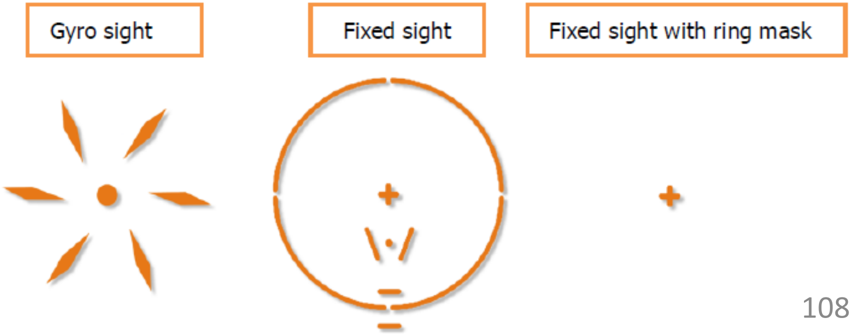
Fixed Reticle Pattern, K-14 Sight, Diameter 71.12 Mils



Movable Reticles





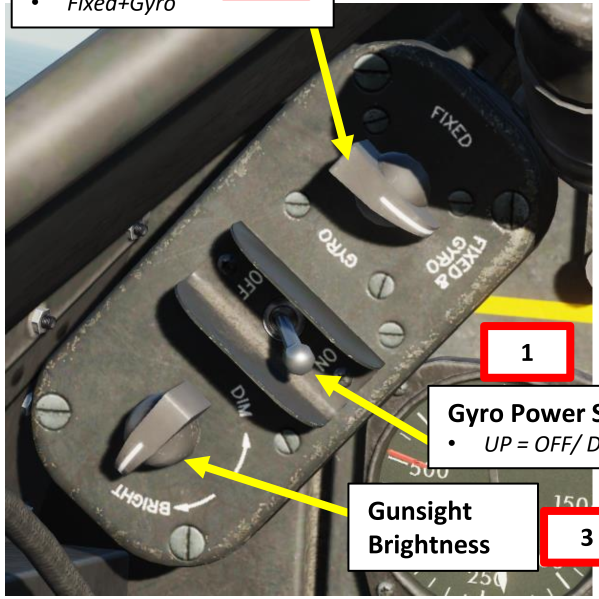


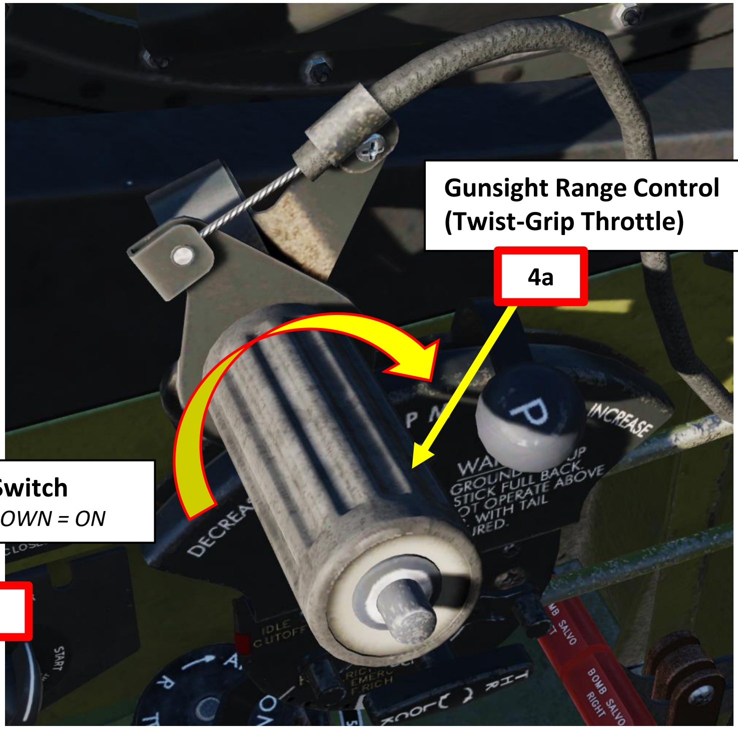
K-14 GYRO GUNSIGHT

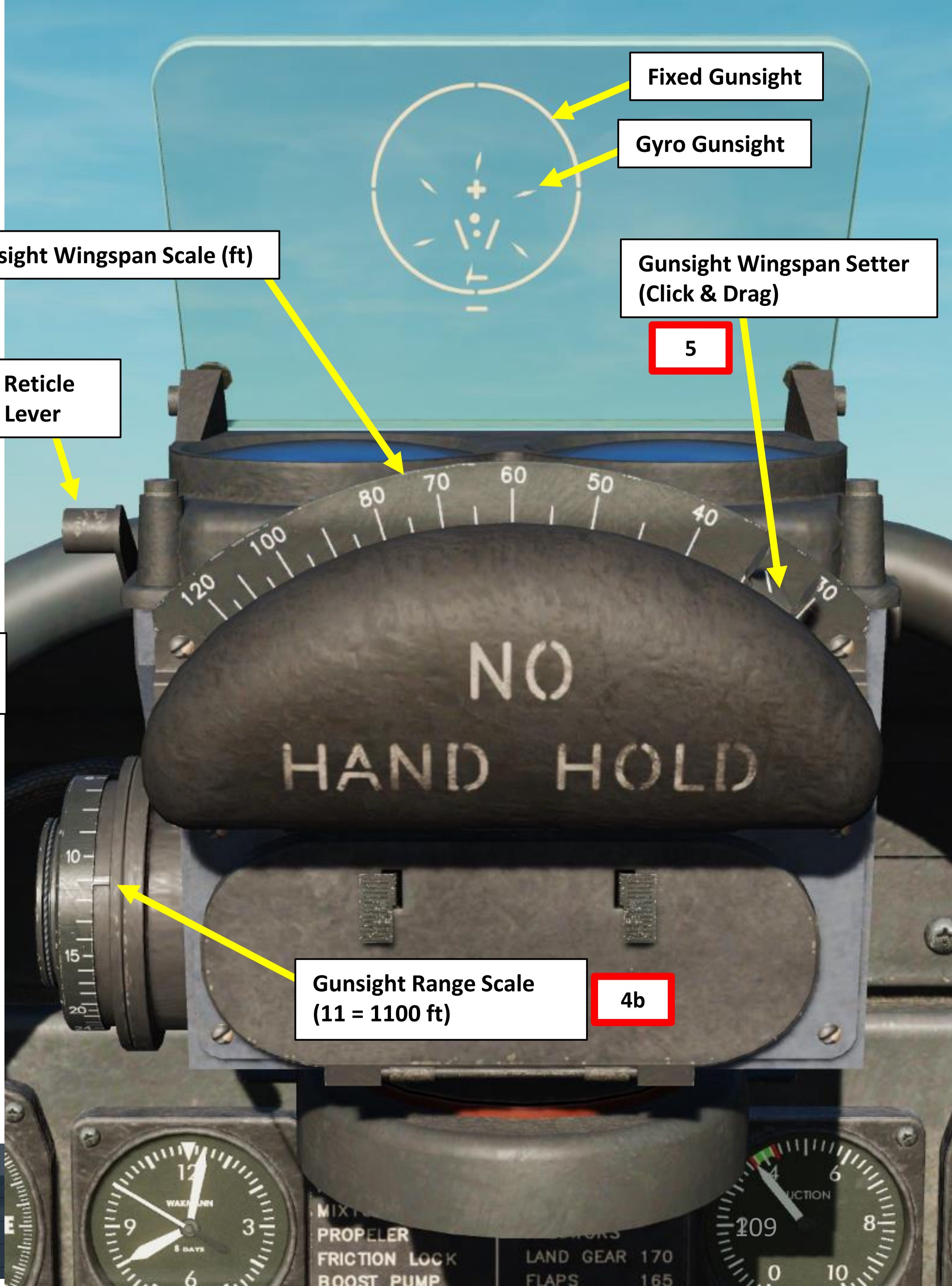
To use the gunsight properly:

1. Set Gyro Power switch – ON (DOWN)
2. Select Gunsight Mode as required (I recommend Fixed + Gyro)
3. Adjust gunsight brightness
4. Set gunsight range scale (recommended: 1100 ft) by using your twist-grip throttle ("Gunsight Range to Target Decrease/Increase" controls)
5. Set gunsight wingspan scale (recommended: 32 ft for a Bf.109 or a FW190) by using the wingspan setter
6. Fire guns when the wings of the target fit within your gunsight reticle

Consult this tutorial about using the gunsight:
https://www.youtube.com/watch?v=vCCuwzKV5wo





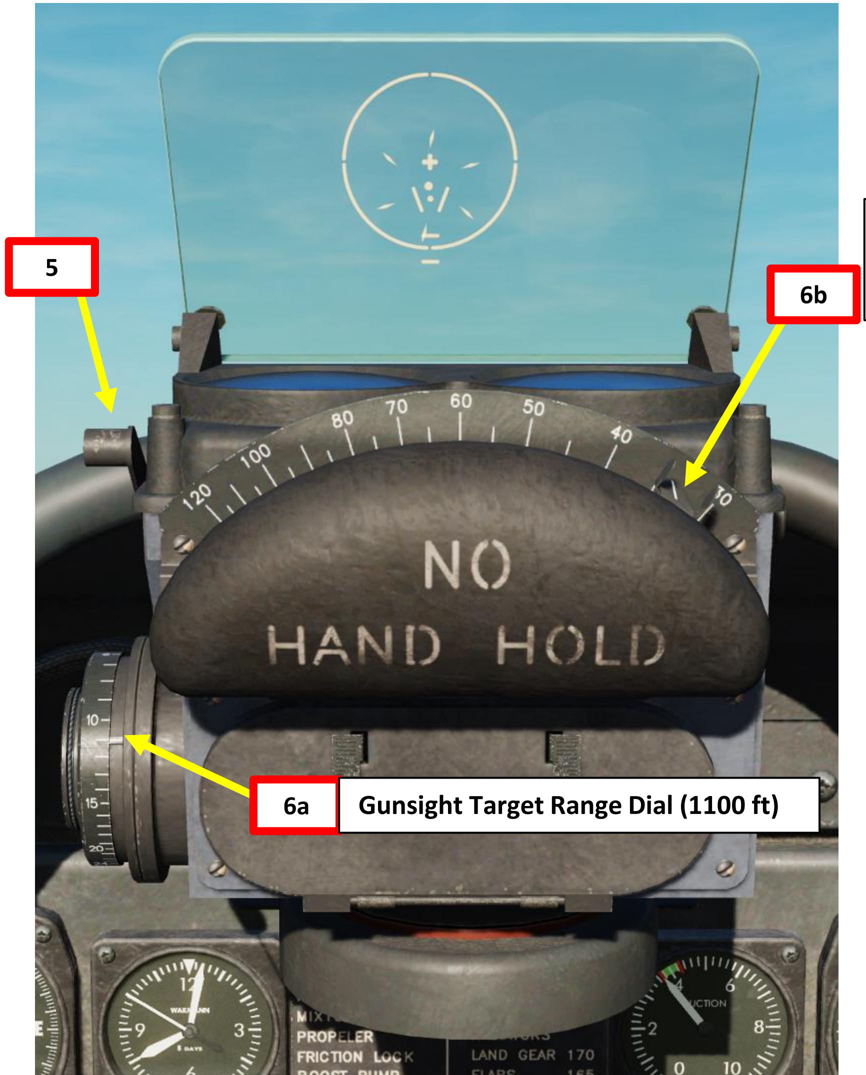


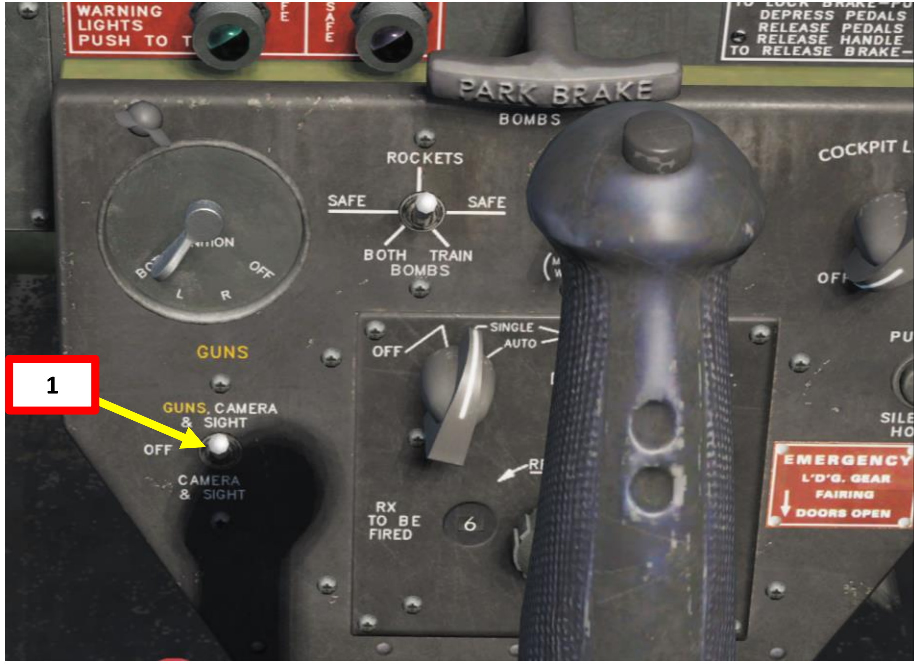
Gunsight Controls

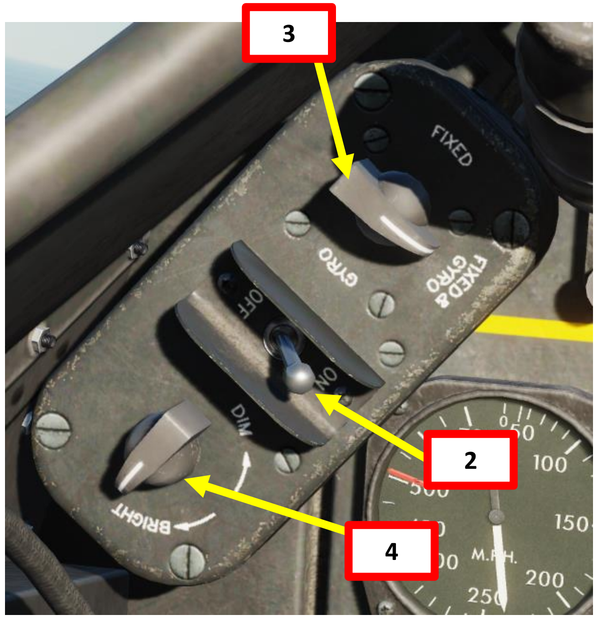
Action	Category	Keyboard	Throttle - HOTAS W...	Joystick - HOTAS Wa...
Gunsight range to target Decrease	K-14 gunsight	.		JOY_BTN11
Gunsight range to target Increase	K-14 gunsight	;		JOY_BTN13
Gunsight target span Decrease	K-14 gunsight	/		JOY_BTN12
Gunsight target span Increase	K-14 gunsight	,		JOY_BTN14
High Blower lamp test	Engine Control Panel			

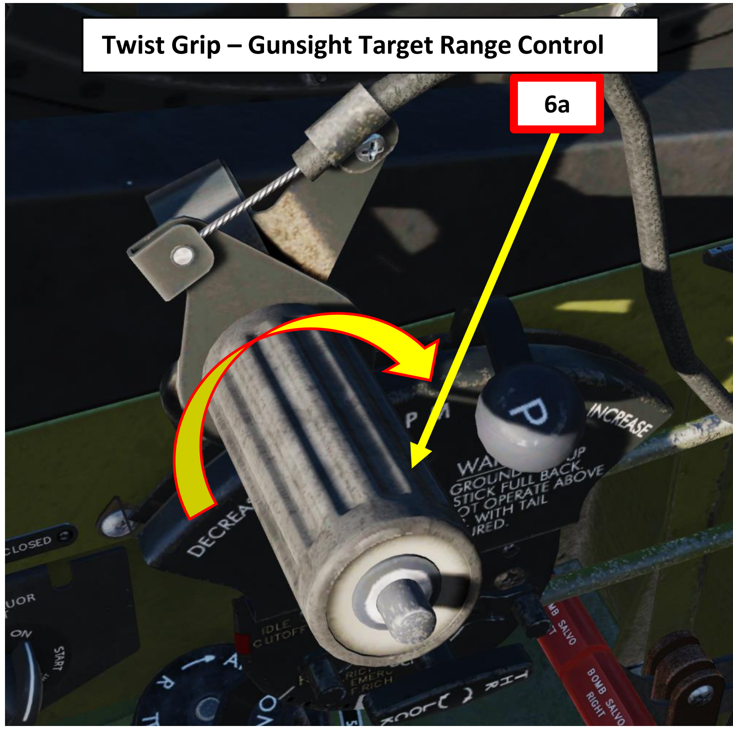
M2 BROWNING 0.50 CAL MACHINEGUNS

1. Set your guns safety OFF by setting safety switch to GUNS (UP)
2. Set Gyro Power switch – ON (DOWN)
3. Select Gunsight Mode as required (I recommend Fixed + Gyro)
4. Adjust gunsight brightness
5. Set Gunsight Fixed Reticle Mask Lever as desired (DOWN if you want to hide the fixed sight, UP if you want to display the fixed sight)
6. Set gunsight range (a) and wingspan scale (b) as required (see K-14 Gyro Gunsight tutorial)



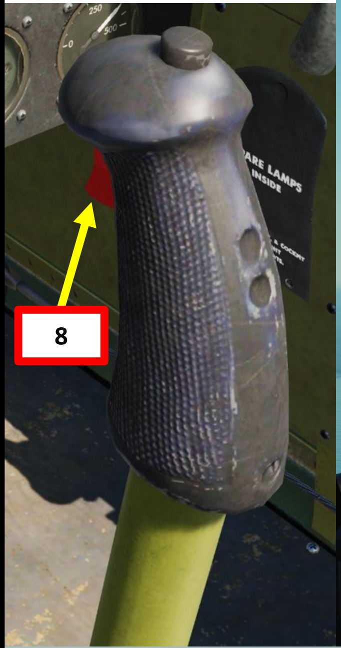


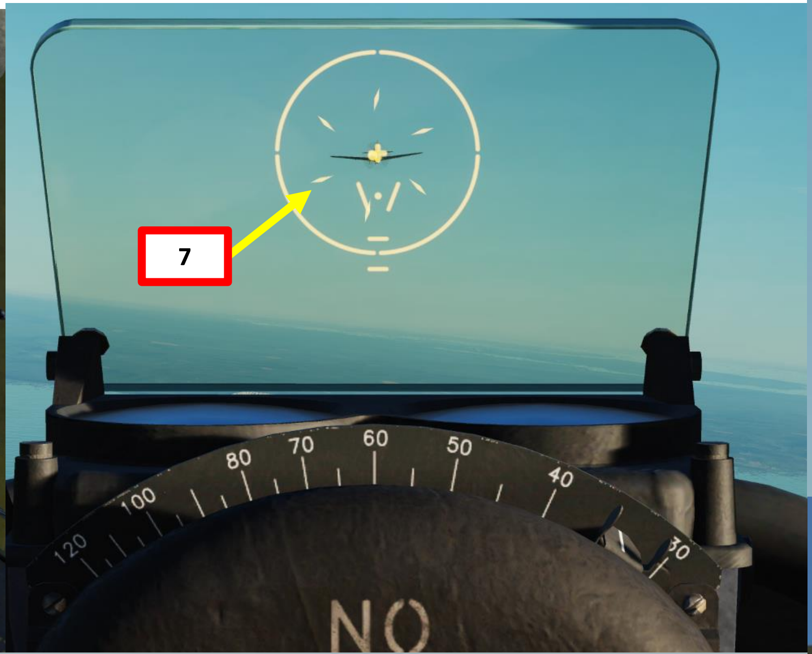


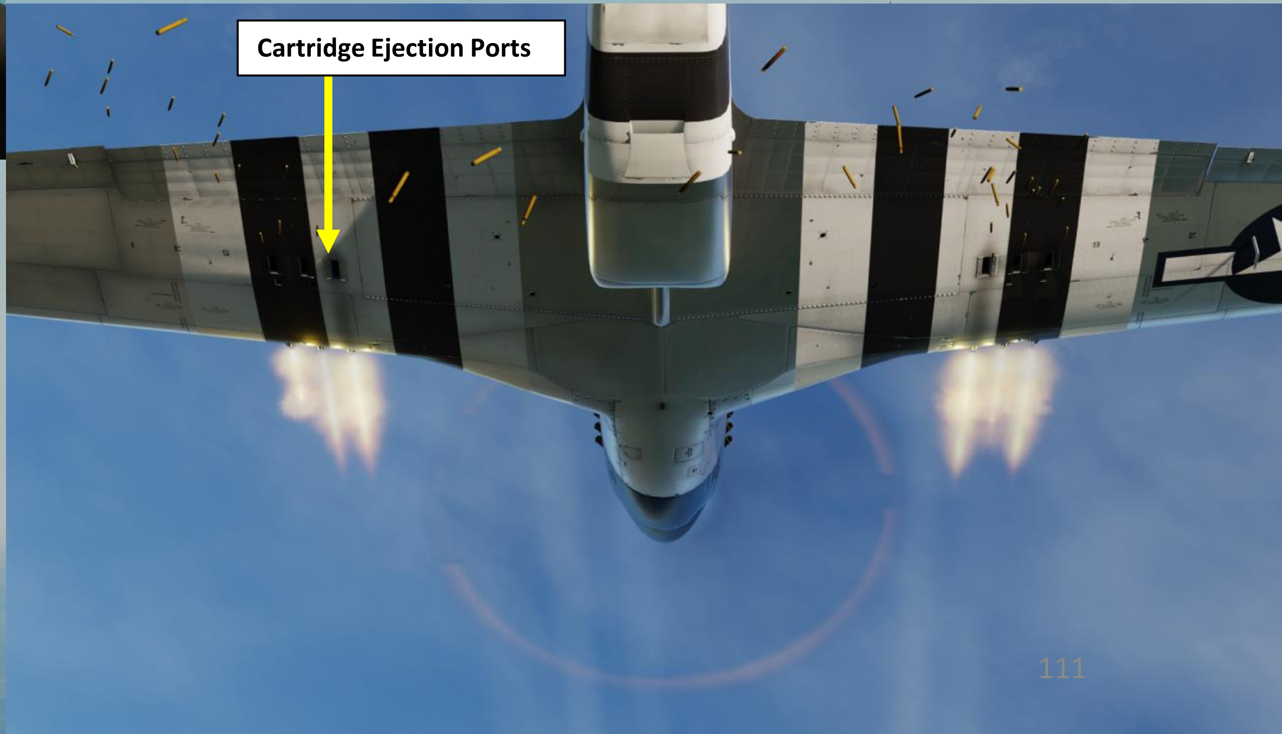


M2 BROWNING 0.50 CAL MACHINEGUNS

7. Place the wings of the target fit within your gunsight gyro reticle
8. Squeeze the machinegun trigger (Spacebar) to fire machineguns.



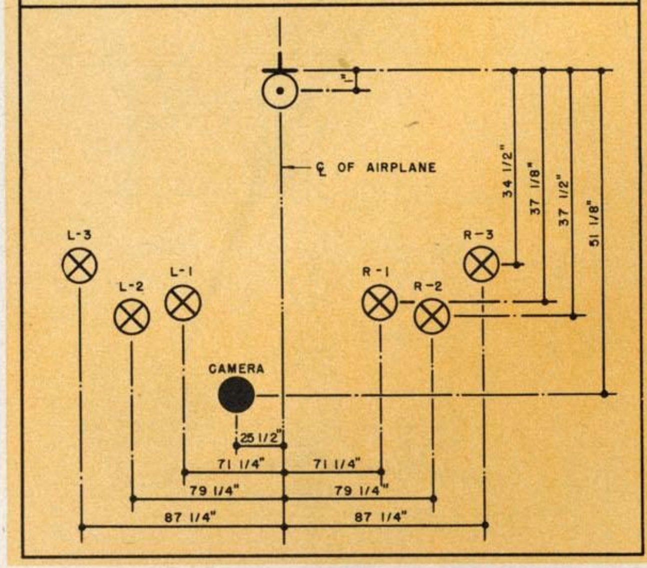




M2 BROWNING 0.50 CAL MACHINEGUNS

ARMAMENT BALLISTICS

1000 INCH BORESIGHT TARGET



TARGETS SHOWN ARE FOR HARMONIZATION UNDER THE FOLLOWING CONDITIONS: (BASIC HARMONIZATION)

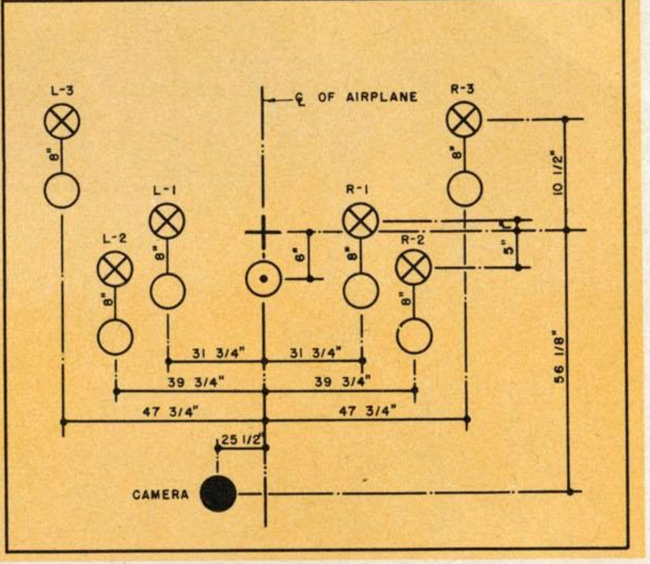
CAL. I.A.S. = 300 M.P.H.
ALTITUDE = 15,000 FT.
T.A.S. = ±373 M.P.H.
WEIGHT = 9,500 LBS. ± 200 LBS.
ANGLE OF ATTACK (∝p) = 13 MILS NOSE UP
LEVEL FLIGHT (1"g")

- ✛ = MARK WHERE LINE FROM SIGHT IS PARALLEL TO FUSELAGE LEVELING LUGS.
- ⊙ = MARK WHERE SIGHT PIP IS AIMED FOR HARMONIZATION WITH BULLET PATTERNS. (SIGHT SETTING FOR THIS HARMONIZATION.)
- ⊗ = MARK WHERE BORE IS AIMED FOR 1000 INCH AND 500 FOOT TARGETS.
- ○ = MARK FOR CENTER OF IMPACT OF 10 ROUNDS AT 500 FT. TARGET.
- ● = MARK WHERE CAMERA IS AIMED MAKING CAMERA PARALLEL TO SIGHT LINE. THIS POINT REPRESENTS THE CENTER OF THE PICTURE FRAME.

GUN LOCATION AT AIRCRAFT

CALIBER 0.50	VERT. (FROM SIGHT)	HORIZ. (FROM PLANE ℄)
L. & R. NO. 1 GUNS	44.732"	79.123"
L. & R. NO. 2 GUNS	44.002"	87.091"
L. & R. NO. 3 GUNS	43.493"	95.076"
CAMERA	50.140"	25.561"

500 FT. FIRE-IN & BORESIGHT TARGET



FLIGHT ANGLE	ALT.	CAL. IAS	± TAS	MIL ANGLE "μ" 1 "g"	2 "g"	3 "g"	4 "g"
LEVEL FLIGHT	0'	250	250	+1.0	+8.1	+15.0	+22.1
		300	300	—0.6	+5.0	+10.8	+16.4
		350	350	—1.9	+2.9	+7.5	+12.3
		400	400	—3.1	+1.1	+5.1	+9.2
		450	450	—3.9	—0.4	+3.2	+6.7
LEVEL FLIGHT	7000'	200	222	+4.1	+14.0	+23.8	—
		250	276	+1.5	+9.1	+16.7	+24.4
		300	331	—0.3	+5.8	+12.0	+18.1
		350	386	—1.8	+3.4	+8.5	+13.7
		400	440	—3.1	+1.5	+5.8	+10.2
LEVEL FLIGHT	15000'	200	251	+5.0	+16.1	+27.0	—
		250	313	+2.0	+10.6	+19.0	+27.6
		300	373	0	+6.8	+13.7	+20.4
		350	434	—1.6	+4.1	+9.5	+15.4
		400	493	—3.1	+2.0	+6.6	+11.5
LEVEL FLIGHT	30000'	150	242	+13.0	+31.8	—	—
		200	320	+7.0	+20.6	+34.1	—
		250	398	+3.3	+13.7	+24.1	+34.5
		300	471	+0.8	+8.9	+17.3	+25.4
		350	543	—1.3	+5.6	+12.2	+19.0

FLIGHT ANGLE	CAL. IAS	∝p (WT. = 9500 LBS.) 1 "g"	2 "g"	3 "g"	4 "g"
LEVEL FLIGHT	150	+134	+296	—	—
	200	+63	+155	+246	—
	250	+30	+89	+147	+206
	300	+13	+53	+94	+134
	350	+2	+32	+61	+91
	400	—6	+18	+40	+63
	450	—10	+8	+26	+44

∝p = MIL ANGLE BETWEEN THE FUSELAGE LEVELING LUGS AND THE FLIGHT PATH. THIS DATA IS DERIVED FROM THE BEST AVAILABLE ANGLE OF ATTACK CHARTS, BUT IS NOT GUARANTEED. THE BORESIGHT TARGETS AND "μ" ANGLES ARE BASED ON THIS ANGLE OF ATTACK CHART.

μ = MIL ANGLE BETWEEN THE SIGHT LINE AND THE PROJECTILES AT ANY RANGE OUT TO 2000 FEET. WHEN THE MIL ANGLE IS MINUS THE PROJECTILES ARE ABOVE THE SIGHT LINE; WHEN PLUS THEY ARE BELOW. THIS MIL ANGLE ACTS ALONG THE VERTICAL AXIS OF THE SIGHT. THE MIL ANGLE "μ" IS ONLY APPLICABLE WHEN THE AIRCRAFT IS HARMONIZED AS SHOWN IN THE ABOVE BORESIGHT AND FIRE-IN TARGETS.

TRAJECTORY DATA - FORWARD FIRE

GUN	CAL. 0.50
AMMUNITION	A.P. M-2
MUZZLE VELOCITY- FT./SEC.	2700

AUTHORITY: ABERDEEN DATA FT. 50 AC-M-1 & 1ST IND. TO LETTER FROM ORD. DEPT. EGLIN FIELD, FLA. 15 APRIL, 1944 TO CHIEF OF ORDNANCE, WASHINGTON, D.C.

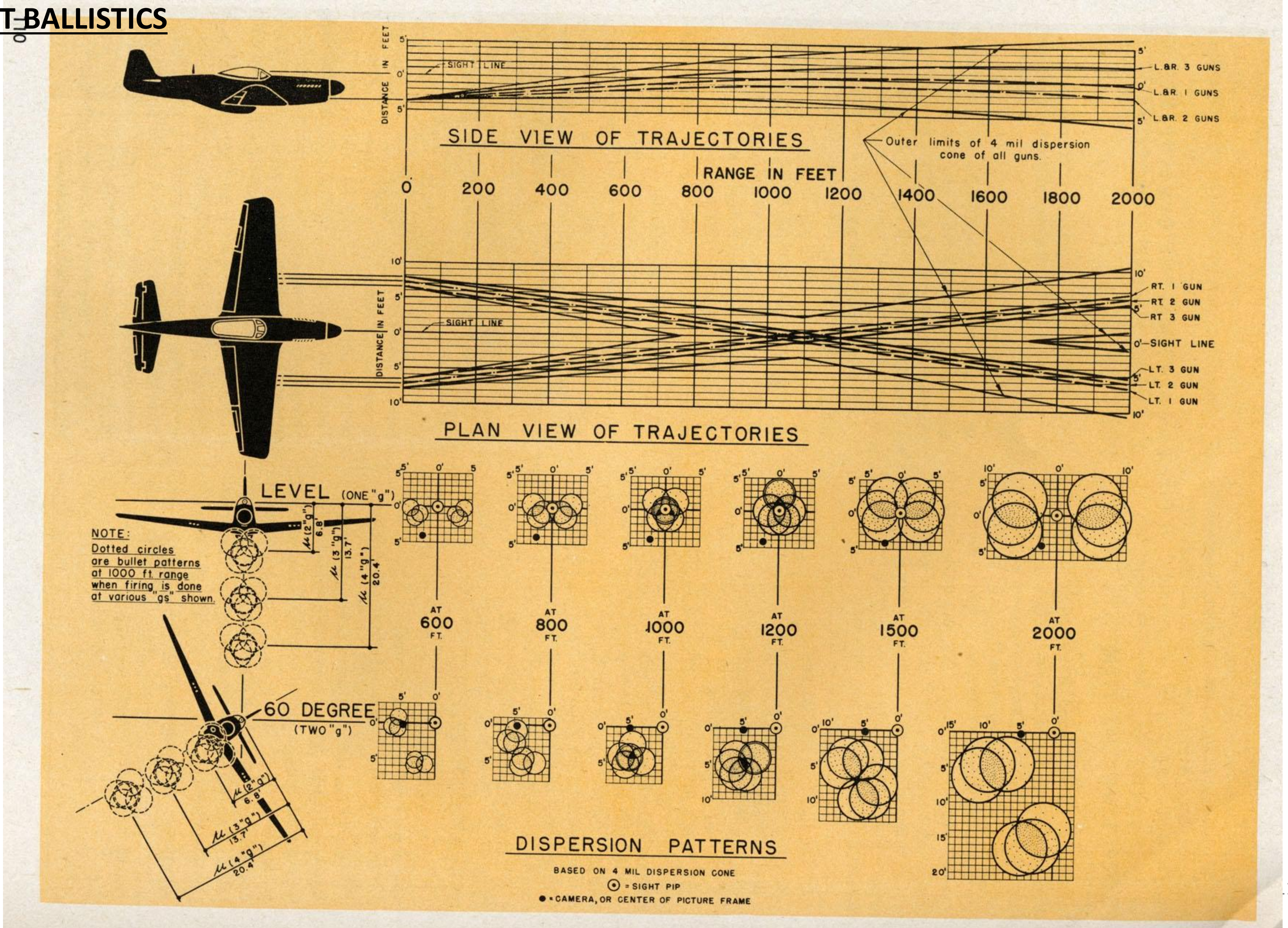
HARMONIZATION CHART P-51D

BASIC HARMONIZATION (300 M.P.H. CAL. I.A.S)

AT 355 M.P.H. CAL. I.A.S., F.S.L. IS PARALLEL TO F.P.

111

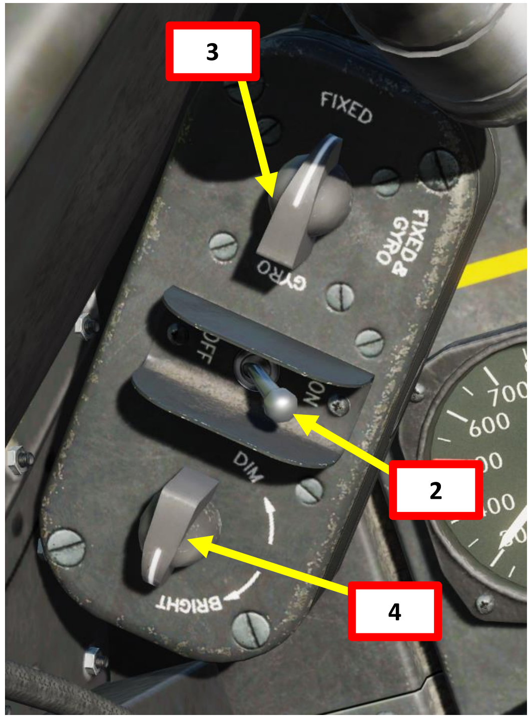
ARMAMENT BALLISTICS

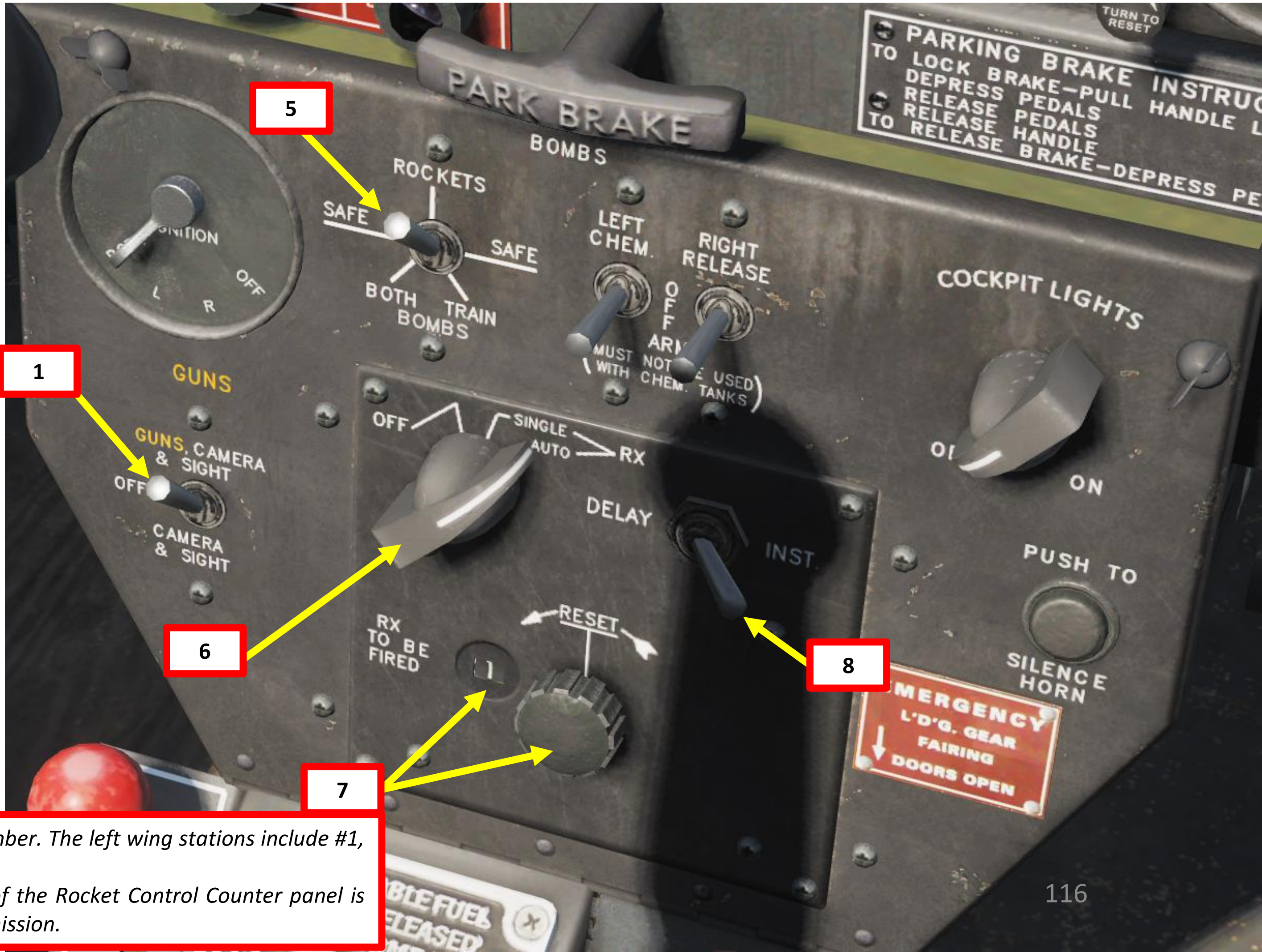


HVAR 5-INCH ROCKETS

HVAR 5-INCH ROCKETS

1. Set your gun/camera/sight safety OFF by setting safety switch to GUNS (UP)
2. Set Gyro Power switch – ON (DOWN)
3. Select Gunsight Mode as required (I recommend Fixed)
4. Adjust gunsight brightness
5. Select "ROCKETS" weapon mode (UP)
6. Select desired rocket firing mode
   a) Single = Fires 1 Rocket
   b) Auto = Fires Multiple Rockets as long as Weapons Release button is pressed.
7. Select rocket counter if Auto Firing Mode is selected
8. Select rocket fuze delay (Delay or Instantaneous)





The Rocket Counter window indicates the next rocket to be fired according to station number. The left wing stations include #1, 3, 5, 7, and 9. The right wing stations include #2, 4, 6, 8, and 10.

- *Note, stations 7, 8, 9, and 10 are not installed when bombs are carried. The knob of the Rocket Control Counter panel is used to set the desired rocket station for fire. This should be set to 1 at the start of a mission.*

HVAR 5-INCH ROCKETS

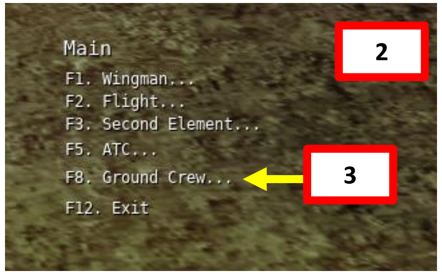
9. There are many different attack profiles, but typically I would recommend starting from 1500-2000 ft above ground level.
10. When you have the target in sight, roll in and reduce throttle to maintain a 15 to 20-degree dive with an airspeed between 350 and 420 mph.
11. Line up the target with center cross of the fixed sight.
    - *Note: Keep in mind that there are other available reference points/techniques to pull lead before launching the rocket.*
12. Make sure you are not slipping when aiming for the target.
13. When you are 1000 ft away from the target, Fire rockets by pressing “Weapons Release” button (RALT+SPACE).
14. Apply full power and pull away from the blast. Recovery altitude should be about 75 ft above ground level.

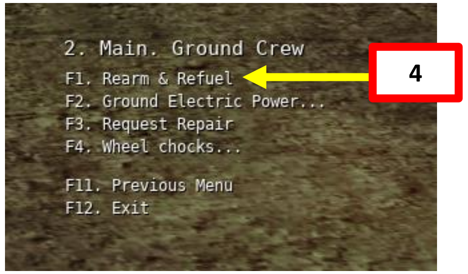
HVAR 5-INCH ROCKETS

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.

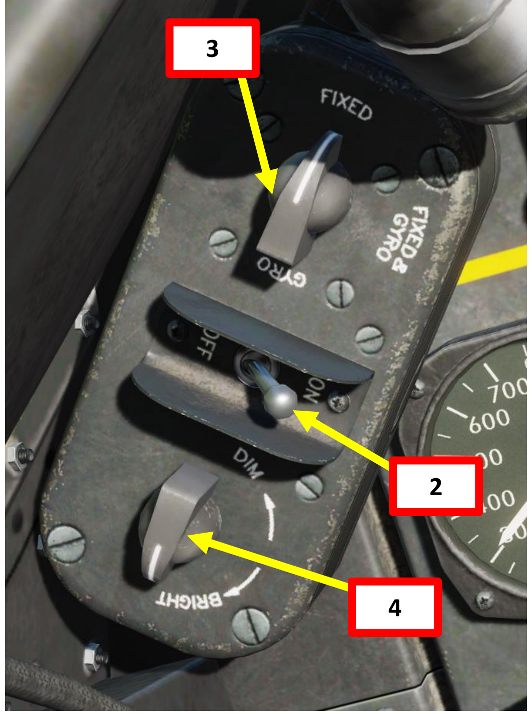


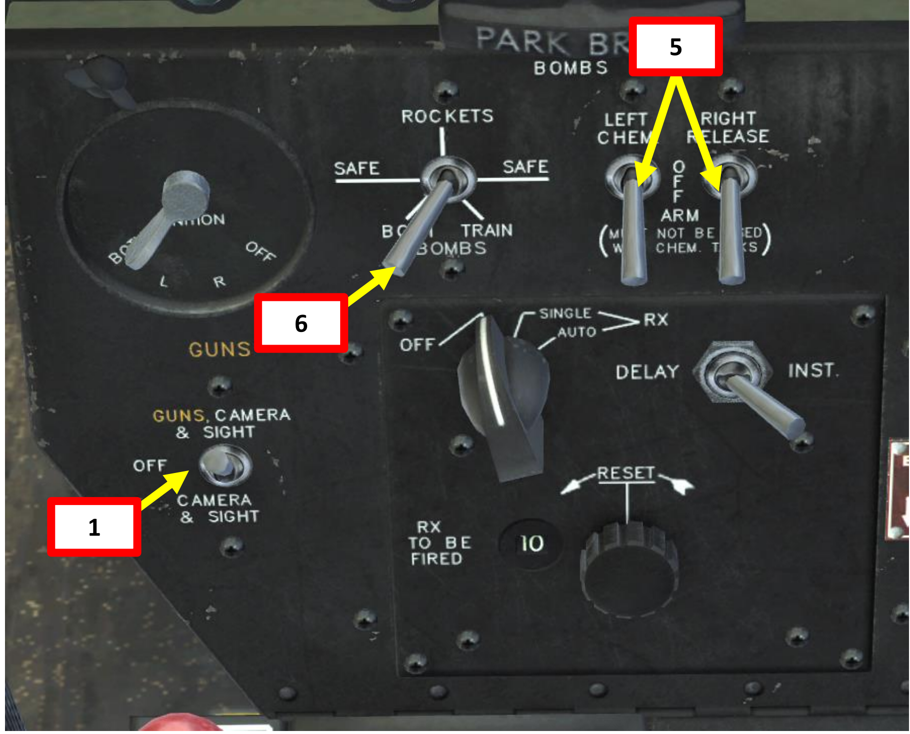


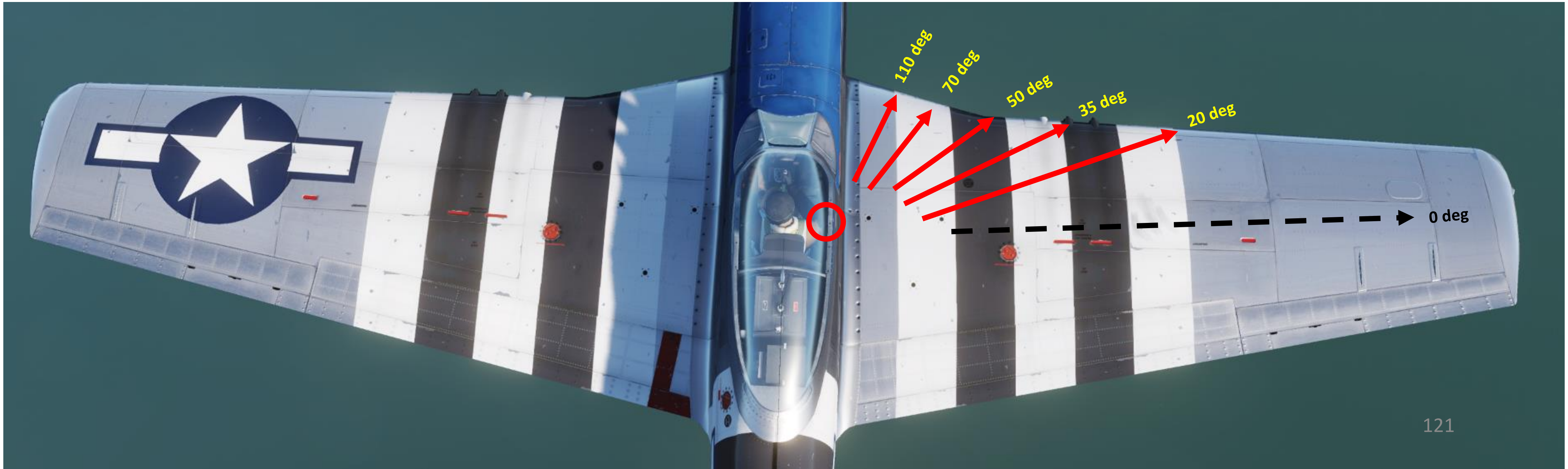
BOMBS (M64 – 500 LBS)

BOMBS (M64 – 500 LBS)

1. Set your gun/camera/sight safety OFF by setting safety switch to GUNS (UP)
2. Set Gyro Power switch – ON (DOWN)
3. Select Gunsight Mode as required (I recommend Fixed)
4. Adjust gunsight brightness
5. Arm bombs by setting bomb arming switch to the ARM position (DOWN)
6. Select bomb release mode
   a) BOTH = 2 bombs at the same time
   b) TRAIN = 1 bomb at a time
7. We will use the "Wing Line" bombing technique. Simply put, you use reference points on the wing (angle lines) to determine when to turn on the target and drop your bombs.

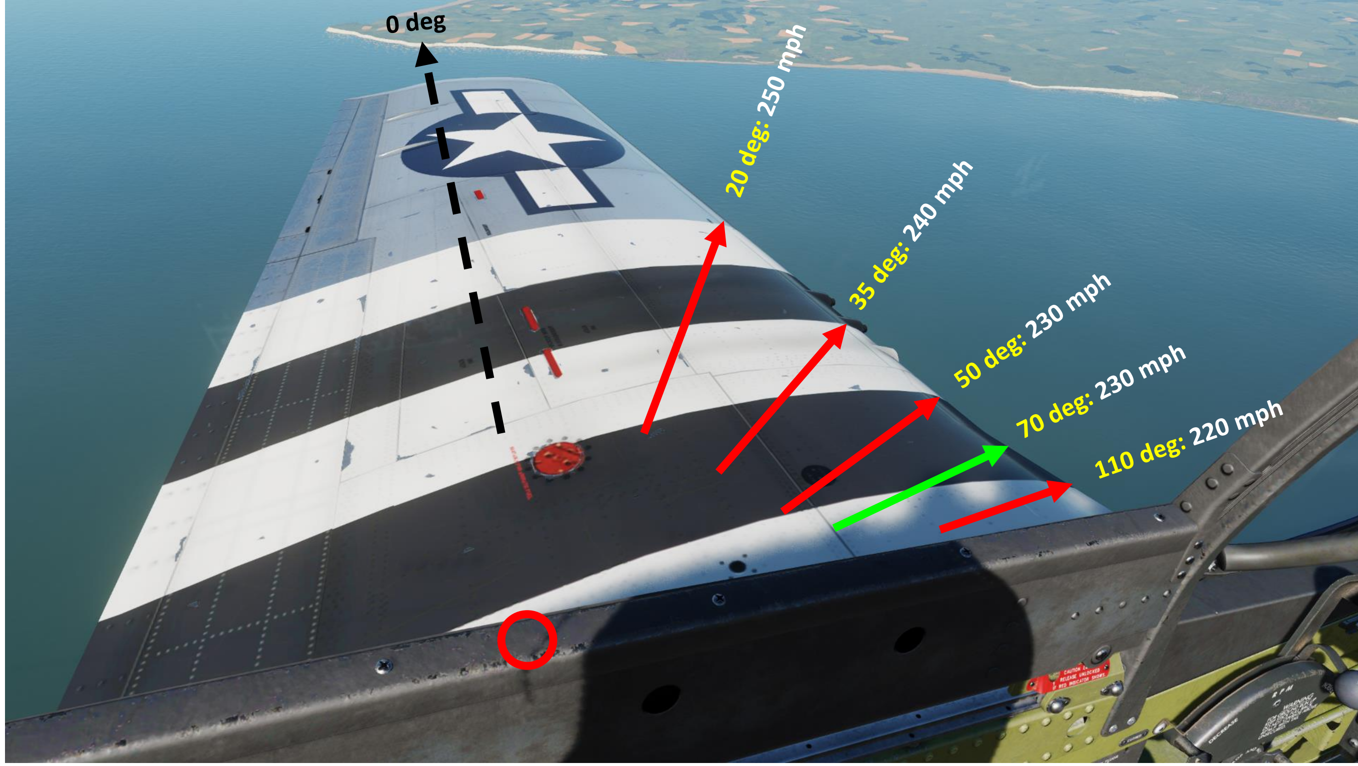


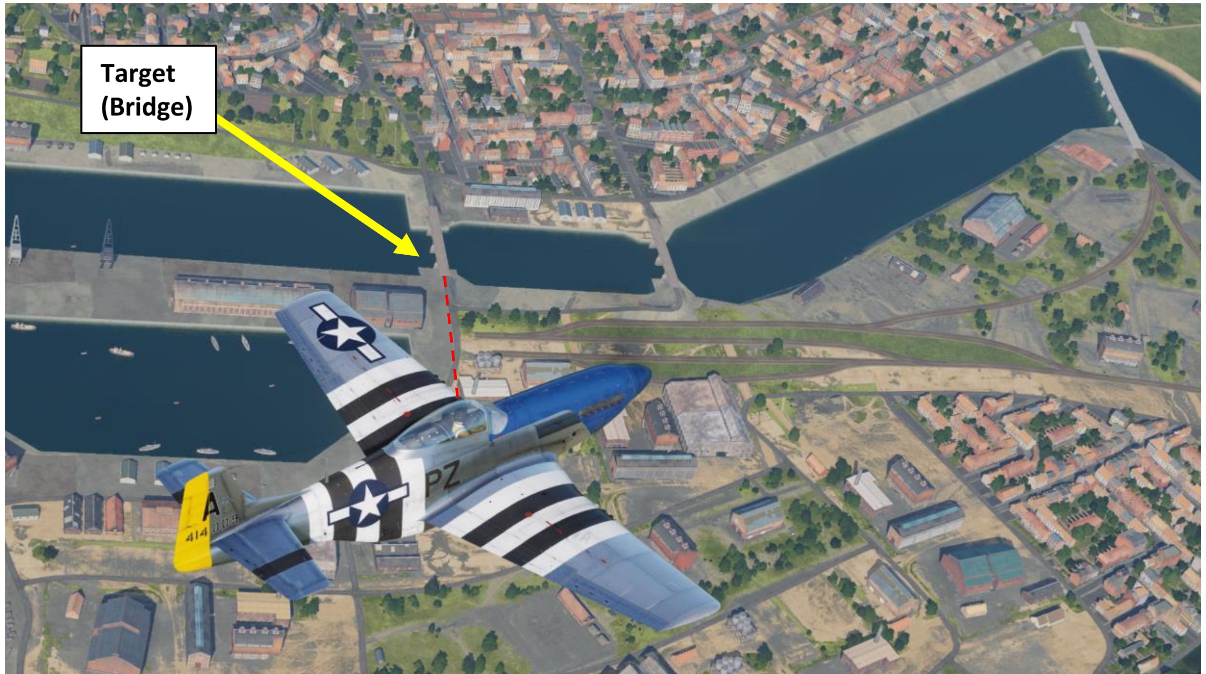




BOMBS (M64 – 500 LBS)

8. Plan your bombing profile
   a) Choose a reference point (wing line) on your wing. In our case, we will choose the 70 deg line.
      - Alternatively, you could use other reference points that are easier to remember like the 35 deg line, which crosses the center machinegun of the wing.
   b) Using the Bombing Attack Profile table, we determine that the Entry Altitude is 7000 ft and the Entry Speed is 230 mph.
   c) Additionally, the Approach Time is 16 seconds, the amount of lead required is 107 mils. The expected firing range is 3600 ft.
9. Approach the target by flying level at the required Entry Altitude (7000 ft) and Entry Speed (230 mph).



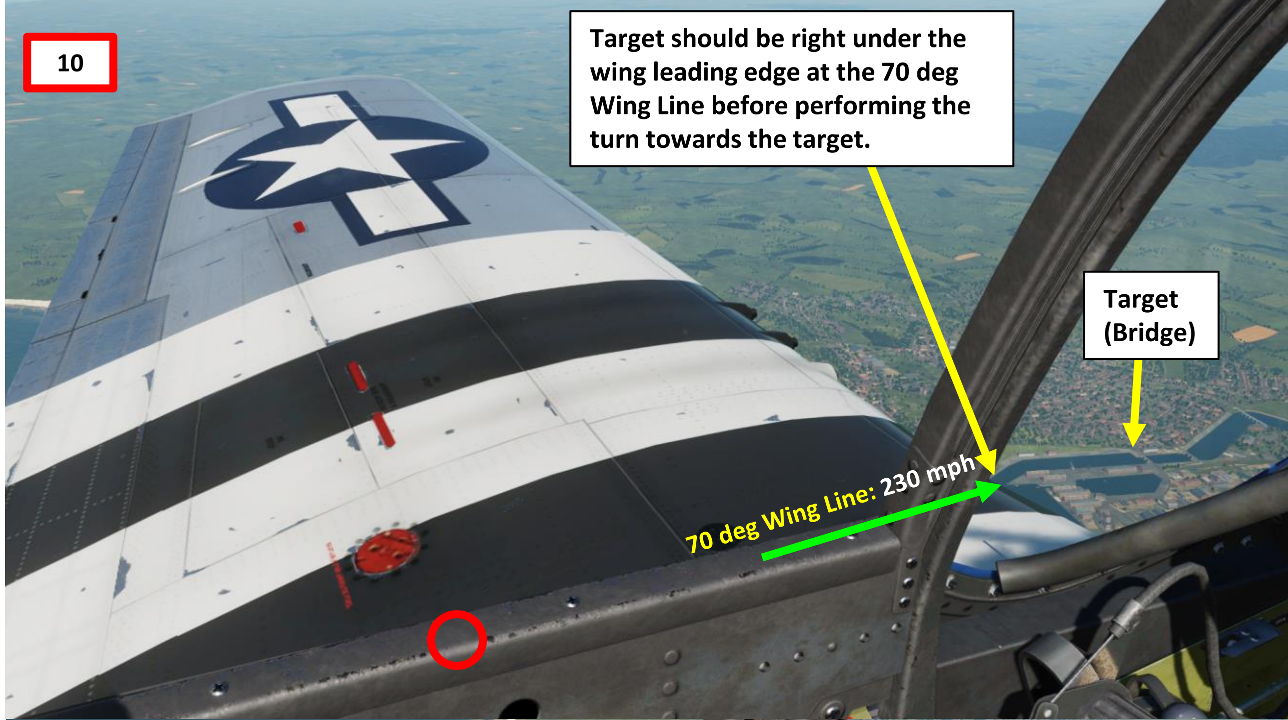


P-51 Bombing Attack Profile

Wing Line (deg)	Entry Altitude (ft)	Entry Speed (mph)	Approach Time (sec)	Lead (mils)	Firing Range (ft)
20	2000	250	16	106	1300
35	3500	240	16	106	1800
50	5000	230	16	106	2400
70	7000	230	16	106	3600
110	11000	220	16	106	4900

BOMBS (M64 – 500 LBS)

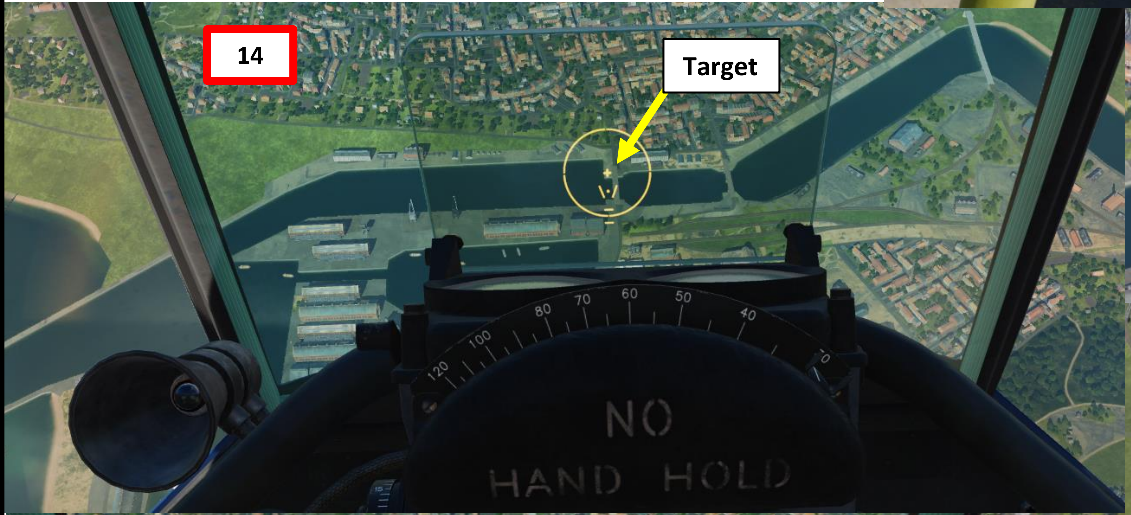
10. When the target disappears under the wing leading edge at the 70 deg wing line, perform a gentle turn under the horizon in the direction of the target.
11. As you start your turn, start counting to 16 seconds in your head. This will allow you to do a countdown when to drop your bombs.
12. While turning, regulate speed so that the target remains visible. This turn has to be very steady and made without excessive use of the rudder.
13. Throttle back at idle power and perform a dive between 30 and 90 deg. The steeper the dive angle the better precision you will have.



Target is right under the wing leading edge at the 70 deg Wing Line; start performing the turn towards the target.

BOMBS (M64 – 500 LBS)

14. Line up the target with the center of the gunsight reticle.
15. Pull lead to bring the target slightly under the nose (107 mils).
16. When target is lined up under your nose and you finish counting to 16 (this should bring you at an altitude of about 3000 ft over the target) release bombs by pressing the Bomb Drop button on the throttle (“RSHIFT+SPACEBAR” binding). All bombs equipped will drop simultaneously.

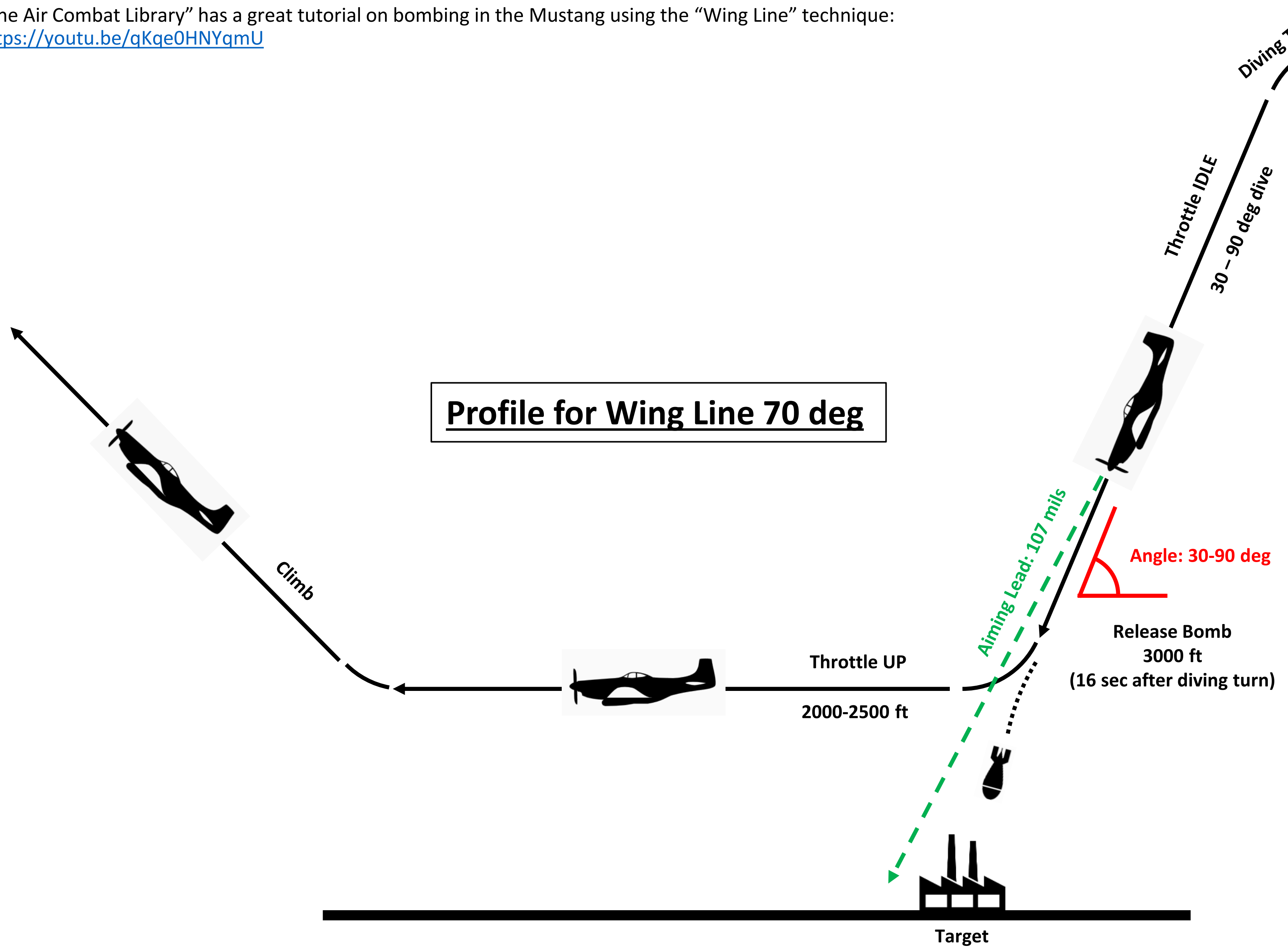


BOMBS (M64 – 500 LBS)

17. 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.
18. 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 (M64 – 500 LBS)

"The Air Combat Library" has a great tutorial on bombing in the Mustang using the "Wing Line" technique:
https://youtu.be/qKqe0HNYqmU



P-51D WING LINE METHOD

Wing Line (Altitude/Airspeed):
20 - 2000ft - 250 mph
35 - 3500ft - 240 mph
50 - 5000ft - 230 mph
70 - 7000ft - 230 mph
110 - 11,000ft - 220 mph

Time to Count:
Bomb - 16 seconds
Rockets - 14 seconds
Guns - 13 seconds

Lead:
Bombs - 6 degrees (107 mils)
Guns/Rockets - None

- Line up Target with Wing Line at long distance while flying straight and level

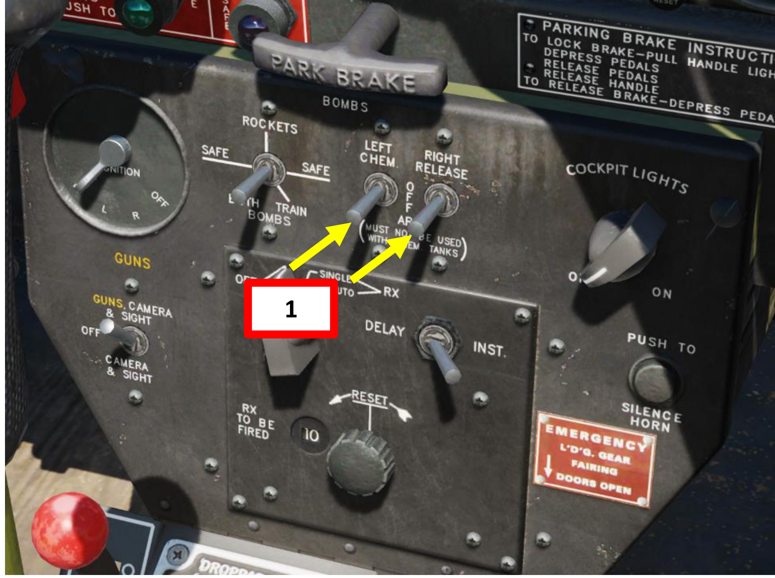
- As Target touches the wing, begin a diving turn and start counting

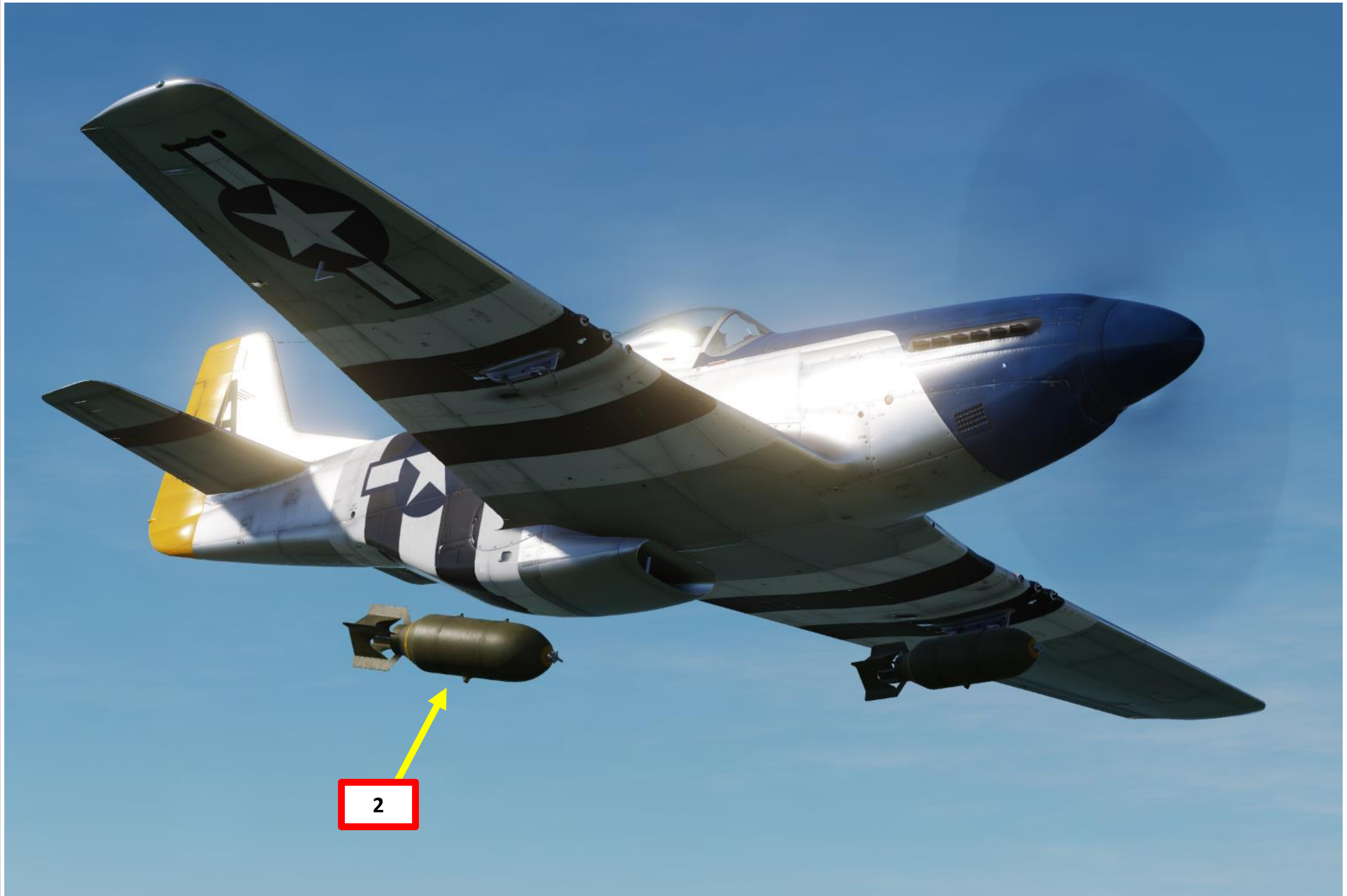
- At the correct time, fire the desired weapon at the target

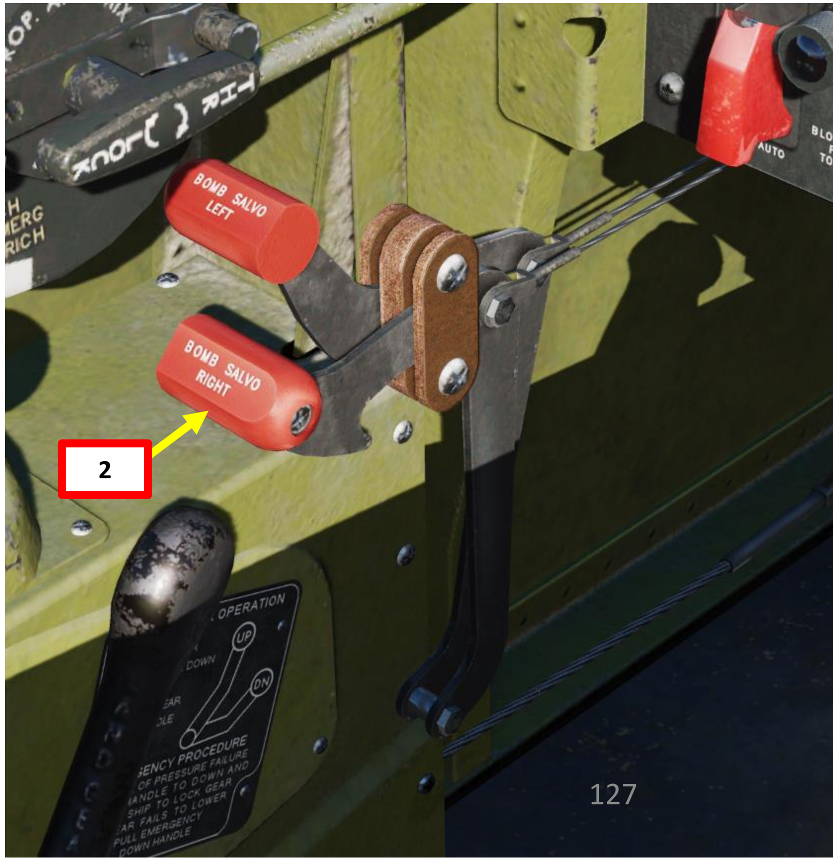
Source: The Air Combat Library Wing Line Tutorial

BOMB JETTISON

1. Disarm bombs by setting bomb arming switch to the OFF position (MIDDLE).
2. Jettison desired bomb by pulling the appropriate BOMB SALVO LEFT/RIGHT lever AFT. This will jettison the bomb without the fuze being armed.

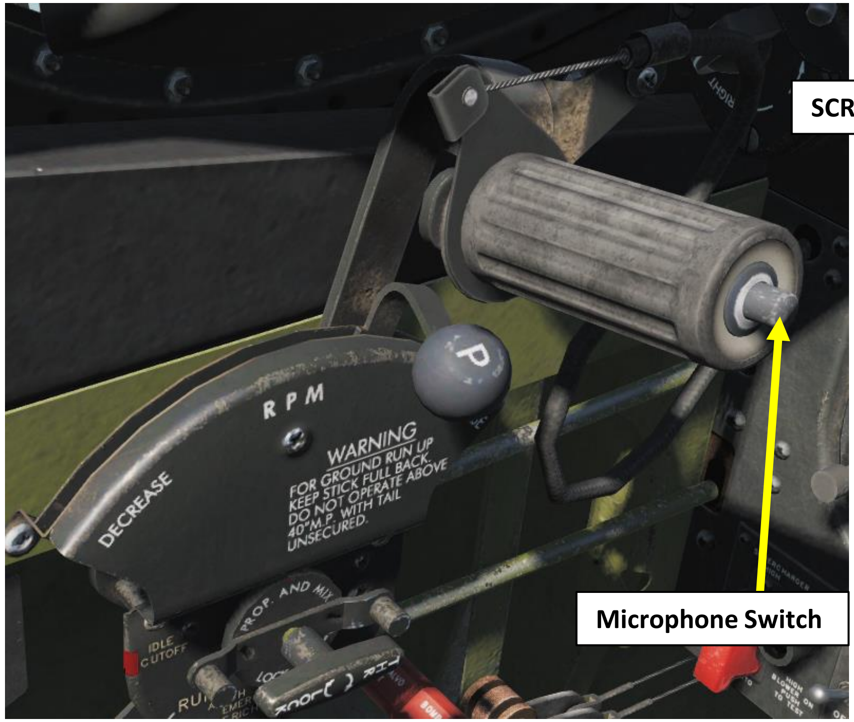


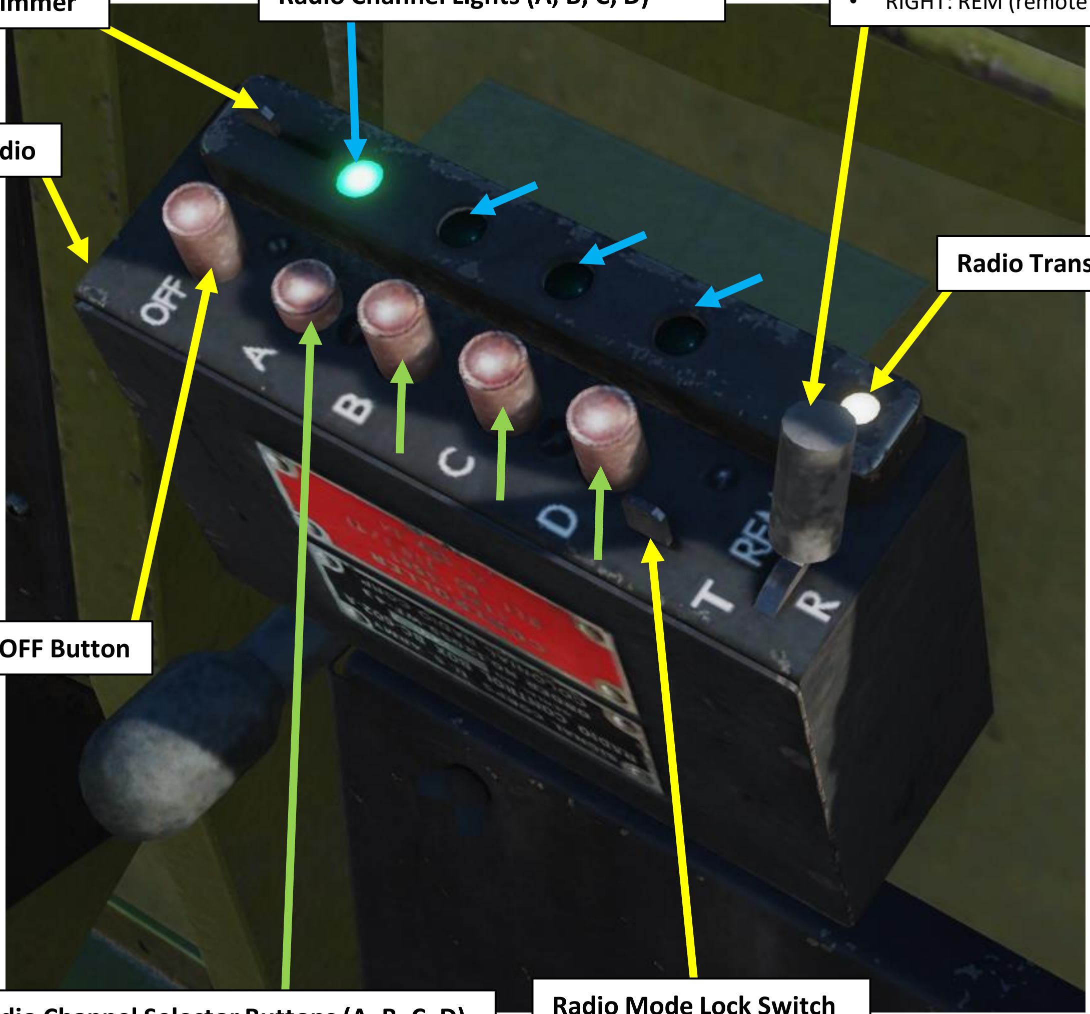




SCR-522-A VHF RADIO

The P-51D is equipped with a SCR-522 VHF (Very High Frequency) radio system. Radio frequencies are preset in the mission editor for 4 different channels and cannot be changed manually during flight.



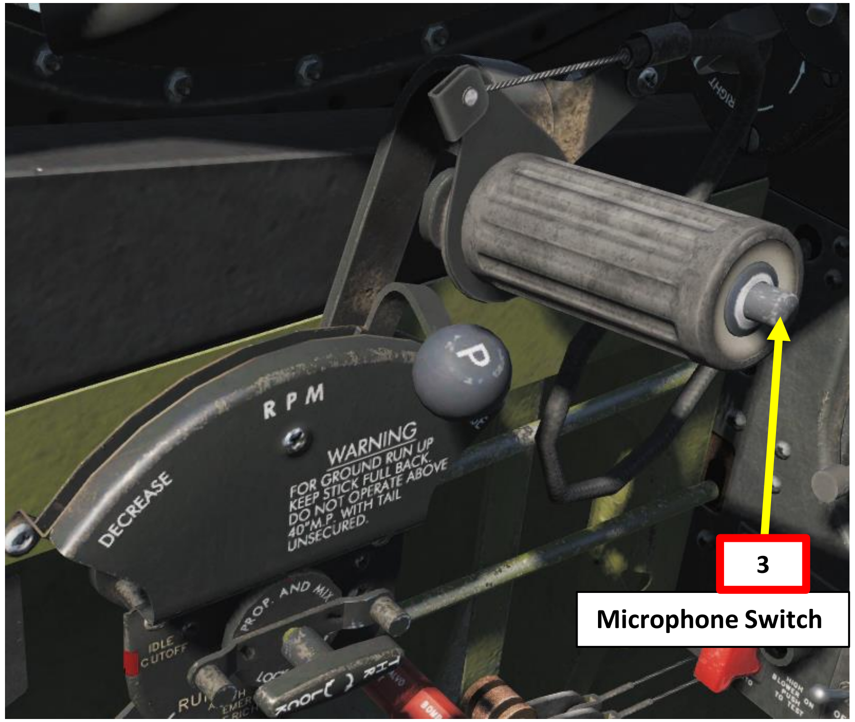


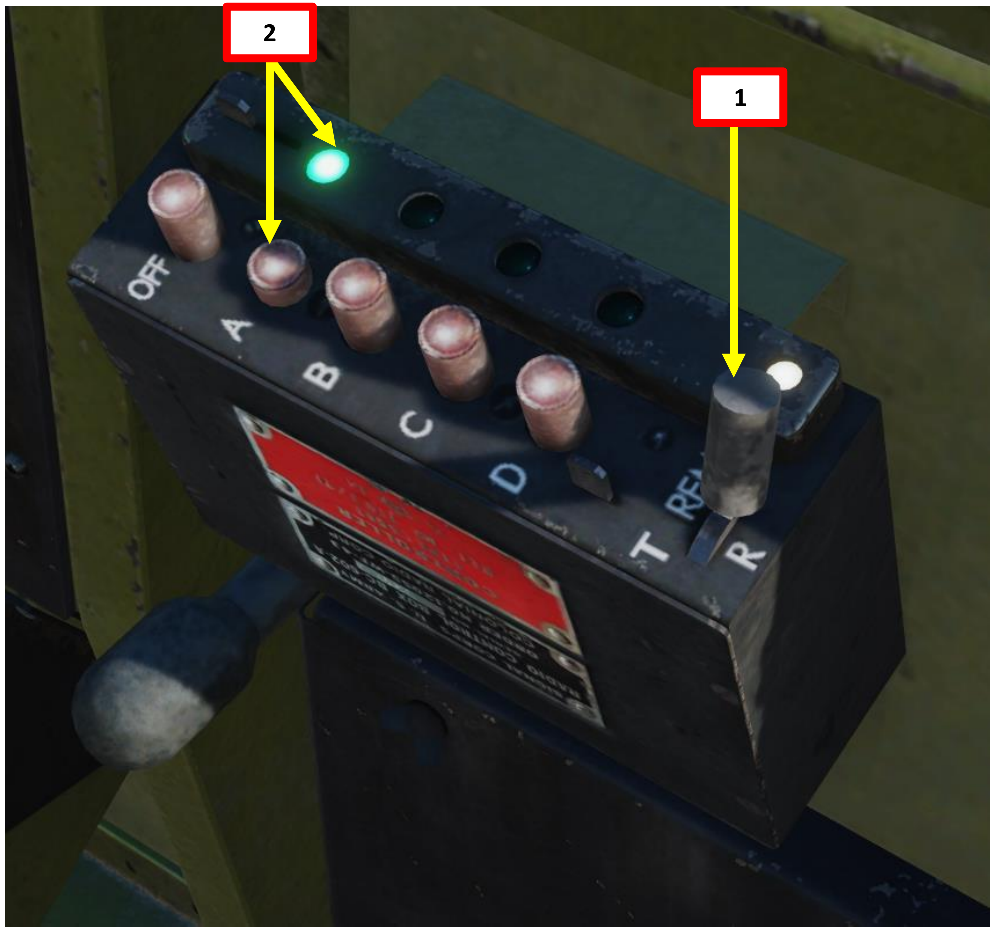
RADIO FREQUENCY RANGE: 100 - 156 MHz

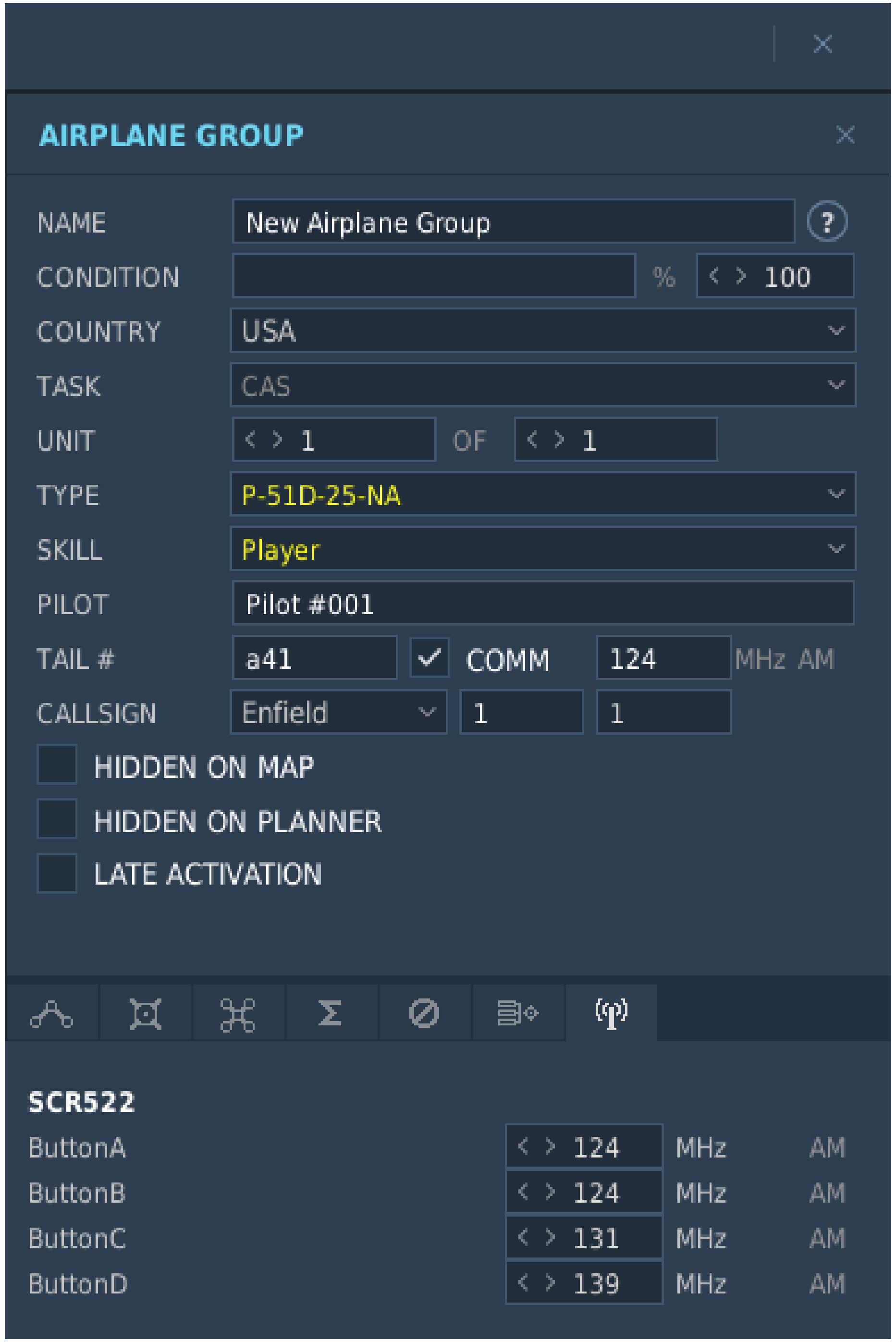
SCR-522-A VHF RADIO

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 Push-to-Talk switch on your throttle to transmit ("COMM PUSH TO TALK" control, or "RALT+\")







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.

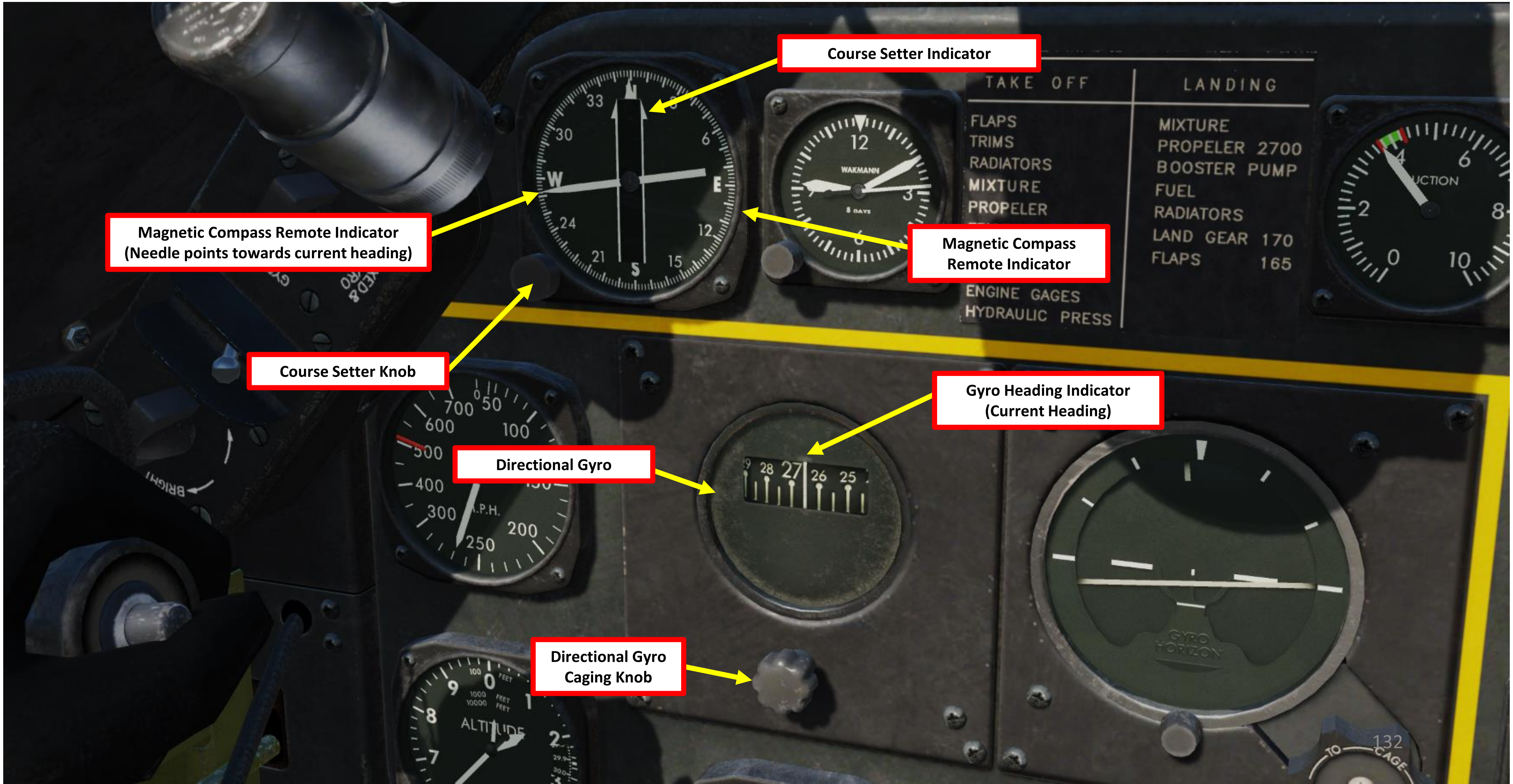
Channel B:
- Common to all VHF-equipped control towers. It is normally used to contact the control tower for takeoff and landing instructions

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.

NAVIGATION INSTRUMENTS

Most of the navigation must be done visually in the Mustang. Consult the Gyro and Remote Indicator Compass (Magnetic Compass) to determine your current magnetic heading.



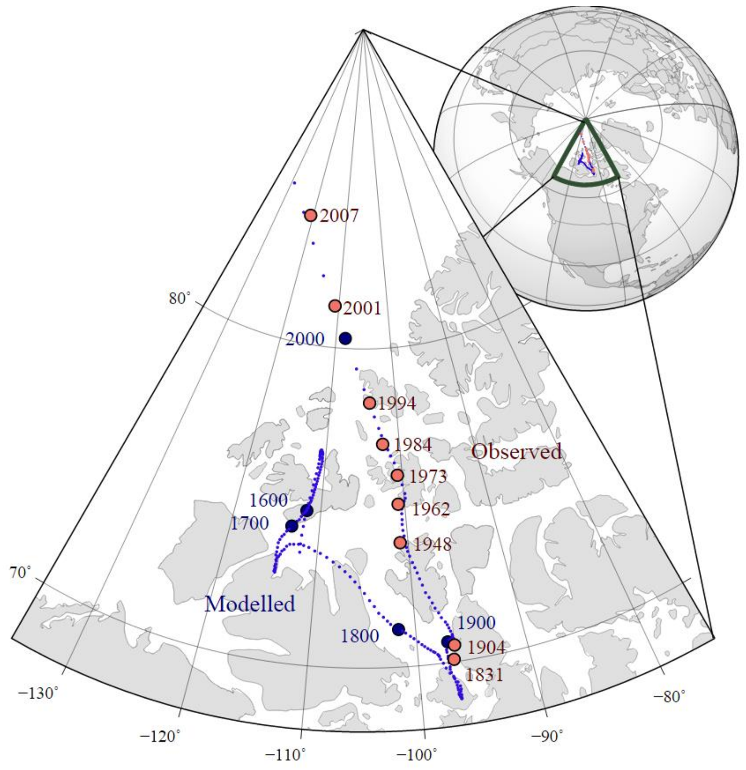
MAGNETIC VARIATION

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

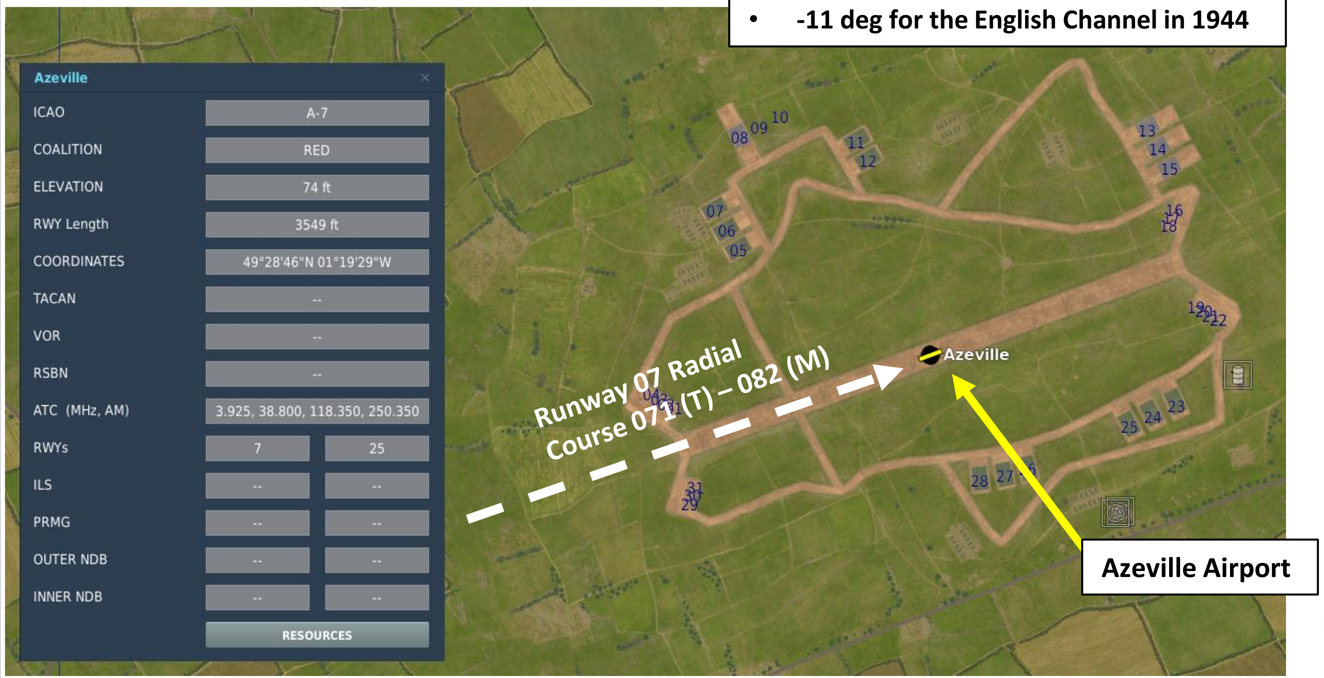
As an example, if the runway heading that you read on the F10 map in Azeville is 071 (True Heading), then the direction you should take with your magnetic compass course should be 071 subtracted with the Magnetic Variation (-11 degrees), or 082. In other words, you would need to use a course of 082 (M)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

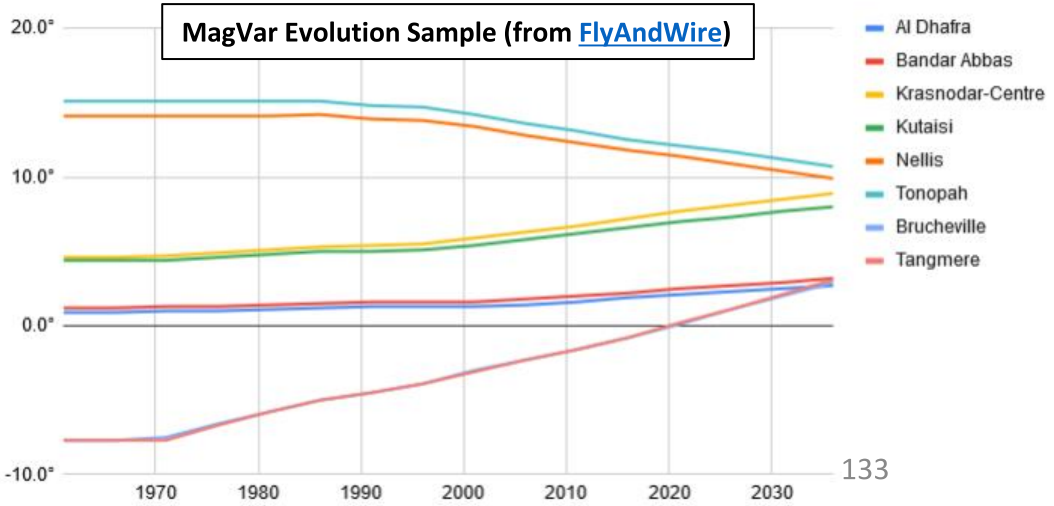


The movement of Earth's north magnetic pole across the Canadian arctic, 1831–2007.

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

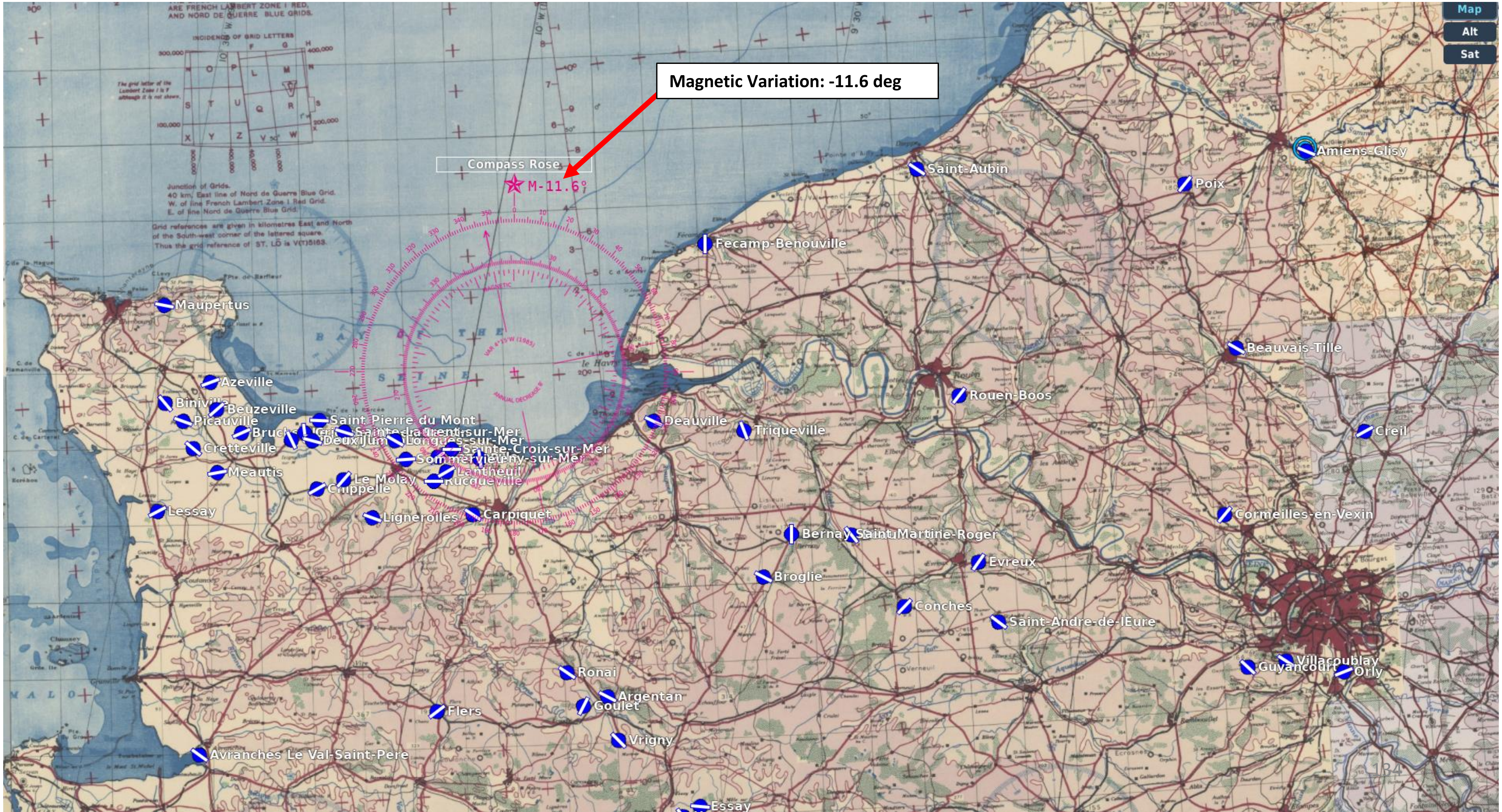


MagVar Evolution Sample (from FlyAndWire)



MAGNETIC VARIATION

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



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

ID	England	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

ID	France A—Deauv	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	AERODROME LOCATED IN THE WESTERN CLUSTER	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		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	Airfield	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

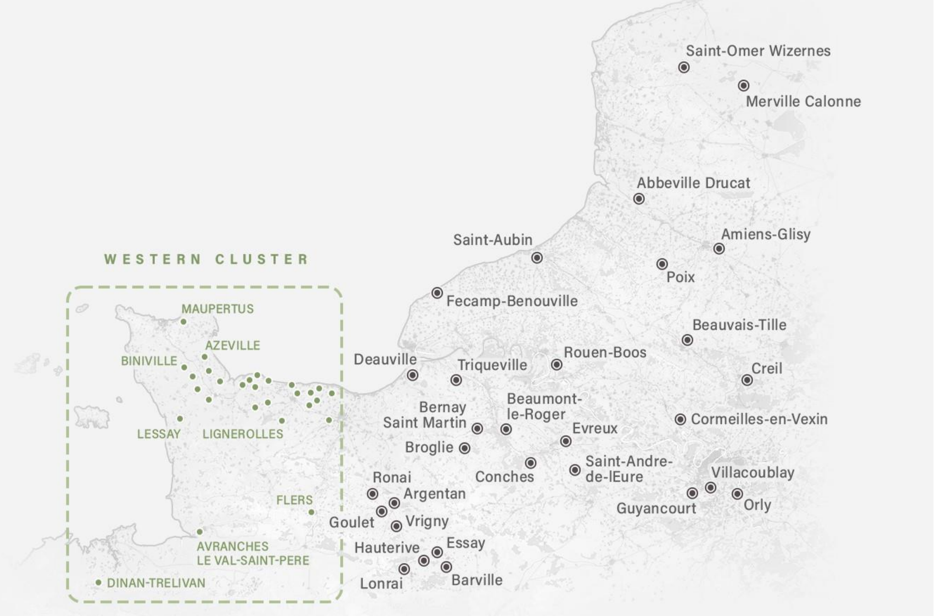
DimOn

France

S–V

ID	Airfield	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°

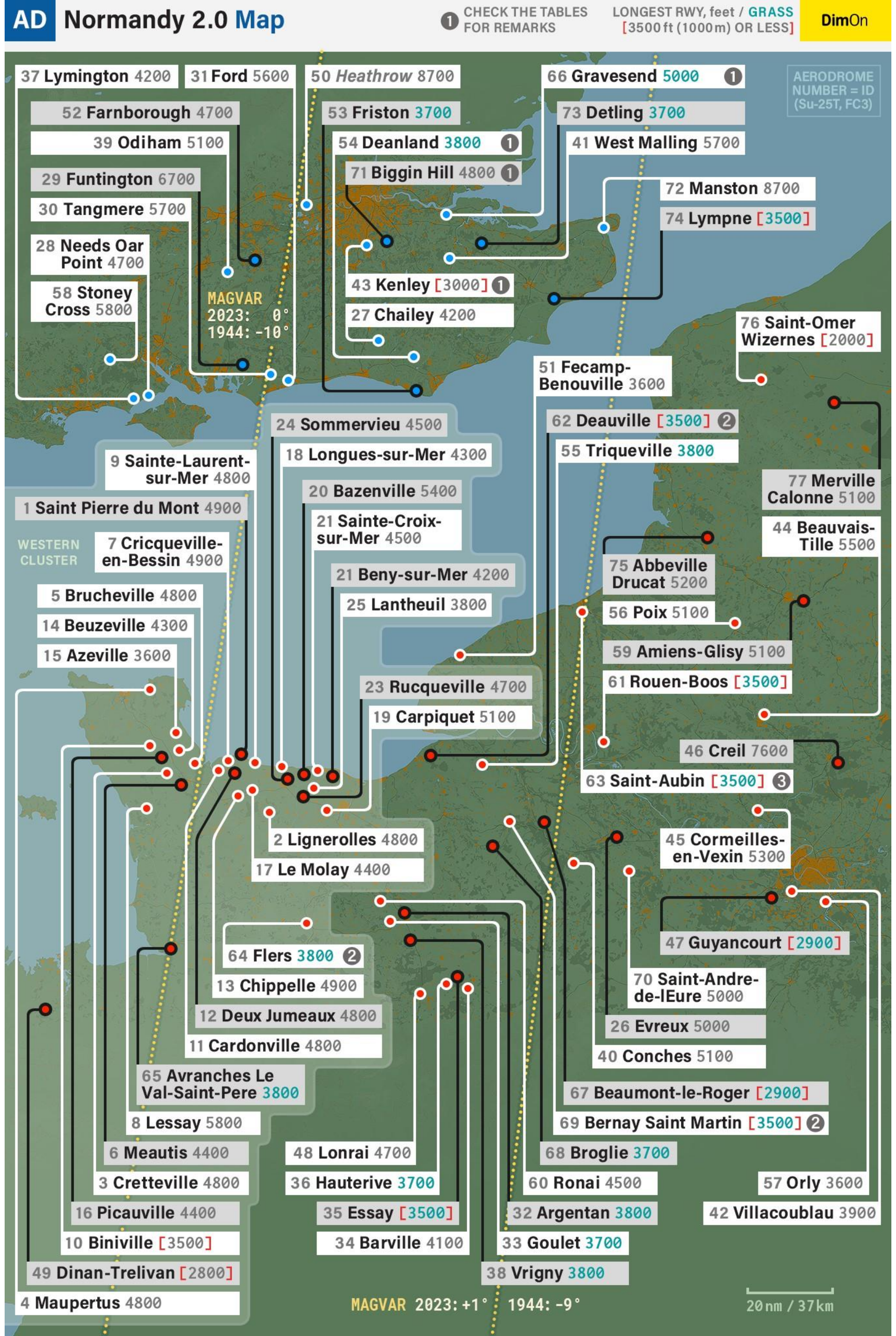
IMPROPERLY NAMED RUNWAYS ARE IN STRIKETHROUGH



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	Name / 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
England					
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

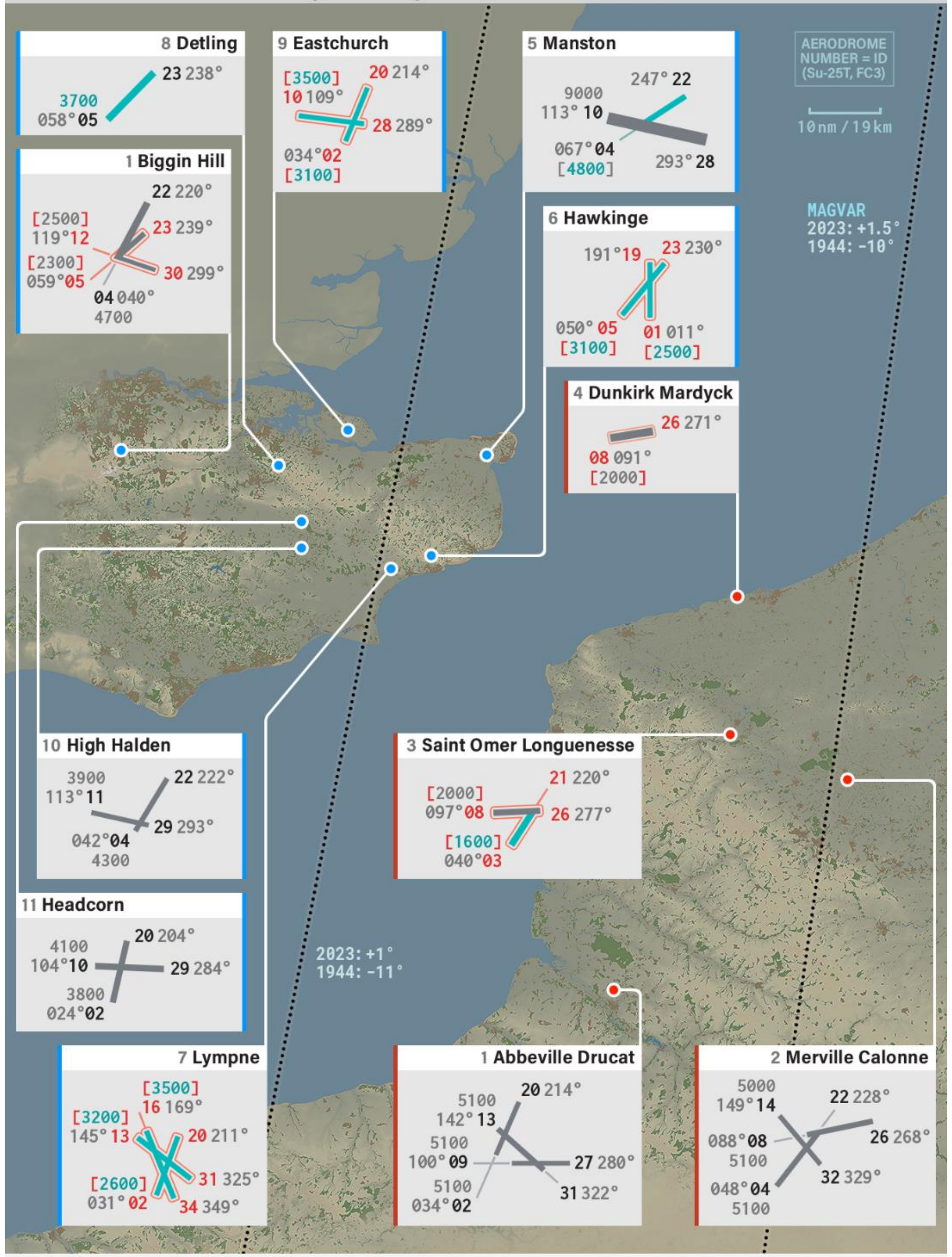
Adjust the above magnetic headings when flying in the following years (expect about 1 degree of error):

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°

AIRCRAFT VARIANTS

There are two variants of the Mustang modelled in DCS: the P-51D-25-NA and the P-51D-30-NA variants. There are no difference between the two variants in terms of performance; they use the same engine and have the same wing profile. The D-25 was used in the ETO (European Theater of Operations) while the D-30 was used in the PTO (Pacific Theater of Operations). The difference lies mainly in terms of on-board equipment (antennas).

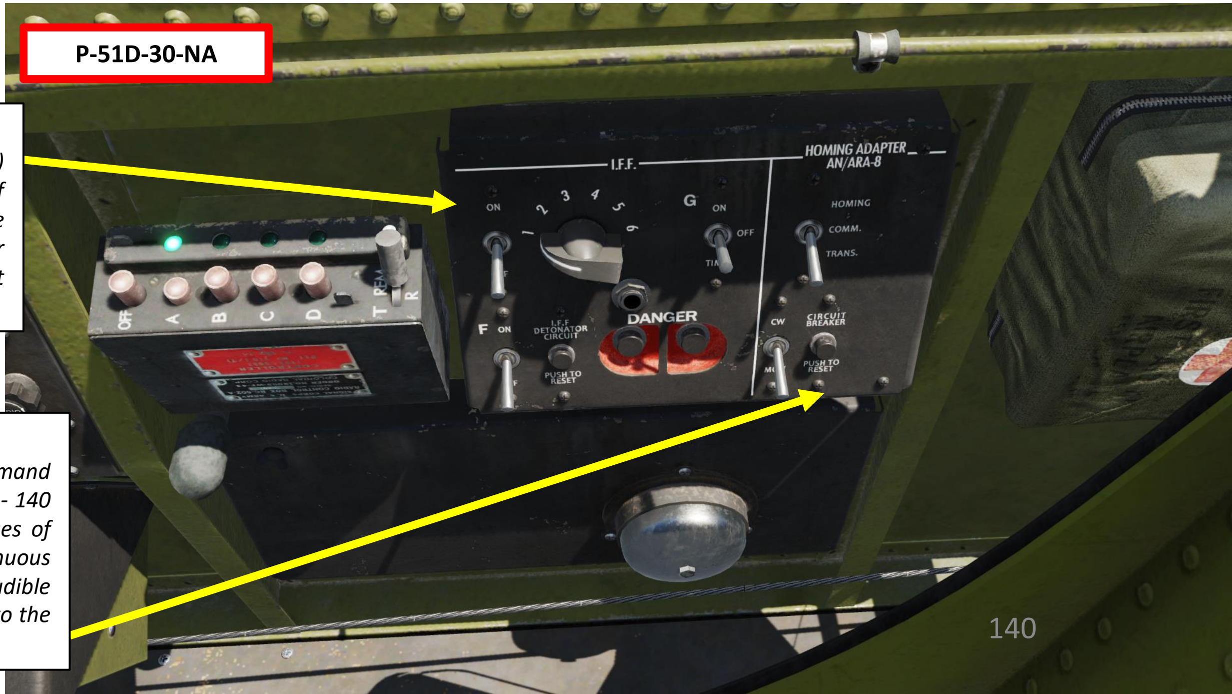
AIRCRAFT VARIANTS

P-51D-25-NA Variant

The D-25 was mainly used in Europe. The version we have is stripped of the IFF panel and the Homing Adapter system.

P-51D-30-NA Variant

The D-30 was used in the Pacific. The D-30 had to navigate over long distances and navigation was very challenging in the middle of the ocean. The AN/ARA-8 Homing Adapter system panel is installed (but not functional in DCS) and was used to home on radio emitters. The IFF (Identify-Friend-or-Foe) Panel is not functional in DCS either, but it was used as a method of responding to radar interrogators. This system would tell the ground radar operator whether your aircraft was friendly or enemy based on your response code/frequency.



IFF (Identify-Friend-or-Foe) System
The SCR-695-A IFF (Identification Friend or Foe) radio set permits automatic transmission of identification signals upon reception of a challenge signal from a properly equipped friendly air or surface unit. It can also be used to transmit emergency or distress signals.

AN/ARA-8 Homing Adapter System
The AN/ARA-8 Homing Adapter unit is used in conjunction with the SCR-522-A command radio to permit homing on any transmitting carrier within the frequency range of 120 - 140 MHz. In addition, this equipment may be used for air-to-air homing for the purposes of rendezvous. Homing can be performed on continuous wave (CW) and modulated continuous wave (MCW) signals. Homing signals are provided to the pilot in the form of an audible signal in the headset, Morse code character D (– . .) when the transmitting station is to the left and Morse code character U (. . –) when the transmitting station is to the right.

Dogfighting in the P-51D Mustang is an art that is easy to learn, but very difficult to master. On various forums, you will read a thousand different theories about "how to dogfight" or "why it sucks monkey balls" or "why it's the most overpowered aircraft ever". Everyone has an opinion on the Mustang, but few people have a truly "informed" opinion about it. I will try to give you some tips that are intended to be as unbiased and factual as possible.

First, the P-51D Mustang was built to be a high-speed, long-range escort fighter. While the majority of allied fighters like the Spitfire had a range of about 430 miles, a P-51 equipped with external fuel tanks had a range of about 1,650 miles. The distance between London and Berlin being approximately 600 miles, the Mustang became the aircraft of choice to escort the bombers during the bombing campaign over Germany.

Therefore, the Mustang 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. This partially explains why the Mustang can sometimes seem "worse" in most aspects than other fighters at low altitude: it was meant to be a high-altitude fighter. 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.

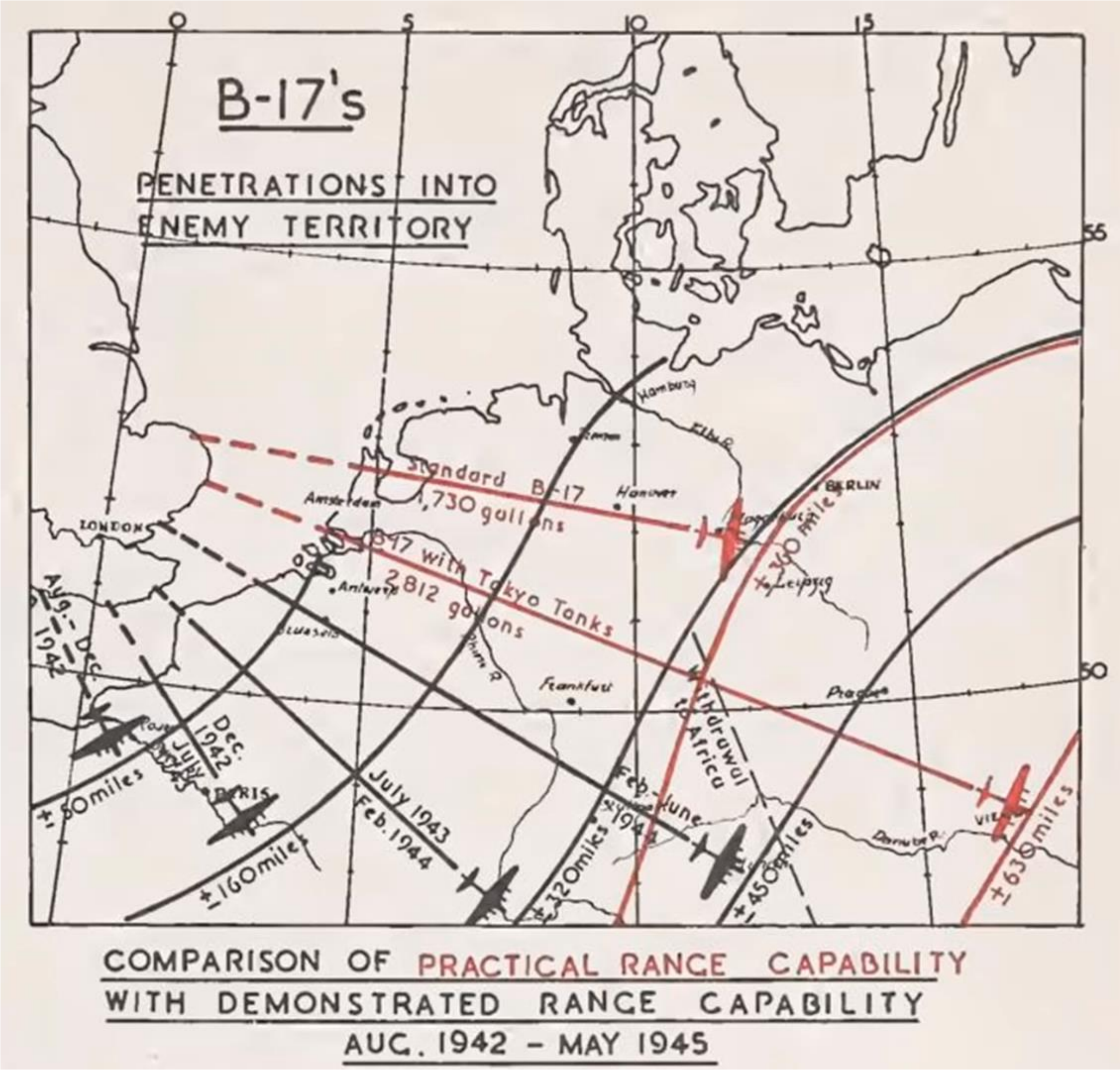
During dogfights, I would advise you to keep your energy state (airspeed and altitude) high at all times. These principles apply to every single aircraft, but particularly to the Mustang too. If you have to make a quick turn, you will notice that the Mustang's wing configuration has an airfoil of a laminar-flow design, which provides low drag at high speeds but has the inconvenient of inducing violent accelerated stalls and spins if you pull too hard on the stick when turning and banking. A good trick is to deploy 10 to 20 degrees (1 to 2 notches) of flaps before beginning a turn and to retract your flaps immediately afterwards to gain back airspeed. The Mustang can have a surprisingly good turn rate when your flaps are deployed; this can be used to your advantage when you need to evade an enemy that is bouncing you.

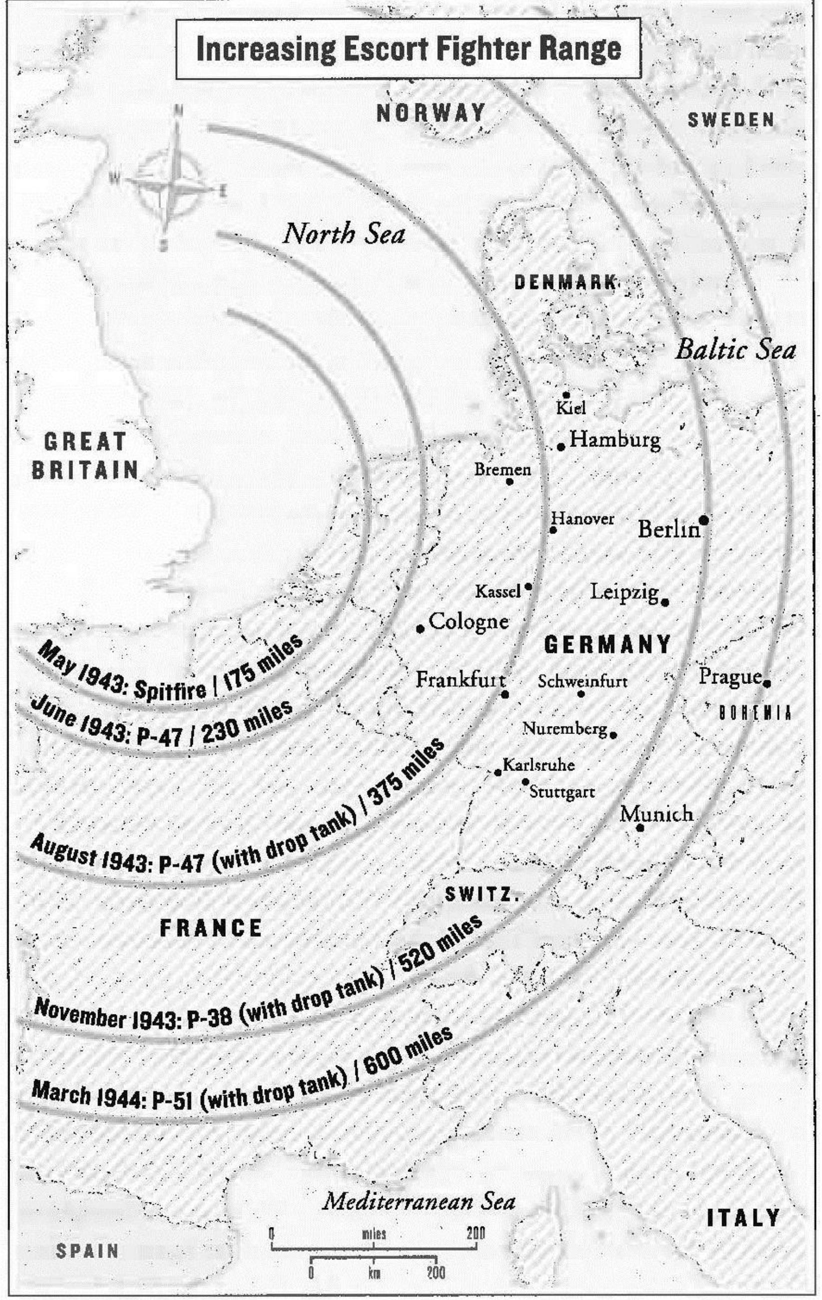
It is also important for you to realize that the P-51D modelled in DCS is an early 1944 variant , while the Bf.109K-4 and FW.190D-9 entered service in late 1944. Therefore, the P-51D of early will underperform in comparison to the P-51D of late 1944 since the maximum allowable manifold pressure went from 67 inches of Hg to 75 inches of Hg, partly due to a change of fuel grade. There have been extensive and heated debates on "what fuel grade should be used" on the Eagle Dynamics forums.

While we could argue day and night about what the P-51D should or should not be, the conclusion remains the same. The P-51D must be used in the following way if you want to survive against experienced Bf.109 or FW.190 pilot:

- 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
- 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.

The laminar flow wings of the Mustang made it the perfect fighter for long flights since it generated minimal drag and allowed for high altitude flights over long distances. The Mustang, alongside the P-47, was one of the few aircraft that had sufficient endurance (with external fuel tanks) to follow the B-17 Flying Fortress bombers from bases in England to the heart of Germany. Mustang squadrons like the Tuskegee Airmen of the 332nd Fighter Group (nicknamed the "Red Tails") became famous for their escort missions and their dedication to protect the bomber crews through long flights that could last for hours.





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.

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.

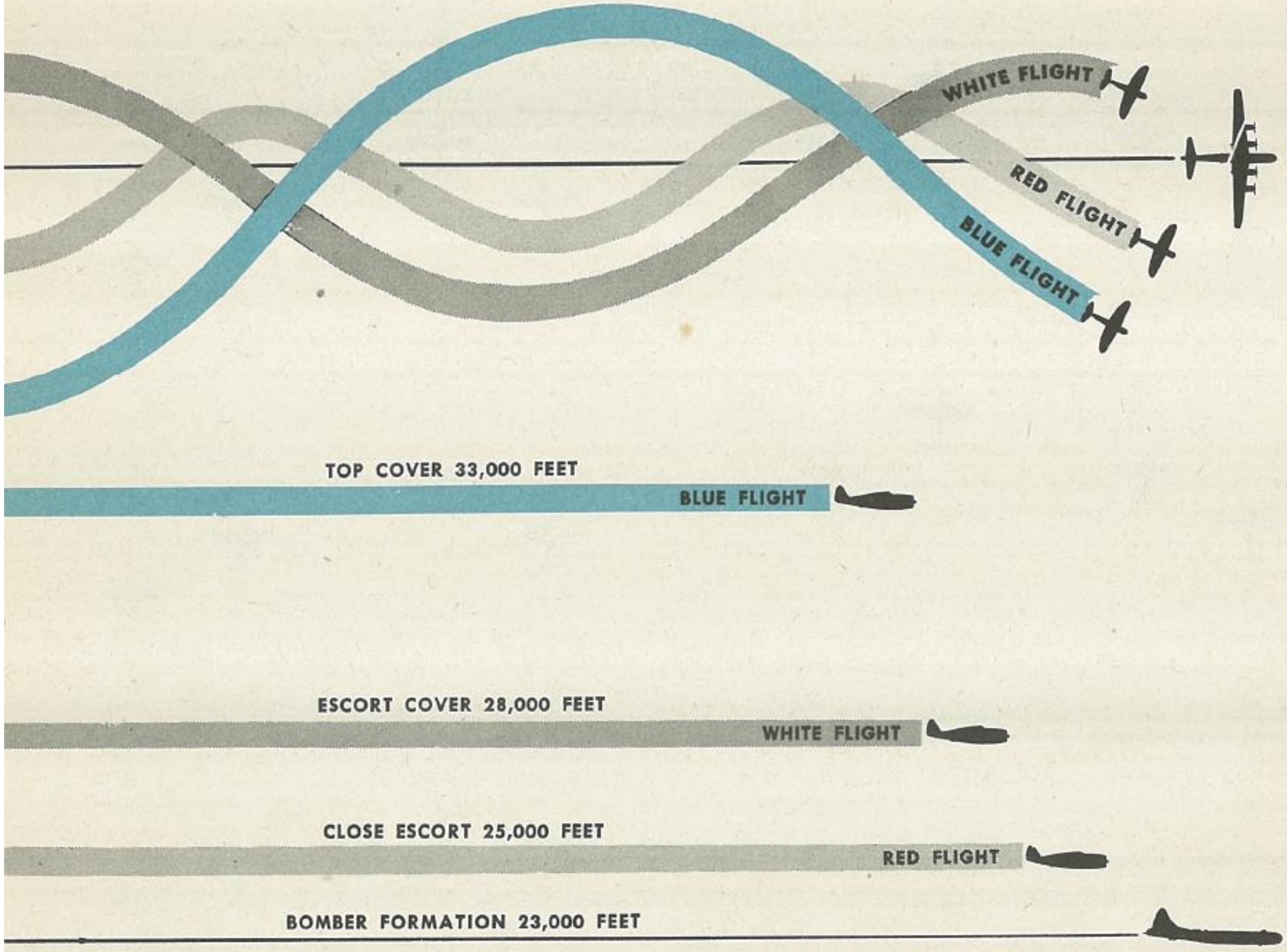
Rhubarb patrols began in December 1940; while the pilots were allowed to attack ground targets if any presented itself their primary objective was to bring down German aircraft. By mid-June 1941, Fighter Command had flown 149 Rhubarb patrols (336 sorties) claiming seven enemy aircraft brought down for 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 P-51 participated in a significant number of “**Ramrod**” operations, which were similar to Circus but with destroying a target being the principal aim. I suggest you try out some escort missions if you want to experience a very different way to fly in the P-51.

SQUADRON ESCORT OF A BOMBER FORMATION

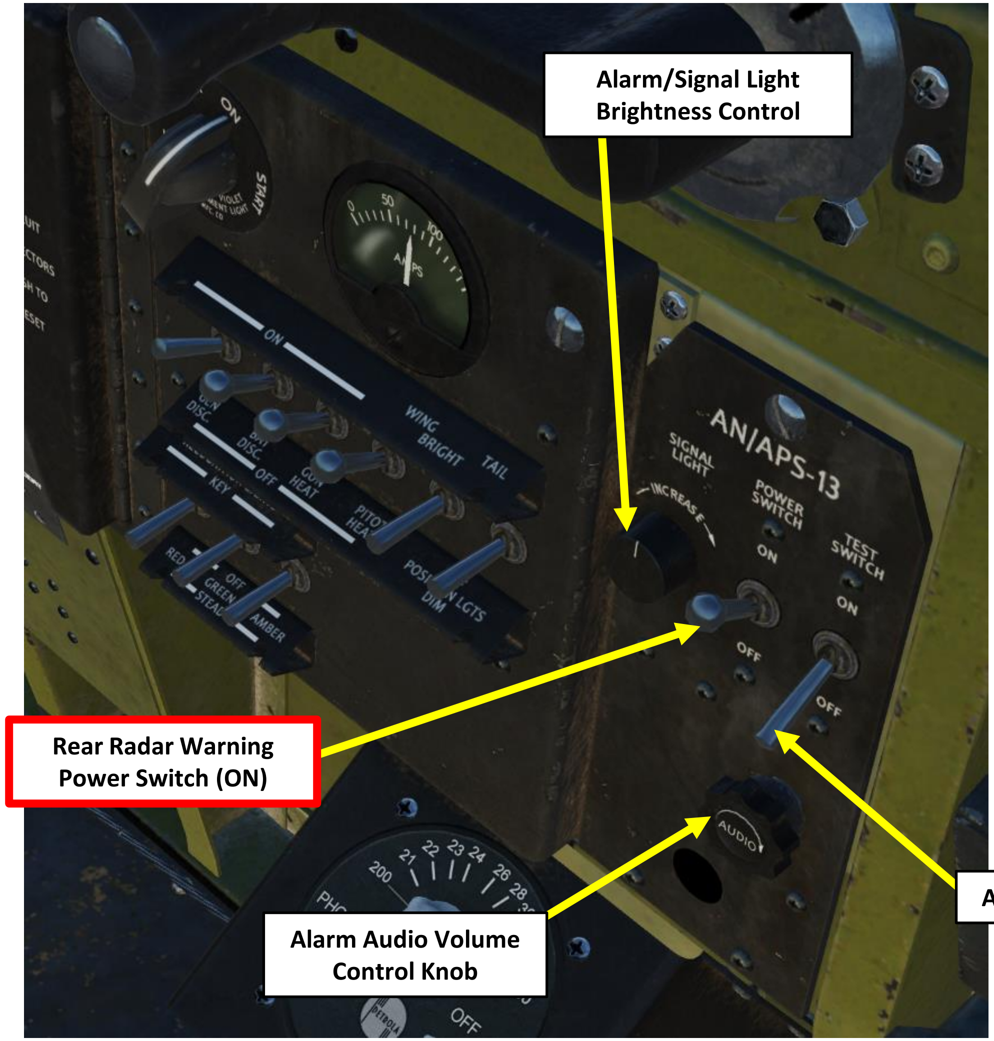
(Taken from P-47 documentation)



AN/APS-13 REAR WARNING RADAR SYSTEM

The P-51D is equipped with the AN/APS-13 Rear Warning Radar System, which will trigger an alarm sound and light when a contact is behind you. This is very useful for situational awareness. Keep in mind that this radar is somewhat primitive and will not distinguish friend from foe.

To turn on the Rear Radar Warning switch, simply turn the Rear Radar Warning Power Switch ON (UP). An audible alarm sound and light will be triggered when an aircraft is behind you.



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,

THANK YOU TO ALL MY PATRONS

Creating these guides is no easy task, and I would like to take the time to properly thank every single one of my Patreon supporters. The following people have donated a very generous amount to help me keep supporting existing guides and work on new projects as well:

- ChazFlyz

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C-101 1.5.3 Beta
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