INKOMPETENT'S REALISTIC FLIGHT MANUAL FOR IL-2 STURMOVIK

BATTLE OF MOSCOW, BATTLE OF STALINGRAD, AND BATTLE OF KUBAN

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TABLE OF CONTENTS

ABOUT THIS GUIDE

This guide is made for those players of IL-2 Sturmovik who would like to fly with ”real” procedures, but who either don’t have copies of original manuals, who don’t want to try to filter the relevant information from manuals, or who don’t have the language skills to read some of them. Some of these procedures are more for fun, immersion, or role-playing while others actually are useful within the game, like stall and spin recovery procedures, glide speeds, plane-specific routines for emergency landings, etc.

Because IL-2 Sturmovik is a “soft” simulator with focus on the air combat rather than the detailed operation of the planes’ avionics and mechanisms I have omitted operations like detailed engine starts, manual locking of landing gear and flaps, radio operation, emergency systems, etc. from this guide. For those who are interested in those features I’d like to refer to the original manuals.

For cases where manuals refer to specific control settings, like for example ”AUTO RICH” fuel mixture, I have included what percentage of that particular setting is required in-game to make the manual more accessible.

I have attempted to use as many sources as I have been able to find, both American, British, German and Russian. For cases where I have not been able to find model-specific manuals I have assumed similar operation of similar planes. The manuals that I have used as sources for this guide are listed in the chapter for each specific plane.

Because manuals are written very differently, with different focus and different layouts, I have attempted to create a standardised layout in this manual to make it easier to read. This means that for some planes the layout of the manual is significantly different from the original manuals.

BELL P-39L-1 ”AIRACOBRA”

Sources:

- ”T.O. No. 01-110FG-1 - Pilot's Flight Operating Instructions for the P-39 K-1 and P-39 L-1 Airplanes” (1944)

AIRCRAFT SPECIFICATIONS

AIRFRAME LIMITATIONS

Maximum landing gear operating speed (V_{LO}): 200 mi/h (322 km/h)

Never exceed speed (V_{NE}): 523 mi/h (842 km/h)

ARMAMENT

Fixed-aperture holographic sight with sun filter

Primary armament

1x 37 mm M4 cannon (30 rounds)

2x .50 cal. AN/M2 machine guns (400 rounds)

4x .30 cal. AN/M2 machine guns (1200 rounds)

POWERPLANT

Allison V-1710-63, liquid-cooled V12 engine with single-stage supercharger

Curtiss electrically controlled constant-speed propeller

UNDERCARRIAGE

Tricycle undercarriage with steerable nose wheel

SYSTEMS OPERATING PROCEDURES

PROPELLER CONTROLS

FLYING PROCEDURES

TAXIING

1. Release parking brakes
2. Get the airplane moving before attempting any turn

TAKE-OFF

1. Trim rudder to 4° right and elevator to 3 – 4° nose up. Aileron trim should be neutral.
2. Adjust coolant and oil shutter controls to maintain nominal temperatures
3. Due to the tricycle landing gear it is important to get the nose off the ground as soon as possible. The nose should be gently eased off the ground when a speed of 100 mi/h (161 km/h) is attained.

4. Raise landing gear once reasonable altitude has been gained and verify that it is up
5. Raise flaps, assuming they have been used during take-off
6. Throttle down to a manifold pressure of approximately 37.5 inHg and reduce engine speed to about 2600 rpm.

CLIMB

The best climbing speeds are as follows:

Altitudes up to 5000 ft. (1500 m)	162 mi/h (261 km/h) IAS
Altitudes 5000 ft.to 10,000 ft. (1500 – 3000 m)	160 mi/h (257 km/h) IAS
Altitudes above 10,000 ft. (3000 m)	158 mi/h (242 km/h) IAS
...with a drop of 1 mi/h (1,6 km/h) for every 1000 ft. (300 m) additional altitude	

FLIGHT

1. To increase engine power during flight, set the fuel mixture to the "AUTO RICH" position, adjust the engine speed to the desired rpm, and then readjust the mixture controls if necessary.
2. To decrease engine power during flight, adjust the throttle to the desired manifold pressure, adjust the engine speed to obtain the desired rpm, and then readjust the mixture controls as necessary.
3. In cruising flight, maintain instrument readings in the following regimes for optimal performance:
   a. RPM — 1600 to 2400
   b. Oil inlet temperature — 60 to 80° C
   c. Oil pressure — 60 – 70 psi
   d. Coolant outlet temperature — 100 – 120° C

   Note: If any of the above mentioned readings are very irregular, lower throttle to determine if they can be corrected. If not, land the airplane.

STALLS

The airplane has good stalling characteristics, at about 105 mi/h with flaps up, and 90 mi/h with flaps down. The airplane will mush considerably at stalling speeds. A stall occurs first at the centre section of each wing, and then progresses outwards. To recover, ease the pressure on the stick and allow the speed to build up sufficiently, or approximately 130 to 140 mi/h (209 to 225 km/h), as to completely un-stall the centre sections.

SPINS

Deliberate spinning is not recommended. However if a spin occurs, rapid recover can be made as follows:

1. First apply full opposite rudder
2. Wait until rudder effect is noticeable *then* apply full forward stick
3. Aileron as follows and simultaneously with forward stick:
   a. No ammunition in wings; aileron with spin will help
   b. 300 to 1000 rounds in each wing gun box; aileron against (e.g. left stick in right spin) is extremely important
4. The spin is usually oscillatory in rate and it is mandatory that the opposite rudder be applied when the spin is at its slowest
5. If the procedure above is followed, the airplane will recover in one-half turn. If the procedure is not followed closely, the airplane may not recover.

AEROBATICS

1. Normal loops, slow rolls and Immelmanns are all done with ease
2. The following aerobatics are not recommended:
    a. Snap rolls
    b. Outside loops
    c. Spinning

DIVING

It is necessary to trim nose heavy when diving this airplane, otherwise the airplane will make a severe pull-out as speed is attained. The maximum permissible diving speed is 523 mi/h (841 km/h). 475 mi/h (764 km/h) is the maximum recommended indicated airspeed.

DO NOT CLOSE THE THROTTLE TO ALLOW A MANIFOLD PRESSURE OF LESS THAN 20 IN.HG. DURING A DIVE.

LANDING

1. Approaching the airfield, lower speed to 200 mi/h.
2. Lower the landing gear and verify that it is lowered.
3. Lower the flaps if desired or if necessary due to short runway
4. Land at 95 – 100 mi/h (153 – 161 km/h), in a conventional nose-up landing
   Note: Do not land at higher speeds unless necessary, as it causes significantly longer landing runs.
5. Let the plane roll out until the nose gear settles without pilot input
6. Once rolled out, retract flaps
7. Open oil and coolant shutters fully

EMERGENCY PROCEDURES

ENGINE FAILURE DURING TAKEOFF OR FLIGHT

1. Put the nose down to maintain flying speed
2. Raise the landing gear if level and firm ground is not ahead
3. Fully lower the flaps
4. Turn off the engine, and land straight ahead

CURTISS P-40E-1 ”KITTYHAWK”

Sources:

- ”Pilot Training Manual for the P-40” (1944)
- TO01-25CF-1 - Pilot's Operating Instruction Manual for the Curtiss P-40 Series D&E Warhawk (10 April 1943)
- “ALD-3F2 Handbook of Operation and Maintenance for Allison V-1710 F Type Engines – 3rd Edition” (1943)
- AN01-25CN-1 - Pilot's Flight Operating Instructions for P-40N Series (25 September 1944)

AIRCRAFT SPECIFICATIONS

V-SPEEDS

Maximum flap extended speed (V_{FE}): 140 mph (225 km/h) IAS

Maximum landing gear operating speed (V_{LO}): 175 mph (280 km/h) IAS

Never exceed speed (V_{NE}): 480 mph IAS (770 km/h)

Best rate of climb speed (V_Y): 150 – 160 (240 – 260 km/h) mph IAS

Landing configuration stall speed (V_{S0}): 84 mph (135 km/h) IAS

Clean configuration stall speed (V_{S1}): 90 mph (145 km/h) IAS

ARMAMENT

Fixed-aperture holographic sight with sun filter

Primary armament

6x .50 Cal AN/M2 machine guns (1410 rounds, 235 rounds per gun)

Optional armament/equipment

4x .50 Cal AN/M2 machine guns (940 rounds). Replaces the 6x machine guns

Additional ammunition for 6x machine guns: Increases ammunition load to 1686 rounds

Additional ammunition for 4x machine guns: Increases ammunition load to 2460 rounds

4x RS-82 high-explosive rockets with optional air burst

1x FAB-250sv general-purpose bomb

1x FAB-500M general-purpose bomb

Rear-view mirror

CANOPY

The airplane has a sliding canopy. The canopy has an emergency release allowing the canopy to be jettisoned from the plane.

FUEL SYSTEM

Five tanks: Two front wing tanks of 35 gal. (130 l) each, two main wing tanks of 50.5 gal. (190 l) each, and one fuselage tank behind the pilot of 62.5 gal. (240 l).

Normal fuel consumption is 50 – 60 gal. (190 – 230 l) per hour, or 2½ hours of flying time.

POWERPLANT

Allison V-1710-39, liquid-cooled V12 engine with single-stage supercharger.

Curtiss-Electric, constant-speed propeller.

UNDERCARRIAGE

Hydraulically actuated. Conventional tailwheel undercarriage with rotating tail wheel. Manual tail wheel lock.

20 seconds to retract.

SYSTEMS OPERATING PROCEDURES

POWER MANAGEMENT

ENGINE POWER OPERATION

The P-40 lacks an automatic manifold pressure regulator. Therefore the pilot must always beware of the engine's manifold pressure.

If you reduce the rpm first you get a jump in manifold pressure which can cause detonation if the relation of rpm to manifold pressure is greatly altered. An engine running at constant power settings receives a constant amount of fuel and air from the blower. If you lower the rpm and the manifold pressure remains constant the blower continues to supply the same fuel/air charge. The engine, running at lower speed cannot absorb this charge, as a result pressures in the lower and cylinder heads build up and cause detonation. Therefore never reduce rpm before manifold pressure.

If you advance the throttle before you increase the rpm the same thing happens as when you reduce rpm before manifold pressure in decreasing power. As the engine picks up speed (rpm), the manifold pressure drops. This is a normal and desired reaction.

Note: Above 12,000 feet, increased rpm gives you **increased** manifold pressure.

When engine power is increased or decreased the carburettor mixture control, propeller governor and throttle must be readjusted in the following order:

1. To Increase engine power:
    a. Adjust mixture control to obtain the fuel/air ratio specified for the power desired.
    b. Adjust the propeller control to obtain the desired rpm.
    c. Adjust throttle control to obtain the desired manifold pressure.
    d. Readjust mixture control if necessary.
2. To decrease engine power:
    a. Adjust throttle control to obtain the desired manifold pressure.
    b. Adjust the propeller control to obtain the desired rpm.
    c. Readjust throttle if necessary.
    d. Adjust the mixture control to obtain the desired fuel/air ratio.

WAR EMERGENCY RATINGS

War emergency ratings are when the manifold pressure of the engine is pushed in excess of the engine's guaranteed ratings. These ratings can cause damage to the engine and should therefore only be used when emergency conditions exist.

War emergency ratings are not guaranteed power ratings but are maximum manifold pressure ratings which may be used for emergency power operation when certain airplane and engine requirements have been met:

1. In combat or pre-combat areas and then *only when emergency conditions exist.*
2. The mixture control must be set in either "AUTO RICH" or "FULL RICH" position.
3. All operation of emergency ratings *must* be with the propeller control set in "AUTO" position to maintain 3000 rpm.
   Caution: Never change propeller setting from the 3000 rpm automatic position using war emergency rating manifold pressures. Changing propeller pitch to any setting below 3000 rpm will increase the break mean effective pressure (BMEP) of the engine in excess of established safe limits and may result in detonation with extremely damaging results to the engine.
4. During the use of war emergency ratings the oil inlet temperature *must not* exceed 95° C.
5. During the use of war emergency ratings the coolant outlet temperature should not be permitted to exceed 125° C.

Caution: During operation at war emergency ratings the manifold pressure should be reduced immediately if there is any indication of engine malfunctioning such as detonation, rough engine, overheating, etc.

DETONATION

1. Indications of detonation:
   Engine roughness does not necessarily indicate that detonation is present, but when unusual roughness is encountered it may be due to detonation.
2. Cause and prevention:
   a. A too low fuel/air ratio. Do not operate at mixtures that are too lean.
   b. Operating engine above permissible limitations, including too high oil and coolant temperatures. Observe Specific Operation Instructions.
   c. Rapid or uneven power change. Operate the throttle lever slowly, smoothly and evenly.
   d. Stop detonation immediately if present by performing the following actions in the order listed:
      i. Reduce manifold pressure.
      ii. Enrich mixture.

PROPELLER CONTROL

The airplane has a four-way selector switch for propeller control. The available positions are ”AUTO”, ”FIXED PITCH”, ”INC. RPM” and ”DEC. RPM”.

1. The automatic constant speed control may be used by placing the switch in ”AUTO” position. When in ”AUTO” mode the propeller governor control lever is used to control the engine rpm.
   Note: The markings on the propeller governor control lever are approximate. The desired rpm should be optained accurately by reading the tachometer.
2. The propeller pitch may also be adjusted manually by putting the switch in the ”FIXED PITCH” position. When in this mode the engine speed is adjusted with the the ”INC. RPM” and ”DEC. RPM” positions until the desired rpm is obtained.
3. If the propeller goes out it is likely to go to either maximum high or maximum low rpm. Here is what you do:
   a. Move the propeller selector switch from ”AUTO” to the ”FIXED PITCH” position.
   b. Try to increase or decrease your rpm (whichever is needed) by moving the selector switch to the ”INC. RPM” or ”DEC. RPM” positions.
   c. If you can’t adjust the rpm immediately, re-set the manifold pressure ti the minimum that maintains flight, and land at the nearest field.

Caution: If the tachometer oscillates while the propeller is in the ”AUTO” position, move the selector switch to the ”FIXED PITCH” position. If the oscillation continues you know that the trouble is either the engine or instruments. If the oscillation stops the trouble is in the propeller or propeller controls.

FUEL SYSTEM

The engine is equipped with a pressure type carburettor incorporating a mixture control having four main control settings: “IDLE CUT-OFF” (0%), “AUTO LEAN” (33%), “AUTO RICH” (66%), and “FULL RICH” (100%). When the mixture control lever is in “AUTO RICH” or “AUTO LEAN”, altitude mixture control is automatically maintained.

1. Above desired cruising manifold pressure and speed, set the mixture control lever at “AUTO RICH”.
2. At or below maximum cruising manifold pressure and speed the mixture control may be set at “AUTO LEAN” if fuel economy is important.
3. To regulate the fuel mixture to give a greater fuel economy, use the following procedure:
   a. With the mixture control in “AUTO-RICH”, obtain the cruising conditions desired.

b. Change propeller selector switch from “AUTO” to “FIXED PITCH”.
c. Lean out the mixture until a drop of 10 to 20 rpm is indicated. The position may possibly be between “AUTO LEAN” and “IDLE CUT-OFF”.
Caution: This procedure may lead to detonation. If this does happen, immediately enrich the mixture and return the propeller switch to “AUTO”.
d. If any changes in cruising conditions or altitude are made the mixture control setting should be checked by repeating the above operation.

Caution: When operating in “AUTO LEAN” mixture adjustment, change to “AUTO RICH” immediately before a rapid change in altitude or a change in cruising conditions is made.

Never use the FULL RICH position except when the engine detonates or war emergency rating is used. Before you increase the mixture setting to “FULL RICH”, reduce power as much as possible.

OIL SYSTEM

1. The oil system is regulated by manual control of the cowl shutters.
2. If the oil temperature rises above 85°C when you are cruising, open the coolant shutters all the way, reduce the power, and dive the airplane slightly.
3. If the oil overheats when you are climbing, open the cowl shutters and level off, reduce the power, and dive the airplane slightly.
4. Temperatures in excess of those listed below should not be the cause of forced landings, unless they are also accompanied by oil pressures below the prescribed minimum. The minimum oil inlet temperatures listed are conservative, but continued operation below the limits specified should be avoided.

GRADE OIL	1120 (summer grade)	1100 (winter grade)
Air temperature at ground	4° C and above	-7°C to 27° C
Safe maximum oil inlet temperature	95° C	85° C
Safe minimum oil inlet temperature	20° C	10° C

a. The low temperatures listed for each grade are sufficiently high that even under severe conditions, starting or warming-up difficulties should not ordinarily result.
b. The minimum oil inlet temperatures listed are conservative, but continued operation below the limits specified should be avoided.
c. At outside air temperatures above 38° C it may be impossible to stay within the 95° C maximum oil inlet temperatures under some flight conditions.

Caution: If the oil overheats when you are climbing, open the cowl shutters and level off, reduce power, and start a slight dive with the shutters open. If that does not help, go back to the field and land.

COOLING SYSTEM

1. The coolant system is regulated by manual control of the radiator shutters.
2. For normal ground operations, on take-off and on landing, the shutters should be in FULL OPEN.
3. When climbing and cruising, adjust the shutters to maintain a coolant temperature of 85°C to 125°C. The desired temperature is between 95°C and 105°C.
4. Whenever the coolant temperature reaches 115°C during cruising or 125°C while climbing, follow the procedures for oil overheating described in the preceding section.

Caution: Do not extend radiator shutters at IAS in excess of 175 mph (280 km/h).

FLAPS

1. The flaps are manually controlled
2. The flaps are gradually deployed, and have a maximum angle of 45°
3. The deployment angle of the flaps is indicated with a pointer on the flap- and landing gear position instrument.

UNDERCARRIAGE

1. Gear down - The landing gear may be lowered when the IAS is 175 mph (280 km/h) or less. It requires approximately 20 seconds to extend the wheels completely.
2. Gear up – The gear may be raised at any speed. It requires approximately 20 seconds to retract the wheels completely.
3. Brakes:
    a. The brakes are operated with the rudder toe brake pedals
    b. Never apply brakes suddenly as it may cause the airplane to nose over.
    c. The plane is equipped with parking a brake. The parking brake will release automatically by pressing on the toe brakes.

Caution: Do not operate the landing gear on the ground, because the wheels will retract.

LIGHTS

The plane is equipped with a landing light. When turning on the landing light switch the lamp will be extended to its operating position. Do not operate the landing light at speeds in excess of 175 mph (280 km/h)
Caution: Do not operate the landing light for more than 3 minutes.

POWER SETTINGS

Engine mode	Manifold Pressure	Engine RPM
Idling	-	1000
Take-off (Maximum)	52” (for 1 minute	3000
Take-off (Recommended)	45” (for 5 minutes)	3000
Climb (Maximum)	45.5” (for 5 minutes)	2600
Climb (Recommended)	35”	2500
Cruise (Maximum)	37.2”	2400
Cruise (Recommended)	30”	2300
Landing	-	2600

FLYING PROCEDURES

FLIGHT CHARACTERISTICS

GENERAL

The P-40 has no bugs and no tricky, unusual or undesirable characteristics in take-off, landing and flight. It responds quickly to controls and is highly manoeuvrable. For a fighter it is very stable in flight, but its stability depends on you. You must **fly** the airplane every second from the second you start till you shut off the engine after landing. You cannot doze at the controls of a P-40.

TURNS

The P-40 has few equals in manoeuvrability below 15,000 feet (4,600 m). It turns inside nearly all other high-performance fighters. You can make any kind of turn if you coordinate your controls smoothly. Always use a

steady pressure on the controls; don't pull the control stick back hard. Constant use of the rudder trim tab controls reduces the energy required to work the rudder and makes coordination easier.

Before the P-40 reaches the stalling point in a turn it gives you plenty of warning by shuddering violently. When it begins to shudder, relax back pressure on the stick. You can make a turn just above the stalling point even while the airplane is shuddering, if you coordinate your controls smoothly. Such a turn is a maximum turn. A higher rpm setting allows you to make a tighter turn.

A sudden uncoordinated maximum turn usually results in a high-speed stall. If you don't correct the stall immediately the airplane snaps into a spin.

Don't make turns in an ordinary climb because they reduce your rate of climb considerably. In a climbing turn to the right you need extra rudder pressure. When you turn to the left however, you need little rudder pressure. If your IAS decreases you need more rudder to enter climbing turns.

DIVES

The plane is very stable in dives regardless of speed, but with an increasing tendency to roll right the faster it goes. The roll should be compensated for with left rudder and left rudder trim. Elevator and rudder loads are heavy at high diving speeds.

TRIM

During certain flight conditions the plane should be trimmed as follows:

1. Landing gear DOWN – Nose heavy until re-trimmed
2. Flaps DOWN – No appreciable change
3. During dive – Strong yaw to right
4. During climb – Strong yaw to left

HIGH-ALTITUDE CHARACTERISTICS

1. The P-40 operates best around 12,000 feet (3,650 m). Above 15,000 feet (4,600 m) there is a marked decrease in engine power.
2. To add additional power above 15,000 feet (4,600 m), put the mixture control switch in "AUTO LEAN" and increase rpm.
   Caution: Do not increase rpm past 2,600
3. When flying at high altitudes, remember that the tendency of the airplane to mush and your own tendency to over-control increases greatly. Anticipate the need for corrections and begin correcting sooner at high altitudes than you would at low altitudes.
4. Perform high-altitude aerobatics with the same airspeeds and with the same control pressures that you use at low altitudes. Because the air is thinner at high altitude you need more space to manoeuvre your airplane.

ENGINE WARM-UP

Note: Engine warm-up is usually not relevant in IL-2 Sturmovik as the player generally starts with a warmed-up engine.

1. Once the engine is running, set the throttle to maintain an engine speed between 800 and 1000 rpm until oil pressure begins to come up.
2. Make sure that the propeller selector switch is in AUTO.
3. Engine warm-up:

    a. Idle the engine between 500 and 800 rpm for 30 seconds after normal idling oil pressure (15 psi) as indicated, and then continue the warm-up at 1,400 rpm.
    b. Set radiator shutters as required.
    c. Continue running the engine until the temperatures for the oil inlet is at least 15° C and the coolant is 60° C.
4. After warm-up has been completed, advance throttle to obtain 2300 rpm.
5. Set the propeller governor control at 2800 rpm.
6. Check fuel and oil pressures:
    a. Oil pressure should not exceed 120 psi during warm-up, and the normal oil temperature should be 60° C to 80° C, with a maximum of 95° C.
    b. Fuel pressure for idling should be maintained at 10 psi, and for operating 16-18 psi.

Note: If warming the engine in extremely cold weather, start with radiator shutters closed. Do NOT increase the engine speed to more than 800 rpm until the oil has reached a temperature of 40° C. If warming the engine in very hot weather, don't start the engine until you are ready to taxi.

TAXIING

1. Use only enough power to start rolling.
2. Wing flaps up.
3. Open the radiator shutters.
4. The view ahead is very poor when taxiing. It is therefore necessary to keep your canopy open and to keep swinging the airplane from side to side for visibility directly ahead.
5. Taxi slowly, use brakes lightly and intermittently, and hold the stick well back. The P-40 noses over easily!
6. For the pre-flight check, stop off the runway at an angle of about 45° to the runway so that rear and forward vision of the runway is unobstructed.

Caution: Avoid prolonged idling of the engine under 1,000 rpm to prevent fouling the plugs.

PRE-FLIGHT CHECK

1. Wing flaps up (unless needed, at which point they should not be more than ½ down).
2. Trim tabs set to: Rudder and elevator trim tabs should be set to neutral.
3. Set the left aileron trim tab flush with the trailing edge of the aileron.
4. Engine speed set to 2800 rpm.
5. Mixture control "AUTO RICH".
6. Propeller control set to "AUTO".
7. Oil pressure 60 – 80 psi, and oil temperature between 60°C and 85°C.
8. Fuel pressure 12 – 16 psi.
9. Coolant temperature between 85°C and 125°C.
10. Set radiator shutter control to wide "OPEN".
11. If a belly bomb is carried the arming handle should be in the "SAFE" position so that the bomb may be safely dropped in an emergency.
12. Perform a propeller check:
    a. Set the propeller lever to 2300 rpm.
    b. Pull the propeller lever back until the tachometer drops a full 200 rpm, then return the control lever back to the full forward position. Make sure the engine regains the original rpm setting.
    c. To check manual operation of the propeller, place the propeller switch to "FIXED PITCH", move the "DEC. RPM" until the tachometer shows a 200 rpm drop, then place the propeller switch to the "INC. RPM" position until the tachometer shows that the original rpm has been regained, then return the propeller switch to the "AUTO" position.
13. Set flaps as required, but never over one-half way down.

TAKE-OFF

1. Select a reference point on the horizon that you can keep clearly in sight during the take-off.
2. Move the throttle forward steadily and evenly to 45.5” Hg. Apply the power smoothly as a sudden burst of power might make your airplane turn strongly to the left. Even with smooth application of power the airplane tends to the swing to the left, which must be compensated by the use of right rudder.
3. As soon as you have sufficient speed, get the tail up slightly. Don’t take off in a three-point position.
    a. Do not force the tail up violently in the early stages of the take-off run as this makes you lose the use of the steerable tail-wheel before you gain rudder control.
    b. During take-off torque tends to make the left wing drop; compensate with right aileron.
4. Keep going straight down the runway by the use of the rudder alone
5. Allow the airplane to fly itself off the ground.
6. Raise landing gear when safely off the ground and verify that it is raised.
7. Reduce the throttle to 33 inches Hg. and 2,350 rpm for climbing as soon as definitely airborne.

Note: If flaps were used for take-off, don’t raise them till at least 500 ft. (150 m) off the ground.

Caution: Anticipate the sudden resultant loss of lift caused by raising the flaps.

AFTER TAKE-OFF

1. Climb at a power setting of 33 inches Hg manifold pressure and 2,350 rpm engine speed. Climb at 150 – 160 mph (240 – 255 km/h) to the desired altitude.
2. Coolant and oil temperatures generally run higher than normal while climbing. If any temperature persists in running high, level off until it drops.
3. When the desired altitude is reached, level off and reduce throttle to 27 inches Hg, and approximately 2,100 rpm for cruising.
4. Adjust the radiator shutters to keep the engine within nominal temperatures and re-trim the airplane so that it flies straight ahead without your hands on the controls.
5. Check engine and fuel instruments at least once every 5 minutes.

LANDING

1. Approach
    a. Make the following pre-landing check:
        i. Mixture control “AUTO RICH” (66%).
        ii. Manifold pressure set to 18 inches Hg and engine speed set to 2230 rpm.
        iii. Propeller control set to “AUTO”.
        iv. Radiator shutters adjusted to keep the coolant temperature below 105°C.
    b. When cleared to land, approach the airfield at 170 mph (275 km/h).
    c. Open the canopy and open the radiator shutters.
    d. Lower the landing gear when below 175 mph IAS (280 km/h) and verify that it is lowered.
    e. Re-trim the airplane.
    f. Turn into the final approach at no less than 500 feet (150 m) altitude and a distance of not more than ¼ mile.
    g. Fully lower flaps when below 140 mph IAS (225 km/h).
2. Landing:
    a. Establish a glide of 110 – 115 mph (175 – 185 km/h) and re-trim the plane to be slightly tail-heavy.
    b. Cut the throttle and land at three-point. If bouncing, compensate with throttle.
    c. Keep the airplane rolling straight down the runway by using rudder and brakes. Don’t try to turn off the runway until the airplane has slowed sufficiently to give you complete control over it.

    Note: You need about 2,000 feet (600 m) of runway from the point of contact to the end of the roll. If you are unable to land within the first third of the runway, go around.

3. Cross-wind landing :
    a. Avoid cross-wind landing whenever possible.
    b. When landing in strong crosswind of more than 15° or in gusty wind, come in slightly hot, wheels first, and don't use more than 30° of flaps. The recommended way to correct for crosswind in the P-40 is by dipping a wing into the wind. After the airplane is on the ground, be careful not to over-control it. In a crosswind the nose tends to swing into the wind.
4. Wet landings:
    a. When landing on a wet surface, take it easy with your brakes and control.
    b. A wheels-first landing is your best bet.
    c. Use ½ flaps.
    d. Taxi slowly and use your brakes sparingly.
5. Go-around procedures:
    a. When you start to go around, advance the throttle smoothly to 37 inches Hg, set the engine speed to 2600 rpm and climb to 500 feet. Because your flaps are down it takes longer to gain altitude.
    b. Set the flap handle to "NEUTRAL" (i.e. stop extending or retracting flaps).
    c. Retract the landing gear.
    d. Fly straight ahead until you reach 500 feet before you make a turn. Don't turn with more than 30° f flaps down unless it is absolutely necessary, and then only with the nose level or down.
    e. At 500 feet reduce the manifold pressure to 35 inches Hg and the engine speed to 2500 rpm.
    f. Do not try to retract the flaps below 500 feet. Here is why: When you put the flap handle in the "UP" position the flaps rise instantly, thus causing the plane to lose altitude. The best way to retract flaps without losing altitude is by "milking" them up. This is done by rapidly shifting the flap handle between the "UP" and "NEUTRAL" positions until the flaps are all the way up.
    g. Rejoin the traffic pattern and repeat the landing procedure.
6. At conclusion of landing run:
    a. Close the throttle.
    b. Fully open the radiator shutters.
    c. Raise the wing flaps.
7. Emergency take-off if landing is not completed:
    a. Open the throttle and after propeller rpm has stabilized, increase rpm to 2,800.
    b. Do not retract the flaps until above a 500-foot altitude.
8. Stopping of engine:
    a. Apply toe-brakes and set parking brake lever.
    b. Hold flight control stick back and run engine up to about 18 inches Hg for 30 seconds.
    c. Move the mixture control to "IDLE CUT-OFF".
    d. When propeller stops rotating, turn ignition switch "OFF".

Note: You need about 2,000 feet of runway from touch-down to full stop.

GLIDES

1. The glide ratio for the P-40 with power off is approximately 4½ feet forward for every 1 foot down at a speed of 150 mph (240 km/h) with wheels and flaps up and no overload.
2. In an emergency, keep your gliding speed at 150 mph (240 km/h). Never let your speed fall below 140 mph (225 km/h), and don't make turns steeper than 45°.
3. For long power-on glides:
    a. Maintain a manifold pressure of at least 20 inches Hg.
    b. Clear your engine by applying significant throttle every 2 or 3 minutes to keep the plugs from fouling and the engine from becoming too cold.
    c. Don't let your coolant temperature fall below 85° C.
4. When gliding in for a landing, use your trim tabs to establish an indicated airspeed of about 110 – 115 mph (175 – 185 km/h).

STALLS

1. The stalling speed of the P-40 is approximately 84 mph (135 km/h) with wheels and flaps down, and 80 mph (145 km/h) with wheels and flaps up.
2. The P-40 can stall at any speed and in any position if you do not coordinate your controls properly.
3. If a high-speed stall develops it usually snaps the airplane. Unless you immediately ease back the pressure on the stick the plane will go into a spin. Avoid high-speeds stalls as recovery may need significant altitude, if it at all is possible.
4. Low-speed stalls are relatively safe. If you enter one, cut the throttle, neutralize the stick and rudder, and wait till the nose naturally points well down before starting the recovery.
5. If you stall in an unusual position – like the top of an Immelman Turn – retard the throttle, neutralize the stick and rudder and wait until the nose is well down before starting recovery.

Note: Avoid stalls below 8000 feet as you may not have room to recover.

DIVES

1. Recovery from a high-speed dive need at least 5,000 feet of altitude. 8,000 feet of altitude for dives at maximum diving speeds.
2. Do not exceed a diving speed of 480 mph IAS or 3120 rpm.
3. When diving the P-40 tends to roll to the right. The higher the speed of the dive, the greater the tendency roll. Compensate by using left rudder and left rudder trim tab control.
4. Pull out smoothly from a dive. A too sudden movement may throw the plane into a high-speed stall. Pull out should start at 8,000 feet for dives at maximum diving speeds.
5. Vertical dives from above 20,000 feet (6,100 m) are not recommended because of the risk for suffering compressibility.
6. Pull back out of a dive firmly and smoothly. Do not jerk back on the stick a sudden, jerky pull-out may throw the plane into a high-speed stall. This is especially dangerous close to the ground.

Note: The P-40 has a short tail and that means greater rudder and elevator loads. This means that a lot of rudder and elevator pressure may be needed in a high-speed dive.

Caution: Do not close the throttle to allow a manifold pressure of less than 20 inches Hg during a dive! Failing to do so may result in engine malfunction.

SPINS

Never spin the P-40 intentionally. All spins should be avoided. Spins in the P-40 are usually a result of the following:

1. Tight vertical turns.
2. Uncoordinated turns.
3. Stalling out in vertical manoeuvres like a loop or Immelmann Turn.
4. Steep turns at low airspeeds.

In case of normal spins (yaw and roll movement in the same direction), follow this procedure:

1. Cut the throttle.
2. Apply full opposite rudder to stop the turn.
3. Push the stick forward to build up normal diving speed.
4. Smoothly and gently pull out of the dive. If the pull-out is rushed it will result in another spin.

Note: You lose about 1000 feet per turn in a spin. Recover takes about 2000 feet after the airplane stops turning.

In case of inverted spins (yaw and roll movement in opposite directions) the spin must first be turned into a normal spin, to then be recovered with the above procedure. To turn and inverted spin into a normal spin, follow this procedure:

1. Cut the throttle immediately
2. Apply full back pressure on the stick
3. Apply rudder pressure *with* the spin, not against it

4. When the airplane goes into a normal spin, follow the normal spin recovery technique

If you can't break a spin and if sufficient altitude remains, cut the throttle and take your hands and feet off of the controls. The airplane usually recovers by itself after 2-3 turns.

AEROBATICS

Prohibited manoeuvres are:

1. Outside loop
2. Inverted flight
3. Inverted spin
4. Snap roll at speeds in excess of 140 mph IAS (225 km/h)
5. Slow roll at speeds in excess of 285 mph IAS (460 km/h)
6. Spin of more than three turns
7. Spin with baggage or any other overload

Caution: All aerobatics are prohibited when a bomb is installed.

LOOPS

1. Enter the loop at about 275 mph (440 km/h)
2. Greatly increase the back pressure on the stick until the airplane passes beyond the vertical position and you can see the horizon behind you
3. Release the back pressure on the stick and let the plane fly itself around the top of the loop

BARREL ROLLS AND SLOW ROLLS

Perform barrel rolls and slow rolls between cruising speed and 285 mph (460 km/h). Do not perform them above 285 mph (460 km/h).

LOST PROCEDURES

If you get lost it may be imperative to achieve maximum endurance in the aircraft. For maximum fuel economy, reduce the manifold pressure to 26 inches Hg and the engine speed to 2190 rpm.

INSTRUMENT FLYING

1. Your instruments work better at slower speeds: Slow your airplane and lower ¼ flaps.
2. Increase RPM to 2600.
3. If you want to climb, climb at a speed of 160 mph (260 km/h).
4. Make up your mind about how you are going to get out of the weather: Will you turn around, climb above, or let down? When you have made a decision, stick to it.
5. Here are the best indicated air speeds:

Cruise	175 mph (280 km/h)
Climb	150 – 160 mph (240 – 260 km/h)
Let-down	140 – 150 mph (225 – 240 km/h)

NIGHT FLYING

The technique of night flying is closely related to instrument flying. A few suggestions:

1. Be super-careful when taxiing. Use your landing light intermittently except in extremely congested areas. Never use your landing light for more than 10 seconds at a time.
2. Make an accurate check on your flight instruments.

3. On an especially dark night you may have trouble finding the horizon, therefore make sure to monitor all gyro instruments frequently.
4. Do absolutely no acrobatics.
5. Know the location of emergency landing fields in the area over which you are flying.

NIGHT TAKE-OFF

The things you have to remember when taking off at night are these:

1. Be sure your running lights are on before starting the engine.
2. If you use your landing light for taxiing, remember to retract it before starting the take-off or immediately after take-off.
3. When taking off, pick a point on the horizon in front of you and hold to that point so that you can take off on a straight course.

NIGHT LANDING

1. You are safer landing wheels first than three-point because of reduced visibility and your own tendency to level off high at night.
2. Use the landing light at your own discretion. If you plan to use the landing light, extend it after your last turn into the field. Do not extend the landing light when you are flying over 140 mph (225 km/h).

Caution: The landing light should not be used when there is fog on the ground because glare and blindness may result, depth perception is distorted, and you may mistake the top of the fog for the ground.

EMERGENCY PROCEDURES

1. In an emergency:
    a. Find out what's wrong with the airplane.
    b. Find out whether it can be corrected in the air.
    c. If it can be corrected, take immediate measures.
    d. If it can't be corrected, land at the nearest airfield.
2. Bail out only when:
    a. The airplane is out of control or burning.
    b. You are flying over water.
    c. You are over rough, craggy or mountainous terrain.
    d. You are flying at night, if you can't make it to an airfield.

FORCED LANDINGS

FORCED LANDINGS

1. With power on:
    a. If you can reach an airfield, land wheels-down.
    b. If you can't make an airfield, raise the landing gear. Even if the wheels are partly extended they will collapse upon impact with the ground.
2. With power off:
   If the engine fails completely and there is any doubt you can make it to an airfield you are better off landing wheels up than wheels down because:
    a. You do much less damage to the airplane in a wheels-up landing than if you try a wheels-down landing and mess it up.
    b. You are personally in less danger.

c. It is difficult to determine the point of contact on the ground when you land wheels-down with power off.
Note: It is better to overshoot than undershoot the point of contact.

Note: A wheels-up landing requires approximately ⅓ the landing space of a wheels-down landing.

FORCED LANDING ON AIRFIELDS

If you can make it to an airfield you must stay close to the airfield and keep enough speed and altitude to land wheels-down from any angle. Take note of the following:

1. If you are approaching the airfield and have too much altitude, get near the edge of the field and S back and forth until you come down enough to land.
2. If you are overshooting, use a nose-low forward sideslip to lose altitude. The P-40 isn't an airplane to slip and loses altitude fast.

Caution: You may find it easy to lose altitude, but you may find it impossible to regain it.

FORCED LANDING AT NIGHT

If you must make a forced landing without power and you are near an airfield, turn on all landing lights and come in wheels-up.

Caution: If you are not near an airfield you have one option: BAIL OUT!

SWAMPY AND ROUGH TERRAIN

The first rule for landing on rugged terrain is to keep your wheels up. Even if the ground seems smooth, land wheels-up.

ENGINE FAILURE DURING TAKE-OFF

If the engine fails on take-off and you have less than 1000 feet altitude **do not** attempt to try to turn back to the airfield. Doing so will almost certainly result in a catastrophic landing at the very best, and possibly with your death. Instead:

1. Release bomb if attached.
2. Nose down immediately to maintain speed.
3. Raise your landing gear, **continue straight ahead**. If possible, make sure that the landing gear is fully retracted before the emergency landing.
4. Set mixture control to "IDLE CUT-OFF".
5. Set ignition switch to "OFF".
6. Lower the wing flaps.
7. Keep the nose of the airplane well down and maintain a gliding speed of approximately 110 mph (180 km/h) straight ahead.

Caution: Land the airplane on its belly! Do NOT attempt to lower the landing gear.

ENGINE FAILURE DURING FLIGHT

1. Release bomb if attached.
2. Maintain an approximate 150 mph (240 km/h) glide.
3. Set mixture control to "IDLE CUT-OFF".
4. Turn the ignition switch to "OFF".
5. Lower the wing flaps.
6. Open the canopy.
7. Land at minimum safe speed. Land into the wind whenever you can.

Note: Only attempt a wheels-down emergency landing if you can land on an airfield or a sufficiently long, firm stretch of road. Otherwise land wheels-up (belly-land). A wheels-up landing is easier to do right, and when done right is very safe.

When you must make a forced landing at an airfield stay near it and keep enough speed and altitude to make a gears-down landing. If having too much altitude, get near the airfield and approach it in S-turns. If you still are overshooting, do a nose-low forward slip to bleed altitude fast. The P-40 does it well, but make sure to keep the slip coordinated not to stall the plane. Remember that it is better to overshoot slightly than to undershoot as regaining enough altitude might be impossible.

DITCHING

The P-40 is not the best airplane in the world to ditch. If you are at 1,000 feet (300 m) or more and you run into trouble over water it is generally a better idea to bail out than to ditch.

If you decide to ditch, follow this procedure:

1. Release bomb if attached. MAKE SURE THAT THE FUSE IS SAFE!
2. Open or emergency release the canopy.
3. You may use flaps to slow your landing, but it is not recommended. They act as diving vanes which tend to force the airplane's nose underwater.
4. Establish and maintain a glide at 110 mph (180 km/h).
5. The surface of the water indicates the force and direction of the wind:
    a. On a calm surface, land upwind.
    b. On a wavy surface with whitecaps but no spray, land *along* the top of the waves and parallel with the swell.
    c. On high waves with foam being whipped into spray, land upwind on the up-slope of the waves.
6. When the airplane has stopped, immediately leave the airplane.

FIRE

The airplane has no fire extinguishing features, therefore if fire breaks out during flight, bail out immediately! If there is insufficient altitude to do so, then attempt a swift forced wheels-up landing.

Note: Often a failure of the oil or coolant systems causes the engine to smoke. A smoking engine does not mean the airplane is on fire.

GUNNERY

The airplane does with the standard ammunition load of 1410 rounds (235 rounds per gun) have ca 10 seconds of firing time.

Never fire a burst longer than 3 seconds; a longer burst is harmful to your guns and may cause them to jam.

BOMBING

The P-40 can carry one bomb under its fuselage of up to 500 kg weight. There are two primary bombing methods to deliver this bomb onto the target: Skip-bombing and dive-bombing.

SKIP-BOMBING

Skip-bombing is the most accurate kind of bombing that can be performed with a fighter. It can be performed as low as you dare fly, but it is recommended to not do so below 50 feet (15 m) altitude.

There are three basic rules for skip-bombing:

1. You should maintain a straight and level approach for at least 5 seconds before the bomb is released.
2. Try to undershoot the target, because undershooting allows the bomb to skip into its target.
3. Always used delayed-action bombs. They give the airplane time to get out of danger before the explosion, and they delay the explosion until the bomb can skip onto the target.

DIVE BOMBING

1. Come in over the target at 4,500 feet (1,400 m), pull up, and slow the aircraft the airplane to 150 mph (240 km/h).
2. Roll over and start your dive. Be sure the airplane is properly trimmed for high speed so that it won't be necessary to use much left rudder. Do not dive faster than 350 mph (560 km/h) IAS.
3. Put the bead of your gunsight on the centre of the target as you dive. The angle of the dive should not be greater than 70° or smaller than 45°. Just as you start the pull-out, release the bomb.
4. Pull out of the dive at 1,000 feet (300 m) or more. Do not jerk back on the stick during the pull-out because you might get into a high-speed stall.

DOUGLAS A-20B "HAVOC"

FOCKE-WULF FW 190 "WÜRGER" A-3 & A-5

HEINKEL HE 111 H-6 & H-16

HENSCHEL HS 129 B-2

ILYUSHIN IL-2 "STURMOVIK" MODEL 1941, 1942 & 1943

Sources:

- "Инструкция Летчику по Эксплуатации Самолета Ил-2 с Мотором АМ-38" (1942)
  "Pilot's Operating Instructions for the Airplane IL-2 with AM-38 Engine" (1942)

AIRCRAFT SPECIFICATIONS

ARMAMENT

Fixed-aperture holographic sight with sun filter

IL-2 MOD.1941

Primary armament

2x 7,62mm ShKAS machine guns (1500 rounds)

2x 20mm ShVAK cannons (420 rounds)

With any combination of:

4x FAB-50sv general-purpose bombs

4x FAB-100M general-purpose bombs

8x RS-82 high-explosive rockets with optional air burst

Optional armament/equipment

2x 23mm VYa-23 cannons (300 rounds). Replaces the 20mm ShVAK cannons.

6x FAB-50sv / FAB-100M general-purpose bombs

2x FAB-250sv general-purpose bombs

8x RBS-82 armour-piercing rockets

8x ROFS-132 high-explosive rockets

IL-2 MOD.1942

Primary armament

2x 7,62mm ShKAS machine guns (1500 rounds)

2x 20mm ShVAK cannons (500 rounds)

With any combination of:

4-6x FAB-50sv general-purpose bombs

4x FAB-100M general-purpose bombs

8x RS-82 high-explosive rockets with optional air burst

Or with:

6x FAB-100M general-purpose bombs

Optional armament/equipment

2x 23mm VYa-23 cannons (300 rounds). Replaces the 20mm ShVAK cannons.

2x 37mm Sh-37 cannons (80 rounds). Replaces the 20mm ShVAK cannons.

2x FAB-250sv general-purpose bombs

8x RBS-82 armour-piercing rockets / 8x ROFS-132 high-explosive rockets

Rear turret with 1x 7,62mm ShKAS machine gun (500 rounds)

POWERPLANT

Mikulin AM-38, liquid-cooled V12 engine with single-speed supercharger

UNDERCARRIAGE

Conventional tailwheel undercarriage with rotating tail wheel. Manual tail wheel lock.

SYSTEMS OPERATING PROCEDURES

POWER SETTINGS

Engine mode	Manifold pressure (mm Hg.)	Engine RPM
Take-off	1180	2150
Nominal	1180	2050
Cruise (Maximum)	< 950	-
Cruise (Recommended)	< 950	1850

WHEEL BRAKES

1. The brakes are pneumatically operated
2. Brakes are applied with the use of a single brake lever on the control column
3. Differential control is provided through the rudder pedal linkage bar. Brake force on a single wheel is proportional to amount of rudder kicked in that direction.

FLYING PROCEDURES

START-UP AND TAXIING

1. Fully open oil shutters
2. Open water radiator shutters depending on outside air temperature. You want the temperature to be between 80 – 110° C
3. Unlock the tail wheel

PRE-FLIGHT CHECKS

1. Tail wheel locked
2. Open shutters for oil and water radiators
3. Test engine on nominal power
4. Inlet oil temperature between 40 – 60° C
5. Outlet oil temperature between 70 – 115° C
6. Water temperature between 80 – 110° C

TAKEOFF

1. Apply full throttle
2. Maintain direction with the rudder. Do *not* use the brakes
3. After lift-off, hold the plane steady till an airspeed of 240 – 250 km/h is reached, then start climbing
4. Check instruments. They should be as follows:
    a. Engine RPM 2150
    b. Water temperature 90 – 115° C
    c. Outlet oil temperature 80 – 120° C
5. Retract the landing gear and control that it successfully retracts

AFTER TAKEOFF

1. Decrease pressure on the stick by trimming the elevator
2. Set climbing airspeed to 240 – 250 km/h
3. After the proper height is reached, level out and reduce throttle till manifold pressure is at 950 mm Hg. or less
4. Re-adjust elevator trim, engine rpm, and throttle for cruising. The most fuel-economical cruise setting is achieved at 1850 rpm and a speed of 250 – 270 km/h
5. Make sure to maintain nominal water and oil temperatures:
    a. Water temperature 80 – 110° C
    b. Inlet oil temperature 40 – 80° C
    c. Outlet oil temperature 70 – 115° C

FLIGHT IN ENEMY AIRSPACE

1. Adjust propeller pitch for an engine RPM of 2050
2. Increase speed according to flight plan
3. Before approaching the target area, do:
    a. Close oil radiator shutters to protect it from enemy fire
    b. Adjust airspeed to 300 – 320 km/h
4. When leaving the target area, open the oil radiator shutters

LANDING

1. Reduce airspeed to 240 – 250 km/h
2. Lower the landing gear and verify that it is lowered
3. Reduce airspeed to 220 – 230 km/h
4. Close water radiator shutters to maintain a temperature of 90° C or higher
5. Approach the runway by gliding towards it in a straight line at 210 – 220 km/h
6. Lower the flaps
7. Trim the elevator to balance out the plane
8. Lowered the speed to 185 – 190 km/h for the final approach
9. During landing with lowered flaps, pull the control stick full back to perform a stable 3-point landing During landing with raised flaps, don't pull the control stick all the way back or the tail will touch ground first
10. Use brakes on the runway smoothly. Apply brakes with caution and first after rolling 30 – 40 m
11. Maintain control stick full back until landing run speed is reduced to taxiing speed
12. Raise the flaps, unlock the tail wheel and open the cockpit to taxi off the runway.

JUNKERS JU 52/3M

JUNKERS JU 87 "STUKA" D-3/G-1

JUNKERS JU 88 A-4

LAVOCHKIN-GORBUNOV-GUDKOV LAGG-3 SERIES 29

LAVOCHKIN LA-5 SERIES 8

Sources:

- Инструкция Летчику по Зксплуатации Технике Пилотирования Самолета Ла-5 с Мотором М-82 ФН (21 апреля 1944)
  Pilot's Manual for Operation and Piloting Technique of the La-5 with the M-82 FN Engine (April 21, 1944)
- Методические указания по технике пилотирования самолета Ла-5 с мотором М-82 (12 июля 1943)
  Methodical instructions on the technique of piloting the La-5 aircraft with the M-82 engine (July 12, 1943)

AIRCRAFT SPECIFICATIONS

AIRFRAME LIMITATIONS

ARMAMENT

Fixed-aperture holographic sight with sun filter

Primary armament

2x 20mm ShVAK cannons (340 rounds)

Optional armament/equipment

2x FAB-50sv general-purpose bombs

2x FAB-100M general-purpose bombs

RPK-10 radio compass

Flat windscreen

Special guns ammo load. Allows use of pure high-explosive or pure armour-piercing belts for the cannons

SYSTEMS OPERATING PROCEDURES

OIL SYSTEM

COOLING SYSTEM

SUPERCHARGER CONTROL

The plane has a two-stage supercharger with manual control.

To change stage on the supercharger, reduce the engine speed to 1900 – 2000 rpm not to burn the clutch, and once the supercharger is in second stage increase engine speed back to previous setting.

Note: Regardless of height, use of the second stage of the supercharger is forbidden at take-off settings.

WHEEL BRAKES

1. The brakes are pneumatically operated
2. Brakes are applied with the use of a single brake lever on the control column
3. Differential control is provided through the rudder pedal linkage bar. Brake force on a single wheel is proportional to amount of rudder kicked in that direction.

FLYING PROCEDURES

TAXIING AND PREPARATION FOR TAKE-OFF

1. Open oil radiator to maintain nominal oil temperature
2. Ensure that propeller pitch is set to 100 %
3. Open the cowling shutters
4. Bring the plane to a halt and test engine before take-off at 1700 – 1800 rpm.
5. Check instrumentation. The readings should be:
    a. Cylinder head temperature between 140 – 205° C
    b. Oil temperature between 50 – 75° C

Take-off is forbidden:

1. At the following settings:

At rated settings	less than 2350 rpm
At take-off settings	less than 2450 rpm
At take-off settings	more than 2500 rpm

2. When temperature of cylinder heads is higher than 205° C or lower than 140° C
3. When oil temperature is less than 50° C

6. Check that runway is clear of obstacles

TAKE-OFF

1. If needing a short take-off run, lower flaps 15 – 20°
2. Smoothly apply throttle and control the plane's yaw with the rudder
3. Gently push the stick forward to lift the tail off the ground
4. Once airborne, increase the speed to 250 km/h and begin climbing
5. Raise the landing gear and verify that it is raised
6. If taking off with flaps extended, do not retract them until at least 100 m above ground
7. Use the trim wheel to stabilize the plane, and increase speed to 260 km/h
8. At a height of 100 – 150 m reduce throttle and engine speed settings to nominal power

AFTER TAKE-OFF

1. At heights up to 3000 m, keep an indicated air speed of 260 km/h. At heights above 3000 m, reduce the speed by 10 km/h per 1000 m

2. When reaching 3500 m in the climb, engage the second stage of the supercharger.
3. Once height is reached you can raise the cylinder head temperature to a maximum of 250° C (maximum duration 15 minutes). In the case of overheating the engine, increase the engine speed to 2300 rpm.

LEVEL FLIGHT

1. At all heights horizontal velocity must be at least 250 km/h IAS
2. To achieve the longest possible duration of flight it is imperative to follow the charts for calculation of the range and duration of flight
3. In the case of economy cruise or patrol at 4000 – 4500 m it is recommended to use the first supercharger stage, since using the second stage consumes significantly more fuel.
4. Periodically check the instruments to see that the engine runs within acceptable limits:
    a. Oil temperature:
        i. Recommended 65 – 75° C
        ii. Maximum 85° C for no more than 10 minutes
    b. Cylinder head temperature:
        i. Recommended 180 – 215° C
        ii. Maximum 240° C for no more than 10 minutes
    c. Oil pressure: 5.5 – 6.5 kg/cm^2
    d. Fuel pressure: 1.4 – 2.0 kg/cm^2
5. In horizontal flight, do not allow the cylinder head temperature drop below 140° C

COMBAT

1. To gain maximum speed when meeting an opponent, ensure that you:
    a. Close the canopy. A closed canopy increases the maximum speed by 15 – 18 km/h
    b. Close cowling and radiator shutters. Excess exposure to airflow will reduce speed by 45 – 50 km/h and increase turn time by 1.5 – 2 seconds
    c. Ensure that the flaps are completely raised. The drag from even slightly deployed flaps can reduce the maximum speed by up to 20 km/h
    d. For flights at an altitude of 1500 – 2000 m, use the boost by pushing the throttle and propeller pitch controls as far forward as possible, and ensure that engine reaches a speed of 2500 rpm and that the manifold pressure reaches 1180 mmHg.
2. When the second supercharger stage is used, do not let the manifold pressure build up to more than 1000 mmHg to avoid degenerating engine performance
3. At heights greater than 4000 m, engage the second stage of the supercharger
4. Monitor the instruments to ensure that the cylinder head temperature does not go past 240° C and that the oil temperature doesn't go past 85° C

AEROBATICS

TURNS

Perform turns with a bank of 60 – 70° at speeds of 320 – 340 km/h. The aircraft is stable in a turn, but if excessive force is applied on the control stick the plane will rock from wing to wing.

The plane reacts well to deflection of ailerons and will quickly go from one turn to another.

If speed is lost in a turn so that the aircraft begins to fall to one side, push the stick forward to bring the nose down to build speed.

DIVING

The plane is stable in a dive, and regardless of if running the plane at high or low throttle it has little tendency to roll or yaw.

1. Make sure that plane is flying with a minimum speed of 260 km/h, an engine rpm of at least 2200, and that the undercarriage is fully raised
2. Initiate the dive by banking the plane at least a 15-20° to gain visibility of the planned dive path
3. Maximum speed in a dive is 625 km/h
4. Maximum engine rpm in a dive is 2600

COMBAT TURN

ROLL

BARREL ROLL

SIDE SLIP

LOOP

SHAVIAR LOOP

IMMELMANN

STALLING

STEEP CLIMB

HAMMERHEAD

LAVOCHKIN LA-5FN

MACCHI C.202 ”FOLGORE” SERIES VIII

MESSERSCHMITT BF 109 E-7

AIRCRAFT SPECIFICATIONS

ARMAMENT

Fixed-aperture holographic sight with sun filter

Primary armament

2x 7,92mm MG 17 machine guns (2000 rounds)

2x 20mm MG FF/M cannons (120 rounds)

Optional armament/equipment

4x SC 50 general-purpose bombs

1x SC 250 general-purpose bomb

Armoured windscreen

Removed headrest

Additional armour plates

MESSERSCHMITT BF/ME 109 F-2 & F-4

Sources:

- Versuchs-Bericht No. 109 05 E 43 – Hochgeschwindigkeitsversuche mit Me 109 (15 April 1943)
  Test Report No. 109 05 E 43 – High speed tests with Me 109 (15 April 1943)

AIRCRAFT SPECIFICATIONS

V-SPEEDS

Never exceed speed (VNE): 735 km/h (at 4.5 km)

ARMAMENT

Fixed-aperture holographic sight with sun filter

BF 109 F-2

Primary armament

1x 15mm MG 151 cannon (200 rounds)

2x 7,92mm MG 17 machine guns (1000 rounds)

Optional armament/equipment

1x 20mm MG 151/20 cannon (200 rounds). Replaces the 15mm MG 151

4x SC 50 general purpose bombs

1x SC 250 general purpose bomb

BF 109 F-4

Primary armament

1x 20mm MG 151/20 cannon (200 rounds)

2x 7,92mm MG 17 machine guns (1000 rounds)

Optional armament/equipment

2x 15mm MG 151 cannons (270 rounds) in under-wing gun pods

2x 20mm MG 151/20 cannons (270 rounds) in under-wing gun pods

4x SC 50 general purpose bombs

1x SC 250 general purpose bomb

POWERPLANT

BF 109 F-2

Daimler-Benz DB 601 N, liquid-cooled V12 engine with fluid-coupling supercharger

VDM 9-12087 propeller, constant-speed, electrically adjustable, automatically controlled. The propeller can be manually controlled in a variable-speed/fixed-pitch mode.

BF 109 F-4

Daimler-Benz DB 601 E, liquid-cooled V12 engine with fluid-coupling supercharger

VDM 9-12010 propeller, constant-speed, electrically adjustable, automatically controlled. The propeller can be manually controlled in a variable-speed/fixed-pitch mode.

MESSERSCHMITT BF/ME 109 G-2 & G-4

Sources:

- ”10056 - Messerschmitt Bf 109 G-2 Flight and Maintenance Manual” (March 1943, United States State Aircraft Factory 112)
- ”Bv-Fl 109 G-2, Ga-2 - Bedienungsvorschrift-Fl” (Juni 1942) (incorporated in later L.Dv.T.2109 G-2/Fl)
  ”Bv-Fl 109 G-2, Ga-2 - Operating Instructions-Fl” (June 1942)
- ”L.Dv.T.2109 G/Fl Exerzier-Karte, Bf 109 G, Ausgabe Dezember 1942”
  ”L.Dv.T.2109 G/Fl Drills-Card, Bf 109 G, December 1942 Edition”
- Versuchs-Bericht No. 109 05 E 43 – Hochgeschwindigkeitsversuche mit Me 109 (15 April 1943)
  Test Report No. 109 05 E 43 – High speed tests with Me 109 (15 April 1943)

AIRCRAFT SPECIFICATIONS

V-SPEEDS

Design manoeuvring speed (V_A): 240 km/h IAS

Maximum flap extended speed (V_{FE}): 250 km/h IAS

Maximum landing gear extended speed (V_{LE}): 350 km/h IAS

Maximum landing gear operating speed (V_{LO}): 250 km/h IAS

Never exceed speed (V_{NE}): 750 km/h IAS (at 4.5 km)

Best rate of climb speed (V_Y): 250 km/h IAS

ARMAMENT

Fixed-aperture holographic sight with sun filter

Primary armament

1x 20mm MG 151/20 cannon (200 rounds)

2x 7,92mm MG 17 machine guns (1000 rounds)

Optional armament/equipment

2x 20mm MG 151/20 cannons (270 rounds) in under-wing gun pods

4x SC 50 general purpose bombs

1x SC 250 general purpose bomb

POWERPLANT

Daimler-Benz DB 605 A, liquid-cooled V12 engine with fluid-coupling supercharger

VDM 9-12087 propeller, constant-speed, electrically adjustable, automatically controlled. The propeller can be manually controlled in a variable-speed/fixed-pitch mode.

Radiators: One radiator under each wing with automatically controlled shutters. The radiators contains one water- and one oil-section each. The radiator shutters can be manually controlled.

UNDERCARRIAGE

Conventional tailwheel undercarriage with rotating tail wheel. Manual tail wheel lock.

SYSTEMS OPERATING PROCEDURES

AIRSCREW SYSTEM

1. For general operation, fly with airscrew pitch control in ”Automatic” mode
2. For gliding with idle throttle at less than 200 km/h indicated the automatic system must be switched off to ensure that the airscrew’s end limit is not exceeded
3. Manual setting must be used when:
    a. Flying with economy-cruise settings. The throttle and propeller pitch must be kept in compliance of the recommended engine RPM and manifold pressure. For dives the automatic system must be re-enabled.

b. Flying sailing-flight with fully coarse airscrew pitch (0 pitch), or when the constant-speed governor fails.

4. When flying with manual airscrew control, make sure that the airscrew is not adjusted beyond 12 o'clock as the airscrew pitch end limiter is at 12:30 o'clock and must not be exceeded.
   Maintain awareness of engine RPM and manifold pressure so that desired values are maintained and limits not exceeded.

Note: If a dive is initiated by pushing the stick forward and while being at full throttle, or if suddenly applying full throttle mid-flight, be advised that you may over-rev the engine.

FLAPS

1. The flaps are manually controlled
2. The flaps are gradually deployed, and have a maximum angle of 40°
3. The flaps should never be fully extended at speeds above 250 km/h
4. The deployment angle of the flaps are indicated with lines on the left wing's flap's forward edge. Each line indicates 10° of deployment, where the first solid line is 10°, the two-sectioned line 20°, the three-sectioned line 30°, and the last solid line is 40°. When the flaps are fully raised no line should be visible.

FUEL SYSTEM

The low-fuel warning light will be turned on when there is fuel for only 20 minutes of flight left (100 litres).

OIL SYSTEM

1. The oil system and its associated radiator shutters are automatically controlled, but can be manually controlled when required.
2. The temperatures should be maintained within the below parameters:

Oil inlet temperature	
Minimum	30° C
Normal	75 – 80° C
Short duration	85° C

BE ADVISED: At the point of writing (IL-2 Sturmovik version 2.009d) there is no way to see the oil temperature in the Bf 109 G. The temperature indicator only shows water temperature, and cannot be toggled (with the button above and to the right of the indicator) to show oil temperature.

COOLING SYSTEM

1. The coolant system and associated water radiator shutters are automatically controlled, but can be manually controlled when required.
2. Maximum temperature is 110°C at sea level. The altitude should be taken into account for the coolant water's boiling temperature.
3. If the thermostat fails or in special cases, the thermostat can be shut off and the radiator flaps can be operated manually.
4. If the cooling system suffers a leak because of fire, immediately shut off the cooling system by operating the corresponding lever on the left or the right side in the cockpit.

POWER SETTINGS

Bf 109 G-2			
Engine mode	Engine RPM +/-2 %	Manifold pressure (ata)	Altitude (km)
Take-off, climb and combat power	2600	1.30 + 0.02	0
Maximum continuous power	2300	1.15 + 0.02	0
Climb and combat power	2600	1.30 + 0.02	5.8
Maximum continuous power	2300	1.15 + 0.02	5.5
Economy cruise	2100	1.00 + 0.02	5.7
Bf 109 G-4			
Engine mode	Engine RPM +/-2 %	Manifold pressure (ata)	Altitude (km)
Take-off and emergency power	2800	1.42 + 0.02	0
Climb and combat power	2600	1.30 + 0.02	0
Maximum continuous power	2300	1.15 + 0.02	0
Emergency power	2800	1.42 + 0.02	5.7
Climb and combat power	2600	1.30 + 0.02	5.8
Maximum continuous power	2300	1.15 + 0.02	5.5
Economy cruise	2100	1.00 + 0.02	5.7

FLYING PROCEDURES

START-UP AND TAXIING

1. Make sure flaps are completely raised
2. Make sure cooling water temperature does not go above 110° C
3. Unlock the tail wheel
4. Taxi by zig-zagging along the taxiway to improve visibility. Apply throttle for left turns, and cut throttle and use brakes for right turns

PRE-FLIGHT CHECK

1. Flaps in take-off position; 20°
2. Airscrew pitch control set to “Automatic”
3. Oil temperature is not below 40° C
4. Radiator shutters in open position
5. Horizontal stabilizer trimmed to +1° for the G-2, and +/- 0° for the G-4

TAKEOFF

1. Make sure that the plane is aligned with the runway and that the tailwheel is locked
2. Increase throttle in increments to ”Take-off” power setting
3. After reaching 180 km/h, gently let the airplane off the ground
4. Raise the landing gear and verify that it is up
5. Reduce throttle to 1.25 ata
6. At 230 km/h raise the flaps (only if at safe altitude!)
7. Reduce throttle to 1.15 ata
8. Set radiator control to “Automatic”
9. Trim the aircraft as needed for climb and cruising

CLIMBING

1. Climb at 270 km/h to the desired altitude (Note that Indicated Air Speed drops by ca 2% per 1km altitude, and climb speed should be reduced accordingly)

DIVING

1. Adjust the horizontal stabilizer so that the plane stays in the dive only when you push the stick forward. Due to forces on the elevator and stabilizer increasing with speed the horizontal stabilizer must be continuously adjusted.
2. The pitch control **must** be set to ”Automatic”
3. Adjust the throttle lever to the white line (Ca. 35%)
4. Maximum allowed RPM in a dive is 2800
5. Maximum allowed speed in a dive is 750 km/h
6. Do not allow the oil- and coolant temperatures to drop below 20° C.

Using full stick deflection in a dive may cause fractures in the airframe. If done in a high-speed dive these fractures could be so severe that the airframe falls apart.

LANDING

1. Make sure that airscrew pitch control is set to ”Automatic”. If manual control is needed, set the airscrew pitch to the 11:30 position.
2. Reduce throttle to 0.65 ata
3. Reduce speed to 250 km/h
4. Lower landing gear and verify that it is lowered
5. Set flaps to take-off position; 20°
6. Control throttle to maintain 230 km/h
7. When in the turn before landing approach, deploy flaps fully, trim the plane to -5°, and maintain a glide speed of 200 km/h
8. Set radiator flaps to open position
9. Approach the runway in a 180 km/h glide
10. Once rolling on the runway, raise the flaps. Use the brakes as little as possible during roll-out.

GLIDING

1. Decrease the throttle to idle
2. Take care that oil and coolant temperatures do not drop below 40° C

EMERGENCY PROCEDURES

EMERGENCY LANDING

1. When flying at low altitude (less than 1000 m), take note of if there is ground in the immediate vicinity that allows a landing with extended undercarriage or not, for example a road. If the terrain doesn’t a wheels-up landing (belly landing) is required. A low-altitude, wheels-up landing is performed as follows:
    a. Make sure that the approach speed is 200 km/h
    b. Deploy flaps fully
    c. Turn off the engine
    d. Do not remove the canopy as it protects you in the case of rolling over

2. When flying at higher altitude (more than 1000 m), attempt to find an airfield or road to land on to allow a landing with extended undercarriage. A higher-altitude wheels-down landing is performed as follows:
    a. In order to travel as far as possible, only deploy the landing gear and flaps below 1000 m altitude
    b. The airscrew pitch control should be switched to manual mode and the pitch set to full coarse (0 pitch).
    c. Deploy landing flaps fully

d. Turn off the engine

MESSERSCHMITT BF/ME 109 G-6

Sources:

- ”10056 - Messerschmitt Bf 109 G-2 Flight and Maintenance Manual” (March 1943, United States State Aircraft Factory 112)
- ”Bv-Fl 109 G-2, Ga-2 - Bedienungsvorschrift-Fl” (Juni 1942) (incorporated in later L.Dv.T.2109 G-2/Fl)
  ”Bv-Fl 109 G-2, Ga-2 - Operating Instructions-Fl” (June 1942)
- ”L.Dv.T.2109 G/Fl Exerzier-Karte, Bf 109 G, Ausgabe Dezember 1942”
  ”L.Dv.T.2109 G/Fl Drills-Card, Bf 109 G, December 1942 Edition”
- Versuchs-Bericht No. 109 05 E 43 – Hochgeschwindigkeitsversuche mit Me 109 (15 April 1943)
  Test Report No. 109 05 E 43 – High speed tests with Me 109 (15 April 1943)

AIRCRAFT SPECIFICATIONS

AIRFRAME LIMITATIONS

Design manoeuvring speed (V_A) = 240 km/h IAS

Maximum flap extended speed (V_{FE}): 250 km/h IAS

Maximum landing gear extended speed (V_{LE}): 350 km/h IAS

Maximum landing gear operating speed (V_{LO}): 250 km/h IAS

Never exceed speed (V_{NE}): 750 km/h IAS (at 4.5 km)

Best rate of climb speed (V_Y): 250 km/h IAS

ARMAMENT

Fixed-aperture holographic sight with sun filter

Primary armament

1x 20mm MG 151/20 cannon (200 rounds)

2x 7,92mm MG 17 machine guns (1000 rounds)

Optional armament/equipment

2x 20mm MG 151/20 cannons (270 rounds) in under-wing gun pods

4x SC 50 general purpose bombs

1x SC 250 general purpose bomb

POWERPLANT

Daimler-Benz DB 605 A, liquid-cooled V12 engine with fluid-coupling supercharger

VDM 9-12087 propeller, constant-speed, electrically adjustable, automatically controlled. The propeller can be manually controlled in a variable-speed/fixed-pitch mode.

Radiators: One radiator under each wing with automatically controlled shutters. The radiators contains one water- and one oil-section each. The radiator shutters can be manually controlled.

UNDERCARRIAGE

Conventional tailwheel undercarriage with rotating tail wheel. Manual tail wheel lock.

SYSTEMS OPERATING PROCEDURES

AIRSCREW SYSTEM

5. For general operation, fly with airscrew pitch control in ”Automatic” mode
6. For gliding with idle throttle at less than 200 km/h indicated the automatic system must be switched off to ensure that the airscrew’s end limit is not exceeded
7. Manual setting must be used when:
    a. Flying with economy-cruise settings. The throttle and propeller pitch must be kept in compliance of the recommended engine RPM and manifold pressure. For dives the automatic system must be re-enabled.
    b. Flying sailing-flight with fully coarse airscrew pitch (0 pitch), or when the constant-speed governor fails.
8. When flying with manual airscrew control, make sure that the airscrew is not adjusted beyond 12 o’clock as the airscrew pitch end limiter is at 12:30 o’clock and must not be exceeded.
   Maintain awareness of engine RPM and manifold pressure so that desired values are maintained and limits not exceeded.

Note: If a dive is initiated by pushing the stick forward and while being at full throttle, or if suddenly applying full throttle mid-flight, be advised that you may over-rev the engine.

FLAPS

5. The flaps are manually controlled
6. The flaps are gradually deployed, and have a maximum angle of 40°
7. The flaps should never be fully extended at speeds above 250 km/h
8. The deployment angle of the flaps are indicated with lines on the left wing’s flap’s forward edge. Each line indicates 10° of deployment, where the first solid line is 10°, the two-sectioned line 20°, the three-sectioned line 30°, and the last solid line is 40°. When the flaps are fully raised no line should be visible.

FUEL SYSTEM

The low-fuel warning light will be turned on when there is fuel for only 20 minutes of flight left (100 litres).

OIL SYSTEM

3. The oil system and its associated radiator shutters are automatically controlled, but can be manually controlled when required.
4. The temperatures should be maintained within the below parameters:

Oil inlet temperature	
Minimum	30° C
Normal	75 – 80° C
Short duration	85° C

BE ADVISED: At the point of writing (IL-2 Sturmovik version 2.009d) there is no way to see the oil temperature in the Bf 109 G. The temperature indicator only shows water temperature, and cannot be toggled (with the button above and to the right of the indicator) to show oil temperature.

COOLING SYSTEM

5. The coolant system and associated water radiator shutters are automatically controlled, but can be manually controlled when required.
6. Maximum temperature is 110°C at sea level. The altitude should be taken into account for the coolant water's boiling temperature.
7. If the thermostat fails or in special cases, the thermostat can be shut off and the radiator flaps can be operated manually.
8. If the cooling system suffers a leak because of fire, immediately shut off the cooling system by operating the corresponding lever on the left or the right side in the cockpit.

POWER SETTINGS

Bf 109 G-2			
Engine mode	Engine RPM +/-2 %	Manifold pressure (ata)	Altitude (km)
Take-off, climb and combat power	2600	1.30 + 0.02	0
Maximum continuous power	2300	1.15 + 0.02	0
Climb and combat power	2600	1.30 + 0.02	5.8
Maximum continuous power	2300	1.15 + 0.02	5.5
Economy cruise	2100	1.00 + 0.02	5.7
Bf 109 G-4			
Engine mode	Engine RPM +/-2 %	Manifold pressure (ata)	Altitude (km)
Take-off and emergency power	2800	1.42 + 0.02	0
Climb and combat power	2600	1.30 + 0.02	0
Maximum continuous power	2300	1.15 + 0.02	0
Emergency power	2800	1.42 + 0.02	5.7
Climb and combat power	2600	1.30 + 0.02	5.8
Maximum continuous power	2300	1.15 + 0.02	5.5
Economy cruise	2100	1.00 + 0.02	5.7

FLYING PROCEDURES

START-UP AND TAXIING

5. Make sure flaps are completely raised
6. Make sure cooling water temperature does not go above 110° C
7. Unlock the tail wheel
8. Taxi by zig-zagging along the taxiway to improve visibility. Apply throttle for left turns, and cut throttle and use brakes for right turns

PRE-FLIGHT CHECK

6. Flaps in take-off position; 20°
7. Airscrew pitch control set to "Automatic"
8. Oil temperature is not below 40° C
9. Radiator shutters in open position
10. Horizontal stabilizer trimmed to +1° for the G-2, and +/- 0° for the G-4

TAKEOFF

10. Make sure that the plane is aligned with the runway and that the tailwheel is locked
11. Increase throttle in increments to ”Take-off” power setting
12. After reaching 180 km/h, gently let the airplane off the ground
13. Raise the landing gear and verify that it is up
14. Reduce throttle to 1.25 ata
15. At 230 km/h raise the flaps (only if at safe altitude!)
16. Reduce throttle to 1.15 ata
17. Set radiator control to “Automatic”
18. Trim the aircraft as needed for climb and cruising

CLIMBING

2. Climb at 270 km/h to the desired altitude (Note that Indicated Air Speed drops by ca 2% per 1km altitude, and climb speed should be reduced accordingly)

DIVING

7. Adjust the horizontal stabilizer so that the plane stays in the dive only when you push the stick forward. Due to forces on the elevator and stabilizer increasing with speed the horizontal stabilizer must be continuously adjusted.
8. The pitch control **must** be set to ”Automatic”
9. Adjust the throttle lever to the white line (Ca. 35%)
10. Maximum allowed RPM in a dive is 2800
11. Maximum allowed speed in a dive is 750 km/h
12. Do not allow the oil- and coolant temperatures to drop below 20° C.

Using full stick deflection in a dive may cause fractures in the airframe. If done in a high-speed dive these fractures could be so severe that the airframe falls apart.

LANDING

11. Make sure that airscrew pitch control is set to ”Automatic”. If manual control is needed, set the airscrew pitch to the 11:30 position.
12. Reduce throttle to 0.65 ata
13. Reduce speed to 250 km/h
14. Lower landing gear and verify that it is lowered
15. Set flaps to take-off position; 20°
16. Control throttle to maintain 230 km/h
17. When in the turn before landing approach, deploy flaps fully, trim the plane to -5°, and maintain a glide speed of 200 km/h
18. Set radiator flaps to open position
19. Approach the runway in a 180 km/h glide
20. Once rolling on the runway, raise the flaps. Use the brakes as little as possible during roll-out.

GLIDING

3. Decrease the throttle to idle
4. Take care that oil and coolant temperatures do not drop below 40° C

EMERGENCY PROCEDURES

EMERGENCY LANDING

3. When flying at low altitude (less than 1000 m), take note of if there is ground in the immediate vicinity that allows a landing with extended undercarriage or not, for example a road. If the terrain doesn't a wheels-up landing (belly landing) is required. A low-altitude, wheels-up landing is performed as follows:
    a. Make sure that the approach speed is 200 km/h
    b. Deploy flaps fully
    c. Turn off the engine
    d. Do not remove the canopy as it protects you in the case of rolling over

4. When flying at higher altitude (more than 1000 m), attempt to find an airfield or road to land on to allow a landing with extended undercarriage. A higher-altitude wheels-down landing is performed as follows:
    e. In order to travel as far as possible, only deploy the landing gear and flaps below 1000 m altitude
    f. The airscrew pitch control should be switched to manual mode and the pitch set to full coarse (0 pitch).
    g. Deploy landing flaps fully
    h. Turn off the engine

MESSERSCHMITT BF 110

MIKOYAN-GUREVICH MIG-3

PETLYAKOV PE-2 SERIES 35 & 87

POLYKARPOV I-16 "ISHAK" TYPE 24

SUPERMARINE SPITFIRE MK.VB

Sources:

- A.P.1565E - Pilot's Notes - Spitfire VA, VB, and VC

AIRCRAFT SPECIFICATIONS

AIRFRAME LIMITATIONS

Maximum speeds:

- Diving: 450 mph IAS
- Undercarriage down: 160 mph IAS
- Flaps down: 140 mph IAS
- Landing lamps lowered: 140 mph IAS

Stalling speeds when loaded to about 6400 lbs are:

1. Flaps and undercarriage UP: 73 mph IAS
2. Flaps and undercarriage DOWN: 64 mph IAS

Restrictions:

- When carrying a bomb spinning is not permitted and violent manoeuvres must be avoided. The angle of dive must at no time exceed 40°.

ARMAMENT

Adjustable-aperture holographic sight with sun filter

Primary armament

2x 20mm Hispano Mk II cannons (120 rounds)

4x .303 in. Browning Mk II machine guns (1400 rounds)

Optional armament/equipment

Merlin 45 engine

External rear-view mirror

FUEL SYSTEM

The fuel system has two internal tanks located in front of the cockpit; one top tank (48 gallons) and one bottom tank (37 gallons) for a total capacity of 85 gallons. The tanks are connected in series with the bottom tank being connected to the fuel cock and fuel pump. The top tank automatically flows into the bottom tank.

Fuel consumption (approximate gals/hr):

1. WEAK mixture at 6000 – 20 000 feet:

Boost (psi)	RPM				
	2650	2400	2200	2000	1800
+4	56	53	51	47	43
+2	51	48	46	43	39
0	47	44	42	39	335
-2	43	40	38	35	31
-4	39	36	34	31	26

2. RICH mixture:

Boost (psi)	RPM	Fuel consumption (gals/hr)
+9	3000	88
+9	2850	84
+7	2650	67

OIL SYSTEM

Oil capacity: 5.8 gallons

POWER SETTINGS

Engine mode	Engine RPM	Boost (psi)	Temp °C	
			Coolant	Oil
Max Take-Off (to 1,000 feet)	3000	+12	-	-
Max Climbing (1 hr. limit)	2850	+9	125	90
Max Rich (continuous)	2650	+7	105 (115)	90
Max Weak (continuous)	2650	+4	105 (115)	90
Combat (5 min. limit)	3000	+12	135	105
Combat (3 min. limit)	3000	+16	135	105

Note:

1. +16 psi boost is obtained by operating the boost control cut-out, bypassing the automatic boost control limiter.
2. Combat boost is permitted only at 2850 – 3000 rpm.
3. The figure in brackets is permitted for short periods if necessary.

SYSTEMS OPERATING PROCEDURES

AIRSCREW SYSTEM

1. The airscrew system is manually controlled, constant-speed. The target RPM is set by the airscrew control lever.
2. There is no override to bypass the constant speed governor.

FLAPS

1. The flaps are split-type and pneumatic.
2. The flaps are two-position only; up and fully down. They can therefore not be used during take-off or combat, but only during landing.

COOLING SYSTEM

WHEEL BRAKES

1. The brakes are pneumatically operated
2. Brakes are applied with the use of a single brake lever on the control column
3. Differential control is provided through the rudder pedal linkage bar. Brake force on a single wheel is proportional to amount of rudder kicked in that direction.
4. Pneumatic instrumentation is located at the lower left of the front dashboard. The instrument has three indicators showing air supply, and left and right applied wheel brake air pressure.

FLYING PROCEDURES

START-UP AND TAXIING

1. Make sure flaps are completely raised
2. Make sure cooling water temperature does not go above 100° C before taxiing, since the engine may become excessively warm for take-off.
3. Unlock the tail wheel
4. Taxi by zig-zagging along the taxiway to improve visibility. Apply throttle for left turns, and cut throttle and use brakes for right turns

PRE-FLIGHT CHECK

1. Trim elevator to one notch below neutral and rudder full right
2. Mixture control to RICH
3. Airscrew set for maximum RPM (100 %)
4. Check contents of the lower fuel tank
5. Flaps UP
6. Radiator shutters fully open

TAKEOFF

1. Throttle up to gated position (RATED BOOST position, 50 %) slowly but steadily
2. Any swinging can be counteracted with coarse use of the rudder
3. If taking off with full load from a small airfield, maximum boost may be used by pushing the throttle all the way through the gate.
4. Gently let the airplane off the ground once speed to do so has been reached
5. Raise the landing gear and verify that it is up
6. Do not start to climb before a speed of 140 mph IAS is attained

CLIMB

The speed for maximum rate of climb is as follows:

Altitude (feet)	Speed (mph IAS)
Sea level to 10 000:	170
10 000 to 16 000	160
16 000 to 21 000	150
21 000 to 26 000	140
26 000 to 31 000	130
31 000 to 37 000	120
Above 37000	115

GENERAL FLYING

1. Stability: The aircraft is stable about all axes.
2. For normal cruising flight the radiator shutter should be in minimum drag position (0 %).
3. Change of trim:
    a. Undercarriage down – Nose down
    b. Flaps down – Nose down
4. For combat manoeuvres climbing rpm should be used.
5. For stretching a glide in the event of a forced landing, the propeller speed control should be pulled right back and the radiator shutter set to the minimum drag position (0 %).

MAXIMUM RANGE

1. Climbing
    a. Climb at +9 psi in boost and 2850 rpm at the speed recommended for maximum rate of climb.
    b. Mixture control at RICH.
2. Cruising
    a. Maximum range will be obtained at intermediate heights. The recommended speeds are as follows:

Altitude (feet)	Speed (mph IAS)
Below 8000	180
8000 – 15 000	160
Above 15 000	150

    At very low altitude the speed may be increased to 200 mph IAS without seriously affecting range.
    b. Fly in WEAK mixture at maximum obtainable boost not exceeding +4 psi (the mixture richens automatically at higher boosts) and reduce speed by reducing rpm, which may be as low as 1800 if this will give the recommended speed. If at 1800 rpm the speed is higher than that recommended, reduce boost.

AEROBATICS

1. Looping
   Speed should be about 300 mph IAS, but may be reduced to 220 – 250 mph IAS when the pilot is fully proficient.
2. Rolling
   Speed should be anywhere between 180-300 mph IAS. The nose should be brought up about 30° above the horizon at the start, the roll being barrelled just enough to keep the engine running throughout.
3. Half-roll off loop
   Speed should be 320 – 350 mph IAS.
4. Upward roll
   Speed should be about 350 – 400 mph IAS
5. Flick manoeuvres
   Flick manoeuvres are not permitted

DIVING

1. The aircraft becomes very tail heavy at high speed and must be trimmed into the dive in order to avoid the dangers of excessive acceleration in recovery. The forward trim should be wound back as speed is lost after pulling out.
2. A tendency to yaw to the right should be corrected by use of the rudder and trimming tab.

APPROACH AND LANDING

1. Reduce speed to 140 mph IAS and carry out the Drill of Vital Actions “U, M, P and Flaps”.

U –	Undercarriage	DOWN (Watch indicators and check green lights)
M –	Mixture control	RICH
P –	Propeller control	Fully forward (100%)
Flaps		DOWN

2. Approach speeds

Approach type	Speed (mph IAS)	
	Flaps down	Flaps up
Engine assisted	85	95
Glide	95	100

3. If having to abort the landing, climb carefully at 120 mph IAS.
4. After landing, raise the flaps before taxiing.

FLYING AT REDUCED AIRSPEEDS

In conditions of bad visibility near the ground, reduce speed to about 120 mph IAS and lower the flaps. The radiator shutter must be opened to keep the temperature at about 100° C and the propeller speed control should be set to give cruising RPM.

EMERGENCY PROCEDURES

STALLING

3. At the stall one wing will usually drop with flaps either up or down and the aircraft may spin if the control column is held back.
4. The aircraft has sensitive elevators, and if the control column is brought back too rapidly in a manoeuvre such as a loop or a steep turn, stalling incidence may be reached and a high speed stall induced. When this occurs there is a violent shudder and a clattering noise through the aircraft which tends to flick over laterally, and unless the control column is put forward instantly, a rapid roll and spin will result.

SPINNING

1. The loss of height involved in recovery may be very great, and the following height limits are to be observed:
    a. Spins are not to be started below 10 000 feet.
    b. Recovery must be started not lower than 5000 feet.
2. A speed of over 150 mph IAS should be attained before starting to ease out of the resultant dive.

YAKOVLEV YAK-1 SERIES 69 & YAK-1B

AIRCRAFT SPECIFICATIONS

SYSTEMS OPERATING PROCEDURES

FLYING PROCEDURES

YAKOVLEV YAK-7B

AIRCRAFT SPEFICATIONS

SYSTEMS OPERATING PROCEDURES

FLYING PROCEDURES