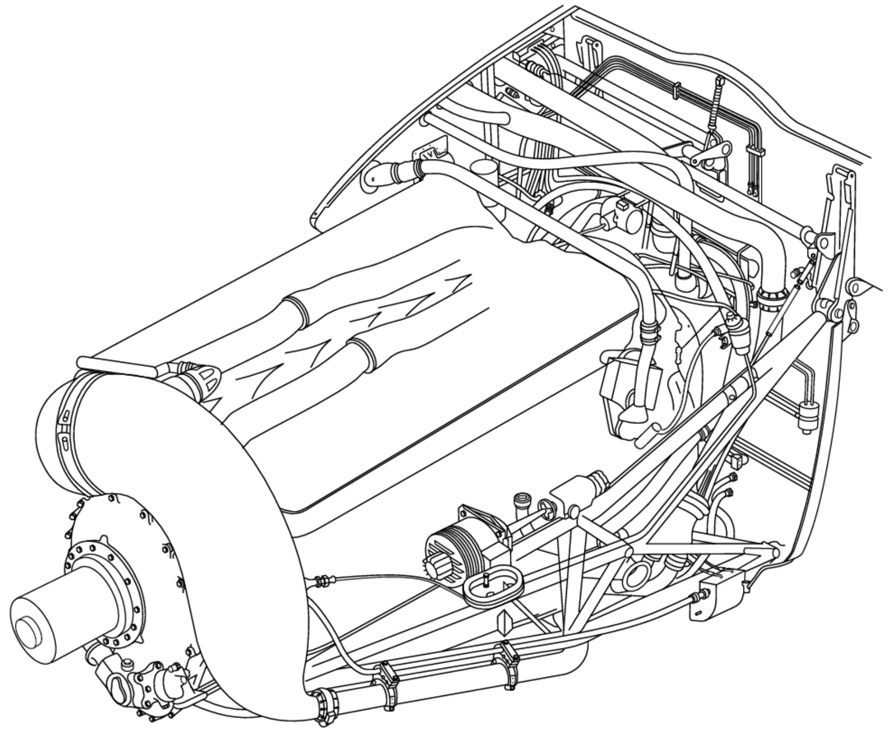
THE MERLIN 25 ENGINE

The Mosquito FB Mark VI is powered by two Merlin 25 engines, which are liquid-cooled, 12-cylinder V-twin piston engines with a compression ratio of 6:1. The throttle, fuel mixture and propeller pitch are controlled from the cockpit.

A two-speed, single-stage, liquid-cooled, high-speed centrifugal type supercharger is driven from the rear end of the crankshaft through a two-speed gearbox. Blower speed changeover is automatically controlled by electro-pneumatic actuators and an aneroid switch that operates at 15,000 feet in AUTO mode. With the exception of a separate turbocharger control unit, the Merlin SU double-choke up-thrust carburetor is fully automatic, minimizing pilot responsibility and the risk of engine damage as a result of improper control.

The drive box is mounted behind the crankcase and carries the magneto, coolant pump, generator drive, electric slewing gear and fuel pump assembly. It contains a spring drive and shafts through which the magneto, camshafts, electric generator, fuel, oil and cooling pumps are driven. The aircraft is equipped with two de Havilland three-bladed propellers, fully featherable, with hydro-automatic control type 5000. In normal operation they are controlled by speed control levers. Normal angle range is 35°, additional feathered range 45°.

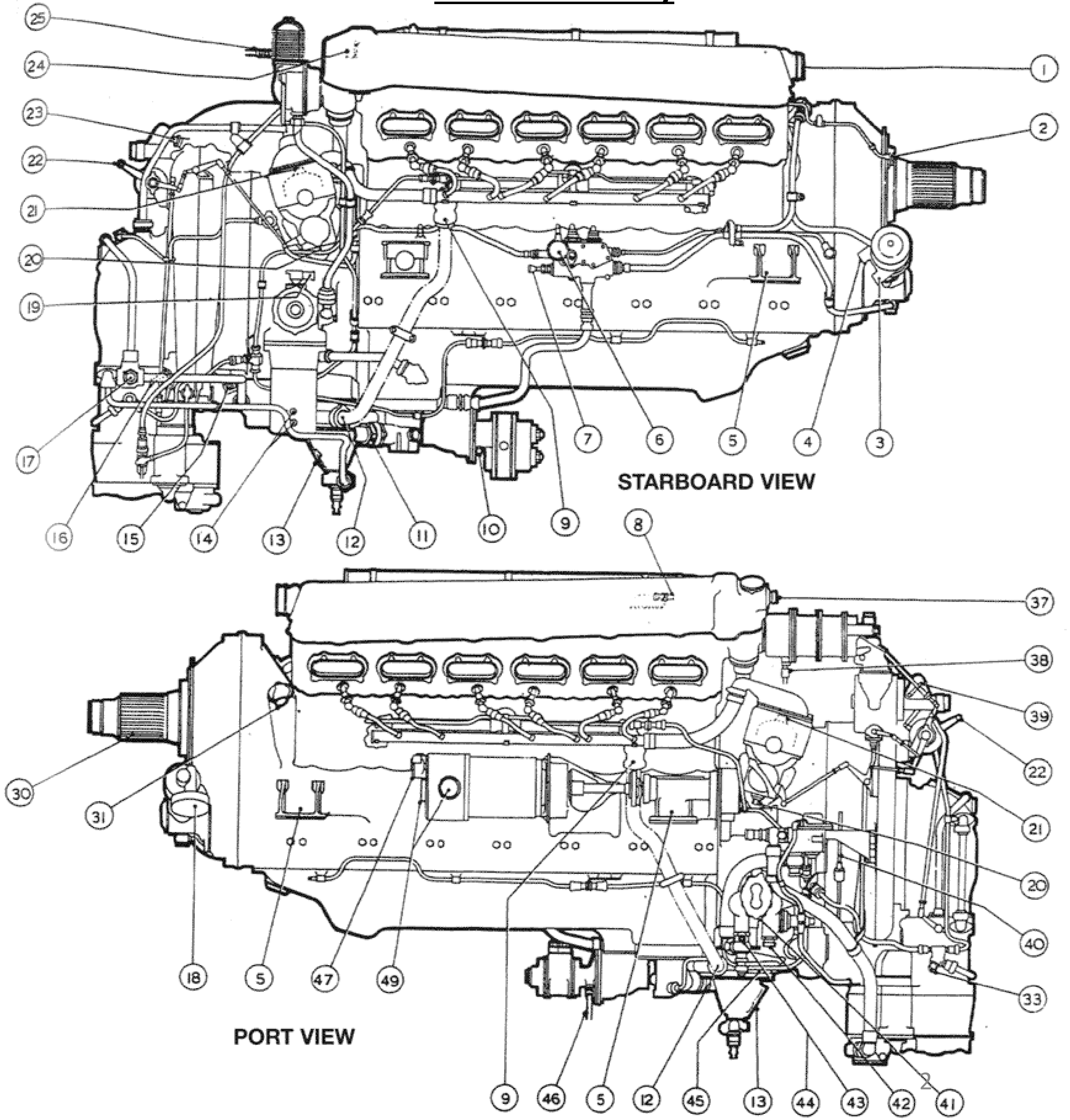
The ignition system consists of two magnets located on the drive box, one on the left and one on the right. Attached to these are high voltage spark plug harnesses with a dual-purpose metal shield that acts as a collector for the induced field around the high voltage wires, returns the resulting electrical current to ground, and prevents radio interference. There are two spark plugs in each cylinder: one magneto provides a spark for the intake side spark plugs and the other for the exhaust side spark plugs to ensure that the engine remains operational if one of the magnets fails.



THE MERLIN 25 ENGINE

1. Coolant Outlets
2. De-icing Connection to propeller
3. Vacuum Pump Inlet
4. Vacuum Pump Return
5. Engine Mounting Feet
6. Oil Pressure Gauge Connection
7. Oil Thermometer Gauge Connection
8. De-icing Inlet Connection
9. Coolant Inlet to Cylinder
10. Dowty Pump Drain
11. Oil Inlet
12. Coolant Pump Outlet
13. Coolant Pump Inlet
14. Starter Motor Terminals
15. Supercharger Bearing Vent
16. Slow-running Cutoff Lever
17. Oil Outlet
18. Constant-speed Propeller Governor Unit
19. Wheelcase Breather Vent
20. Magneto Earthing Connection
21. Magneto Booster Coil Connection
22. Throttle Control Levers (alternative)
23. Boost Gauge Connection
24. Cabin Heater Connection
25. Haywood Air Compressor Outlet
26. I.A.E. Pump Delivery
27. I.A.E. Pump Drain
28. I.A.E. Pump Inlet
29. Fuel Priming Connection
30. Propeller Shaft
31. Crankcase Breather
32. Engine Starting Handle
33. Fire Extinguishing System Inlet
34. R.A.E. Air Compressor Oil Inlet
35. R.A.E. Air Compressor Air Inlet
36. R.A.E. Air Compressor Air & Oil Outlet
37. Engine-speed Indicator Drive
38. R.A.E. Air Compressor Drain
39. Boost Control Cut-Out Lever
40. Two-speed Supercharger Control
41. Fuel Pump Drain
42. Fuel Pump Inlet
43. Fuel Priming Connection to Fuel Pump
44. Oil Dilution Connection
45. Fuel Pressure Gauge Connection
46. Lockheed Pump Drain
47. Electric Generator Terminals
48. Electric Generator Air Cooling Inlet
49. Electric Generator Air Cooling Outlet

Motor Assembly



THE MERLIN 25 ENGINE

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35. R.A.E. Air Compressor Air Inlet
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41. Fuel Pump Drain
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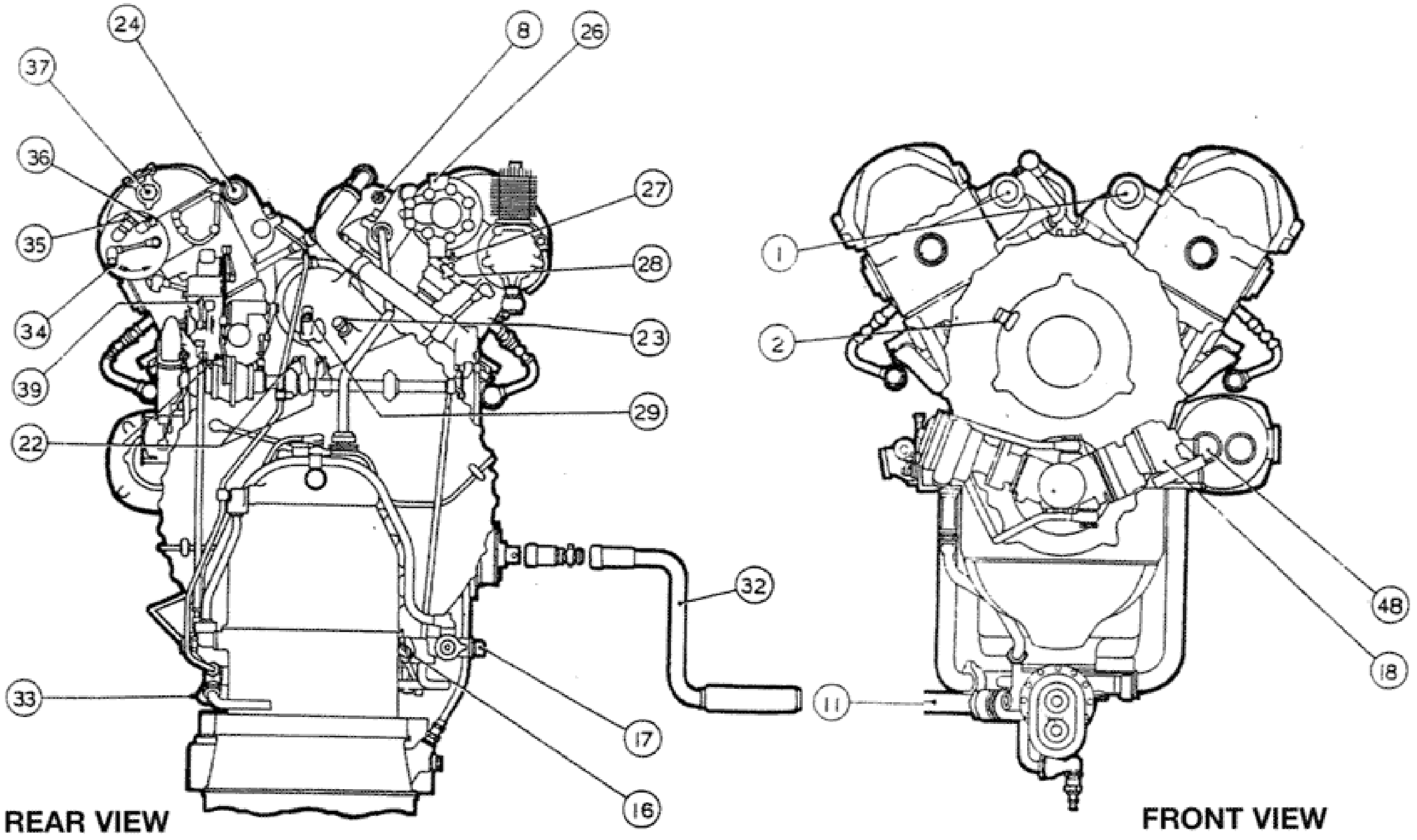
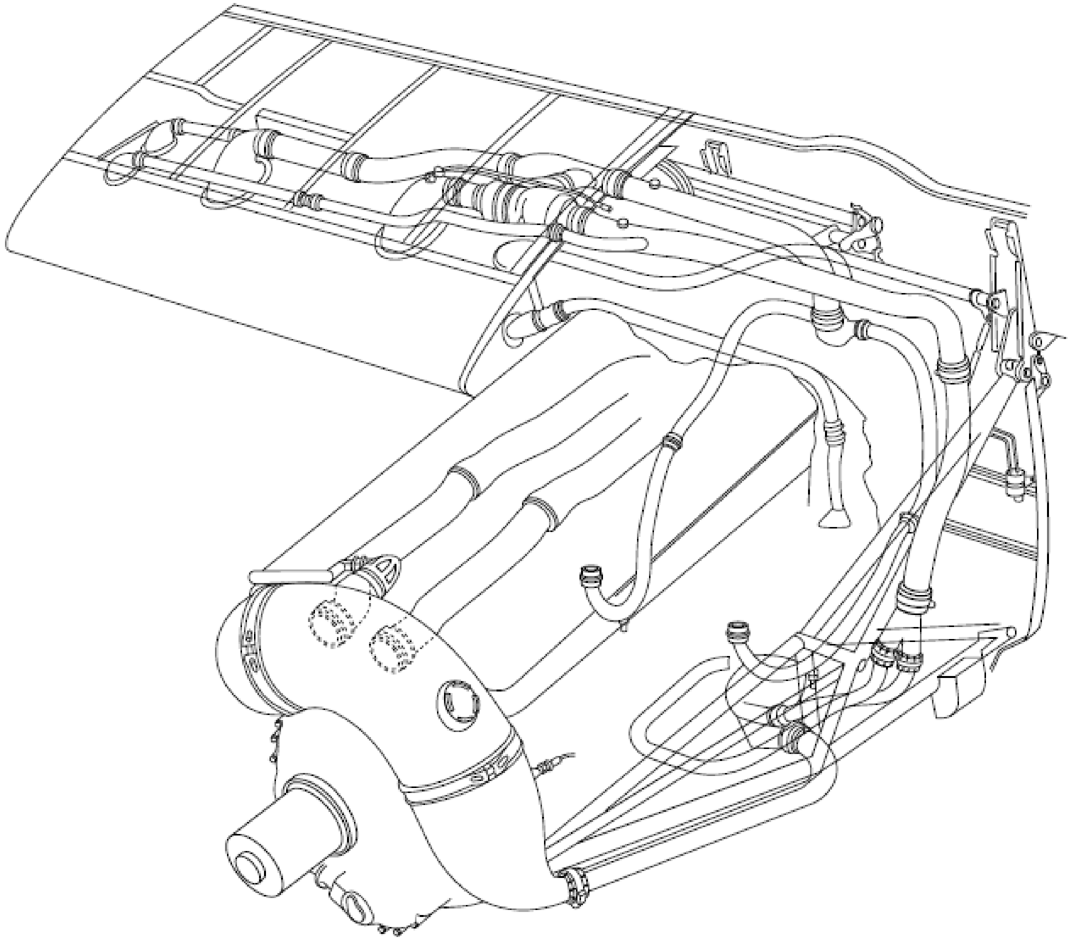
Motor Assembly

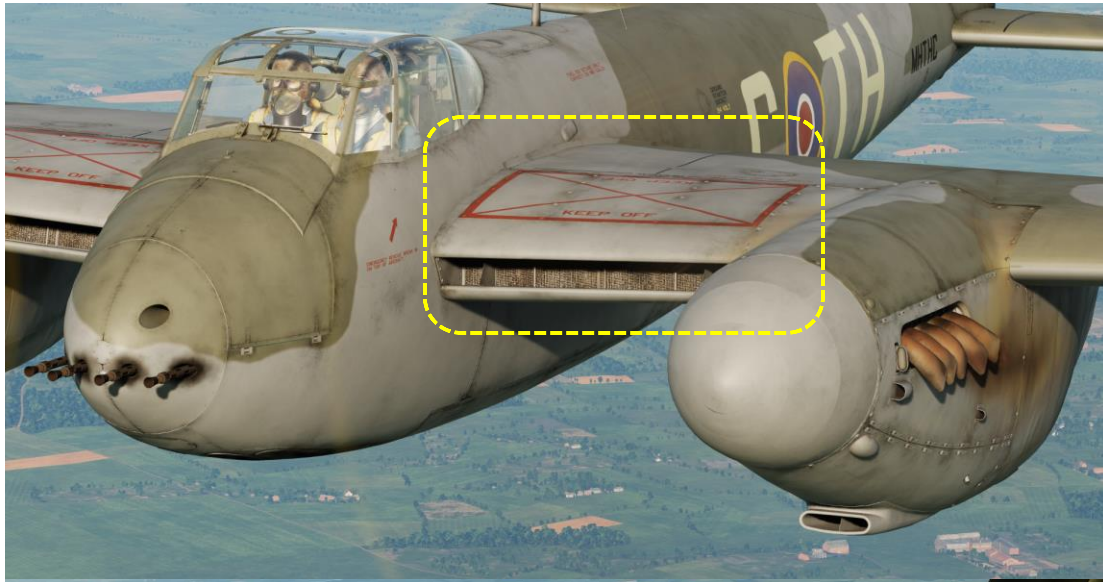


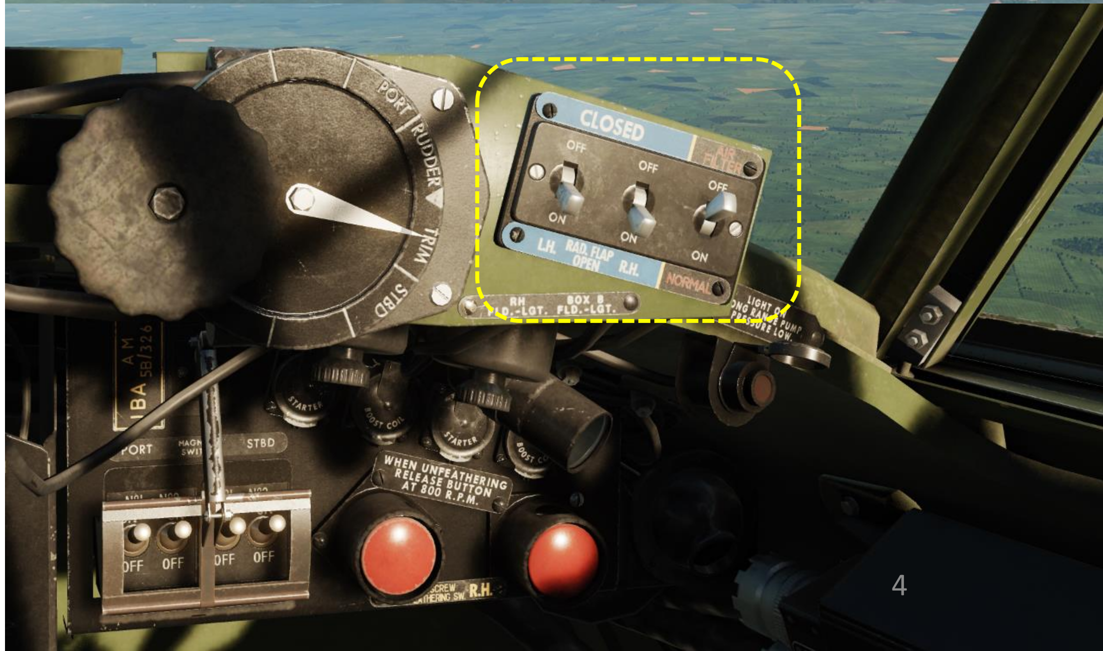
THE MERLIN 25 ENGINE

A coolant tank is located ahead of each engine. When the tanks and coolant lines are full, the system contains 15½ – 16 gallons of coolant: 2.6 gallons is in the tank, 3.9 pints in the radiator and cabin heater and 4.5 pints in the engine. The liquid is composed of 30% ethylene glycol and 70% distilled water. Temperature control is by means of a thermostat and a movable radiator air duct flap controlled by the pilot.

Cooling System





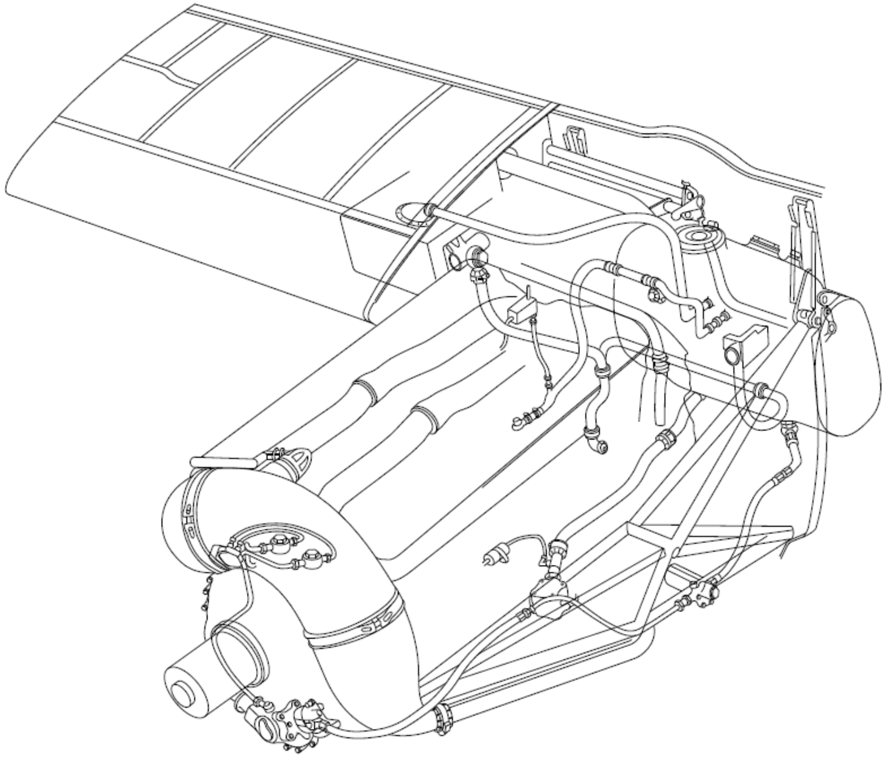


THE MERLIN 25 ENGINE

Two 15 gal. oil tanks are provided and are situated one in each engine nacelle. There are no oil cooler controls for the pilot, but the coolant radiator flaps also serve the oil coolers.

There are four oil circuits in the engine lubrication system: the main pressure circuit, low pressure supply circuit, front sump purge circuit, and rear sump purge circuit.

The main and lower circuits are served by one injection pump and the corresponding safety valves, while each circuit purge is serviced by a dedicated purge pump.



Oil System

1. Long-Range Oil Tanks
2. Valve
3. Clark-Valve
4. Oil Cooler
5. Carburetor
6. Hydromatic Oil Pump
7. Constant Speed Unit (CSU)
8. Engine
9. Oil Separator
10. Valve

-Feed Low-Pressure Lines

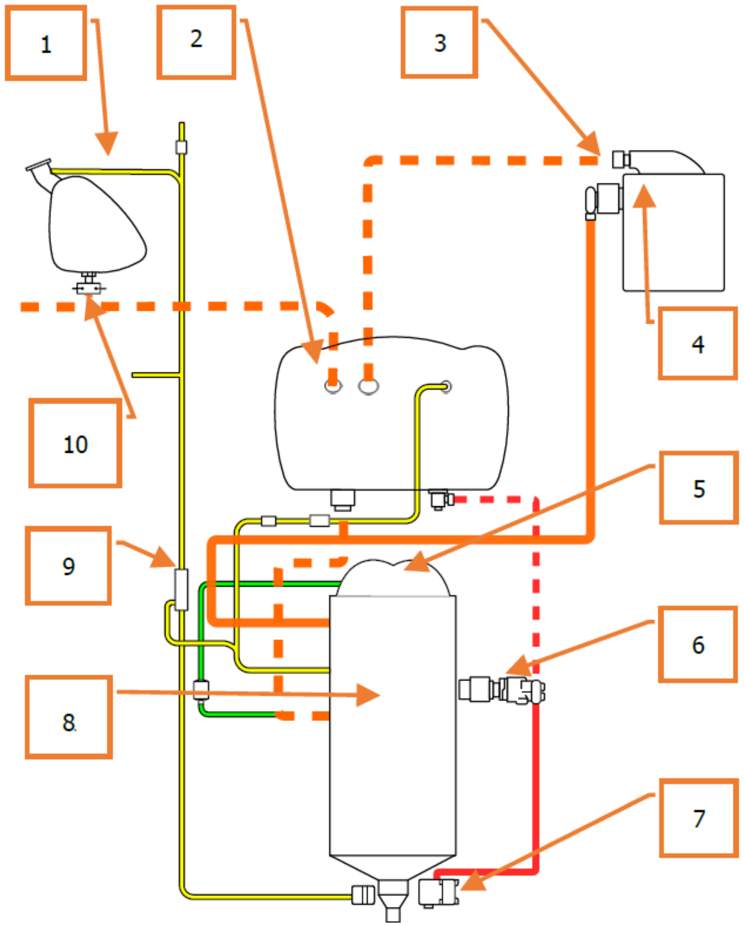
-Return Low-Pressure Lines

-Feed High-Pressure Lines

-Return High-Pressure Lines

-Oil Dilution

-Purging

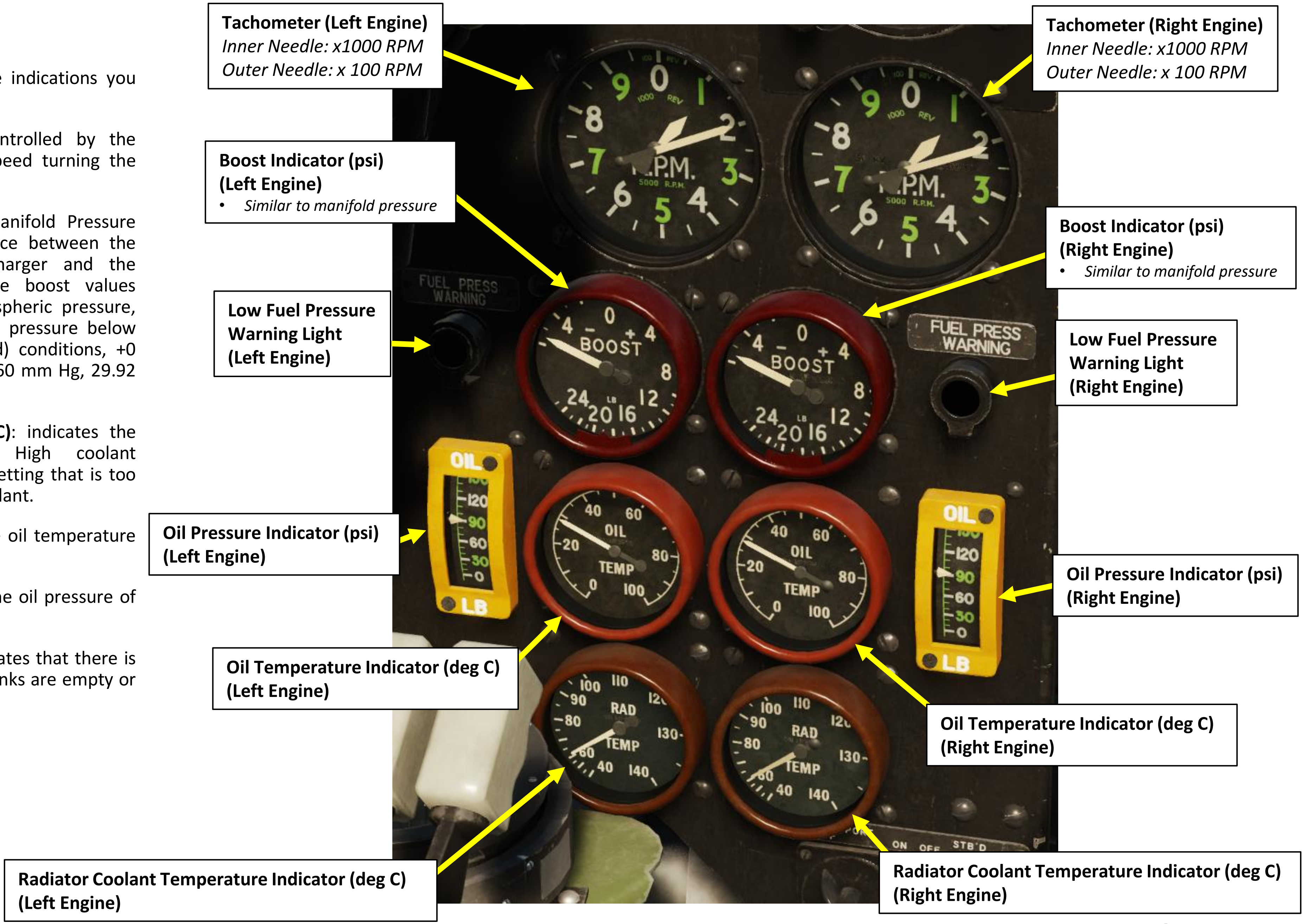


Oil System Schematic

ENGINE INDICATIONS

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

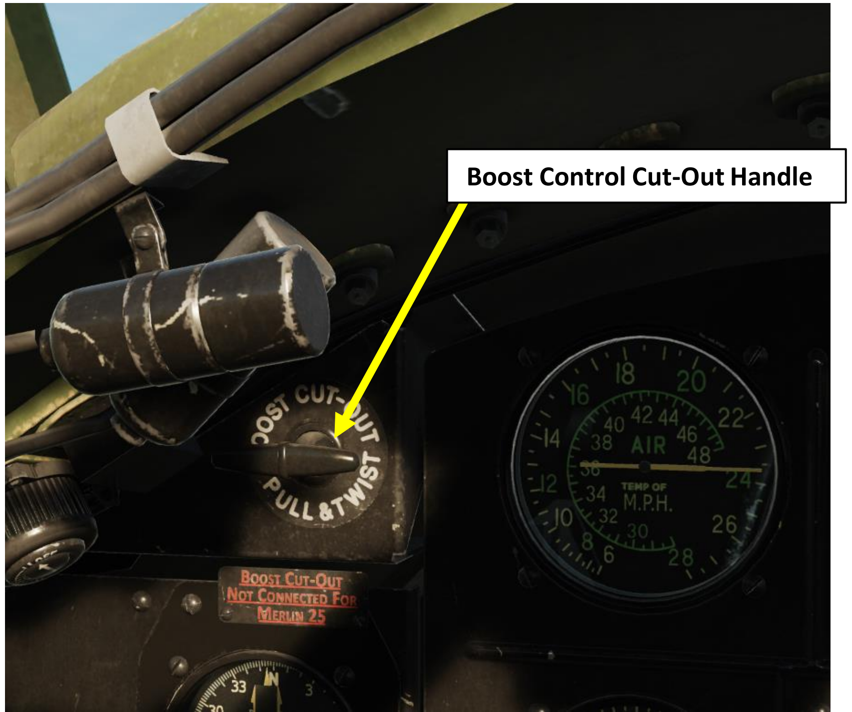
- **Engine Tachometer (x100 RPM)**: Controlled by the engine RPM lever. Indicates engine speed turning the constant speed propeller.
- **Boost Indicator (psi)**: Similar to a Manifold Pressure indicator, Boost indicates the difference between the absolute pressure after the supercharger and the atmospheric pressure in psi. Positive boost values indicate a pressure higher than atmospheric pressure, while negative boost values indicate a pressure below atmospheric pressure. In ISA (standard) conditions, +0 Boost at sea level is roughly 14.7 psi, 760 mm Hg, 29.92 in Hg, 1013.25 mBar, or 101.325 kPa.
- **Radiator 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.
- **Low Fuel Pressure Warning Light**: indicates that there is an abnormally low fuel pressure (fuel tanks are empty or fuel pump is likely failed).

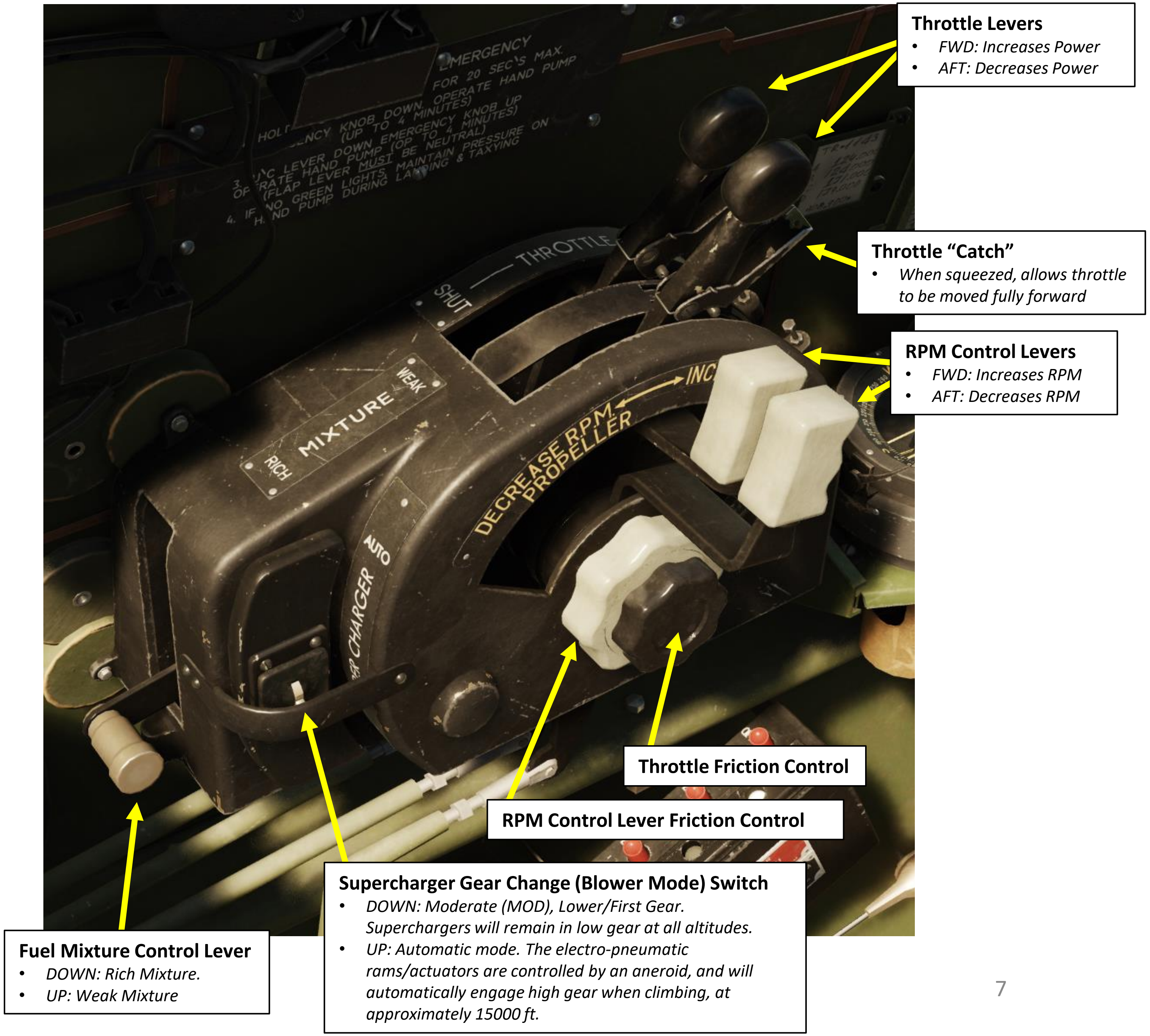


ENGINE CONTROLS

The main engine controls of the Mosquito are:

- **Throttle**: Controls boost pressure (manifold pressure). Normally the throttles can be pushed forward to the stops only. When the small catches on the levers are squeezed the throttles can be pushed fully forward. Merlin 25 engines give 4-12 lb./sq. in. boost at the stops and +18 lb./sq. in. when fully forward.
- **RPM Control Lever**: Controls engine speed turning the constant speed propeller.
- **Supercharger Gear Change Switch**: Controls manual or automatic gear shifting of the supercharger at high altitudes.
- **Boost Control Cut-Out Handle**: Not functional in Mosquito variants powered by the Merlin 25 (our variant). With Mosquito variants powered by the Merlin 23, this handle allows you to obtain additional boost (+14 psi in supercharger low gear).





ENGINE CONTROLS

Throttle and RPM control levers can be mapped to specific axes if you have a throttle quadrant that has enough levers. However, most throttles available on the market only have up to 3 axes available.

For users that do not have 4 axes available, I suggest mapping the Engine RPM and Throttle axes on “Engine (selected) RPM” and “Throttle Engine (selected)”. This means that a single axis can control the lever of your choice.

Here is an example following this axis binding methodology:

- If you want to set a specific boost setting and RPM on the left engine, press “8” to select the left engine, then move the Throttle and RPM axes. Only the left throttle and RPM levers will be controlled.
- If you want to set a specific boost setting and RPM on the right engine, press “0” to select the right engine, then move the Throttle and RPM axes. Only the right throttle and RPM levers will be controlled.
- If you want to control both throttles and RPM levers at the same time, press “9” to select both engines, then move the Throttle and RPM axes. Both the left and right throttles and RPM levers will be controlled.

CONTROL OPTIONS

Mosquito FB Mk. VI S | Axis Commands | Foldable view | Reset catego

Action	Category
Engine (selected) RPM / Propeller Pitch - axis	Engine Controls
Engine RPM / Propeller Pitch, port - axis	Engine Controls
Engine RPM / Propeller Pitch, starboard - axis	Engine Controls
Throttle, engine (selected) - axis	Engine Controls
Throttle, left engine - axis	Engine Controls
Throttle, right engine - axis	Engine Controls

OPTIONS

SYSTEM | CONTROLS | GAMEPLAY | MISC.

Mosquito FB Mk. VI S | All | Foldable view | Reset category to default

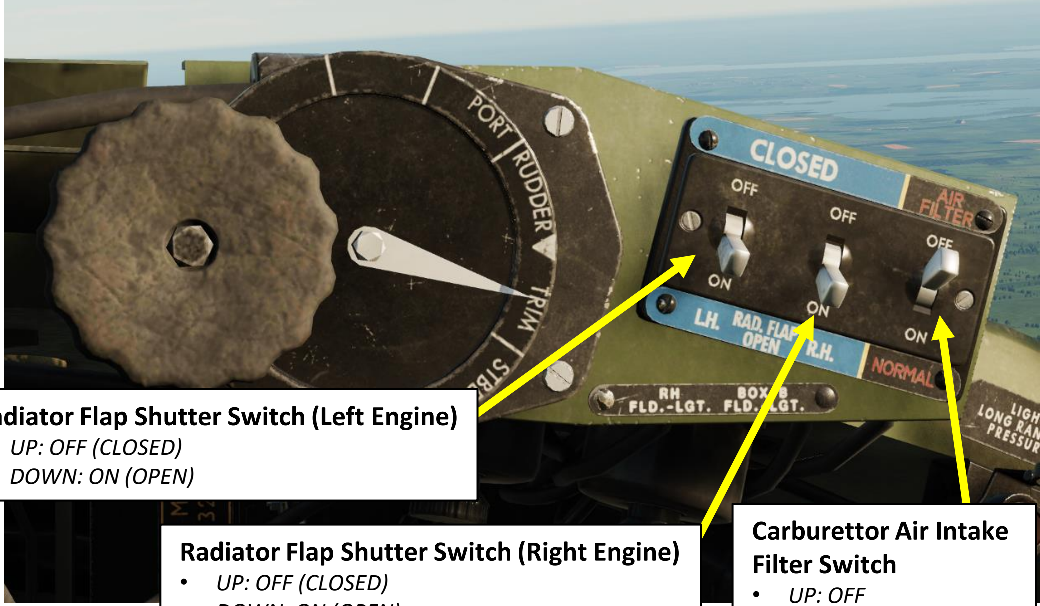
Action	Category	Keyboard
Select Active Engine to control - both	Engine Controls	9
Select Active Engine to control - left (port)	Engine Controls	8
Select Active Engine to control - right (starboard)	Engine Controls	0

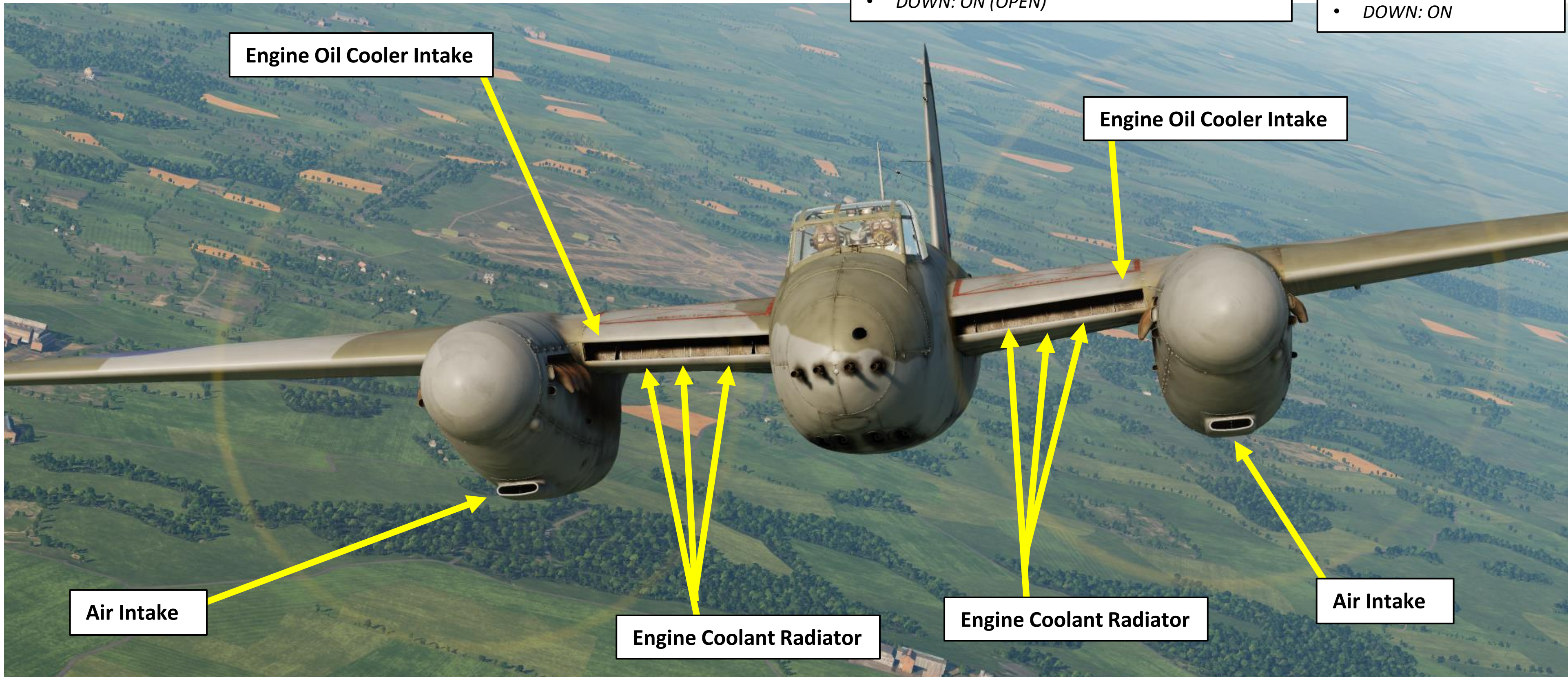
- *“8” controls LEFT Engine*
- *“0” controls RIGHT Engine*
- *“9” controls BOTH Engines*

ENGINE CONTROLS

Here are additional engine controls of the Mosquito:

- **Radiator Flaps Shutter Switches**: Opens (DOWN) or Closes (UP) radiator outlet flaps.
  - Note: It is not possible to set the shutters at intermediate positions between fully open and shut. There are no separate oil cooler controls. Electro-pneumatically operated radiator shutters are fitted at the rear of the combined engine coolant radiator and oil cooler, inboard of each engine. Airflow through the radiator ducts is controlled by these shutters which are operated by two-way switches. Thermostatic and viscosity valves in both coolant and oil cooler systems respectively, ensure rapid "warming up" to predetermined temperatures.
- **Carburettor Air Intake Filter Control**: Controls damper covering passageway of the air intake to the carburetor. The Switch should only be ON (DOWN) when taking off or taxiing in a dusty environment.
  - UP (OFF): Normal Intake (Damper is Open).
  - DOWN (ON): Filter In Operation (damper is shut and air comes from the engine compartment).

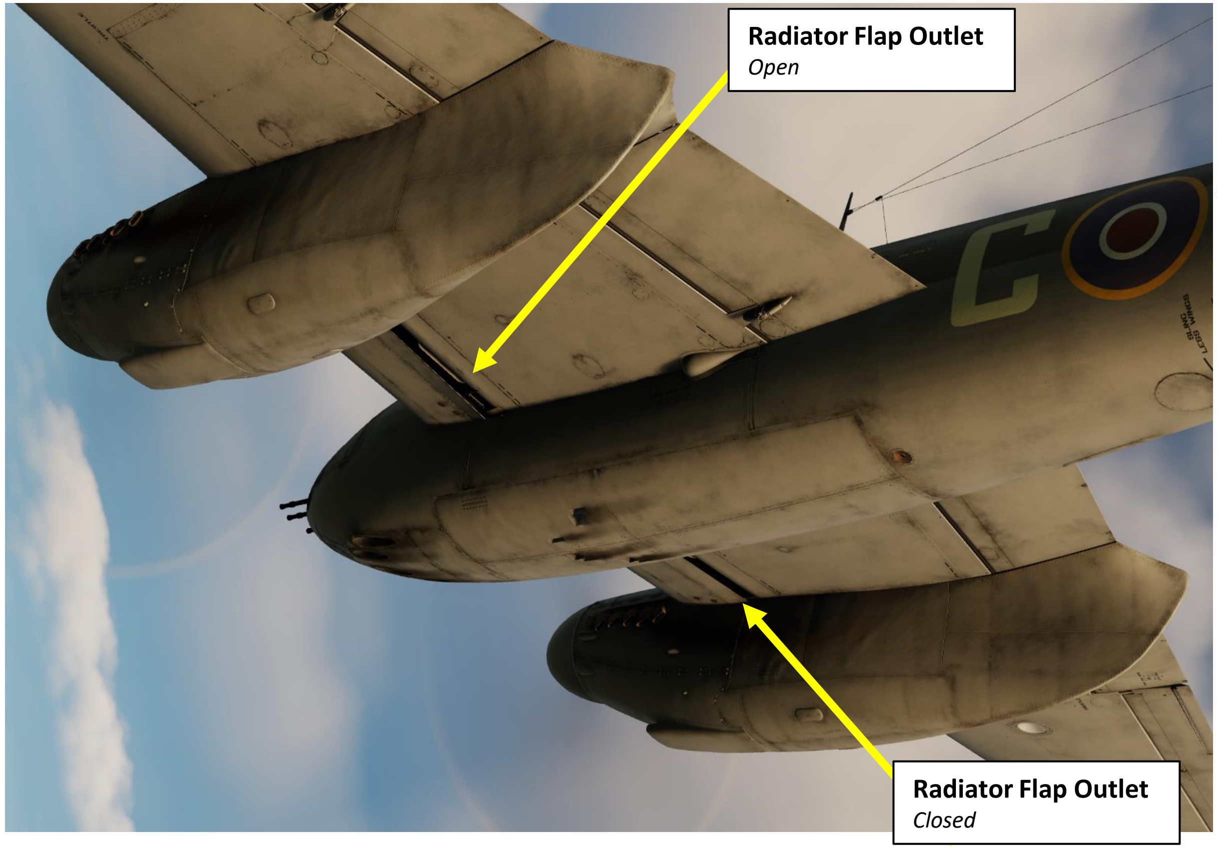


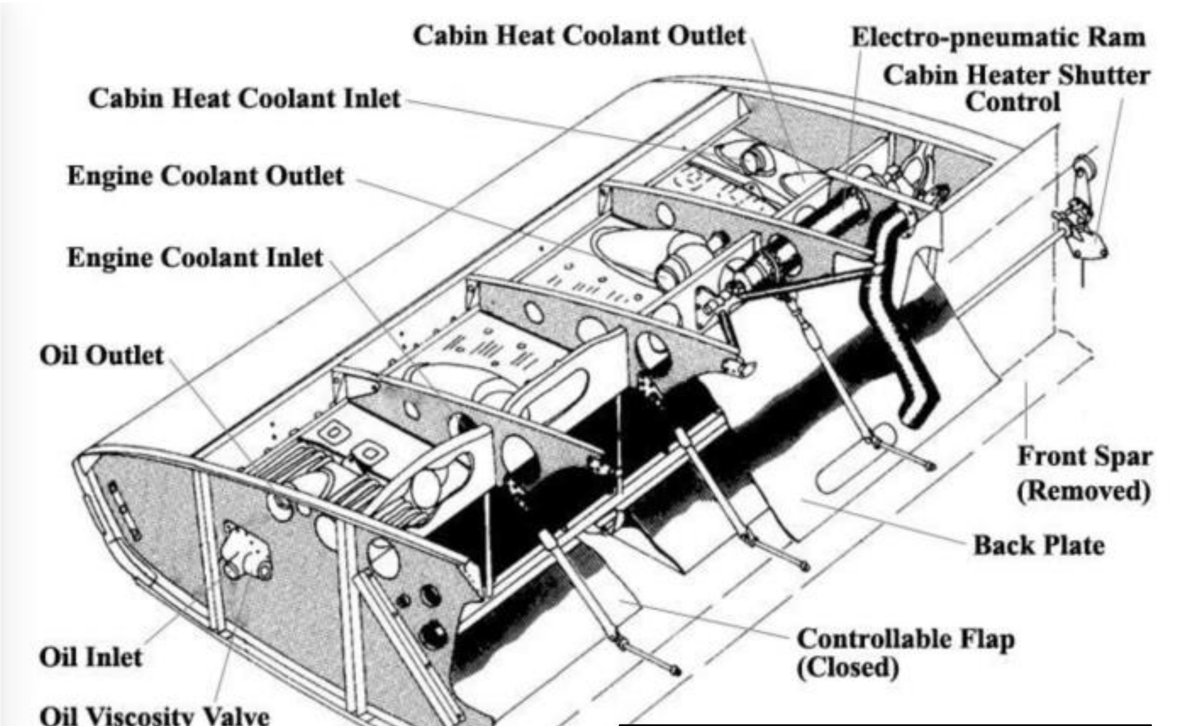


ENGINE CONTROLS

Here are some general rules for **Flap Shutter Settings**:

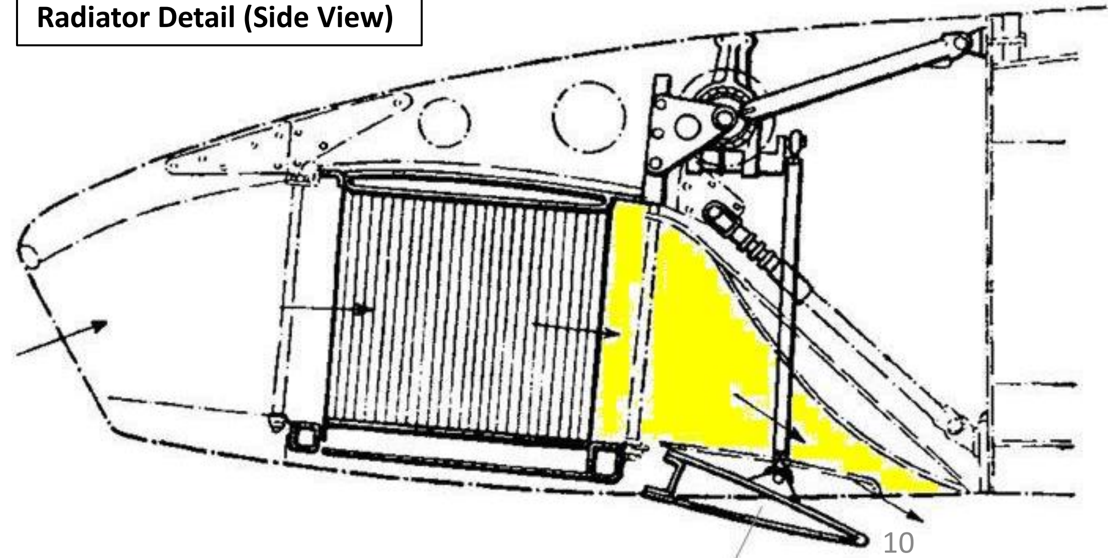
- **On Takeoff:** Flap Shutters OPEN (Switch DOWN).
- **On Approach/Landing:** Flap Shutters OPEN (Switch DOWN).
- **When Flying Level**: As required; CLOSED to minimize drag, OPEN to keep coolant temperatures in check (normal operation).
- **When Climbing**: Flap Shutters OPEN (Switch DOWN) to avoid overheating.
- **When Diving**: Flap Shutters CLOSED (Switch DOWN) to avoid overcooling.
- **When Feathering an Engine**: Flap Shutter of affected (feathered) engine CLOSED (Switch UP) to minimize aerodynamic drag.





Radiator Detail (Rear View)

Radiator Detail (Side View)



Flap Regulates Airflow (Airflow represented in Yellow)

ENGINE CONTROLS

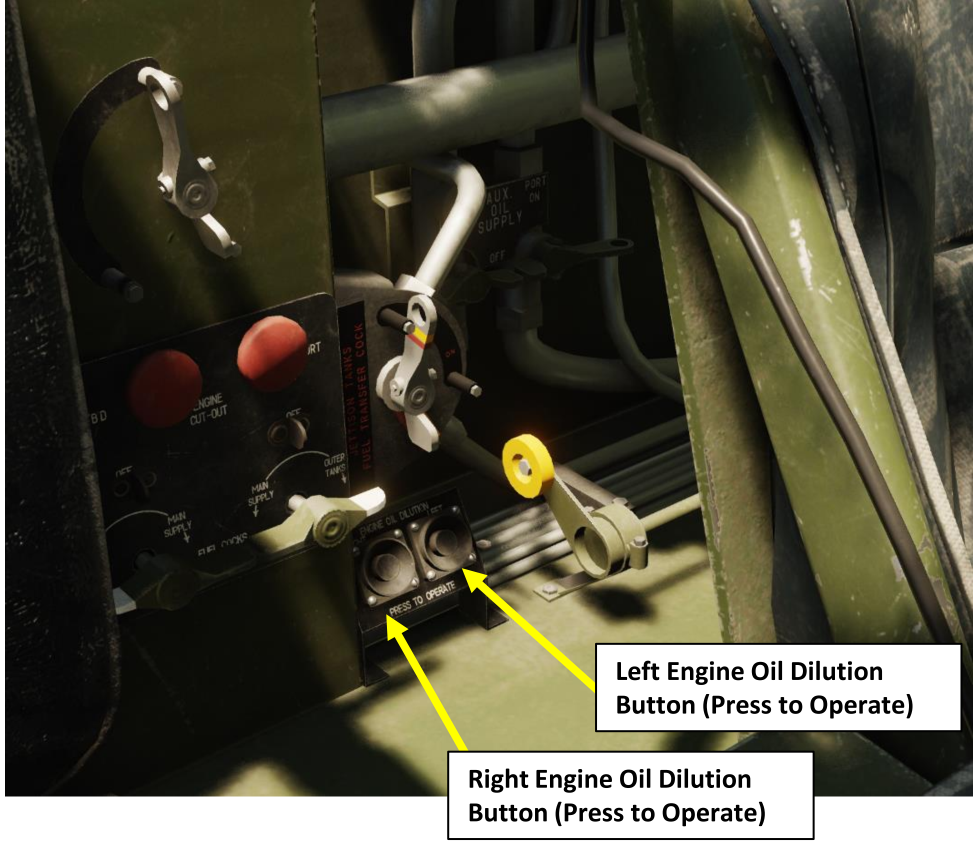
The oil system uses standard air force **oil dilution** equipment. This allows the oil to be thinned with gasoline to make the engine easier to start in ambient temperatures below 40°F or 4°C.

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 buttons behind the pilot seat. 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.

To ensure a cold start at the following temperatures, the oil should be diluted for the times quoted below:

- Between -10 deg C and -15 deg C: 1 minute
- Between -15 deg C and -26 deg C: 2 minutes

During the next start after 2 minutes dilution, the minimum partial boiling-off period at 2000 RPM is 10 minutes. After 1 minute dilution, no special partial boiling-off precautions are necessary.



ENGINE OPERATION & LIMITS

If engine overheats, you can:

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

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

MERLIN 25 ENGINE SETTINGS & LIMITS
100 OCTANE FUEL

Power Setting	RPM	Supercharger Gear	Boost (psi)	Coolant Temperature (deg C)	Oil Temperature (deg C)
Operational Necessity / Emergency Power (5 min limit)	3000	Low/High	+18 (may not be used at RPM below 2850)	Maximum: 135	Maximum: 105
Max Take-Off	3000	Low	+18 (may not be used at RPM below 2850)	-	-
Max Climbing Power (1 hour limit)	2850	Low/High	+9	Maximum: 125	Maximum : 90
Max Continuous	2650	Low/High	+7	Maximum: 105 (115 may be used for short periods only)	Maximum: 90
Minimums					
Oil Pressure (psi)	Minimum in Flight: 30 psi				
Oil Temperature (deg C)	Minimum for Takeoff: 15 deg C				
Coolant Temperature (deg C)	Minimum for Takeoff: 40 deg C				

ENGINE OPERATION & LIMITS

MERLIN 25 ENGINE FUEL CONSUMPTION 100 OCTANE FUEL				
Power Setting	**RPM**	**Mixture**	**Boost (psi)**	**Fuel Consumption (gal/hour per engine)**
Operational Necessity / Emergency Power (5 min limit)	3000	Rich	+18 (may not be used at RPM below 2850)	-
Max Take-Off	3000	Rich	+18 (may not be used at RPM below 2850)	-
Take-Off	3000	Rich	+12	115
Max Climbing Power (1 hour limit)	2850	Rich	+9	95
Max Continuous	2650	Rich	+7	80
	2650	Weak (Lean)	+7	63
	2300	Weak (Lean)	+2	42

SUPERCHARGER BASICS

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

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

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

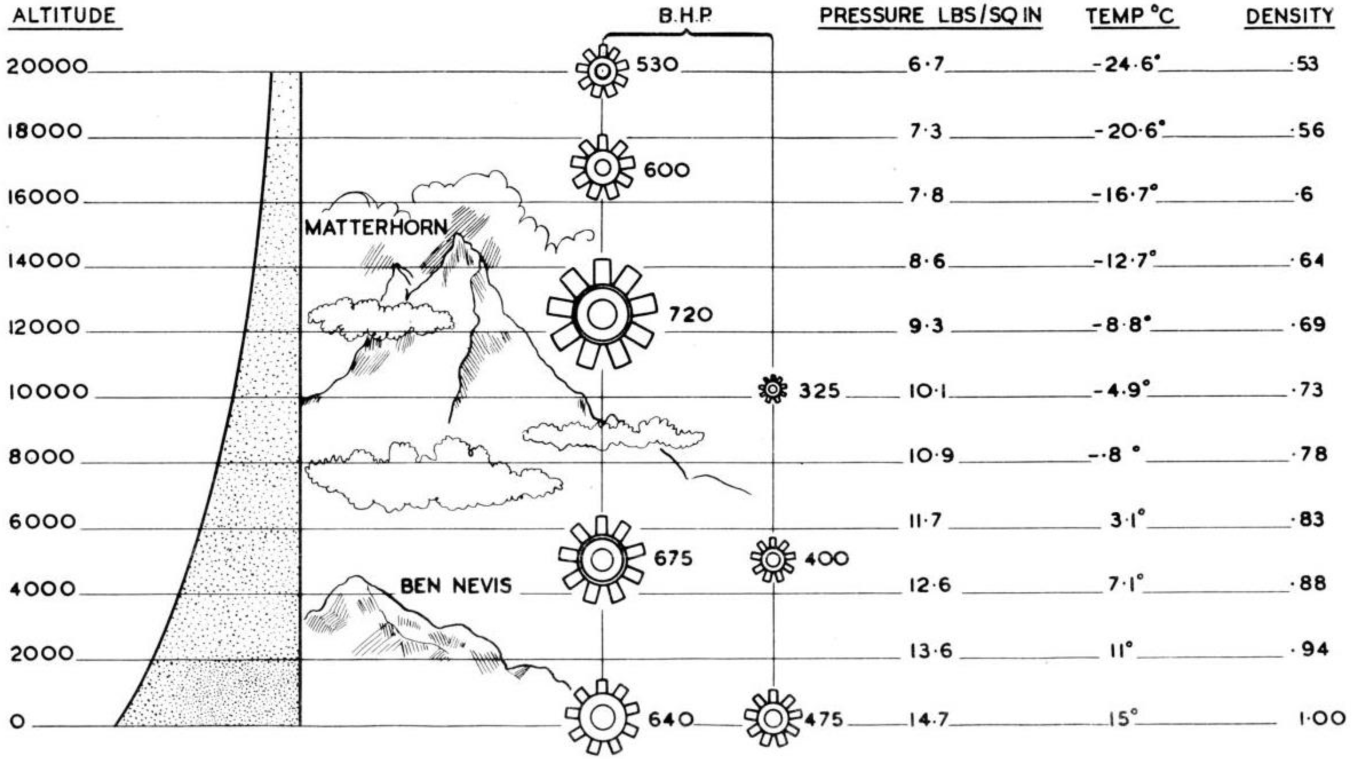
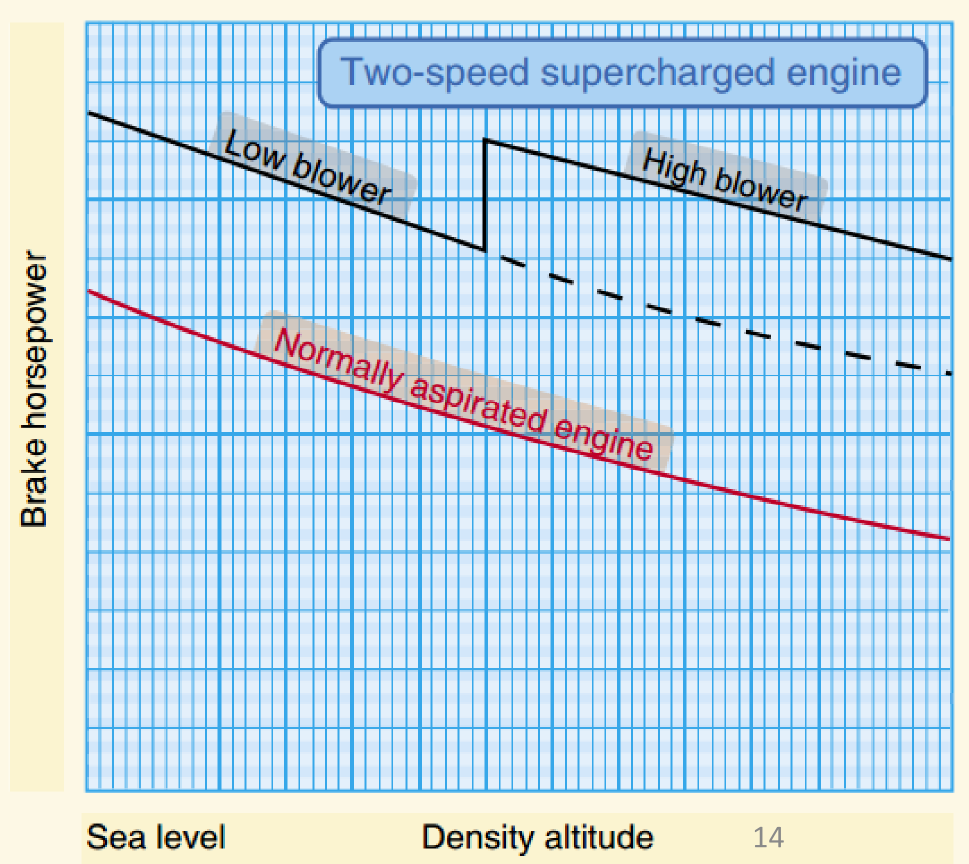


DIAGRAM SHOWING ATMOSPHERIC AND POWER VARIATIONS



SUPERCHARGER OPERATION

The Merlin 25 engine is optimized for low altitude flight. However, the Merlin has a two-speed, single-stage, liquid-cooled, high-speed centrifugal type supercharger, which is driven from the rear end of the crankshaft through a two-speed gearbox. The supercharger raises air pressure at the entrance to the engine cylinders in order to increase both the coefficient of admission and engine power, as well as to maintain a constant air pressure at the entrance to the cylinders during increases in altitude. The supercharger works in either low or high blower mode, selection of which can be automatic or manually set by the pilot. In normal operations, high blower mode starts automatically from 15,000 feet, depending on the amount of ram air being delivered through the carburetor.

Shifting between the first gear "MOD." (moderate supercharger) and second gear speeds may be performed automatically if the Supercharger Gear Change switch in the cockpit is left in the AUTO (UP) position, or manually if set to MOD (DOWN), forcing the supercharger in first gear. When operating under 15,000 ft (or when maximum achievable boost is over +7 psi), the supercharger is typically left to MOD. Why? Because the throttles are very sensitive and the supercharger high gear may not necessarily kick in exactly at the same time for both engines if flying close to the pressure-altitude threshold. In order to avoid having the engines switch gear at different times (which can create an offset between engine boost, causing a torque differential that can potentially be dangerous), it is preferable to set the Automatic mode once you are sure both engines will switch to the high blower simultaneously; basically, when you are at a safe altitude to do so, which is above 15000 ft.

First Gear = Low Blower = Low Manifold Pressure = used between 0 and 15000 ft
Second Gear = High Blower = High Manifold Pressure = used at 15000 ft or higher

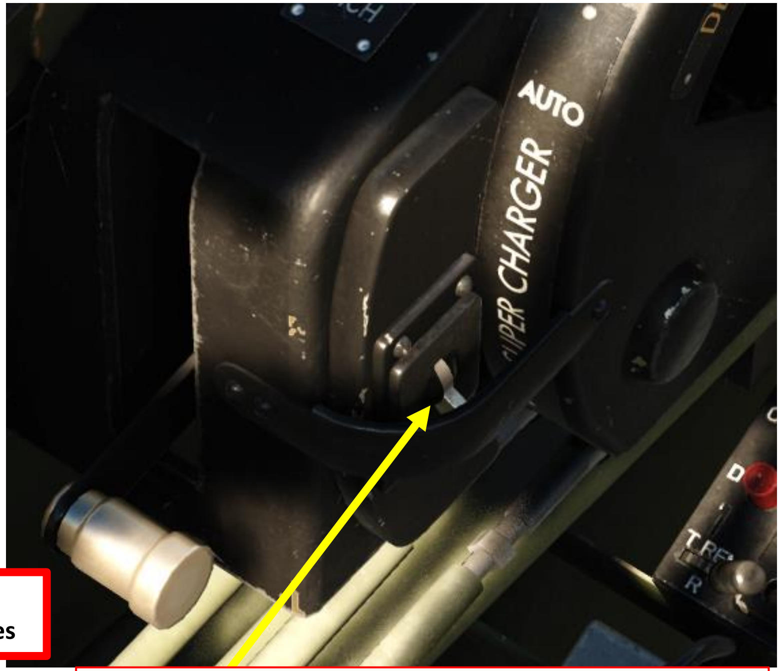
MOD. (Moderate Supercharger Setting) Mode Active
Altitude: 19000 ft

Supercharger Gear Change Switch – DOWN (MOD)
MOD. (Moderate Supercharger Setting) Mode
(Low/First Gear when over 15,000 ft)

Automatic Mode Active
Altitude: 19000 ft

Boost/Manifold Pressure Increases

Supercharger Gear Change Switch – UP (AUTO)
Supercharger in Automatic Mode
(High/Second Gear when over 15,000 ft)



Supercharger Gear Change (Blower Mode) Switch

- *DOWN: Moderate (MOD), Lower/First Gear. Superchargers will remain in low gear at all altitudes.*
- *UP: Automatic mode. The electropneumatic rams/actuators are controlled by an aneroid, and will automatically engage high gear when climbing, at approximately 15000 ft.*

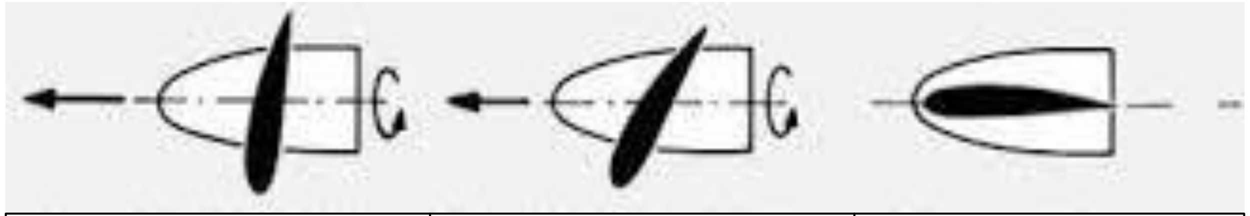
PROPELLER FEATHERING/UNFEATHERING SYSTEM

During normal engine operation, the angle of each propeller is automatically adjusted by the CSU (Constant Speed Unit) governor in order to maximize generated thrust while maintaining a constant engine RPM.

In case of an engine failure, the CSU (Constant Speed Unit) will likely lose control over the propeller blade angle, leaving the propeller at a high angle of attack. At low airspeeds, having the propeller at a "fine" (high) blade angle can generate a significant amount of drag, which can be very dangerous at low speeds (below 180 mph) since it creates a moment that can send the aircraft in a violent, unrecoverable spin. This is why a "feathering" system exists; an oil pump pushes oil into the Constant Speed governor mechanism to turn the blade into a "**feathered**" position (where the blade angle is "fully coarse", minimizing drag in the process). Stopped blades twist to nearly align with the slipstream and no longer present a disc to the relative wind.

The propeller can also be "**unfeathered**", which uses the same oil pump to turn the blade in the other direction towards a "fine" angle. This is useful in cases where aircraft speed is high and the speed of the air can generate enough force on the propeller blades to turn them (windmilling). When unfeathering the propeller, you can try to use windmilling to try to restart the engine and make the Constant Speed Unit governor take over the propeller blade angle control.

Keep in mind that if an engine is damaged due to anti-aircraft artillery or other factors, it is quite possible that the oil pump system that drives the blade angle may be inoperative as well. This will prevent you from being able to either feather or unfeather the propeller.

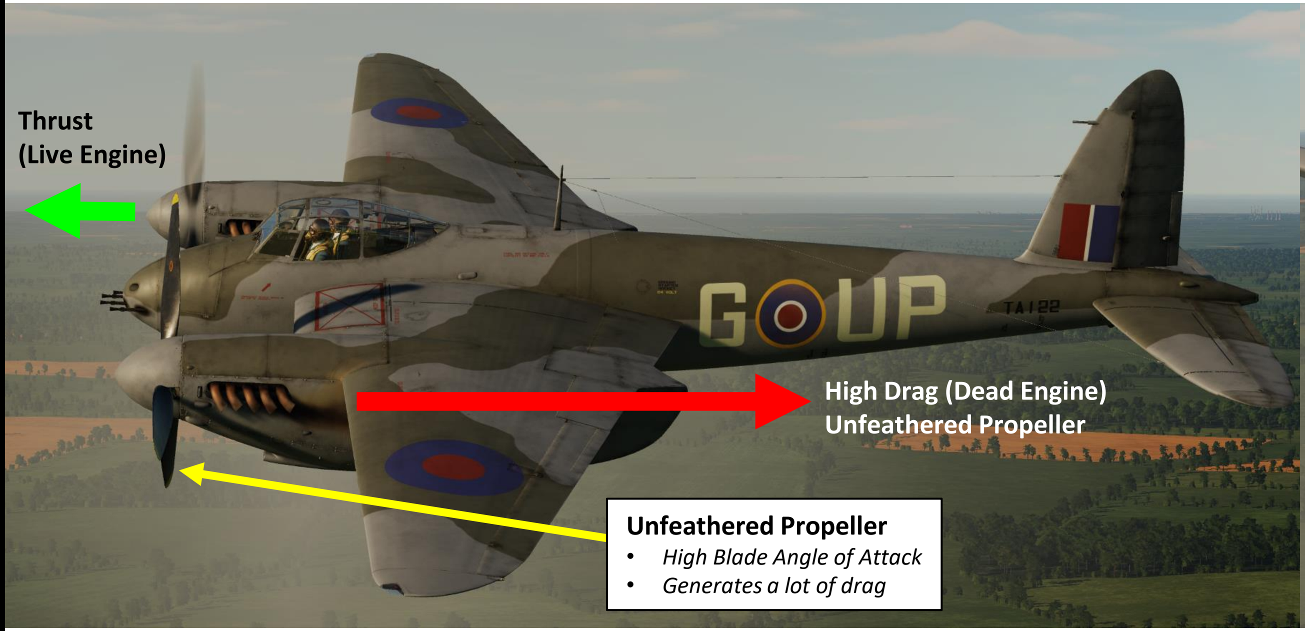


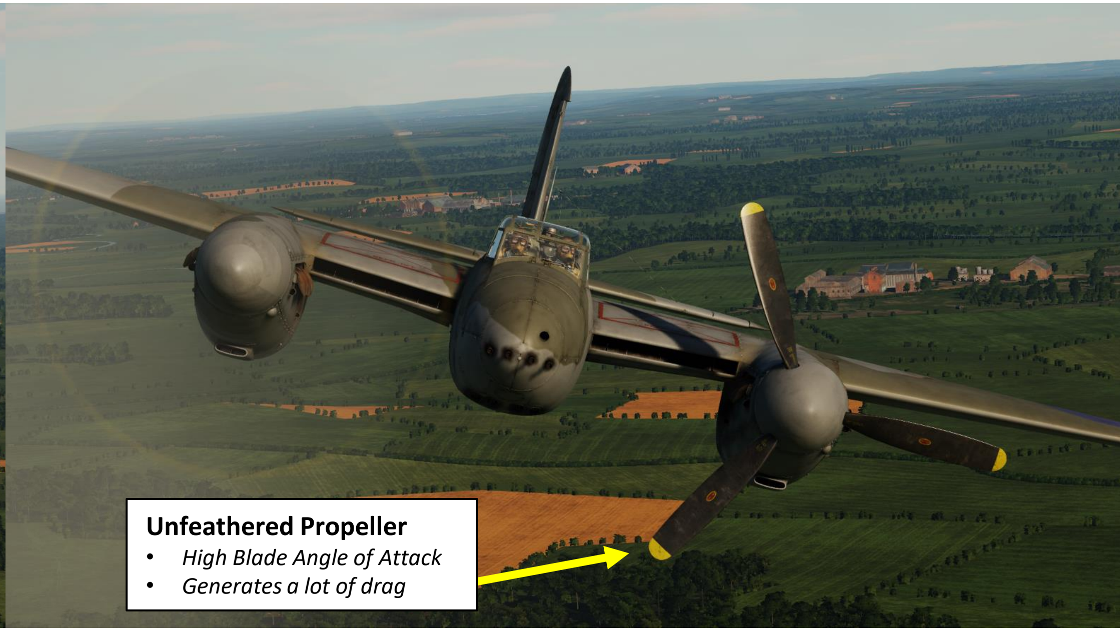
Forward Thrust	Forward Thrust	Zero Thrust
Fine (Low) Pitch Takeoff Small Blade Angle	Coarse (High) Pitch Cruise Flight Normal Blade Angle	Full Feathering Propeller Stopped Large Blade Angle

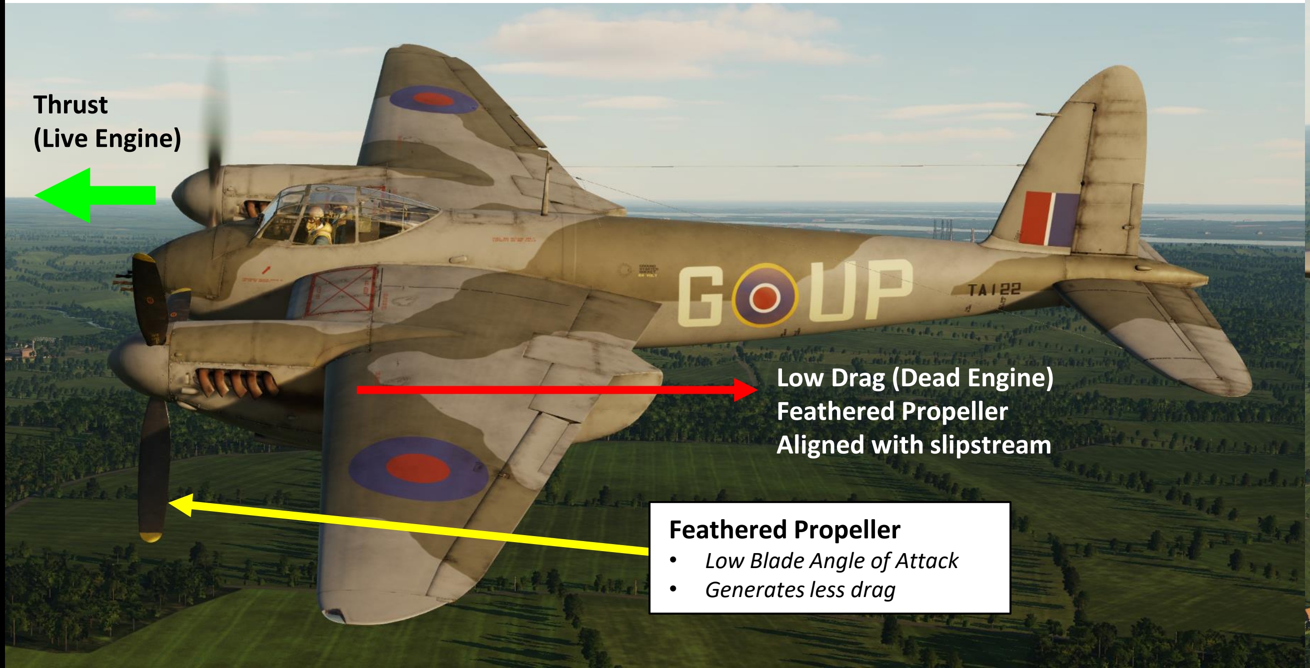
Feathering Button (Left Propeller)
- *Feathers propeller to reduce drag when engine is shut down while in-air*

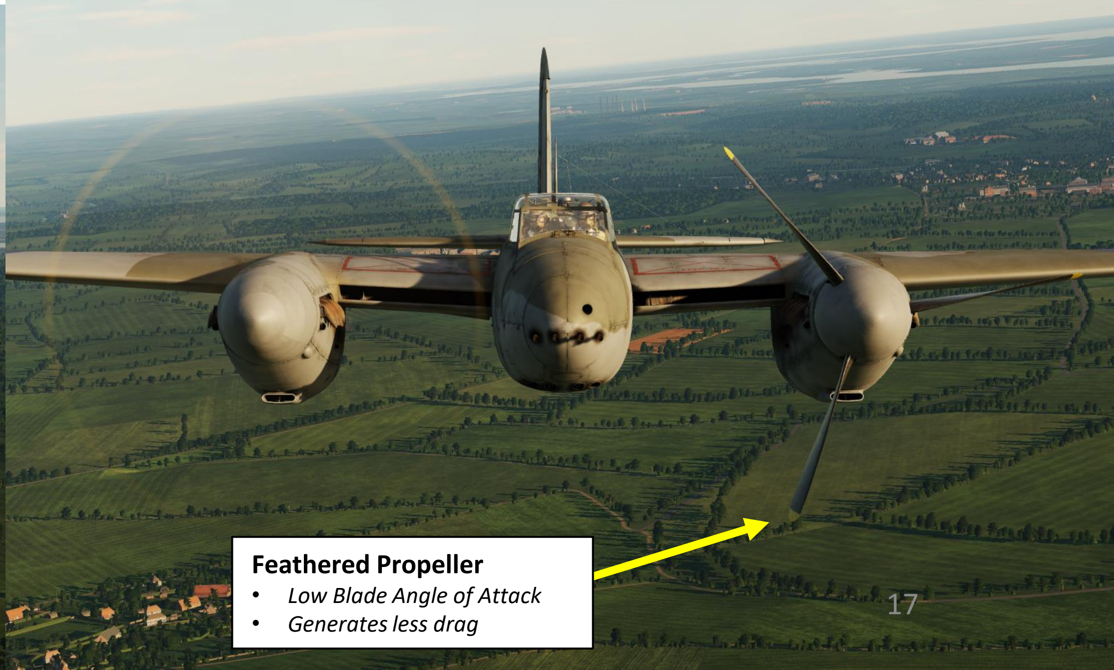
Feathering Button (Right Propeller)
- *Feathers propeller to reduce drag when engine is shut down while in-air*

PROPELLER FEATHERING/UNFEATHERING SYSTEM









PROPELLER FEATHERING PROCEDURE

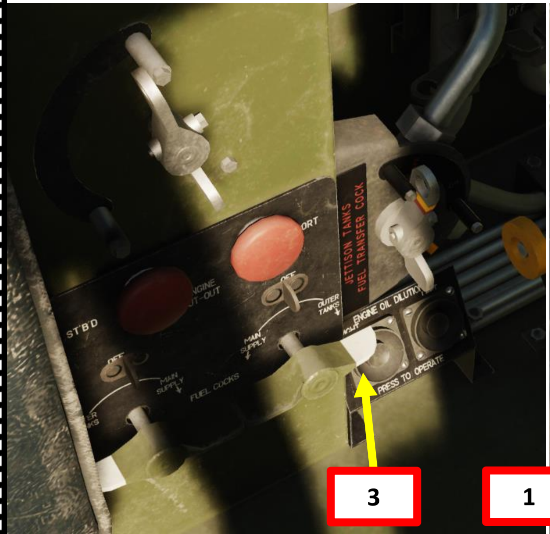
To feather a propeller:

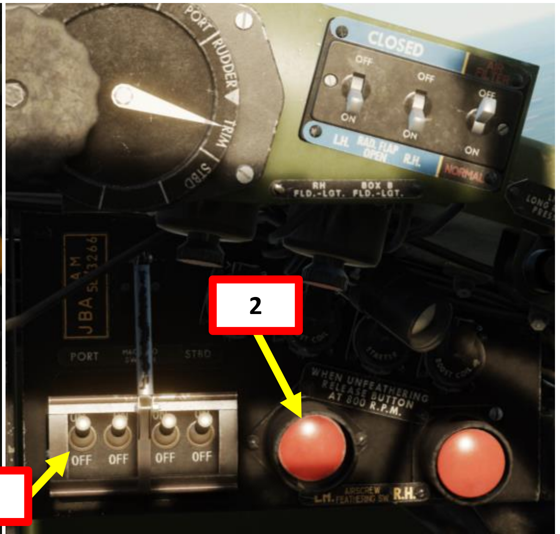
1. Close the throttle
2. Set the Throttle and RPM Lever of the affected engine FULLY AFT.
3. Hold the feathering pushbutton in only long enough to ensure that it stays in by itself, then release it so that it can spring out when the feathering is complete. If it does not spring out, it must be pulled out.
4. Turn off the fuel cock.
5. When the engine has stopped, or nearly stopped, switch off the ignition (Magneto Switches) and close the radiator shutter.

PROPELLER UNFEATHERING PROCEDURE

To unfeather a propeller:

1. Set throttle slightly open and the RPM control lever fully AFT, and then switch on the ignition (Magneto Switches).
2. Hold the feathering pushbutton in until RPM rises to 800-1000 and ensure that it springs out fully.
3. Turn on the fuel cock.
4. If the propeller does not return to normal constant-speed operation, it must be feathered and unfeathered again, releasing the feathering pushbutton at a slightly higher RPM.
5. It is advisable to unfeather at speeds below 200 mph to avoid risk of engine overspeeding.
6. Idle the engine at approximately 1800 RPM until the temperatures reach the minimum for opening up the throttle to cruise power.





ENGINE FIRE EXTINGUISHERS

The Mosquito is equipped with Graviner fire extinguishers, which are fitted in each engine nacelle. If an engine fire is detected during flight, flip the safety cover and press the Fire Extinguisher pushbutton of the burning engine. A chemical agent will be released to extinguish the engine fire. Fire extinguishers operate automatically in the event of a crash.

Note: The Mosquito being made mostly of wood, the aircraft can burn up very quickly. If the fire extinguisher does not work, immediately open the side door and bail out as soon as possible.