

Principal Directorate of Commanding Officer of Artillery of the Red Army

"Approved"
Chief Engineer of the Military Air Service
of the Red Army

Repin

**PILOT'S MANUAL FOR THE USE OF AND
FLYING THE LA5 WITH ENGINE ASh - 82 FN**

Second Edition

Military Publisher
People's Commissariat for Defense
Moscow 1944

Contents	Page
Pre-flight check	3
Preparation for flight, starting and testing of engine	4
Take off	10
Horizontal flight	12
Pilotage	14
Use of weaponry	18
Switching off engine	21

These instructions were compiled by:

Engineer-Major Abovskiy D.D.

Engineer-Captain Alekseenko B.I.

Major Nikiforov A.P.

Major Kubyshkin A.G.

PRE-FLIGHT CHECK

1. Before flight, your mechanic will brief you on the readiness of the aircraft for flight.
2. Make an external visual inspection of the aircraft and check the;
 - (a) propeller to make sure there is no damage to the propeller blades or hub,
 - (b) engine cowling and ensure the cowling is closed and locks are well fastened,
 - (c) undercarriage to check installation of shock absorbers for both legs of the undercarriage and whether tire pressure is correct,
 - (d) airframe to ensure that there is no external damage to the control surfaces, fuselage, tail fin, rudder, whether the connections are tightened with the Pitot¹ tube, and
 - (e) tail wheel.

Note - In winter you must check that the cover is unfastened from the oil radiator.

3. Before getting into the cockpit check that;
 - (a) there are no extraneous items inside.
 - (b) the magnetos are switched off,
 - (c) exterior throttle system is switched on,
 - (d) the pneumatic primer for cannon is correctly set
 - (e) sight PBI - 1a is correctly aligned,
 - (f) the bomb release 'ASBR' is set to 'SO' (Safety On), if the aircraft is to conduct a bombing mission, and
 - (g) the cockpit canopy is clean and undamaged.

Preparation for flight, ignition and engine test

4. Once in the cockpit;
 - (a) check the ease of movement of the joystick and pedals.
 - (b) Adjust seat to your height with canopy closed and adjust your seat position relative to rudder pedals.
 - (c) Adjust elevator trim to neutral and set the rudder trim 5-7mm to port.
 - (d) Adjust straps.
5. Check the throttle action.
6. Check whether fuel stopcock is open (it is situated on the floor to the right of the seat).
7. Ensure that supercharger control lever is set to "1" (as far back as possible).
8. Ensure that the propeller switch is set to "100%" (as far forward as possible).
9. Check the fuel gauge to see how much fuel is in the tanks.
10. Close the oil radiator inlet and side vents of the engine cowling.
11. Check that handle for emergency undercarriage release is off (it is located underneath pump PN-1).
12. Open valve for the air pump and check its pressure (must be minimum of 80 litres).
13. Ensure that levers for controlling undercarriage and flaps are set to 'neutral' position.
14. Check position of flaps.
15. Ensure that both electrical and manual instrumentation is in good condition.

16. Check that the following open and close easily;
 - (a) cockpit canopy
 - (b) cowl flaps
 - (c) forward radiator vents
 - (d) oil radiator inlet
17. Set the sight dial to zero and check that lamps are on.
18. Ensure that oxygen reserves are full and hermetically sealed.
19. Check the voltage of accumulator by checking that chassis lamp is on.

Preparation of engine for ignition

20. Ensuring that the ignition is switched off, give the order "Turn propeller". It is imperative that the propeller is turned through two or three full revolutions before engine ignition, since the presence of fuel or oil in the combustion chamber of the cylinder, and non-observance of this requirement, could cause the cylinder to fail.
21. Release fuel into fuel lines so that fuel pressure gauge indicates 1.2 kg/cm^2 .
22. Fill up starting chamber of pump PN-1 with fuel, which should take 3-7 goes with the plunger. Distribution tap of pump must be set to position "suction filling".

Note 1. At external temperature from +5 to -15C give 3-5 goes, but when external air is colder than -15C press it 7 times.

Note 2. As the engine is starting, there is no need to add further fuel, since the motor starts well without further addition.

Starting the engine

23. Place the throttle in position corresponding to 800-900 revs/minute (approximately 10mm from the throttle's minimum setting).
24. Switch on the accumulator.
25. Give the command "Move away from propeller" and having received answer "Away from propeller", open the valve of the starting unit or give command "Air" (when starting engine with compressed air).
26. When you have answer "Air" open the valve on pump PN-1 (by pushing it away from yourself).
27. After 1 or 2 turns of the propeller switch on the magneto and press on the button of the oscillator (press the button intermittently for 3-5 seconds to stop the coil from overheating).
28. As the engine begins to start up, use the manual fuel pump to maintain pressure in the fuel lines.
29. After ignition close the air valve of pump PN-1 (by moving it back towards yourself) and increase number of revolutions to 1.000/minute.
30. Monitor the oil pressure; at lower revolutions it must be not less than 3kg/cm^2 . If, after ignition, the pressure gauge does not show oil pressure within 5-8 seconds, the engine should be switched off and reason for malfunction determined.

Warming the engine

31. This must take place at 1.000 revs/min until the oil temperature starts to rise. After this, increase number of revolutions to 1.200 per min and run the engine until temperature of incoming oil reaches 50C and temperature of the cylinder heads is 140C . Once these temperatures have been reached the engine can be considered to have been warmed up.

WARNING: While the engine is warming up, the temperature of the cylinder heads will increase faster than the temperature of the oil, so once the cylinder heads have reached 140C , it is necessary to ventilate the engine - to do that open the side vents on the engine cowling.

Testing the engine

32. Take hold of the joystick.
33. Smoothly move the throttle forward until revolutions reach rated setting, 2.400 revs per minute.

The following indicate that the engine is running correctly at rated settings:

Number of revs	2.400 per minute
Pressure	1000+/- 10mm Hg.
Oil pressure	5.5 - 6.5 kg/cm ²
Fuel pressure	1.5 - 2.0 kg/cm ²
Temperature of cylinder heads	not higher than 215C
Oil temperature	65 - 75C

34. Move the throttle forward until revs reach 2.200 - 2.300 revs/min and manifold pressure shows 900 - 930 HG and check if one of the magneto lights has gone out. When the engine is running on one magneto, revs will normally drop by 30 - 60 per minute, up to a maximum of 100 revs/min.
35. Check working of propeller mechanism (using the following checks) by switching the propeller from min. to max. pitch and back again;
 - (a) without changing throttle position (i.e. at 2.200 - 2.300 revs/min) reduce revolutions to 1.700 - 1.800 per minute using propeller pitch,
 - (b) with propeller pitch set to give revs of 1.700 - 1.800 per min. reduce gas for 5 - 10 seconds to give manifold pressure of 800 - 830mm Hg; revolutions should be 1.700 - 1.800 revs per minute (i.e. return to previous settings).
36. Check working of engine at minimum gas settings for which bring throttle as far back and move propeller pitch lever as far forward as possible.

Instrumentation will show:

Revolutions	500 - 600 per minute
Oil pressure	not lower than 2 kg/cm ²
Fuel pressure	not lower than 1.5kg/cm ²

37. Check responsiveness of engine. Adjust throttle smoothly from minimum to maximum settings over 1.5 - 2 seconds.
38. If take off is not intended to be at rated engine settings, but at take off settings, then check engine motor is working at take off settings. For this, set propeller pitch to 100%, smoothly increase gas for 5 - 7 seconds. Manifold pressure should be 1.180mm Hg +/- 10% and revs at 2.500 per minute.

Note: Testing of a new engine at take off settings is allowed only once that engine has been run for 10 hours or more. This 10 hour running-in period allows for detailed checks to be run so that it is safe to force the engine.

39. If there is doubt over correct functioning of the two-speed supercharger, or if the supercharger is to be tested once the engine is first started, then:
 - (a) set throttle at 1.600 - 1.700 revs/min,
 - (b) quickly and smoothly change setting of supercharger speed from position 1 to position 2. Manifold pressure should increase by 20 - 30mm Hg and engine revolutions at first will decrease and then return to initial settings i.e. 1.600 - 1.700 revs/minute.
40. Having ensured that supercharger is functioning normally at its second speed, switch lever back to position 1.

Note 1. Switching from one speed to another must be done with an interval of not less than 2 minutes (to avoid overheating of friction discs).

Note 2. Extended operation of engine (more than 1 minute) at ground level at 0.73 of rated settings ($n=2.100$ revs/min and manifold pressure of 850mm Hg) and higher when supercharger position 2 is engaged is not allowed so as to avoid overheating the cylinders.

Checking and preparation of radio equipment

It is necessary to check that aircraft's radio equipment is working from the airbase's accumulator.

You must check the aircraft radio in the following way

41. Check the condition of radio helmet and microphone.
42. Insert cable from radio helmet into jack.
43. Insert plug with the inscription "TEL" (telephone) into the receptacle. If the aircraft is installed with receiving/broadcast equipment, insert plug of telephone into corresponding socket.
44. Switch dial to "Radio".
45. Set switch (receive/transmit) to position "REC" (receive).
46. Ensure that receiver is in good condition by presence of appropriate noise.
47. Set appropriate frequency on dial.
48. Adjust receiver to the appropriate flight controller's frequency.
49. Having checked the receiver, switch off dial "Radio".
50. If the aircraft is equipped with a receiver, then switch set selector to position "TRS" (transmit).
51. Make a test transmission within one minute.

TAKE OFF

Taxiing

52. Give order "chocks away" and, having received the confirmation of order "chocks removed", begin taxiing.
53. Open oil radiator regulator depending on temperature of incoming oil.
54. For best forward view, move aircraft from side to side.
55. Check brakes while taxiing.

Preparation for take-off

56. Ensure that propeller pitch adjustor is set to 100%.
57. Open the cowling ventilators and oil radiator.
58. Bring the aircraft to a halt and test engine before take-off at 1.700 - 1.800 revs/min (it is necessary to do this to light up the actuator lights).
59. Check instrumentation. The temperature of the cylinder head must not be higher than 205C and not less than 140C; temperature of oil 50 - 75C, oil pressure 5.5 - 6.5 kg/cm² and fuel pressure not less than 1.5 - 2 kg/cm².

Take-off is forbidden

(a) At the following settings:

At rated settings	less than 2.350 revs/min
At take-off settings	less than 2.450 revs/min
At take-off settings	more than 2.500 revs/min

(b) when temperature of cylinder heads is higher than 205C and less than 140C

(c) when oil temperature is less than 50C

(d) when fuel pressure is lower than 1.5 kg/cm²

60. Check that runway is clear of obstacles.

Take-off and ascending to altitude

In the event of having to shorten distance of take-off lower flaps to 15 - 20 degrees and smoothly apply throttle.

61. Keeping your direction steady, lift the tail by pushing the joystick away from you. Correct the tendency of the aircraft to yaw left by applying right rudder.
62. Once airborne, get up to speed of 250 km/h and then climb to height.
63. Raise the undercarriage, checking that it has risen by the relevant signal lights and mechanical indicators. If take-off is made with flaps extended, raise them at a height not lower than 100m.
64. Use trim wheel and apply trim to relieve pressure on joystick and increase speed to 260 km/h.
65. At height of 100 - 150m go to rated settings regime if take-off boost was used and is no longer needed.
66. At heights up to 3000m keep speed to 260km/h. From height of 3000m and above reduce speed by 10km/h per 1000m.
67. From height of 3500m engage second speed of supercharger. To do this, reduce engine revs to 1.900 - 2.000/min and smoothly but quickly switch to second speed (move the lever as far forward as it will go) and then reapply throttle to take revs back to necessary level.
68. In a test flight it is permitted to switch from supercharger positions as the conditions of the flight demand. To do this, gently but quickly move the lever from one end of its travel to the other.
69. Regardless of height, use of second speed of supercharger is forbidden at take-off settings.
70. If for any reason speeds of supercharger are switched twice in a row, then between changeover it is necessary to wait not less than two minutes in order to dissipate the heat in the friction discs which builds up during change from one speed to another.
71. Once height is reached you can raise temperature of cylinder heads to a maximum of 250C (for not longer than 15 minutes). In event of overheating engine increase propeller pitch, increase speed to get revs up to 2.300/min and continue ascent to altitude.

HORIZONTAL FLIGHT

72. At all heights, horizontal flight must be at speeds of not less than 250km/h IAS.

73. illegible

74. illegible

75. illegible

Temperature of oil

Recommended 65 - 75C

Maximum 85C for not more than 10 minutes

Temperature of cylinder heads

Recommended 180 - 215C

Maximum 240C for not more than 10 minutes

Oil pressure 5.5 - 6.5 kg/cm²

Fuel pressure 1.5 - 2 kg/cm²

In horizontal flight do not allow temperature of cylinder heads to fall below 140C.

76. Prepare armament - remove air protection valve from cannon.

77. Switch on "Radio".

78. Place switch to position "TRS" and after 1 - 2 minutes call the ground station and establish connection. To change from transmit to receive set dial to "Recieve".

79. To gain maximum speed when meeting an opponent ensure that you,

- (a) Close canopy (if not already closed), closing the canopy will increase maximum speed by 15 - 18 km/h.

- (b) Close cowl and radiator flaps. Excess exposure to airflow will reduce speed by 45 - 50 km/h and increase turn time by about 1.5 - 2 seconds.
 - (c) Check the position of the tail wheel by using signal light. In the event that tail wheel is not fully retracted, then quickly set the undercarriage control lever to position "raised". If the tail wheel is not fully retracted, the maximum speed of the aircraft will be reduced by 8 - 10 km/h.
 - (d) For a short period of time set valve that controls flaps to position "raised". If flaps are not in place correctly, then pressure created from wind resistance around the wing will reduce maximum speed by 18-20 km/h.
 - (e) For flights at altitude of 1500 - 2000m use the boost and to do that push throttle and propeller pitch controls as far forward as they will go such that revolutions per minute is 2.500 and manifold pressure is 1.180mm Hg. Boost cannot be used for longer than 5 minutes.
The change from boosted manifold pressure (1.180 mm Hg) as a rule is allowed only once engine has been run for longer than 10 hours.
80. At the second supercharger speed do not let manifold pressure build up to higher than 1.000mm Hg to avoid degraded engine performance.
81. At heights greater than 4000m engage second speed of supercharger.
82. Follow instrumentation temperatures and do not allow the temperature of the cylinder heads to go higher than 240C and the temperature of incoming oil to reach 85C.

PILOTAGE

Turns

83. Perform turns with a bank of 60 -70 degrees at speeds of 320 - 340 km/h. The aircraft is stable in a turn. If joystick is applied excessively, the aircraft will rock slightly from wing to wing. The aircraft moves quickly from one turn to another and reacts well to deflection of ailerons. If speed is lost in a turn and aircraft begins to fall to one side, push the joystick away from you.

Diving

84. Enter a dive from a turn or loop the plane into a dive. Diving is permitted up to speeds of 650 km/h IAS. The aircraft dives stably either with or without throttle. There is no tendency to turn in a dive. Ehen diving do not allow propeller to turn at speeds greater than 2.600 revs/min (for longer than 30 seconds). Temperature of cylinder heads during a dive must not be lower than 160C.

Combat turn

85. Combat turns are performed normally at speed sof 500 km/h. Aircraft is stable in combat turn. Exiting a combat turn, hold speed at 250 km/h. You should gain about 1000 - 1100m altitude during a combat turn.

Roll

86. Rolls are performed at speeds of 250 km/h or more. To enter a roll, simultaneously move rudder in the desired direction and the joystick in the same direction but pulled a little back. Once the aircraft is inverted begin to exit the roll i.e. apply rudder in opposite direction to that of the roll so that roll is complete and bring the joystick back to neutral position. After the aircraft is inverted, ease off the rudder and as soon as the aircraft drops its nose 20 - 30 degrees to the horizon lightly bring the joystick back and ease off the throttle: increase and with smooth use of the joystick, bring the aircraft out of its dive.

Barrel roll

87. Perform this manoeuvre at not less than 300 km/h IAS. Initially give the aircraft an angle of attack of 15 - 20 degrees and simultaneously apply 3/4's rudder to and move the joystick in the direction that you wish to roll. At 20 - 30 degrees relative to the horizontal position set controls for exit (rudder to opposite, for neutral attitude joystick and rudder to neutral).

Right barrel roll retains more energy but those to the left are a litter slower and have a greater radius. To perform a left barrel roll use controls more vigorously.

Side slip

88. The aircraft is stable and does not rotate around its lateral or pitch axis when slipping up to 40 - 45 degrees. Keep speed at 250 - 260 km/h. To enter a side slip turn the aircraft to 10 - 15 degrees opposite to the direction in which the aircraft is to slip, maintain that angle and prevent the aircraft from turning in the opposite direction with rudder pedals. To exit, put the aircraft 10 -15 degrees into opposite direction of the slip and keep the plane stable from turning by use of opposite rudder pedals. Exit from this maneuver must be at an altitude of not less than 50 meters. Lower than this height is only for alignment purposes when landing. Speed should be not less than 220 km/h.

Loop

91. Loop should be done without loss of altitude. Speed should be about 460 - 480 km/h. To enter a loop get the aircraft up to about 460 - 480 km/h and smoothly bring the joystick back. As you get to the top of the loop, ease off the joystick significantly. You should avoid both excessive as well as insufficient movement of the joystick. In the event that you apply too much joystick the aircraft will perform, of its own accord, in incorrect hammerhead. In the event of insufficient joystick movement the radius of the loop will increase and momentum of the aircraft will be lost before you get to the top of the loop. When the loop is correctly performed at speed of 400 km/h, slats will extend and this will cause a small level of vibration which can be corrected with the joystick. As you approach the apex of the loop, keep the aircraft from turning to the right by applying left rudder and constantly adjusting the position of the joystick between neutral and fully back. After looping aircraft at the highest point, ease off throttle and as soon as the aircraft is inclined 20 - 30 degrees toward the horizon, push the joystick smoothly away from you and as speed increases, bring the aircraft out of its' dive. Speed at exit should be about 370 km/h.

Shaviar loop

92. To perform a Shaviar loop, get the aircraft up to a speed of 460 km/h by losing a little height. Once entering the loop it is necessary simultaneously to bank the aircraft to 45 degrees. Technique for a Shaviar loop is the same as for a normal loop with the only difference being that during its' completion the same bank angle is used as at the beginning. There is no difference between right and left Shaviar loops. Bring the aircraft out of this manoeuvre at a speed of 370 - 380 km/h. The loop is performed without loss of altitude.

Immelman

93. To perform an Immelman get the aircraft up to about 500 km/h. The movement for the first part of the Immelman is the same as for the first part of a loop. Once you have gotten to the highest point and the aircraft is "on its back", apply rudder and joystick in the direction in which you want to turn the aircraft.

To perform an Immelman to the right, move the joystick smoothly and completely to the right, simultaneously applying full right rudder.

To perform an Immelman to the left, quickly move the joystick fully to the left and simultaneously apply full left rudder.

After the manoeuvre, bring controls back to neutral in order to prevent the aircraft from going into an extreme spin, but without allowing the aircraft nose to drop. There is no difference between performing an Immelman to the left or to the right. Speed at exit from an Immelman should be about 220 - 230 km/h and increase altitude by about 900 - 1000m.

Stalling

94. The aircraft will only stall when severe errors are made in piloting and such errors are combined with excessive movement of joystick and loss of speed. In unintended stalls and in all cases make sure you push joystick away and do not apply any rudder. If this is done the aircraft will exit the stall immediately. To put the aircraft into a stall for training purposes do the following. Ease throttle back and bring the joystick back toward you and reach a speed of 180 km/h: after which smoothly move the rudder fully to the side in which you want to stall. Do not alter controls during a stall. If stalling to the left, the aircraft will jerk, slowing its speed at the end of each rotation. The angle of the aircraft to the horizon will be between 30 - 45 degrees. The aircraft stalls a little more smoothly to the right. Angle to the horizon will be between 50 - 60 degrees. To exit the stall you must move your rudder in the opposite direction in which you are spinning and then place the joystick into neutral position. The aircraft will exit the stall immediately. Once you have exited the stall, bring the rudder back to neutral

and the aircraft will begin to dive. Smoothly bring the aircraft out of the dive. Speed at exit of the stall should be about 370 km/h.

Steep climb

95. A steep climb is made at maximum speed for horizontal flight. Smoothly bring the joystick toward you and set your angle of attack at about 60 degrees. Minimum speed at the conclusion of a steep climb must be at least 250 km/h IAS. Once you have reached 270 km/h IAS gently move the joystick to bring the aircraft into horizontal flight or put the aircraft into a turn with an angle up to 15 - 20 degrees in the desired direction, following instrumentation to make sure that speed is not less than 250 km/h.

Hammerhead

96. To perform a hammerhead from maximum speed in level flight, smoothly move joystick backwards and put aircraft in a position of 70 - 80 degrees relative to the horizon. Once speed has reduced to 240 - 250 km/h move rudder to side that you want to turn and applying full and opposite rudder to avoid putting the aircraft on its' back. once the aircraft has turned through 90 degrees from its' initial direction gently ease off throttle so that it is at minimal setting when the aircraft goes into its' dive. Speed at exit should be about 350 - 370 km/h. There are no differences in exiting a hammerhead to the left or right. The aircraft will take about 700m to get from highest point of the manoeuvre back to level flight.

FIRING WEAPONRY WHILE AIRBORNE

97. Fire in short bursts.
98. In event of having to fire an extended burst, reload by pressing once or twice on the pneumatic reloader. Once reloaded, continue firing.
99. If weapon fires spontaneously, apply the air protection valve.

Observations

1. Synchronous firing can be made under various conditions of engine speed - from 1.300 - 2.400 revs/min.
2. To avoid hitting a propeller blade, do not allow weaponry to overheat.
3. Precise fire can be achieved over distances from 50 - 500m.

Bombing

100. Before releasing bombs, set safety to 'safety off'.
101. Having released safety, which is situated on the joystick, perform bombing run.
102. Check that bombs have been released (both white lights on instrument panel should come on).

ENDING FLIGHT

Lowering undercarriage and tail wheel

103. Lower undercarriage at speed of 300 - 320 km/h. To lower the undercarriage use the lever on your left hand side from setting 'neutral' to 'down'.
104. You can check that the undercarriage is fully down when the green lights come on.

Lowering of undercarriage and tail wheel in emergencies

105. Pull on the cable situated on the right hand floor of the cockpit and check whether the wheels have been released from their locks (red lights should illuminate).
106. Open the valve for emergency undercarriage and tail wheel lowering.

107. Check the undercarriage has lowered by checking that appropriate lights have come on as well as by mechanical indicators (green lights should come on for undercarriage and tail wheel).

Gliding

108. When gliding toward landing, propeller pitch should be set to 100% (lever pushed away from you) in order that you can, if necessary, get engine back up to take off settings.
109. In the event of extended gliding from altitude and to prevent overcooling the engine you should employ radiator vents to control engine temperature and in event that you need to warm the engine increase throttle for a few seconds. Cylinder head temperature should not be lower than 160C.
110. When gliding and throttle is at minimum setting do not sharply increase revs. Changing from minimum to maximum throttle settings should be done over 2 - 3 seconds.
111. Once descending through altitude of 4000m put supercharger to position 1.
112. Maintain speed of the glide with raised flaps at a speed of not less than 220 km/h and with extended flaps at 210 - 220 km/h: minimum speed with lowered flaps is 200 km/h. Study one peculiarity of the LA5: speed lost in executing any part of flight is regained slowly.
113. When coming into land, lower undercarriage at a speed of not less than 250 km/h.
114. Lower flaps by moving the control lever from position "neutral" to "extended" (lever is on left side of the cockpit). Check that flaps are extended. In the event that flaps get stuck check whether flap lever is incorrectly set to neutral position, if so, then flaps will not extend.
Slip in a glide with lowered flaps is less forgiving than with raised flaps and the aircraft nose wants to drop.
After lowering flaps, trim aircraft to stable flight.
115. Glide parallel with landing signs and not more than 40 - 50m to one side of the landing 'T'.

116. After the fourth turn (turning to final) do not glide in directly toward the landing mark T to prevent landing right on it and sliding off the runway.
117. When landing at night and in the absence of landing lights at the airfield, on suitably equipped aircraft switch on landing lights at 70 - 80m.

Aborted landing

118. In the event of having to abort landing, smoothly apply throttle. Once speed of 230 - 240 km/h and altitude of 100m is reached, retract flaps to gain altitude. Flight with lowered flaps should not be done at speeds greater than 280 km/h. In event of change of propeller pitch at minimal prop pitch settings (because of seizure of R - 7 or thickening of oil) there is no possibility of aborting landing. In this case you should.
 - (a) lower flaps only when you are sure that landing approach is correct.
 - (b) When approaching runway lower undercarriage only at speeds of not more than 250 km/h.

Landing procedure

119. The key to good landing is correct procedure.
To make a good landing it is necessary to observe the following,
 - Third turn before approach to runway should be at 90 degrees.
 - Gliding after third turn at angle of less than 90 degrees to landing marks will make landing more precise.
 - Perform final turn at 90 degrees, this ensures correct approach to runway parallel to landing signs.

To make the approach more exactly it is permissible to change angles but to not more than 45 degrees.

Landing

120. Start straightening out the aircraft at an altitude of 6 - 8 m and reduce speed to 200 km/h. At an altitude of 1 m smoothly pull back the joystick.
121. Make a three point landing. The joystick should be pulled back as far as possible. Whichever way the aircraft is landing (either on its' wheels or on all

three points), do not use coarse movement of the joystick so as to avoid an increase in altitude and putting the aircraft onto one of its' wings.

122. Apply brakes smoothly only once the pilot is sure that all three wheels are on the ground, that the joystick is pulled back and the that the aircraft is going straight. Do not apply excessive rudder or braking force since the aircraft will begin to yaw and deviate from its' landing run.
123. Once plane is off runway and taxiing, fully raise flaps.
124. Replace air protection valve on cannons.

Switching off engine

125. Fully open cowl flaps and oil radiator.
126. To cool the engine, set revs to 1.000 - 1.200/minute and maintain that regime until temperature of the cylinder heads is less than 140C.
127. Ensure that propeller pitch is set at 100%.
128. To stop the engine, pull the stop tap toward you after which switch off ignition and smoothly move the gas lever forward.
129. Switch off accumulator.
130. After flight:
 - (a) inform technician about how engine, aircraft, weaponry and any special equipment carried for your flight performed,
 - (b) indicate likely source of any defects to mechanic.

Chief of Technical Directorate of VVS

11 July 1943

Editor - Novik D.A.

Technical Editor Bremeeva E. N.

Proof reader Eygrafova B.N.

G532328 Printed 15.7.44 Publication No. 31856

Typography from Directorate of Military Publisher NKO, named after S.K. Timoshenko.