

D I G I T A L C O M B A T S I M U L A T O R

SPITFIRE ***L.F. Mk.IX***

Quickstart Manual

for DCS World



fly a legend!

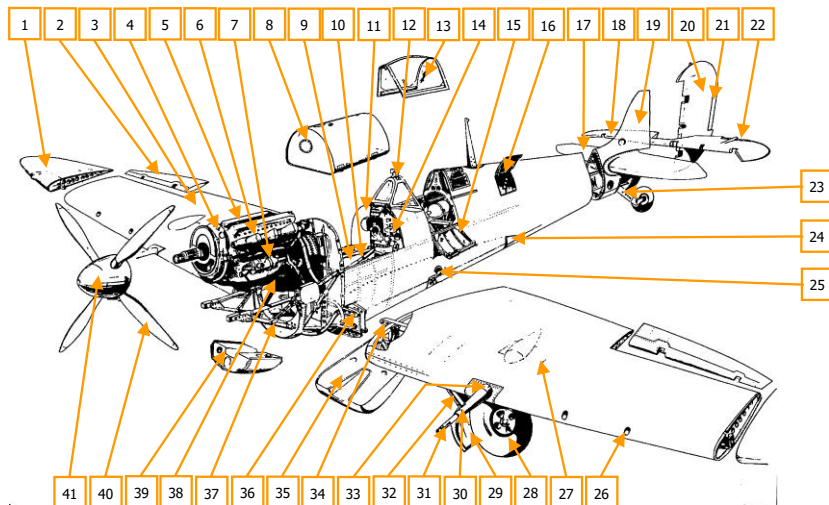


DCS

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Aircraft Design - Main Elements



- | | |
|-----------------------------------|---------------------------------------|
| 1. Wingtip | 23. Tail wheel unit |
| 2. Aileron | 24. Tail portion main plane fillet |
| 3. Right wing | 25. Main plane attach fitting, rear |
| 4. Header tank (cooling tank) | 26. Browning guns bays |
| 5. Engine "MERLIN-66" | 27. Magazine door |
| 6. Exhaust manifolds | 28. Main wheel |
| 7. Generator | 29. Main wheel leg strut fairing |
| 8. Upper fuel tank | 30. Hispano gun fairing |
| 9. Lower fuel tank | 31. Hispano gun |
| 10. Engine struts | 32. Main wheel strut |
| 11. Flameproof bulkhead | 33. Hispano gun adjusting ring |
| 12. Windscreen | 34. Top boom main spar |
| 13. Jettisonable hood | 35. Jettisonable fuel tank |
| 14. Instrument panel | 36. Root attach main plane front spar |
| 15. Pilots access door | 37. Engine mounting |
| 16. Access door radio compartment | 38. Suppressor |
| 17. Tail | 39. Oiltank |
| 18. Elevator | 40. Rotol propeller |
| 19. Tail unit | 41. Spinner |
| 20. Rudder | |
| 21. Rudder trimming tab | |
| 22. Elevator trimming tab | |

COCKPIT

The aircraft cockpit is designed for holding the crew, control surfaces and instruments for the aircraft, engine, and aircraft systems.



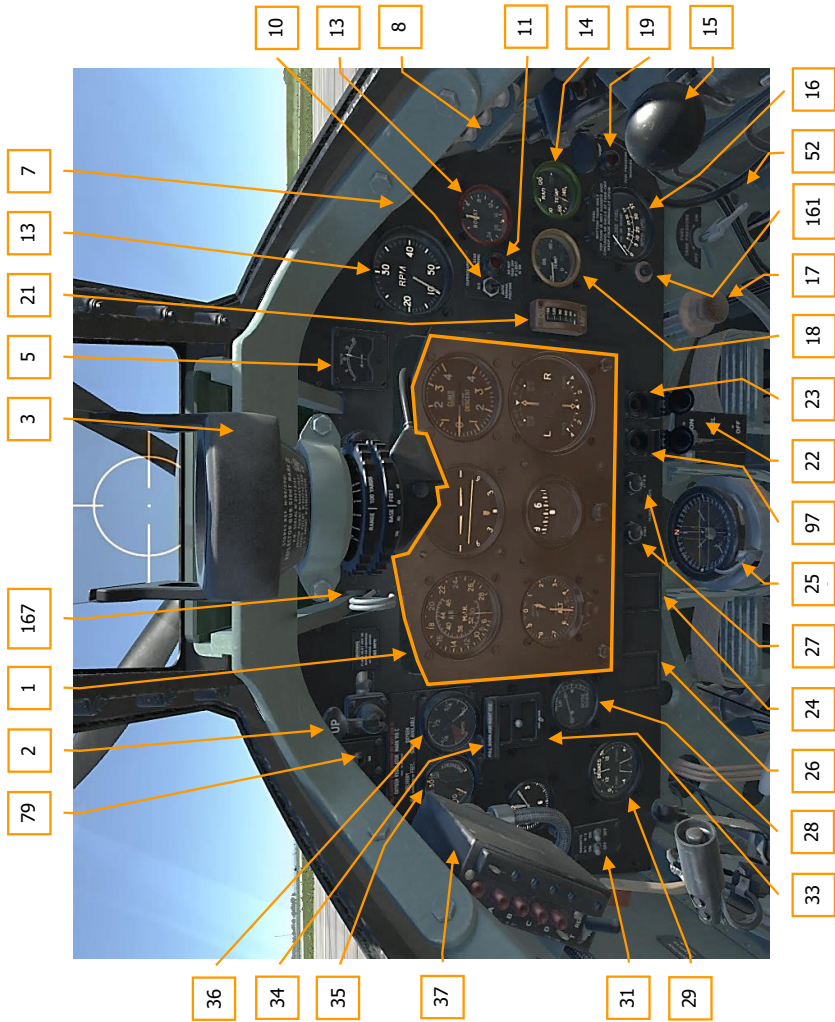
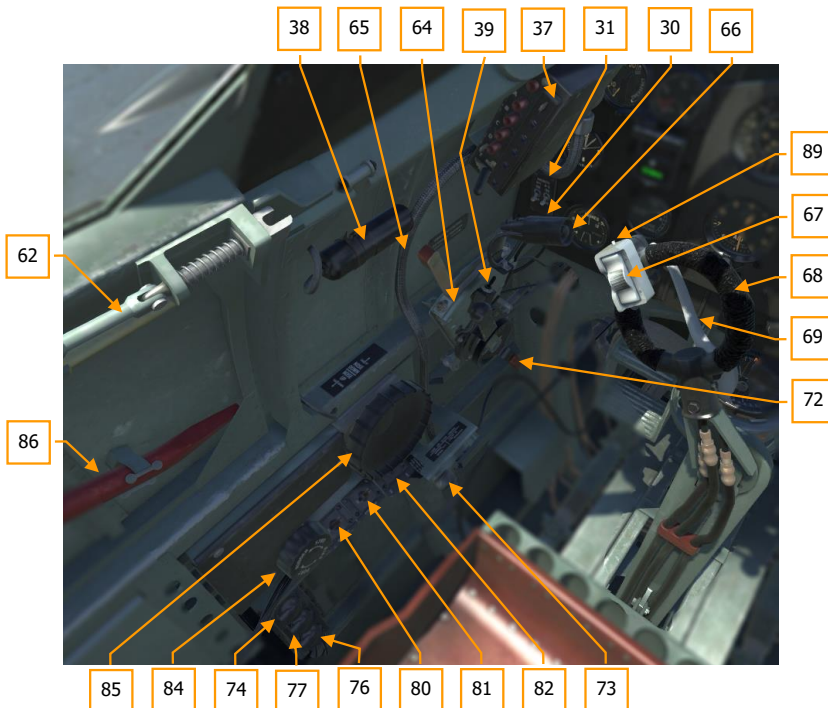


Figure 1: Spitfire instruments

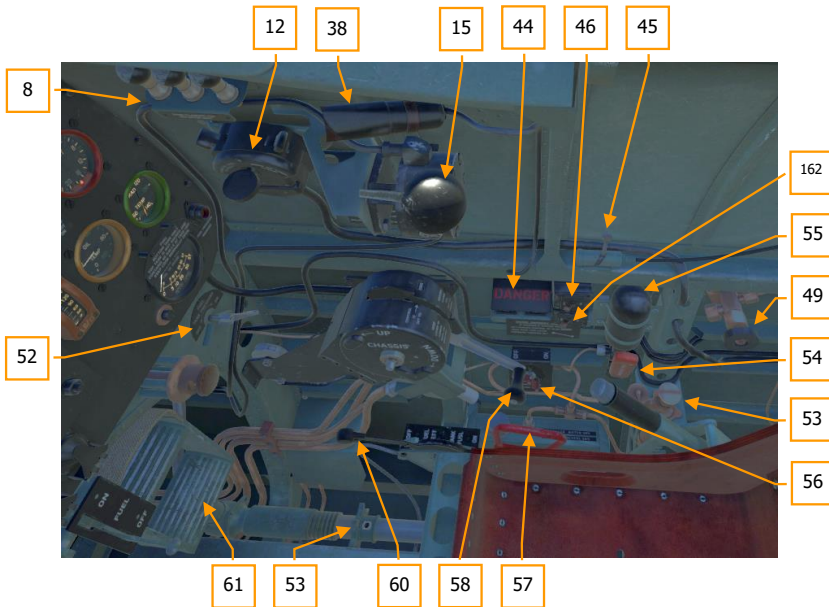
1. Blind-flying panel
2. Flap control valve
3. Mk II Gyroscopic gunsight.
4. Gunsight connector assembly.
5. Voltage meter.
6. Tachometer.
7. Cockpit air vent.
8. Spare lightbulbs for gunsight illumination.
10. Supercharger speed toggle switch
11. Supercharger second speed activation light
13. Boost gauge.
14. Coolant fluid thermometer
15. Manual fuel pump.
16. Fuel gauge.
17. Primer pump (a).
18. Engine oil thermometer.
19. Fuel pressure signal light.
21. Engine oil pressure indicator.
22. Fuel cock handle.
23. Engine starter switch.
24. Compass deviation card.
25. Magnetic compass.
26. Secondary compass deviation card
27. Cockpit lighting rheostat.
28. Elevator trim indicator.
29. Three-pointer air pressure indicator.
31. Magneto toggle switches.
33. Undercarriage warning system.
34. Oxygen regulator.
35. Oxygen flow indicator.
36. Oxygen pressure gauge.
37. Radio system control box
52. Tank pressurization cut-in valve.
79. Nav-light switch.
97. Booster coil button.
161. Fuel gauge button.
166. Gunsight light filter handle

PORT SIDE



- | | |
|--|------------------------------------|
| 30. Throttle Control | 75. Fuel Pump Ammeter Test Socket |
| 31. Ignition Switches | 76. Radiator Flap Test Push-Button |
| 37. Radio Control Unit | 77. Supercharger Test Push-Button |
| 38. Cockpit Floodlight | 78. Fuel Pump Test Push-Button |
| 62. Cockpit Door Handle | 80. Pressure Head Heater Switch |
| 63. Camera Gun Indicator Wedge Plate | 81. Camera Gun Master Switch |
| 64. Propeller Control | 82. Fuel Pump Switch |
| 65. Fuel Cut-Off Control | 83. Generator Failure Lamp |
| 66. Bomb Release Push-Button | 84. Rudder Tab Control |
| 67. Gun Firing Push-Button | 85. Elevator Tab Control |
| 68. Control Column | 86. Hood Jettisoning Crow-Bar |
| 69. Brake Lever | 89. Gun Firing Safety Catch |
| 70. Camera Push-Button | |
| 72. Throttle Control Friction Adjuster | |
| 73. Air Intake Control | |
| 74. Oli Dilution Push-Button | |

STARBOARD SIDE



- | | |
|-----------------------------------|---|
| 8 Reflector Spare Lights | 51. Microphone / Telephone Socket |
| 12. Signalling Switch Box | 52. Fuel Pressuring Cock |
| 15. Fuel Hand Pump | 53. Windscreen De-Icing Pump Plunger |
| 38. Cockpit Floodlight | 54. Undercarriage Emergency Control Lever |
| 39. Beam Approach Master Switch | 55. Undercarriage Emergency Carbon Dioxide Cylinder |
| 42. Control Lock Attachment Lug | 56. Windscreen De-Icing Fluid Cock |
| 43. Oxygen Supply Tube | 57. Drop Tank Jettison Handle |
| 44. I.F.F Radio Push-Buttons | 58. Undercarriage Control Lever |
| 45. Harness Release Controll | 59. Rudder Pedal Adjustment Wheel |
| 46. I.F.F. Radio Master Switch | 60. Drop Tank Fuel Cock Control Lever |
| 47. Incendiary Bomb | 61. Rudder Pedal |
| 48. Clothing Heater Plug | 162. I.F.F. Radio Distress Switch |
| 49. Oxygen Supply Cock | |
| 50. Control Locking Gear (Stowed) | |

FLIGHT PROCEDURES

Motor start-up

Ensure the following:

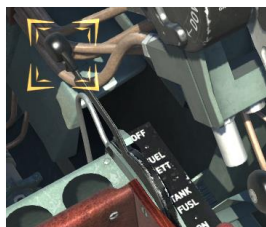
- The stop valve lever must be in the rear (closed) position.



- The undercarriage valve lever must be located in the rear (release) position, while the emergency release lever must be locked in the upright position.



- the external fuel tank valves must be in the OFF (closed) position.



- the fuel cock handle must be in the off position.



- Ensure that all flight instruments are properly connected (joystick, pedals, etc.) to their respective functions. Begin with a test of the rudder pedals – look to the tail section of the aircraft and ensure proper deflection of the rudder to the left and right of the aircraft. Use the designated keypresses or axes: **[Num4]** or **[Num6]** to look backwards, **[Z]** or **[X]** (or the rudder axes) for controlling the rudder. Next, test the function of the flight stick Y axis. Completely push the stick all the way to the end, then pull in the same manner. Next, check the ailerons – Observe the right aileron and move the stick left and right. Then do the same while observing the left aileron.
- Both magneto switches must be in the OFF position



- Fuel tank booster valves must be in the OFF position



- Air pressure in the pneumatic system according to the three-arrow gauge must display a pressure of no less than 250ft/in² where a full load displays 300 ft/in².



- Altimeter fixed at 0. To do this, place the cursor over the highlighted regulator and adjust with the mouse wheel.



- The flaps must be working. Place the flaps lever in the down (deployed) position; to do so, press [F] or the left mouse button with the cursors on the highlighted lever. Look to the left

and right of the aircraft and ensure that both mechanical indicators located on the aircraft wings have deployed. Then return the flaps lever to the up (retracted) position and ensure that the mechanical indicators have returned to their original position.



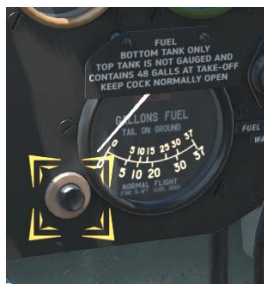
- Ensure proper operation of the movable part of the canopy – **[LCtrl+C]** shuts the canopy, while **[LShift+C]** opens it. Check whether there is dirt on the Plexiglas, and whether the emergency release bolts are shut.
- Move the throttle handle forward until the visual warning system located on the motor control column activates. Press **[Num+]** or push the throttle forward.



- At the same time, make sure that 1. the undercarriage status light shows a green light and "DOWN" on the inscription. 2. the fuel pressure warning light is red. Once the warning systems have been tested, return the throttle to its initial position by pressing **[Num-]** or by pulling the throttle.



- Check the quantity of fuel on the tanks. Press the button on the gauge and observe the arrow. Release the button after checking.



The aircraft is now ready for engine startup.

To startup the engine, perform the following procedures:

- Depress the brakes, so that the aircraft remains in place during engine startup. Place the mouse cursor over the highlighted section of the control stick and roll the mouse wheel.



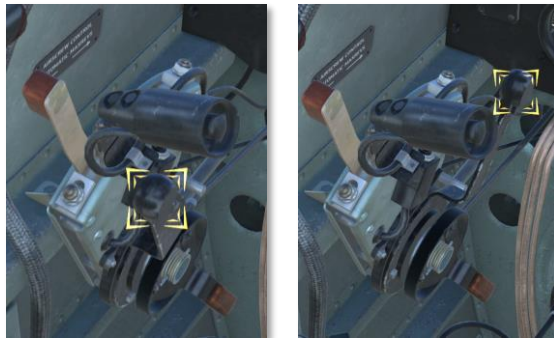
- Place the fuel cock handle in the ON position. Left-click on the highlighted handle or press [T].



- Move the throttle forward by 10-12mm starting from the rearmost position. Press [Num+] or push the throttle of your joystick system.



- Set the pitch lever to its frontmost position. Press **[PageUp]** or move the throttle axis.



- Move the dust filter lever to the frontmost position (FILTER IN OPERATION). Press **[H]** on the keyboard or click the highlighted lever.



- Turn the handle of the primer pump. Hover your mouse over the highlighted section and roll the mouse wheel. Then perform the required number of complete movements by the primer pump in order to fill the engine. To do this, press and hold **[Insert]** or the left-mouse button with the cursor on the highlighted section. The following table shows the number of complete movements to be performed by the piston pump depending on the outside temperature:

Outside air temperature, °C	+30°	+20°	+10	0°	-10° ~ -20°
Number of complete movements	2 - 3	4	5	5 - 6	Up to 15

Commented [B1]: Пршприца

Commented [O.S.2]:



- Create fuel pressure using the wobble pump (9-10 pumps) until the warning light begins to flash. Press **[LCtrl+Insert]** or click the highlighted section in the cockpit.



- Switch on both magnetos by placing their switches in the ON position. **[LShift+End]** and **[RShift+End]**, or click on the highlighted switches in the cockpit.

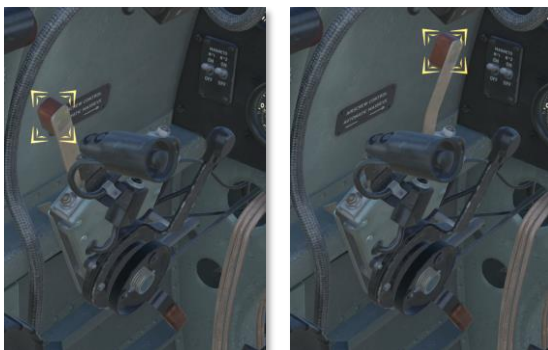


- Pull back the protective caps on the starter and booster coil buttons by clicking on the highlighted elements.



- Simultaneously press the starter and booster coils: the keybinds are **[Home]** and **[Delete]** respectively. After the first spark in the motor, move the stop valve lever forward

by pressing [M] on the keyboard or by clicking it with the mouse. Then release the starter and booster coil buttons.



- If motor startup fails, pull back the stop valve lever and repeat the process beginning from engine filling.



Engine warmup

- After successful engine startup, pull back the idle cut-off control to its rearmost position.



- Ensure that the oil pressure is within 60-120ft/in².



- Return the protective caps of the starter and booster coil buttons by clicking on them.



- Turn the handle of the primer pump by highlighting it with the cursor and rolling the mouse wheel.



- Set the throttle to the position corresponding to 1000-1200 RPM according to the tachometer.



- Continue to warm the engine at an RPM of 1000-1200 until the oil temperature reaches 20°C and the coolant fluid temperature reaches 60°C (shown by the left and right instruments respectively)



Engine runup

During engine runup, double check the control instruments, which must show the following figures:

Basic modes of operation of the Merlin 66 engine, with 100 octane fuel									
Basic data	Mode	Takeoff		Combat		Nominal		Cruising	
		I spd.	II spd.	I spd.	II spd.	I spd.	II spd.	I spd.	II spd.
Horsepower		1325	-	1680*	1440	1310	1135	985	865
				1750**	1630	1410	1315	1095	1030
RPM		3000	-	3000	3000	2850	2850	2650	2650
Boost	ft/in ²	+12	-	+18	+18	+12	+12	+7	+7
	mm Mercury	1350		1690	1690	1380	1380	1120	1120
Altitude limits in m. (w/o ram air flow)		305	-	1680	4960	2750	5800	3660	6330
Time for uninterrupted operation, in minutes		5	-	5	5	60	60	Unltd	unltd

*- Data for sea level

** - Data on approximate altitudes.

23. Using the throttle lever, set a boost pressure of 4 ft/in² and check the ff.:

- 1.) Activation of the second speed compressor, for which the compressor speed selector switch located on the dashboard must be set to "AUTO" (automatic gear shifting,) and click on the button for testing the activation of the compressor second speed, located on the left side of the pilot's seat.

The signal lamps on the dashboard serves as confirmation of successful activation of the compressor second speed.

NOTE. Before activation of second speed, first ensure that the pressure of the pneumatic system has not fallen below 150 ft/in².

- 1.) Operation of the propeller regulator. To do so, move the pitch lever from its frontmost position to the rear position, reducing the RPM to 250-300. Afterwards, push the lever to its frontmost position, which should return the RPM to its full value.
- 2.) Operation of the automatic temperature regulator for the cooling fluid and oil. To do so, push the control button of the radiator grates. Opening of the radiator valves tunnels must be control by the technician located near the aircraft.
- 3.) Using the throttle, set a pressure of 9ft/in², and by alternately switching off the magnetos ensure proper operation of the ignition system by checking for a decrease in RPM and by ear. Decrease

- in RPM with one working magneto, compared to the RPM when both are active, must not exceed 100RPM.
- 4.) Check engine response and motor operation on takeoff mode: set the pressure to 12ft/in² over 2-3 seconds using the throttle at an RPM of 3000.
 - 5.) When testing the motor, ensure the ff:
 - Completely pull on the stick.
 - Hold on to the aircraft's tail with a weight of about 2 people.
 - Do not allow an increase in coolant temperature beyond 120°C and oil temperature beyond 85°C.
 - Take note whether the electric generator is working (check the voltmeter arrows) and test the radio equipment for 2-way communication.

Takeoff and Climb

Taxiing

1. Prior to taxiing, ensure that all instruments are working and double-check the position of the levers and handles.
 - Coolant temperature between 60° C - 120° C.
 - Oil temperature between 20° C - 80° C.
 - Pitch lever in the position corresponding to the takeoff mode. (fully up front)
 - External tank valves shut off.
 - Main fuel tank valves on.
 - Undercarriage lever in the DOWN position.
 - Pneumatic system air pressure no less than 220 ft/in².
 - Weapon safeties engaged.
 - Radio systems turned on and tuned into the assigned frequencies.
2. Buckle up!
3. Give the command to remove the wheel pads. Upon receiving confirmation, begin taxiing.
4. Double-check proper brake operation during taxi. Upon completely depressing the brakes and pulling on the stick, the aircraft must remain in place even with the motor working (with an RPM up to 1800)
5. For best view of the surrounding area, raise the pilot seat and open the canopy.

NOTE

1. *Fast taxiing on uneven terrain is dangerous. Due to the narrow track of the aircraft undercarriage, when one wheel hits an uneven surface, the aircraft may come into contact with the ground.*
2. *Minimize engine work and shorten taxi time when working in hot weather as the engine may quickly overheat.*
3. *Taxiing on soft ground without an escord on the tail of the aircraft is prohibited.*
4. *The stick must be completely pulled back during taxiing.*

Before takeoff

1. Before taking off, once more check if all systems are normal: check instruments and their readings. Check the position of the following:

- i. Elevator trimmers neutral, rudder trimmers 7-8 mm to the right to counteract the aircraft's tendency to yaw left.
 - ii. Main fuel valves in the on position.
 - iii. External fuel tank valves shut off.
 - iv. Fuel boost valve in the OFF position.
 - v. Pitch lever fully forward.
 - vi. Flaps lever in the UP position (retracted)
2. Apply breaks and increase RPM.
3. Check for debris on the runway, and check surroundings.

Checklist „before takeoff“

T - Trimming	Trimmer half a division "nose down" Rudder: Full right
P - Propeller control	Fully forward
F - Fuel	Check contents of lower main tank Drop tank cock – OFF Pressuring cock – OFF Electric booster pump - OFF
F - Flaps	UP
S - Supercharger	Over-ride switch – AUTO Red light out

Takeoff

1. Throttle up until a boost value of 8-12 ft/in² is achieved depending on the aircraft load and the airfield condition. Depending on the acceleration, begin to release the stick in order to raise the tail for takeoff position. Compensate for the aircraft's tendency to yaw left by yawing right and try to keep takeoff path as straight as possible.

Liftoff occurs at 90-95mph IAS.

2. To avoid aircraft ballooning and the consequent loss of speed, do not immediately attempt a climb after liftoff, but follow the runway just above the ground until an IAS of 140mph is achieved, after which the pilot may begin to climb and retract the undercarriage.
3. To raise the undercarriage, first pull back the undercarriage control lever and take it out of the slot, and then push it into the forward position and press it against the board. Leave the lever in this position and watch the signal lights. As soon as the undercarriage begins to retract, the green light goes out and lights up red when the undercarriage is fully retracted and locked in place. The undercarriage lever shuts off automatically - the lever drop into the upper groove and the hydraulic valve in the quadrant on the undercarriage lever will show the position of "IDLE" (neutral). In addition, when retracting the undercarriage, the pilot will hear the wheels settling in the wings.

If the undercarriage does not retract, repeat the process and hold it in the front position. Deployed and unlocked landing gears slow down the aircraft and may lead to engine overheat.

NOTE. After retracting the undercarriage, it is necessary to turn out the anti-dust filter.

Climbing

- To achieve maximum rate of climb, pilots may make use of maximum power ($P_k=12 \text{ ft/in}^2$, $n=2850 \text{ RPM}$). In extreme situations even combat mode may be used ($P_k=18 \text{ ft/in}^2$, $n=3000 \text{ RPM}$), but for no longer than 5 minutes.
- In all cases where maximum rate of climb is not required, climbing may be performed with a pressure 7ft/in^2 and 2650RPM. Doing so conserves fuel and increases total flight range.
- Refer to the following table for the most efficient speeds for climbing at certain altitudes:

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

- While climbing, ensure that the temperatures for coolant and oil do not exceed 125° and 90° C respectively.
- Control of the radiator grates is automatic depending on the coolant temperature. The grates open at temperatures above 115°C . In case of system failure, the grates may be opened by pressing the button located on the left side of the pilot seat.
- Supercharger 2nd speed engages automatically at 13500-14000 ft while climbing. While descending, the supercharger returns to 1st speed past 12500 ft.
- If it is necessary to use 1st speed past 13500-14000 ft, set the dashboard switch to MS.
- Fuel boost valve must be set to off. Switch on only in response to the red light signaling a loss of fuel pressure (lower than 10ft/in^2)
- Rules for using the fuel tanks:
Startup, motor warmup, takeoff: Use main tanks. Switch fuel feed to use external tanks only at altitudes above 2000ft (600m) and only when external tanks are in place.
- Before dropping external tanks that have not been fully exhausted, first connect the main fuel tanks, then release.
- If the external tanks have no fuel remaining, or if it has been jettisoned, ensure that the valve for the external tanks is completely shut off. If they are not completely closed, the system will be fed air and may lead to interruptions in the motor operation.
- Periodically check remaining fuel levels while in flight by pushing the fuel gauge button. The gauge will begin to show remaining levels only after it begins feeding off the lower tank.

Preparing weapons systems for use in flight

13. Remove the weapon safeties by moving it from left to right. A pin will come out of the upper part of the trigger system that signifies weapons readiness.
14. Regulate the sight glow intensity by using the rheostat located under the gunsight on the dashboard. The rheostat has three positions – OFF, NIGHT, and DAY.

In-flight radio system testing

15. While in flight, periodically hail the ground stations to check if the radio is working.
16. In case of loss of contact between the ground station, continue to hail and receive until restoration of communications according to the schedule approved by the chief of communications.

Level flight

1. Circling flight may be performed at indicated airspeeds no less than 150mph without external tanks, and no less than 175mph with external tanks.
2. Operational flights, rebasing, patrol flights, loitering at target areas, flights in reserve regiments (with the exception of aerobatics and air combat training) must be performed under the economic regimes.
3. When switching flight modes to reduce airspeed, perform these steps in the following order:
 - Set the required (reduced) airspeed with the throttle lever.
 - Set the specified RPM with the pitch lever.
 - If the aircraft experiences a reduction in airspeed, then achieve the required airspeed by means of the throttle lever.
4. When switching flight modes to increase airspeed, perform these steps in the following order:
 - Set the specified RPM with the pitch lever.
 - Using the throttle lever, set the boost to the required airspeed. Take care not to exceed the boost settings conforming to the chosen flight mode.
5. In order to achieve maximum speeds (for use during enemy contact, pursuit, air combat, and retreat) the motor must be set to operate at the nominal or combat modes of flight (depending on the circumstances.) To do so, first set the RPM, followed by the boost settings corresponding to the chosen mode of flight.

NOTE. Motor operation in combat mode is permitted for periods no longer than 5 minutes. Additionally, the oil and cooling fluid temperatures must not be allowed to exceed limits.
6. The aircraft is easily balanced by trimmers on the entire diapason of horizontal flight. An aircraft properly configured may be left to fly uninterrupted without pilot intervention.
7. A complete loss of speed during horizontal flight on an aircraft with normal weight and throttled-down engine will happen under the following conditions:
 - when gears and flaps are retracted – at 85mph IAS.
 - when gears and flaps are deployed – at 75mph IAS.

Distance and duration of flight under different modes

(without external tanks) $G_{\text{н}}=3392 \text{ KG}$, $V_{\text{top}}=392 \text{ L}$.

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

Weapons control

- Control of the guns is by means of the pneumatic system and the triggers installed on the control sticks.
- Both cannons and machineguns can be fired separately from each other or simultaneously. Pressing the upper part of the trigger opens fire from the machineguns; the lower part for cannons; and the middle part for simultaneous fire from both weapon types.
- Reloading of the weapons systems may be performed only on the ground.
- Weapons fire must be in short, controlled bursts: 10-15 rounds per burst from the machineguns, and 3-5 rounds per burst from the cannons.

Flight Termination

Preparing for landing

- Engage the safeties for the weapon triggers. Ensure that:
 - Pitch lever is set to low pitch. (frontmost position)
 - second supercharger speed is off (red light off)
 - gauges show an internal pressure of 220 ft/in² in the air system and 800 ft/in² in the brake system.
- Open the canopy.

Checklist „before landing“

U - Undercarriage	DOWN
--------------------------	------

P – Propeller control	Fully forward
S - Supercharger	Red light out
F - Fuel	Main fuel valve – OPEN Electric booster pump - ON
F - Flaps	DOWN

Normal gear deployment

1. Deploy gears at a speed of 150-160mph IAS before the third turn.
Prior to deploying the landing gears:
 - 1) For 2-3 seconds hold the undercarriage lever in its frontmost position to relieve the locks.
 - 2) Sharply pull the lever to its rearmost position and leave it there. The lever will automatically lock into the gap as the undercarriage locks in place in the deployed position. The hydraulic valve indicator will once again show IDLE.
 - 3) If there is resistance when attempting to pull the lever backwards, then repeat step 1, but this time hold the lever for longer (3-5 seconds.) In this case, provide additional relief to the locks by reducing airspeed to 120-130 mph and lowering the RPM to 1200-1800, or by briefly and energetically nosing down.
 - 4) Once the green undercarriage signal lights are shown, double-check undercarriage deployment and locking.

Gliding descent

1. Straight gliding descent with retracted undercarriage and flaps is performed at a speed of 100-120 mph IAS; with deployed gear and flaps, 100-110 mph IAS.
2. Avoid overcooling the engine. On lengthy gliding descents, raise the engine RPM to 2400-2500 for 5-6 seconds every 3-4 minutes.
3. Reliable motor acceleration is guaranteed when the coolant temperature is not lower than 60° C and oil temperature is not lower than 20° C.
4. Turning before landing approach must be done at a speed of 150mph IAS. (assuming final approach is started at an altitude of no lower than 500ft)
5. Deploy flaps at a speed no greater than 160mph by pulling the flap deploy handle downwards.
6. Check instruments to ensure that the flaps have indeed deployed successfully.
NOTE. *In case of pneumatic system malfunction and a loss of pressure (below 120 ft/in²), perform the landing with retracted flaps, setting aside compressed air for the brakes.*
7. After flaps deployment, smoothly pull the stick to reduce speed to 100-110 mph IAS, which is the normal gliding speed.

Go-around

If forced to go-around:

- Smoothly push throttle to maximum.
- retract the undercarriage (flying with a deployed undercarriage can cause an overheat of the coolant) and begin a climb.
- at an altitude of no lower than 300 ft and at a speed of 130mph IAS: retract flaps.

Landing

1. When landing with deployed flaps, flare at an altitude of 6-7 meters; when flaps are retracted, this must be done at 5-6 meters. Complete touchdown at 0.25m-0.5m.
2. For touchdown on all three points, do not completely pull back on the stick.
3. After touchdown, periodically depress the brake trigger. Avoid braking sharply when the aircraft may potentially nose over – begin braking only when the stick is fully pulled back.
4. After your ground speed is under control, retract the flaps by returning the handle to the UP position.
5. Observe the runway and proceed to taxiing.

After taxiing

1. Cool the engine by letting it run for 2-3 minutes at an RPM of 800-1000.
2. Stop the motor by pulling the shutdown lever from its frontmost position all the way back to the slot, then smoothly push the throttle forward.
3. After motor shutdown, shutoff ignition and close the fuel valve.
4. Shutoff all electrical systems.

Aiming

Gunsight – General Characteristics

A Mk.II (8B / 2361) aircraft collimator sight is installed on the dashboard of the aircraft. It consists of two parts:

- Optical viewfinder (collimator)
- rangefinder

The optical system consists of the reticle, a lens, a reflector, and a light filter. The reticle has a ring, as well as a point at the center of two short vertical and two long horizontal strokes. The reticle is etched on an opaque plane-layer lens. The bottom of the reticle is illuminated by an electric lightbulb. The rays pass through the lens reticle and fall on the reflector glass, which is installed at an angle of 45 ° to the optical axis of the system. The reflector reflects the rays from the light source at an angle of 90 ° in the direction of the observer, who sees the image of the glowing reticle as if it was focused at infinity.



The gunsight rangefinder consists of two cams, the horizontal lines of the reticle, two scales and two handwheels.

The rangefinder mechanism provides a change in the interval between the visible image of the horizontal lines of the gunsight reticle. This interval is variable and is the basis for measuring the distance to the target. The value of the interval between the lines of the visible image of the sight grid depends on the angle of rotation of the range handwheel (upper) and from the target base handwheel (lower). Rotate the upper handwheel manipulates the upper scale, called the range scale, while the lower hand manipulates the lower scale, called the base scale (target size). The range scale is calibrated in hundreds of yards, and the base scale - in feet.

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

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

Gunsight – Specifications

1. Reticle ring diameter – angular values:
 - In degrees 6° 44'
 - In thousandths 118

2. Reticle rings radius - angular values:
 - In degrees $3^{\circ} 22'$
 - In thousandths 59
3. When shooting, this ring corresponds for allowance at an aspect of $2/4$ and target speed of 322 km/h.
4. At target aspect of $1/4$, target speed should be 644 km/h

Aiming method adopted by the Air Force in England

In the RAF, lead angle is determined by the magnitude of the angular velocity of the target relative to the aircraft that is opening fire. This speed is sometimes called the transverse velocity.

Acquisition of such a firing solution requires the pilot to determine the target lateral speed by eye. By using the reticle ring as a yardstick, the shooter may take into account the relative lead angle at any transverse speed of the target. Thus it is necessary to know the aspect and direction of the target's relative increase. We must remember that, taking into account the English target leading technique, the target relative direction line should be passing through the reticle center, and not the continuation of the longitudinal axis of the aircraft.

Aiming method adopted by the USSR Red Air Force

The Mk.II sight has one ring with a radius of 59 thousandths. Soviet Air Force sights have 2 rings:

- large, with a radius of 105 thousandths
- small, with a radius of 70 thousandths

A $2/4$ aspect and the following target speeds are taken into consideration using the rings.

- For the large ring, target speed of 600 km/h
- For the small ring, 400 km/h

The large ring is used for targeting enemy fighters, while the smaller ring is used for enemy bombers.

A comparison of these data shows that weapon fire using the Mk.II sight against enemy bombers at an aspect of $2/4$, we must take lead for $1/7$ greater than the radius of the ring; when firing at enemy fighters with a $1/4$ aspect, we must take lead for $1/8$ less than the radius of the ring.

In all cases, the continuation of the longitudinal axis of the target aircraft must pass through the center of the ring.

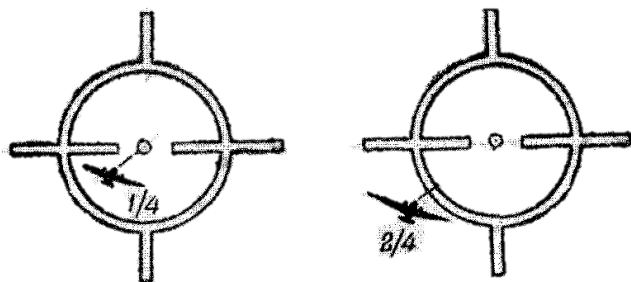


Figure 2: Aiming at a bomber with an airspeed of 400kph. Different aspects

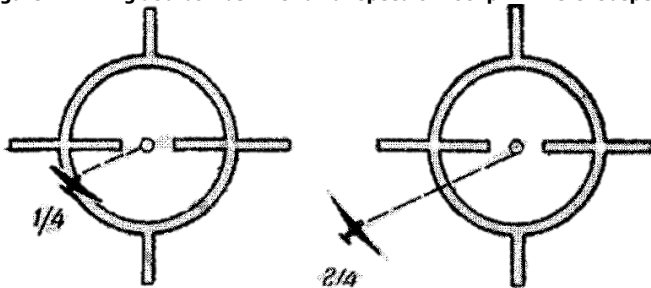


Figure 3: Aiming at fighter aircraft with a speed of 600kph. Different aspects

Determining target distance

The rangefinder device assists the pilot in determining the correct range from which he may begin to open fire. Distance is not measured during fire. Such use of the rangefinder allows the pilot to enter a correction on the gunsight using the range scale and the scale base (target size) knobs either before flight or during approach on target. In the process of rapprochement with the purpose of the pilot follows the apparent target size. When target size becomes equal to the space between the horizontal lines of the reticle, target range will be equal to the set target distance. At this point, the pilot should begin to open fire, taking into account target lead in accordance with the target aspect and aircraft type.

Main Keyboard Bindings

Engine Control

Auto-Startup	"RWin - Home"
Auto-Shutdown	"RWin - End"
Throttle DECREASE	"Num+"
Throttle INCREASE	"Num-"
Engine RPM Increase	"PageUp"
Engine RPM Decrease	"PageDown"
Main Fuel Cock Toggle	"T"
Primer	"Insert"
Primer Lock Toggle	"LShift - Insert"
Carburettor Air Filter, Toggle	"H"
Magneto 1, Toggle.	"LShift - End"
Magneto 2, Toggle.	"RShift - End"
Supercharger Mode, Toggle	"RShift - S"
Operate Wobble Type Fuel Pump	"LCtrl - Insert"
Booster Coil Button Cover	"LShift - Delete"
Booster Coil Button	"Delete"
Starter Button Cover	"LShift - Home"
Starter Button	"Home"
Mixture Control, Toggle	"M"
Radiator, Toggle	"A"

Aircraft Control

Flaps, Toggle	"F"
Landing Gears, Toggle	"G"
Landing Gears, Emergency Deploy	"LCtrl - LShift - G"
Wheel Brakes	"W"
Rudder Left	"Z"
Rudder Right	"X"

Elevator Trimmer, Nose Up	"RCtrl - ."
Elevator Trimmer, Nose Down	"RCtrl - ;"
Rudder Trimmer, Left	"RCtrl - ,"
Rudder Trimmer, Right	"RCtrl - /"

Gunsight and Weapons Fire

Gunsight Base Increase	"LShift - O"
Gunsight Base Decrease	"LCtrl - O"
Gunsight Range Increase	"RShift - O"
Gunsight Range Decrease	"RCtrl - O"
Guns Safety Lever	"LShift - Space"
Fire Machineguns	"Space"
Fire Cannons	"RAlt - Space"

Cockpit

LH Dashboard Lamp Brightness INCREASE	"LShift - N"
LH Dashboard Lamp Brightness DECREASE	"LCtrl - N"
RH Dashboard Lamp Brightness INCREASE	"RShift - N"
RH Dashboard Lamp Brightness DECREASE	"RCtrl - N"
Side Door, Close	"LAlt - LShift - C"
Side Door, Open	"LAlt - LCtrl - C"
Canopy, Close	"LCtrl - C"
Canopy, Open	"LShift - C"
Emergency Exit	"LCtrl - E"

Kneeboard

Kneeboard, Toggle	"RShift - K"
Kneeboard, Current Position	"RCtrl - K"
Kneeboard, Previous Page	"["
Kneeboard, Next Page	"]"

Radio Communications

Radio, Power Offr	"LCtrl - `"
Radio Channel A	"LCtrl - 1"
Radio Channel B	"LCtrl - 2"
Radio Channel C	"LCtrl - 3"
Radio Channel D	"LCtrl - 4"
Radio Mode R	"LCtrl - 5"
Radio Mode REM	"LShift - 5"
Radio Mode T	"LAlt - 5"
AWACS, Request Base	"LWin - U"
Attack My Target	"LWin - Q"
Attack Ground Targets	"LWin - G"
Attack AA Targets	"LWin - D"
Dispatch wingmen - complete mission and RTB	"LWin - E"
Dispatch wingmen - complete mission and rejoin	"LWin - R"
Dispatch wingmen - Rejoin Formation	"LWin - Y"
Communication Menu	"\"
Push-to-Talk	"RAlt - \\"
Toggle Formation	"LWin - T"
Cover Me	"LWin - W"
Switch Dialog	"RShift - \\"
Return to Main Menu	"RCtrl - \\"