

ЯК-18Т



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***Warning! This Flight manual is for MSFS simulation purposes only!
Some parts of it have been omitted and changed. Do not use for real life flying!***

Federation of Light Aviation Russia

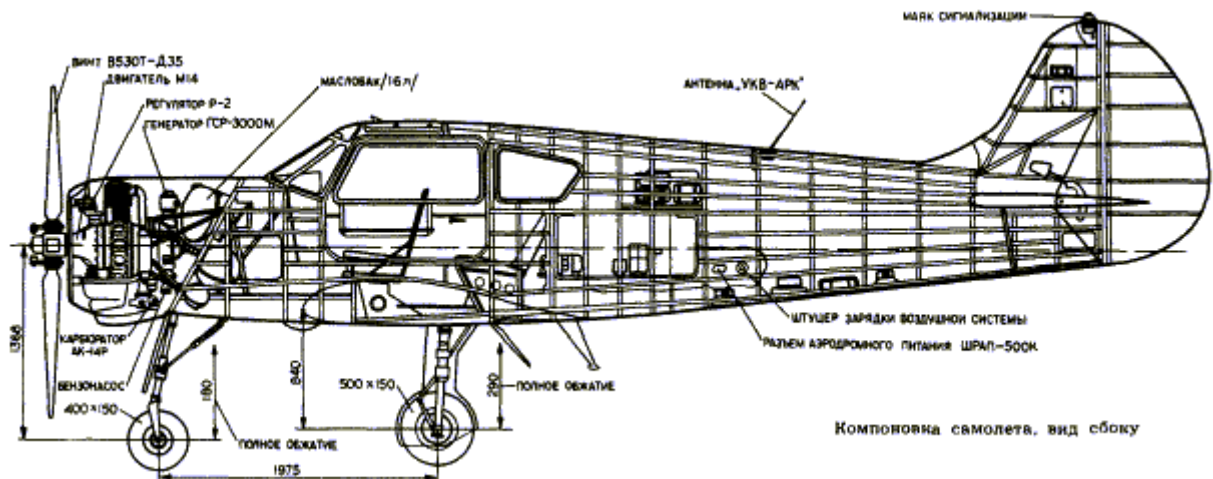
**FLIGHT MANUAL – AIRCRAFT YAK-18T
ENGINE – M-14P**

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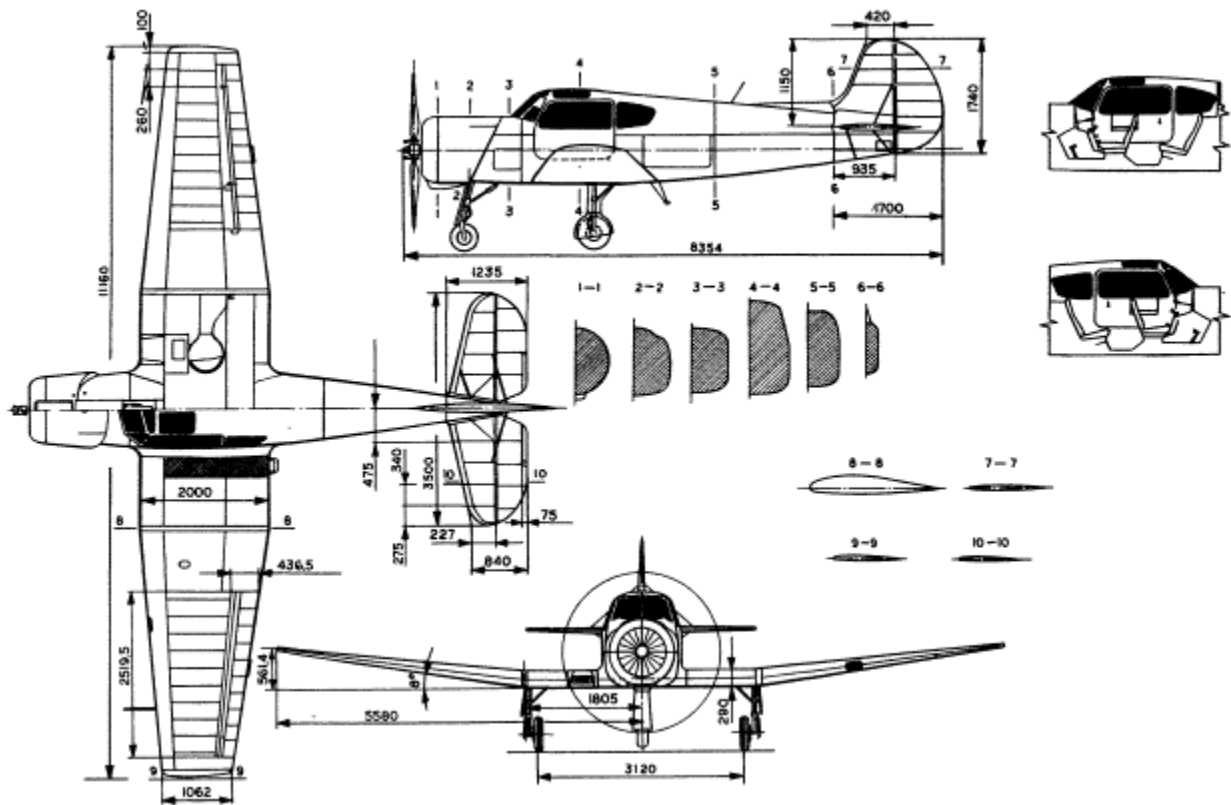
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Компоновка самолета, вид сбоку



Section 1 GENERAL INFORMATION

1.1. Aircraft Dimensions

1.1.1. General Information

Aircraft length	8390 ±16 mm
Main wheel track	3120 ±20 mm
Wheel base length	1955 ±6 mm
Main wheel tire dimensions	500/150 mm
Nose wheel tire dimensions	400/150 mm
Propeller ground clearance	160 mm
Aircraft pitch angle on ground	2°

Note:

1. There is no restriction for the top limit of power and manifold pressure at take-off and nominal power settings.
2. 99.4 % is equal to 2900 RPM.
3. Max. allowed time of continuous operation on:
 - Take-off power - not higher than 5 minutes
 - Max. RPM - not higher than 1minute
 - Others power settings - unlimited.
4. Max. RPM - 101 %.
5. Spool up time from idle (26 %) to take-off regime (V=0, H=0) - not higher than 3 sec.
6. Maximal in-flight RPM is 109 % - not higher than 1 sec and not higher than 30 minutes during the life time of the engine.

1.2.2. Fuel Grade (Octane Number)

Fuel - gasoline B91/115

1.2.3. Carburettor

Designation AK-14P
Type aerobatic

1.2.4. Fuel Pressure Before Carburettor

Idle 0.15 kg/cm²
Other power settings 0.2-0.5 kg/cm²

1.2.5. Fuel Pump

Designation 702ML
Quantity per engine one

1.2.6. Fuel Filter (Fine Filtering)

Designation 8D2.966.064
Type gravity
Filtration grade 36-40 micron

1.2.7. Oil Grade (Summer and Winter Operations)

MS-20 or MK-22

1.2.8. Oil Usage in Cruise I

8 g/BHP in hr

1.2.9. Oil Pressure in the Main System

Idle, not lower than 1 kg/cm²
Other power settings 4-6 kg/cm²

1.2.10. Engine Inlet Oil Temperature

Recommended 50-65° C
Minimum 40° C
Maximum continuous, not higher than 75° C
Maximum, up to 15 min 85° C

1.2.11. Cylinder Head Temperature

Recommended 140-190° C
Minimum 120° C
Minimum continuous 140° C
Maximum continuous 220° C

1.2.12. Carburettor Intake Air Temperature

+10 ÷ + 45°

1.2.13. Magneto

Designation M9-25M
Type four-spark, shielded
Quantity per engine two

1.2.14. Spark Plugs

Designation SD - 49SMM
Quantity per cylinder two

Cylinders Ignition order ... 1-3-5-7-9-2-4-6-8

1.2.15. Engine Start System

Pneumatic

1.2.16. Propeller

Designation V530TA-D35
 Type Pulling, constant speed
 Rotation counter clockwise
 Diameter 2.4 m
 Number of blades two
 Low pitch blade angle at 1 m radius 14° 30' ±10'
 High pitch blade angle at 1 m radius 34° 30' ±30'
 Blade turn angle 20° ±40'
 Weight 40 kg + 2 %

1.3. General Flight Performance of Aircraft (Standard Atmosphere)

Max indicated airspeed at sea level 262 km/h
 Effective ceiling 4000 m

To prevent engine overheating, it is recommended to use Nominal II (High-Cruise) power setting (RPM=70 %) up to 3000 m, at indicated airspeed:

- 170 km/h at external air temperature at ground level up to +20°C
- 180 km/h at external air temperature at ground level above +20°C

At 3000m and above it is allowed to use Nominal I (Climb-out) power setting at 165 km/h IAS

Climb time to 4000 m is not higher than 35 minutes

Take-Off & Landing Performance

T. O. Weight, kg	Lift Off Speed, km/h	T. O. Run, m	Total Distance Over 10m-obstacle	Aborted T. O. Distance, m	Approach Speed, km/h	Landing Roll, m	Total Distance Over 15m-obstacle
1650	135	370	670	850	130	470	790
1500	125	265	640	650	120	390	690

**Section 2
 OPERATIONAL RESTRICTIONS**

2.1. Flight Restrictions

Max. permitted IAS during dive 300 km/h
 Turbulence penetration airspeed 300 km/h
 Max. landing gear and flap operating airspeed 200 km/h
 Stall speed, G=1570-1620 kg, power setting - idle:
 Clean 120-123 km/h
 Flap extended, gear down 112-114 km/h
 Stall speed at Nominal I (Climb-out power), clean 102-105 km/h
 Stall speed at take-off power, flap extended, gear down 97 km/h
 Maximum operational G-forces:
 Take-off weight 1500 kg positive + 6.4 negative -3.2
 Take-off weight 1650 kg positive + 5 negative -2.5
 Max. crosswind, 90° to runway, T. O. and landing 15 m/s

Flights above 4000 m without oxygen equipment are **forbidden**.

2.2. Weight and Balance Data

	Training	Aerobatic
Take-off weight	1650kg	1510kg
Max. useful load	438kg	303kg
Fuel	100kg	100kg
Load without fuel	338 kg	203 kg
Crew, including pilot	80 kg	185 kg (2)
Students	240 kg (3)	-
Oil	18 kg	18 kg
Empty weight	1212 kg	1207 kg
C. of G. position, %MAC, take-off, gear up	24.5% MAC	19.5% MAC
C. of G. position, landing, gear down (fuel 10%, oil 50%)	23.4% MAC	17.8% MAC
C. of G. position, empty aircraft, gear down	18.5% MAC	18.5% MAC

Note:

1. Empty weight tolerance $\pm 1\%$
2. Empty weight CG tolerance $\pm 1\%$ MAC
3. Landing gear extension moves CG forward for 0.5-0.7% MAC
4. In "aerobatic" configuration (1510 kg), the crew weight is indicated with parachutes (12.5 kg each).

2.3. Other restrictions

In "training" configuration (1650 kg) the number of crew members should not exceed three persons. It is **prohibited** to place anyone on rear seat if the front seat is unoccupied.

In a normal training flight, if no parachutes carried, aerobatics are **prohibited**.

With the crew of two in the 'aerobatic' configuration the aircraft permits limited aerobatic flight, if the parachutes are wearied on by the crew.

Inverted flight and negative "G" aerobatics are **prohibited** on Yak-18T.

Section 3 PREFLIGHT INSPECTIONS AND CHECKS

3.1. Pre-flight Inspection and Checks of Aircraft by Pilot

Before flight the pilot should receive report from the aircraft maintenance technician about the aircraft condition, amount and grade of fuel and oil. It must be verified that fuel from fuel tank sump quick-drain valve is sampled to check for water, solids and - in winter - ice crystals. Presence of chocks under the wheels and availability of fire-extinguishing equipment near the aircraft must be checked.

3.1.1. Initial Preparations

Before inspection of the aircraft, ensure that all protective covers are removed and measures are taken to prevent accidental landing gear retraction, engine start, switching on of aircraft electrical equipment, or flap retraction. To do that:

- check that the battery switch is in OFF position
- all circuit-breakers and switches are in OFF position
- magneto switch - in "O" position
- gear lever - in DOWN position and secured
- flaps lever - in retracted position.

In winter time - ensure that snow, frost, or ice are removed from all surfaces of the aircraft.

3.1.2. Aircraft Inspection

Before external aircraft inspection, the pilot-in-command must check the aircraft logbook to ensure that any equipment failures from previous flight have been rectified, and all necessary maintenance procedures have been performed.

1. During external walk-around inspection, check:
 - propeller spinner for damage, cracks, and lock-wire presence
 - propeller blades setting

- engine cowling for damage and proper closure and locking of cowling locks and doors
- absence of fuel or oil leaks
- nose gear condition, landing gear position signal light switch, wheel tire condition (proper tire static compression is 15-20 mm), "shimmy" damper condition for oil leaks; visible part of nose-gear shock absorber for static compression of 150-180 mm.
- main gear condition, landing gear position signal lights switches and static dischargers, wheel tire condition (proper tire static compression is 25-30 mm), shock absorbers compression 175-200 mm.
- centre part of the wing from beneath (flap fully retracted, absence of oil leaks)
- right wing for damage, air inlet and oil cooler condition, absence of oil leaks, gear position mechanical indicator for damage, navigation light condition; aileron for damage, hinge condition, lock removed, and free movement.

Note:

When outside air temperature is below -5°C, check that the oil cooler radiator screen is installed.

- on the right side of the fuselage, the cabin door, access door for damage and proper attachment; windows, fuselage skin, and radio antennas for visible damage
- tail plane, for visible damage and locks removed; elevator and rudder hinges for condition and freedom of movement; struts for proper attachment; elevator trim tabs for neutral position, rear navigation light and flashing beacon for damage
- on the left side of the fuselage, the cabin door, access door, fuselage skin, and windows condition; radio altimeter, ADF, and marker receiver antennas for damage
- right wing for damage, navigation light condition; aileron for damage, hinge condition, lock removed, and free movement; Pitot tube for damage, proper attachment and cover removed; gear position mechanical indicator for damage, landing light condition, stall-warning sensor for cover removed and free movement

2. Check fuel and oil quantity:

Verify fuel quantity visually in both tanks and using the fuel gauge in the cockpit. When tanks are full, fuel level should be below fuel filler cap bottom end by not higher than 30 mm. Total fuel capacity is 193 litres.

Oil level is checked using the external oil level measuring stick and should be:

- minimum - 8 litres
- for aerobatic flight - not higher than 14 litres
- for circuit (traffic pattern) training - 18 litres
- for cross-country flights - 20 litres

Total oil tank capacity - 30 litres.

3. During aerobatic flight, before entering the cockpit, check:

- general cockpit condition, absence of loose items, seats for damage, and door locks for proper operation
- Safety belts and shoulder harnesses condition and operation
- parachutes presence in the seat compartment (adjust the parachute straps if necessary)
- canopy windows for damage and cleanness.

4. After entering the cockpit pilot should:

- put feet on pedals under straps and, if necessary, adjust seats to provide full and free controls movement
- ensure parachute opening carabineer is connected to the seat ring
- check safety belt lock condition
- buckle up the safety belt and lock up shoulder harnesses; tighten belts and shoulder harnesses and secure shoulder harnesses with handle on the seat
- connect headset plug to the onboard radio connector
- check free door opening and closure, ensure security of locks
- check full and free travel of control yoke and pedals and full and correct deflection of control surfaces
- visually check instruments condition; set altimeter to zero altitude and check QFE (tolerance ± 1.5 mm Hg if outside temperature is between +15°C and +35°C, and ± 2.5 at other temperatures)
- check the clock, set if necessary.

5. "Battery - External Power" switch - to "Battery" position; "Gear Position Indication", "Engine Instruments", and "Turn & Slip Indicator" circuit breakers - to "ON", and check:

- gear position indication (three green lights - ON); to check red lights - push the button
- elevator trim operation (when trim in neutral position, the light "Trim Neutral" should come on)
- electrically operated instruments operation (needles in initial position)
- fuel quantity indicator operation; check fuel quantity - total, and separate in left and right tanks
- **battery charge under load - switch "Navigation Lights" circuit breaker on for 10-15**

sec

and push voltmeter button, voltage should be not lower than 24 volts.

After that, check operation of primary and navigation instruments and systems and radio equipment. For night flights, check lighting system.

Warning! To prevent battery discharge, if engine is not running, to check operation of primary and navigation instruments and systems and radio equipment, use auxiliary ground power. If engine is running, keep engine RPM not lower than 44% and use alternator.

6. Check engine controls:

- throttle movement from idle to power
- propeller pitch lever movement
- carburettor heat lever for free movement (after checking, turn off carburettor heat by moving the lever fully up)
- cowl flaps and oil cooler duct shutter for free movement.

Note:

Throttle check is carried out with the fire cock closed.

7. Open the fire cock (push the fire cock lever fully forward).

8. Open the air pressure system by turning the air pressure system charge cock fully to the left, and check:

- air pressure in main and auxiliary systems; normal pressure is $45 \div 55 \text{ kg/cm}^2$
- landing flap operation and position indication: ensure ground crew is clear of flap area; to extend, move flap lever to DOWN position, red light "Flap Down" on indication lights panel should come on; to retract, move flap lever to UP position, the light should come off
- secure of wheel brake system; make sure there is no escaping air noise when the brake lever is fully pulled and the pedals are in neutral position

3.2. Engine Start, Warm-Up and Run-Up

3.2.1. Before Engine Start

When external air temperature is $+5^\circ\text{C}$ or below, it is necessary to pre-heat it before engine start using an external heater until cylinder head temperature reaches $+30^\circ\text{C}$, and propeller can be turned easily by hand.

If external air temperature is between $+5^\circ\text{C}$ and $+10^\circ\text{C}$, it is allowed to start the engine without pre-heating, provided the oil in the engine oil system is diluted with gasoline.

Engine can be started using aircraft battery as well as external power source.

Before starting the engine, it is required:

- on dusty airfields - dampen the parking area with water
- check that aircraft is untied, chokes placed under the wheels, and fire extinguishing equipment is provided
- control surfaces locks are removed
- Pitot tube protective cover is removed
- ensure that propeller area is clear of people, vehicles, and equipment
- close oil cooler flaps; in winter - close cowl flaps as well
- check that propeller pitch lever is in low pitch (high rpm) position
- set the throttle to $1/3$ of full throttle ($28 \div 38\%$)
- ensure that the fire cock is open
- if external temperature is below 0°C , move the carburetor lever down to ON position
- ensure that:
 - Magnetos are OFF (in "0" position)
 - "Battery - Ground Power" switch - OFF
 - "Ignition" circuit breaker - OFF
- request the ground crew to turn the prop (2-3 rotations)
- in the process of turning the prop, put the primer handle into "Cylinder" position and pump with 2-3 strokes; in winter - with 3-5 strokes
- put the primer handle to "Feed" position and create the fuel pressure before carburetor of $0.2 \div 0.5 \text{ kg/cm}^2$

Warning!

1. Don't turn the prop if the engine is hot.

2. Don't pump more than prescribed to avoid oil flood which may result in piston

damage or fuel accumulation in lower cylinders producing hydraulic lock.

3. It is strictly prohibited to add fuel through exhaust system or spark plug holes.

3.2.2. Engine Start

1. To start the engine:

- shout out "Clear prop" to ground crew and, upon receiving answer "Prop clear", switch on the "Battery - Ground Power" switch
- circuit breakers "Ignition", "Landing Gear Indication", "Engine Instruments", "Turn & Slip Indicator", and "Generator" - to ON position
- turn the starter button cover counter clockwise to line up the red marks, and push the button. Pushing time no more than 3 seconds continuously
- after 3-5 propeller turns, turn magneto switch to "1+2" position.

Note:

1. To improve starting process, after engine "catches", it is advised to pump the primer a few times
2. During engine start, after engine "catches", it is allowed to stabilize the start up by moving throttle back and forth inside the range of 28÷60%, movement tempo 2-3 seconds.
 - after the engine starts, release the starter button, set RPM 38÷41%, while monitoring the oil pressure.
2. If oil pressure does not reach 1.0 kg/cm² within 15-20 seconds after start up, stop the engine immediately and find out the reason.
3. After start-up, secure the primer handle, and warm up the engine.

If the engine doesn't start after two attempts, stop trying and find out the reason.

Warning!

Before another start-up attempt, following all appropriate safety procedures, turn the propeller for 4-6 turns, to prevent hydraulic lock from unburned fuel from previous priming procedure.

3.2.3. Engine Warm-Up

1. Engine warm-up is performed at 41-44% RPM until the oil temperature starts to rise. With increase in temperature, bring engine RPM up to 44-48% in summer, 51% in winter and continue engine warm up until the cylinder head temperature reaches 120°C, and the oil temperature 40°C
2. Engine warm-up considered complete when cylinder head temperature is not lower than 120°C, oil temperature is not lower than 40°C, and air temperature at carburetor intake is not lower than +10°C
3. After engine warm-up is complete, perform propeller hub warm up by changing the prop pitch from high pitch to low and back twice.

3.2.4. Engine Run-Up

1. Engine run-up is performed with cowl flaps and oil cooler flaps opened. Before engine RPM is increased, put all control surfaces to neutral position, and set the parking brake.
2. Check the operation of engine at Nominal II (High-Cruise Power), move throttle lever fully forward, moving prop lever back to the required position at the same time

Engine instruments should read:

RPM	70%
Manifold pressure	P ₀ +75±15 mm Hg
Oil pressure	4-6 kg/cm ²
Fuel pressure	0.2-0.5 kg/cm ²
Oil temperature	40÷75°C
Cylinder head temperature, not higher than	190°C
Air temperature at carburetor intake, not lower than	+10°C

Engine should run smoothly without vibration. To prevent overheating as the result of insufficient air flow, avoid continuous running of the engine on the ground at Nominal settings.

3. Check magnetos and spark plugs:

- set propeller to low pitch (high rpm) by moving prop lever fully forward
- with the throttle, set engine RPM at 64-70%
- switch one magneto OFF and check the RPM drop
- switch both magnetos ON till RPM return to normal
- switch the other magneto OFF and check RPM drop
- switch both magnetos ON

RPM drop on either magneto should be not higher than 3%.

4. Check alternator operation:

- set engine power to Idle

- with throttle, set engine RPM to 57-58%
- "Alternator Failure" light should extinguish, meaning the alternator proper operation
- check the voltage, gauge should read 27-29 volts
- switch on equipment necessary for flight ("PO-250", "Radio altimeter", "ADF", "Intercom", "Marker", "VHF Radio", "PT-200", "Course System", and "Beacon" circuit breakers; at night time - "Navigation Lights" and "Landing Light")
- switch on "Stall Warning", check stall warning system operation.

5. Exercise prop for RPM drop:

- with the throttle, set engine RPM to 70% (propeller - in low pitch position (high rpm))
- move the prop pitch lever to "High Pitch" (full back) . Engine RPM should decrease to 53%
- move the prop pitch lever to "Low Pitch" (full forward). Engine RPM should increase back to 70%

During the propeller and governor check, the oil pressure may momentarily drop to 2 kg/cm, but restore to previous readings in 8-11 seconds.

6. Check the propeller RPM governor operation:

- with the throttle, set engine RPM to 70% (propeller - in "Low Pitch")
- with the prop pitch lever, set engine RPM to 64%
- smoothly moving the throttle back and forth (but not to the full forward or backward position) make sure that engine RPM remains unchanged.

With abrupt throttle movements back and forth, engine RPM may change by 2-3%, but should stabilize in 2-3 seconds.

7. Check engine operation at Take-Off power setting (during 20-30 seconds):

- move the prop pitch lever to low pitch position (full forward)
- move the throttle to full forward position

Engine instruments should read:

RPM	95-99%
Manifold pressure	Po+125±15 mm Hg
Oil pressure	4-6 kg/cm ²
Fuel pressure	0.2-0.5 kg/cm ²
Oil temperature	40÷75°C
Cylinder head temperature, not higher than	220°C
Air temperature at carburetor intake, not lower than	+10°C

8. Check engine operation at Idle RPM, set propeller at low pitch (high rpm), move throttle lever fully back.

Engine should run smoothly, engine instruments should read

RPM	26%
Oil pressure	1 kg/cm ²
Fuel pressure	0.15 kg/cm ²

To avoid oil grease-staining of the spark plugs, the time of engine operation at "Idle" should not exceed 5 minutes.

9. Check the engine spool up time by moving throttle smoothly, within 2-3 seconds, from full back to full forward position (prop pitch lever in low pitch position). Observe smooth RPM change from "Idle" to "Take-Off" within not more than 3 seconds. To provide normal spool up time, the cylinder head temperature should not be lower than 120°C, and oil temperature not lower than 40°C.

Note:

Spool up time check in flight should be performed at indicated airspeed 160 km/h or below.

Section 4 FLIGHT PROCEDURES

4.1. Preparation for Taxiing and Taxiing

1. After ensuring the engine, instruments, navigation equipment and all other equipment are operating properly, increase engine RPM to 54-57%, and request taxi clearance.
2. Upon receiving taxi clearance, the pilot should:
 - reduce engine power to "Idle"
 - check the doors are properly closed and locked
 - set the pedals and control yoke to neutral position

– apply the wheel brakes and request the ground crew for chokes removal

3. Upon receiving confirmation that the chokes are removed and ensuring that parking brake is released, it is necessary to check the wheel brakes operation. With the pedals and control yoke in neutral position, apply wheel brakes and increase engine RPM to 64-68%. The wheel brakes should be able to hold the aircraft stationary.

4. After wheel brake system check, reduce engine RPM to "Idle", check that the area in front of the aircraft is clear of obstructions, release the brakes, smoothly increase engine RPM and start taxiing. At night or in poor visibility, switch on the taxi light or, if necessary, the landing light.

Landing or taxi light continuous operation time should not exceed 5 minutes.

While taxiing, the control yoke should be held in neutral position. Use the brakes with caution, applying brief brake lever movements

5. Taxi speed on soft surfaces should not exceed 15 km/h, on asphalt or concrete surface - 30 km/h. Taxi speed during turns should not exceed 5 km/h.

Near obstacles, in unfamiliar surroundings, or on wet or uneven surfaces, proceed at lower speeds, with utmost caution.

6. During extended taxi, if it is not possible to use engine RPM required for stable electrical generator operation (42%), to avoid battery discharge, switch off all unnecessary electrical equipment except the radio and rotating beacon, and at night - navigation lights.

7. When approaching the runway, look around to make sure that the runway and approach path are clear. Request permission for runway line-up.

4.2. Before Take-Off

After lining up with the runway centerline, move the aircraft forward for 3-5 m to set the nose wheel straight for take-off. Apply wheel brakes and check:

– artificial horizon AGD-1K operation in accordance with paragraph 6.5.3 of this manual

ATTENTION! TAKE OFF IS ALLOWED ONLY AFTER THE ARTIFICIAL HORIZON IS FULLY OPERATIONAL, WHICH IS IN NO LESS THAN 3 MINUTES AFTER IT IS SWITCHED ON.

– gyro-compass GMK-1A indicates runway heading

– landing flap is retracted

– propeller pitch lever - in low pitch position

– primary flight controls - full and free travel of

– elevator trim in neutral position (the green light "Trim Neutral" is ON on annunciator lights panel)

– all necessary equipment switches and circuit breakers are ON

– turn Pitot Heat ON

ATTENTION: WHILE ON THE GROUND, IT IS ALLOWED TO SWITCH PITOT HEAT ON FOR NO MORE THAN 5 MINUTES.

1. Check engine operation at RPM which would allow to hold the aircraft stationary with brakes applied. Check engine instruments readings.

Engine instruments should read:

Cylinder head temperature, below 140-190°C

Oil temperature 40÷75°C (50-65°C recommended)

Fuel pressure 0.2-0.5 kg/cm²

..... 4-6 kg/cm²

Oil pressure

The engine should run smoothly without vibration and miss-firing.

2. If engine operates normally, check that runway is clear and request permission for take-off.

Note:

In winter, it is allowed to perform take-off with carburetor heat OFF, if the air temperature at carburetor intake is not lower than +10°C. In possible icing conditions, carburetor heat must be turned ON before take-off

4.3. Take-Off and Climb

1. After receiving take off clearance, switch on the "Dangerous Speed" indicator, the stopwatch and the taxi light (or, if necessary, the landing light, release brakes and smoothly move throttle forward to Take-Off power setting.
2. During take-off roll, keep the control yoke in neutral position and control aircraft direction of movement with the rudder
3. After reaching 80-90 km/h indicated airspeed, lift the nose wheel to 10-15 cm from the ground and maintain this position until lift-off.

Aircraft will lift off:

- if the aircraft weight is 1650 kg - at 136 km/h IAS
- if the aircraft weight is 1500 kg - at 129 km/h IAS

Note:

Immediately after take-off, the aircraft has a tendency to increase pitch.

4. After lift-off, accelerate to 160-170 km/h IAS while climbing gradually.
5. At the altitude not lower than 10 m AGL, retract the landing gear. To retract the landing gear:
 - remove the security latch and move the gear lever from "Down" position to "Up" **position, not stopping in neutral position;**
 - **check landing gear retraction - the red indication lights should illuminate, and mechanical indicators should disappear; green indication lights should extinguish;**
 - **when the gear is fully retracted, set the security latch.**
6. **After landing gear retraction at the altitude not lower than 50 m AGL, set engine power to Nominal II (High-Cruise) for climb:**
 - **engine RPM, with prop lever - to 70%**
 - **throttle lever - full forward .**

7. Switch taxi (landing) light OFF.

While climbing, maintain:

- **170 km/h IAS, when the temperature near the ground is below +20°C**
- **180 km/h IAS, when the temperature near the ground is +20°C and above.**

Warning! Maximum continuous time of operation of engine at "Take-Off" power is 5 min.

4.4. Crosswind Take-Off

1. When performing a crosswind take-off, turn the control yoke to deflect the ailerons into the wind, to maintain equal load on both main gear wheels, and to prevent the aircraft from banking.

To compensate for the tendency of the aircraft to turn, use the rudder.

As the ailerons become more effective while the speed increases, gradually turn the yoke towards neutral position to prevent lift-off from one wheel

2. As the indicated airspeed reaches 100 km/h, smoothly pull the yoke to lift the nose-wheel.
During crosswind take-off, the lift-off speed should be higher than normal by 5-10 km/h
3. After take-off, set the appropriate "crab" angle to track the extended runway centerline.

4.5. Climb

1. To prevent engine overheating, climb to 3000 m is conducted using Nominal II (High-Cruise) power setting (RPM=70%) at 170-180 km/h IAS.
Above 3000m, it is permitted to climb using Nominal I (Climb-out) power setting (RPM=82%) at 165 km/h IAS.

2. All the elevator forces should be trimmed out during the climb, and engine instruments readings checked.
3. During climb, constantly monitor engine temperatures, keeping them within recommended limits:
 - Cylinder head temperature, not higher than 140-190°C
 - Oil temperature 50-65°C
4. Maximum continuous cylinder head temperature is 220°C, maximum oil temperature is 75°C, maximum continuous time of operation at oil temperature of 85°C is 15 minutes.
5. If during the climb engine temperatures exceed permitted limits with cowl flaps and oil cooler flaps fully open, the pilot should level off the aircraft and decrease power setting.
6. To decrease power setting, first decrease manifold pressure with the throttle lever, then decrease engine RPM with the propeller pitch lever.
7. If the measures describes above don't lower engine temperatures, the pilot should notify the ATC and land the aircraft at either the home airport or alternate.
8. During climb, engine instruments readings should be
 - RPM 70%
 - Oil pressure 4-6 kg/cm²
 - Fuel pressure 0.2-0.5 kg/cm²
 - Air temperature at carburetor intake, not lower than +10°C
9. If the aircraft enters an area with icing conditions, contact the ATC and change the flight direction or altitude.

Warning!

1. It is forbidden to fly in the known icing conditions.
2. To fly above 4000 m, oxygen equipment should be installed onboard.

4.6. Level Flight

1. Recommended traffic pattern indicated airspeed is 170-180 km/h with landing gear either retracted or extended.
2. Engine power settings for level flight should be used as planned during preflight planning.
3. After reaching the planned altitude, set engine RPM and prop pitch in accordance with the selected power settings.
4. In level flight, if the engine operates normally, the engine instruments should read:
 - Cylinder head temperature, not higher than 140-190°C
 - Oil temperature 50-65°C
 - Oil pressure 4-6 kg/cm²
 - Fuel pressure 0.2-0.5 kg/cm²
 - Air temperature at carburetor intake, not lower than +10°C

Note:

At all power settings, regardless of the flight altitude, oil pressure should be not lower than 4 kg/cm², except at "Idle", when oil pressure should be not lower than 1.0 kg/cm²

5. In warm weather, carburetor heat should be switched OFF, as high carburetor air intake temperature will cause decrease in engine power.
6. Whenever in level flight in high humidity conditions, or when the carburetor air intake temperature below +10°C, switch carburettor heat ON.
7. To check fuel consumption in flight, use the fuel quantity indicator and clock. When remaining fuel quantity in one of the tanks reaches 15 liters, indication lights "Low Fuel Right" and/or "Low Fuel Left" will illuminate. The 30 liters of fuel in both tanks combined provide for 40-45 minutes of flight.

8. Engine power settings in flight are to be changed as the following:

To decrease power:

- decrease manifold pressure
- decrease engine RPM to desired value
- adjust manifold pressure

To increase power:

- increase engine RPM to desired value
- increase manifold pressure

9. During prolonged flight at unchanged power settings, to prevent propeller hub oil from thickening, it is recommended to periodically (every 25-30 min) change propeller pitch from high pitch to low pitch within 55-67%.

10. If the "Engine Chip" light illuminates in flight, the pilot should abort the flight and closely monitor engine performance, the oil pressure and temperature in particular.

In case of the oil pressure drop or temperature rise, report the situation to ATC and perform landing on the closest aerodrome or suitable field.

Warning! It is forbidden to resume flights before the reason for the "Engine Chip" light illumination is investigated.

11. In flight, periodically check the alternator operation by monitoring voltage and the "Alternator Failure" light.

12. At least once in flight (every hour during prolonged flights) check the battery charge current on VA-3 indicator. If the charge current is 30A and more, turn the battery off until the end of the flight.

In case of alternator failure, switch ON the previously switched off battery and continue flight in accordance with recommendations contained in paragraph 5.13 of this manual.

After the flight completion, the battery must be removed from the aircraft.

Warning! If the voltage exceeds 30 volts, 20NKBN-25-UZ battery operation will lead to intense overheating and possible combustion of the battery.

4.7. Flight Maneuvers

Yak-18T aircraft powered with M-14P engine is capable to perform all normal flight maneuvers as well as most aerobatics.

Required crewmembers and altitude are chosen at pilot's discretion and determined by the purpose of every flight

Aerobatics should not be executed if the takeoff weight of the airplane exceeds 1500 kg (3306 lbs) and/or if there is more than 2 persons on board. Recovering from any maneuver must be completed higher than 1000 m AGL (3000 ft). The load factor limit is 3.5-4 g.

Warning!

1. Before performing aerobatic, trim the aircraft for 180 km/h IAS and set the engine RPM to 70%.

2. To prevent engine overspeed, airspeed during aerobatics should not exceed 300 km/h.

3. While performing aerobatics, "Low Speed" and "Stall" indicator lights may blink, and warning signals may sound in the headsets.

If airspeed is inadvertently lost while performing aerobatics and "Low Speed" and "Stall" indicators illuminate, and warning signals sound is heard in the headsets, push the control yoke forward until lights extinguish and warning signals stop sounding.

4.7.1. Turn with 45 deg of Bank

Before entering the turn, set engine RPM to 70% and trim for airspeed of 180 km/h.

Then enter the turn using coordinated control yoke and pedals input.

Monitor the bank angle by watching the position of the nose of the aircraft against the horizon, and double-check by using the AGD-1K artificial horizon indicator.

When desired bank angle and turn rate are achieved, maintain the bank angle by slightly turning the control yoke against the turn and apply forward pressure; at the same time use the opposite pedal to prevent from skidding or slipping. Monitor correct turn performance using the EUP-53 turn-and-slip indicator.

When 25-30° before the desired heading, begin the roll out using coordinated control yoke and pedals input in the direction, opposite to direction of the turn, while applying slight yoke forward pressure. After entering level flight, set flight controls into neutral position.

The aircraft is stable during turns, and is easily controlled while changing turn direction.

4.7.2. Turn with 60 deg of Bank

Before entering the steep turn set engine RPM to 70% and trim for airspeed of 200 km/h. The steep turn roll-in is the same as the shallow turn roll-in. While the bank angle is increased during the roll-in, the manifold pressure should be increased simultaneously so that it reaches full throttle upon reaching the bank angle of 45-50 degrees.

When the bank angle reaches 45 degrees, increase back pressure on the control yoke and reduce the pedal deflection.

When the bank angle reaches 60 degrees, hold the aircraft in the turn by coordinated control inputs. The rate of turn and the bank angle are controlled with the control yoke; the pitch attitude is controlled with the rudder pedals. Applying too much back pressure on the control yoke during the turn can lead to buffeting. To stop the buffeting, release the back pressure.

Start the roll out 30-35 degrees before the desired heading by applying coordinated control yoke and pedals input in the direction, opposite the direction of the turn, while applying yoke forward pressure. After entering level flight, set flight controls into neutral position.

4.7.3. Horizontal Eight

Horizontal eight consists of two steep turns made in opposite directions. The change of the turn direction is made quickly and vigorously without delay. The aircraft is easily controlled while changing turn direction. At the maneuver intermediate point, it is necessary to apply slight yoke forward pressure to maintain airspeed.

While rolling out of the first turn, reduce the manifold pressure to 480-500 mm Hg, and then increase to full throttle while rolling into the second turn.

The maneuver is performed at the following airspeed:

- for horizontal eight with bank angle of 45° – 180 km/h;
- for horizontal eight with bank angle of 60° – 200 km/h.

4.7.4. Chandelle

Before starting a chandelle, ensure there is no other aircraft in the area and choose a rollout reference point (a landmark).

Performing a chandelle:

Set engine RPM to 70% at full throttle and enter a shallow dive to increase airspeed to 280 km/h, then level off and roll the aircraft into a climbing turn with the bank angle of 15-20 degrees and the load factor 3.5-4 g in the direction of the maneuver by fast and smooth pull-up on the control yoke and coordinated yoke and pedals input.

The rate of bank increase must be fast enough so that the aircraft reaches 50 degrees of bank and climb angle upon reaching the 130-degree point of the turn. After passing the 130-degree point, hold this bank and climb attitude.

After reaching the 150-degree point start the roll out by simultaneously moving the yoke and rudder pedal opposite the direction of the maneuver. The airspeed must be no less than 150 km/h when roll out is completed. Simultaneously apply yoke forward pressure to lower the nose to level flight attitude.

4.7.5. Dive

Before entering a dive, ensure there is no other aircraft in the direction of the maneuver, especially down. Check the instruments and altitude.

Entering a dive is performed from level or turning flight at an indicated airspeed of 150 km/h while avoiding getting any significant negative load factor. The dive may be performed with either power-on or power-off up to airspeed of 300 km/h at level off.

During the dive, monitor the engine temperatures. Cylinder head temperature must not be lower than 120° C.

To level off, smoothly apply back pressure on the yoke. The fast pull-up at high airspeed will cause significant load factor. To avoid exceeding 300 km/h when the angle of the dive is 40-45 degrees, begin the level off at airspeed of 280 km/h.

4.7.6. Zoom

The zoom is performed with climb angles up to 50 degrees. Before starting a zoom, set engine RPM to 70% at full throttle and enter a shallow dive to increase airspeed to 280 km/h. Then smoothly set and fix the desired climb angle. Watch the aircraft attitude by watching the position of the nose of the aircraft against the horizon, and double-check by using the AGD-1K artificial horizon indicator.

At airspeed of 170 km/h start to level off. The level off is accomplished with coordinated movements of control yoke and rudder pedal.

The indicated airspeed must not be lower than 140 km/h when the level off is completed.

4.7.7. Spiral

The spiral is made with power-off with bank angles up to 45 degrees at airspeed of 180 km/h or with power setting required for 3-4 m/sec descent.

Before entering a spiral, check the engine instruments, trim for prescribed airspeed and enter the descending turn by coordinated movement of the yoke and rudder pedals. Maintain the bank angle and the turn rate by slightly turning the control yoke against the turn and apply forward pressure; at the same time use the opposite rudder pedal to prevent from skidding or slipping.

Watch the bank angle by watching the position of the nose of the aircraft against the horizon, and double-check by using the AGD-1K artificial horizon indicator.

During the maneuver, monitor the engine temperatures. Cylinder head temperature must not be lower than 120° C.

The indicated airspeed must not be lower than 170 km/h when the roll out is completed.

4.7.8. Sideslip

The sideslip is performed with landing flap either retracted or extended at an indicated airspeed of 170 km/h.

Choose a reference to maintain the direction of flight throughout the maneuver and trim for a glide at an indicated airspeed of 170 km/h. With coordinated control inputs turn the aircraft 10-15 degrees away from the initial course and then smoothly create a bank angle of 20 degrees in the direction of the maneuver while holding the aircraft from turning by opposite pedal deflection.

Maintain the direction of movement by watching the selected reference, maintain airspeed by watching the nose of the aircraft against the horizon and by airspeed indicator, maintain the bank angle by watching the nose against the horizon and double-check by using the AGD-1K artificial horizon indicator.

The level out is accomplished by simultaneous control yoke movement against the bank and slight forward yoke pressure. While the bank angle is decreased bring the pedals to neutral position and trim for gliding flight at an indicated airspeed of 170 km/h. Remove the remaining drift by creating an opposite bank.

During the maneuver, monitor the engine temperatures. Cylinder head temperature must not be lower than 120° C.

4.7.9. Split-S

The Split-S is initiated from level flight at an indicated airspeed of 160 km/h.

To start a Split-S, raise the nose until it is 10-15 degrees above the horizon and then smoothly begin the rotation around the longitudinal axis in the desired direction by coordinated control inputs. The roll rate should be fast enough so the aircraft reaches the inverted position in 2-3 seconds.

After reaching the inverted position, stop the roll, neutralize the pedals, set the throttle to idle and enter a dive by smoothly applying back pressure on the yoke. When the airspeed reaches 190-200 km/h, begin to level off by applying enough back pressure so the airspeed reaches 240-250 km/h when the level off is completed. The level off should be smooth; applying too much back pressure on the yoke will cause significant load factor.

4.7.10. Aileron Roll

The aircraft is capable to perform an aileron roll and a snap roll.

To perform an aileron roll trim for an indicated airspeed of 230 km/h, set engine RPM to 70% at full throttle, raise nose until it is 10-15 degrees above the horizon and hold this pitch attitude. Then smoothly begin to roll the aircraft with the control yoke around its longitudinal axis in the desired direction.

When the aircraft reaches 45-50 degrees of bank, start applying slight yoke forward pressure to prevent the aircraft from turning during the first part of the maneuver and to prevent it from dropping the nose when the aircraft is in the inverted.

After passing the inverted position, when the aircraft reaches 50-40 degrees of bank before the roll out, increase the roll-wise pedal pressure and back pressure to hold the nose of the aircraft on the horizon.

After the level flight is reached, stop the rotation by moving the controls opposite the direction of the roll. When the rotation stops, neutralize the controls.

The rotation of the aircraft is steady and stable throughout the roll.

To perform a snap roll, trim for 190 km/h, set engine RPM to 70%, set manifold pressure with the throttle to 650-700 mm Hg, raise nose until it is 10-15 degrees above the horizon and hold this pitch attitude. Quickly deflect the pedal in the direction of the roll for 1/3rd of its travel, simultaneously apply slight yoke back pressure and turn the yoke in the direction of the roll to begin the rotation of the aircraft around the longitudinal axis.

Hold the aircraft and engine controls steady throughout the maneuver.

When 20-30 degrees before the level flight is reached, begin to stop the rotation by moving the controls opposite the direction of the roll. When the rotation stops, neutralize the controls.

The rolls are performed without altitude loss. The aircraft behavior is the same during right and left rolls.

4.7.11. Loop

The airspeed required for the maneuver should be gained in a shallow dive at full throttle. When the indicated airspeed reaches 280 km/h, start the loop by applying enough back pressure on the yoke to create the load factor of 3.5-4 g.

To counteract the aircraft's natural turning tendency due to propeller drag push on the left rudder pedal.

At the beginning of the maneuver apply back pressure smoothly. When the aircraft reaches pitch attitude of 20-30 degrees, start to increase the rate of pulling back on the yoke, and after passing the inverted position start to decrease it. On the top of the loop apply just enough back pressure to transfer to a dive. If the aircraft seems to be unstable on the top of the loop apply a slight push on the yoke, and then apply the back pressure again.

When the nose of the aircraft passes through the horizon, smoothly decrease throttle to idle, decrease the left pedal pressure and set for a dive.

When the dive angle reaches 90 degrees, begin to level off by applying slight yoke forward pressure to avoid the roll out with high angle of attack. The level off should be started when the airspeed reaches 190-200 km/h. The airspeed should be 270-280 km/h when the level off is completed.

4.7.12. Half-Loop

Before entering the maneuver trim for level flight and choose a rollout reference point (a landmark).

Start the maneuver at the airspeed of 300 km/h. Set engine RPM to 70% at full throttle and enter a shallow dive to gain the required airspeed. The first half of the maneuver is performed faster than the first half of the loop. Pull back for the load factor of as high as 5 g until the 60-degree climb angle. After reaching the 60-degree climb angle, reduce the load factor to 3-4 g.

Approaching the top of the loop, when the pitch attitude is 5-10 degrees inverted above the horizon, the airspeed must not be lower than 150 km/h, perform a half-roll by turning the yoke and the rudder pedal in the desired direction.

When 20-30 degrees before the level flight is reached, begin to stop the rotation by moving the controls opposite the direction of the roll. When the rotation stops, neutralize the controls.

At the end of the half-loop the airspeed should not be lower than 140 km/h. If at the end of the half-loop the airspeed is lower than 140 km/h, do not perform the half-roll; perform the second half of the loop instead.

4.8. Aircraft Behaviour at High Angles of Attack and during Stall

To warn the pilot of the approaching stall there is a SSA-0,7-2,2 signal system installed. The system produces an aural warning in the headsets and visual warning (by use of the annunciator light ОПАСНАЯ СКОРОСТЬ (Dangerous Airspeed) on the instrument panel) for 15 seconds.

The sensor of the system is adjusted so it produces the warning at indicated airspeeds of 130 km/h and less.

On other aircrafts, equipped with system SSKUA-1 warning system, the warning light СКОРОСТЬ МАЛА (Airspeed Too Low) illuminates 20-10 km/h before the stall, and the warning light СРЫВ (Stall) illuminates and the warning horn sounds 10-5 km/h before the stall.

The system is activated by the switch located on the switchboard.

The control surfaces maintain their efficiency on low speeds up to stall speed. During the stall the aircraft lowers the nose and banks to the right or left with insignificant stall buffeting.

If the control yoke is moved forward, the aircraft immediately recovers from stall and increases the airspeed.

The stall speeds in level flight with a load factor of 1 are the following:

- cruise configuration, power at IDLE	120-123 km/h;
- cruise configuration, power at NOMINAL 1 (Climb-out)	102-105 km/h;
- landing configuration, power at IDLE	112-114 km/h;
- landing configuration, TAKE-OFF power	97 km/h.

Higher stall speeds correspond to weight of 1650 kg; lower stall speed – to weight of 1500 kg.

When the aircraft is stalled with the yoke pulled fully aft and with the engine at NOMINAL 1 (Climb-out) power setting, the tendency of the aircraft to roll is more pronounced than in the case when the aircraft is stalled with the engine at IDLE power setting.

If the control yoke is pulled too much during turns and spirals the aircraft quickly drops the nose with simultaneous airspeed and bank angle increase. The more the airspeed during the turn or the spiral, the more the tendency of the aircraft to drop the nose. If the forward pressure on the control yoke is applied, the aircraft recovers immediately.

There is no stall buffeting before the stall, only slight stall buffeting occurs at the stall. The stall behavior during turns and spirals is independent of the engine power setting or center of gravity location.

4.9. Spin

It is permitted to perform only two spin rotations in training purposes from altitude not less than 2000 m.

Before entering a spin, ensure there is no other aircraft in the area, especially down.

With the engine RPM set to 70%, trim the aircraft for straight and level flight at an indicated airspeed of 170 km/h. Check the engine instruments indication. The engine instruments should read:

- cylinder head temperature	180-190° C;
- oil temperature	50-65° C;
- oil pressure	4-6 kg/cm ² ;
- fuel pressure	0,2-0,5 kg/cm ² ;
- carburetor intake air temperature, not less than	+10° C

Select a reference point for recovery.

4.9.1. Inducing a Controlled Spin

Start in level flight configuration described above. Set the throttle to idle and as the airspeed decreases smoothly move the yoke back to hold altitude and wings level.

Warning! 1. It is prohibited to enter a spin when the engine is at higher than idle power setting, or to increase power during spin.

2. It is prohibited for students to perform a spin in solo flight.

When entering the spin divide the attention to the following:

- the position of the nose of the aircraft against the horizon;
- the airspeed indicator;
- the vertical speed indicator.

When the airspeed reaches 125-120 km/h, apply full pedal deflection in the desired direction of the spin. As the aircraft starts to drop the wing and lower the nose, pull the control yoke fully backwards. The control movements should be smooth enough. The procedure of entering the right spin is the same as the procedure of entering the left spin.

Hold the same controls deflection throughout the maneuver.

The rotation of the aircraft in the spin is quick, steady and stable, without jerks.

During the first rotation the pitch attitude is 60-50 degrees below the horizon, during the second turn – 50-45 degrees below the horizon.

During the first three rotations the airspeed and load factor are constant (2 g), the pitch angle gradually decreases and the rate of turn increases.

After 3-4 rotations the spin stabilizes with small wing rocking and with constant airspeed and load factor.

During the first three rotations there are no differences between left and right spins.

After 3-4 rotations the right spin becomes more flat than the left and the stall buffeting appears during right spin.

The line of sight of the pilot should be pointed 25-30° towards the inside of the spin and 20-30° below the horizon.

4.9.2. Spin Recovery

To recover the aircraft from a spin, first, firmly and quickly apply full rudder pedal deflection against the rotation, and in 2 seconds thereafter deflect the control yoke forward for about 1/4-1/5 of its travel. It is not recommended to apply full yoke forward deflection because it leads to (negative) pitch angle increasing, negative load factor, the airspeed increasing and higher altitude loss during recovery.

When the rotation stops, immediately neutralize the pedals, increase the airspeed to 160-170 km/h and then level off the aircraft from a dive by smoothly applying back pressure on the yoke. The airspeed should be 220-240 km/h when the level off is completed.

When the nose reaches the horizon, increase the manifold pressure with the throttle.

Loss of altitude after recovery from the spin of three rotations is 740 m.

Before three full spin rotations are completed, the aircraft recovers from a spin with delay of about one rotation.

During the recovery it is absolutely necessary to deflect the rudder pedals first, not the control yoke. Using the opposite procedure, it may not be possible to recover from a spin.

The aileron deflection up to 1/2 of its full travel does not affect the spin behavior. The full deflection of ailerons in the direction of the spin makes the spin more deep and unstable; the 1/2 or full deflection of ailerons against the spin makes the spin more flat. The aileron deflection affects the right spin more than left spin.

If during the spin the ailerons were erroneously deflected against the spin and the aircraft does not recover after 2 rotations delay (when the controls are set for recover), the pilot must:

- deflect flight controls to the spin direction (during the right spin, apply full right rudder, pull the control yoke all the way aft, neutralize the ailerons). Watching the yoke position, ensure the ailerons are neutralized;
- perform one spin rotation with the flight controls deflected to the direction of the spin;
- to recover, firmly and quickly apply full rudder pedal deflection against the rotation, and in 3 seconds thereafter deflect the control yoke fully forward.

The delay may be 1-1.5 rotations after left spin and 2-2.5 rotations after right spin. After recovering the aircraft enters nearly vertical dive.

- when the rotation stops, neutralize the pedals and recover the aircraft from a dive by applying back pressure high enough to create a load factor of 3-4 g to avoid exceeding the airspeed of 300 km/h.

Note. The spin recovery delay is counted from the moment when the elevator is deflected for recovery.

4.9.3. Inverted Spin Recovery

The inverted spin is more steep than the upright spin. The aircraft recovers from inverted spin without difficulties.

To recover, apply full rudder pedal deflection against the rotation, and in 1-2 seconds thereafter pull on the control yoke to deflect it aft for 1/4-1/5 of its travel.

The delay during the inverted spin recovery is less than one rotation.

Warning! It is prohibited to perform an inverted spin during training flights.

4.9.4. Inadvertent Spin

The aircraft can enter an inadvertent spin only if there is a serious lapse in pilot technique.

An inadvertent spin can occur if while performing a zoom, a loop, a half loop or a chandelle too much back pressure on the control yoke is applied and the rudder pedal is fully deflected to one side at the same time. In that case, the aircraft makes a roll, then drops the nose and enters the spin.

If the aircraft enters an inadvertent spin it is necessary to set the throttle to idle, neutralize the ailerons, determine the direction of the rotation and recover from a spin using one of the methods described in the sections 4.9.2 and 4.9.3 of this manual.

During training flights, when learning to correct the lapses in the pilot technique it is only permitted to enter a spin from a turn or a descending spiral with the engine power at idle.

Warning! It is prohibited to enter a spin from the vertical maneuvers (zoom, loop, half loop, chandelle) in the training purposes.

To enter a spin from a turn or a descending spiral:

- start a turn at a speed of 150-170 km/h and with bank angle of 50-60 degrees;
- while in a turn, apply full back pressure and simultaneously deflect the rudder pedal in the direction of the turn.

The aircraft will enter an evil spin. After second rotation, it stabilizes like a normal spin.

The lowest altitude for inadvertent spin training is 3000 m.

If the yoke is pulled back but the rudder pedals are in neutral position or if the rudder pedals are deflected but the control yoke is not pulled fully aft, the aircraft will not enter a spin, but will enter into unstable steep spiral.

Warning! It is prohibited to enter a spin from a turn or a spiral in the direction opposite the direction of the turn (spiral).

4.10. Landing

4.10.1. Descent and Approach

1. Prolonged descents from high altitudes are to be performed with either landing gear extended and landing flap retracted or landing flap extended and landing gear retracted at airspeed of 160-170 km/h.
2. During the descent, monitor the engine temperatures closely. The cylinder head temperature shall be maintained at 160-180 °C by the throttle setting or using the cowl flaps.
3. After prolonged descent is finished, retract the landing gear (landing flap) and set for normal cruise flight.
4. Approaching the airport, check the air pressure in main and auxiliary air systems (40-50 kg/cm²), contact ATC, and join the circuit (traffic pattern) at the prescribed altitude at airspeed of 170-180km/h.
5. On the base leg of the traffic pattern, at airspeed not more than 200 km/h, extend the landing gear. To extend the landing gear:
 - move the security latch to the left;
 - move the landing gear lever from UP position to DOWN position **without any delay in** neutral position; delaying the lever in neutral position causes struts bump against the locks;
 - check the landing gear extension by signal lights and mechanical indicators (the three green lights should illuminate, the red lights should extinguish and the mechanical indicators should go out);
 - secure the gear lever, moving the security latch to the right; leave the gear lever in DOWN position until the engine shut down.

4.10.2. Approach Planning

1. After landing gear extension maintain airspeed of 170-180 km/h, check the air pressure in the main system and in case of the pressure loss, use the auxiliary system. Turn to the base leg of the traffic pattern at airspeed of 180 km/h.
2. When the turn to the base leg is completed, before starting to descend, check the cylinder head temperature (during a winter do not allow it to fall below 140 °C), set the propeller to low pitch (high rpm) by moving the propeller lever fully forward and check the propeller pitch by RPM indication.

Warning! Maximum continuous engine operation on RPM 101% is 1 minute!

It is permitted to set the propeller to low pitch (high rpm) after the turn to final approach leg before the landing flap extension.

3. Turn to the final approach is to be performed at airspeed not less than 170 km/h. The roll out of the turn should be accomplished at altitude not less than 150 m AGL.
4. On final approach trim for a glide at an indicated airspeed of 150-180 km/h and extend the landing flap. To extend the landing flap move the landing flap lever to full down position and ensure the landing flap is extended as the red annunciator light **ЩИТОК ВЫПУЩ** (Flap Extended) located on the annunciator panel illuminates.
5. After landing flap extension, maintain the indicated airspeed of 150 km/h until the flare. It is recommended to plan approach as so to land a little short, i. e. a power-on approach.

Attention! If the annunciator light **СКОРОСТЬ МАЛА (Airspeed Too Low) or **СРЫВ** (Stall) illuminates and stall warning horn sounds when on the final approach, check the airspeed and if it is less than 150 km/h add power to set required airspeed.**

6. If a power-off approach is performed, it should be finished above 50 m AGL.

7. At altitude of 100-150 m, switch on the taxi or the landing light (at pilot's discretion).
8. If the landing approach does not guarantee the safe landing, it is necessary to make a go-around.
9. On final approach, the maximum allowed rate of descent is 5 m/s.

4.10.3. Go-Around

1. The go-around is possible from any altitude up to the altitude of the flare beginning.

When the go-around decision is made, smoothly (during 1.5-2 seconds) move the throttle lever forward to take-off power position.

When the airspeed reaches 150 km/h, transfer to a climb while increasing the airspeed. On altitude higher than 10 m, retract the landing gear (during the nighttime switch off the landing light).

2. At altitude higher than 50 m, retract the landing flap, set airspeed 160-170 km/h and perform another landing approach.

4.10.4. Flare and Touchdown

1. At altitude of 5-6 m AGL smoothly pull back on the yoke to begin the flare to arrest the descent at a height of about 0.5-0.7 m.
2. Hold the aircraft in the touchdown attitude by gently pulling on the yoke so that the landing occurs from the height of about 0.15-0.25 m with zero bank angle on two main wheels with the nose wheel in the air.
3. After the touchdown, hold the yoke in the touchdown position. When the speed reaches 110 km/h, lower the nose wheel onto the runway and start braking. The braking is permitted if the airspeed does not exceed 110 km/h.
4. When the aircraft stabilizes on the landing rollout on three wheels, check the air pressure in the main air system. If the air pressure is zero in the main system, open the emergency gear release valve **АВАР.ЩАССИ** and then start braking.
5. When the rollout is complete, clear the runway, retract the landing flap, turn of the landing/taxi light (at pilot's discretion), switch off all unneeded electrical devices except the flashing beacon (and navigation lights at night). Assured the brakes are efficient, taxi to the ramp and shut down the engine.
6. After the flight, visually check the condition of the aircraft, the propeller, the antennas and the wheels.

4.10.5. Crosswind Landing

1. During the crosswind approach, track the extended runway centerline by setting up a crab.
2. Take into account that with the crosswind from the left the aircraft has a tendency to settle.
3. After touching down on the main wheels, align the aircraft with the runway centerline by deflecting the rudder. Then neutralize the pedals and after lowering the nose wheel at airspeed of 110 km/h start to brake. Counteract the tendency of the aircraft to lower the downwind wing using the ailerons.
4. The landing approach speed should be 5-10 km/h higher than during a normal landing.

4.10.6. Typical Landing Errors, Their Reasons and Correction Methods

4.10.6.1. High Flare

1. The high flare may take place due to:
 - bad height estimation;
 - an incorrect line of sight of the pilot during the landing;
 - an attempt to land sooner disregarding the height and the speed (usually due to overshoot);
 - too much precaution (insufficient confidence of height estimation).
2. To correct the high flare, consider the following:
 - if the flare is noticed to be started too high, stop pulling back on the yoke and hold it steadily while allowing the aircraft to descend to the height of about 5-4 m; then continue the flare so as to finish the flare at altitude of 0.5-0.7 m. Then begin to gradually pull back on the yoke so that the landing occurs from the height of about 0.15-0.25 m with zero bank angle on two main wheels;
 - if the round out is completed too high (but not higher than 2 m), apply slight yoke forward pressure to let the aircraft to descent to altitude of 0.5-0.7 m then begin to gradually pull back on the yoke so that the landing occurs from the height of about 0.15-0.25 m with zero bank angle on two main wheels;

- if the round out is completed higher than 2 m, the pilot should not stop watching the ground (estimating the height), set the take-off power and make a go-around according to the section 4.10.3 of this manual.

4.10.6.2. “Ballooning”

1. The “Ballooning” may take place due to:

- landing speed is too high (usually due to overshoot);
- eye sight transfer to the ground during landing is too late;
- an incorrect line of sight of the pilot during the landing;
- an interruption of visual height estimation;
- the power has not been set to idle during the flare;
- rough handling of the controls;
- “square flare”, i. e. the flare is accomplished with a one rough pull on the yoke due to flaring too late.

2. To correct the “ballooning”, consider the following:

- if the altitude gained during the “ballooning” is less than 1.5 m, hold the control yoke, and while descending, begin to gradually pull back on the yoke to bring the aircraft to normal touchdown attitude;
- if the altitude gained during the “ballooning” is more than 1.5 m but less than 2 m, it is necessary to gently push forward on the yoke to arrest the descent, and then as the aircraft descends to altitude of 0.5-0.7 m begin to gradually pull back on the yoke so that the normal landing on two main wheels occurs;

It is necessary to take into account that after the correction of the “ballooning” the aircraft will have an increased rate of descent so the pilot needs to use more quick and firm control movements to create the correct touchdown attitude at a height of 0.15-0.25 m. During the correction of the “ballooning” watch the direction of the movement of the aircraft and avoid losing the airspeed.

- if the altitude gained during the “ballooning” is more than 2 m the pilot should not stop watching the ground (estimating the height), hold the wings level, set the take-off power and make a go-around according to the section 4.10.3 of this manual.

4.10.6.3. Bouncing

1. The bouncing may take place due to:

- an incorrect line of sight of the pilot during the landing or an interruption of visual height estimation;
- flaring too low;
- landing speed is too high (usually due to overshoot) with the nose-wheel-first touchdown;
- too much forward pressure on the yoke during the “ballooning” correction (nose-wheel-first touchdown);
- abrupt pull on the yoke at touchdown;
- rough three-point landing.

The aircraft behavior during the bouncing and the correction technique depends on the touchdown speed. If the bouncing occurs at the touchdown speed or higher, it is considered a “high-speed bouncing”. If the bouncing occurs at less than touchdown speed, it is considered a “low-speed bouncing”.

The high-speed bouncing correction is similar to the “ballooning” correction.

The low-speed bouncing is particularly dangerous because the efficiency of controls is less due to low speed and the rate of descent will be greater.

2. To correct the low-speed bouncing, consider the following:

- if the altitude gained during the bounce is less than 1.5 m, hold the control yoke, and while descending, begin to gradually pull back on the yoke to bring the aircraft to normal touchdown attitude on a height of 0.15-0.25 m;
- if the altitude gained during the bounce is more than 1.5 m the pilot should not stop watching the ground (estimating the height), hold the wings level, set the take-off power and make a go-around according to the section 4.10.3 of this manual.

While correcting the low-speed bouncing avoid abrupt forward motions of the control yoke, which can lead to the nose-wheel-first touchdown and therefore progressive bouncing.

4.10.6.4. Key Rules to Prevent Landing Errors

- In any case, do not lose the sight of the ground;
- do not pull on the yoke at the moment of touchdown;
- in case of “ballooning”, do not push on the yoke more than needed;
- in case of airspeed loss, do not allow the aircraft to stall, while removing any yaw with the rudder pedals;

e) when descending, gradually pull the yoke back as the aircraft descends, so the aircraft touches down softly on two main wheels with the nose wheel in the air.

4.11. Engine Shut Down

1. Before the engine shut down switch off the following circuit breakers:
ПО-250, РВ, АРК, СПУ, УКВ, МРП, ПТ-200, АГД, ГМК, СИГН.СРЫВА, МАЯК

(PO-250, radio altimeter, ADF, Intercom, VHF, marker beacons receiver, PT-200, AGD (artificial horizon), GMK (gyrocompass), stall warning, flashing beacon, respectively).

2. The normal cylinder head temperature for engine shut down is 140-150 °C. If the cylinder temperature is higher than normal for shut down, the pilot must cool up the engine. For the most efficient engine cool up it is recommended to open the cowl flaps and set the engine RPM to 28-34% with the propeller set to low-pitch (high rpm).

Note: If there is no possibility to cool up the engine until the cylinder head temperature reaches 140-150 °C, it is permitted to shut down the engine with the cylinder temperature not higher than 170°C. The number of shut downs with the cylinder head temperature of 150-170° C should be marked in the engine logbook.

3. After the engine cool up shut down the engine.

Warning! It is prohibited to make a prolonged engine run on idle before shut down. It may cause the grease-staining of the spark plugs and excessive oil accumulation in the crankcase. This, in turn, may cause the hydraulic lock during the next engine.

To shut down the engine:

- increase the engine RPM with the throttle to 65-68% (with the propeller set to low pitch (high rpm)) for 20-30 seconds to clean the spark plugs;
- decrease the engine RPM with the throttle to 28-34%;
- ensure that the propeller lever is fully forward;
- switch off the magnetos by turning the magneto switch into "0" position;
- smoothly move the throttle lever fully forward.

After the engine stops, set the throttle to IDLE position (fully aft) and close the fire cock.

Note: In the end of the flight day, it is necessary to check the magnetos and the spark plugs according to the procedures described in the section 3.2.4 of this manual.

4. Switch off all remaining circuit breakers and switches on the switchboard.

Warning! It is prohibited to shut down the engine: while it is working on cruise or higher power setting; by using the fire cock (to avoid the back-explosion and fire).

5. After each flight, it is necessary to fix the engine working time (including the working time on take-off power) and the number of engine starts in the engine logbook.

4.12. Engine Operation in Low Ambient Temperatures (Below +5 Centigrade OAT)

Before the cold weather operation the engine must be prepared for such weather conditions (the ambient temperature +5 °C or below).

4.12.1. Before Engine Start

1. To provide smooth engine start and efficient engine operation during winter it is recommended to use the oil dilution and engine preheating before the start.
2. If the ambient temperature is +5 °C and below (the minimum temperature during last 24 hours) use an external heater to heat the engine and oil cooler before the engine start. The temperature of the air the heater provides must not be higher than +120 °C. During preheat cover the engine with the engine cover.
3. If the ambient temperature is between +5 °C and -10 °C (the minimum temperature during last 24 hours) and the oil is diluted, it is allowed to start the engine without preheating.

4. When preheating the engine, take out the oil cooler protective cover and open the oil cooler flaps so to heat the oil cooler more efficiently.
5. The preheating should be considered enough when the cylinder head temperature rises up to +30 °C, the oil temperature – up to +15 °C and the propeller can be easily rotated by hand.

Warning! It is prohibited to rotate the propeller by hand if the engine is cold to avoid damaging the engine parts.

6. When the engine preheating is completed, put the protective cover back into the oil cooler inlet and close the oil cooler flaps. The engine cover should be removed directly before the engine start.
7. If the oil tank is empty, fill the oil tank with the warm oil with temperature of 75-80 °C.

4.12.2. Engine Start

The engine preheated according to the section 4.12.1 of this manual is started according to the section 3.2.2 of this manual.

4.12.3. Engine Operation in Flight

1. The engine power settings at take-off, climb, level flight and descent phases of flight during winter are the same as in the summer.
2. Do not allow the carburetor inlet air temperature to drop below +10 °C.
3. During prolonged flights in cold ambient temperatures to avoid the oil thickening in the propeller hub, after each 25-30 minutes of flight change the propeller pitch angle from low to high and back changing the engine RPM within the range of 67-55%. After that, set the required RPM. During the procedure, the oil pressure may drop down to 2 kg/cm² (it should restore in 8-11 seconds).
4. During prolonged glides or descents, monitor the engine temperatures closely, do not allow the cylinder head temperature to drop below 160 °C.

4.12.4. Post-Flight Engine Service in Low Temperatures

The engine shut down procedure is the same as in the summer, but:

- if the undiluted oil was used, drain the oil from the engine and the oil system, if the expected ambient temperature is going to be lower than -5 °C. Accomplish the oil drain only if the oil temperature is not lower than +30 °C using the oil tank drain valve. After the oil is drained, all the drain valves must remain opened;
- if necessary, dilute the oil before engine shut down.

4.12.5. Operation of Engine on Fuel-Diluted Oil

The installed oil dilution system makes the engine operation in cold weather considerably easier.

The oil dilution system allows:

- to shorten the preheating time before engine start, because the force required to turn the prop lowers considerably;
- to have a better engine lubrication during start procedure due to less oil viscosity.

The oil dilution is to be made if the ambient temperature is +5 °C or less. For dilution, the same fuel the engine operates on is used.

1. The oil dilution order:

- determine the time during which the electrically driven valve ЭКР-3 (EKR-3) must be open (it depends on the oil quantity in the oil tank and how long the engine has worked after previous oil dilution and shall be determined by the table placed in the aircraft).

The fuel quantity necessary for the dilution should be 10-12% of the oil quantity in the oil system by the volume;

- press the EKR-3 valve button while working on the following engine power setting:

engine RPM (prop at low pitch)	54%
inlet oil temperature, °C, not lower than	40
cylinder head temperature, °C, not lower than.....	120

- during the dilution process, monitor the oil pressure, which must not drop more than for 1 kg/cm². If the oil pressure drops for more than 1 kg/cm², stop the dilution;

- when the time, determined by the table, elapses, stop the dilution; do not change the engine power setting for 3 minutes for better mixing of the oil and the fuel;
- shut down the engine;
- during the dilution, do not allow the oil temperature to rise above 50 °C and cylinder head temperature to rise above 160°C.

2. Engine operation differences with diluted oil:

- engine start with the diluted oil has no differences from the engine start with the undiluted oil;
- after start, warm up the engine on RPM 41-44% within 5-6 minutes, then gradually increase the RPM to 51%, ensure the engine is running smoothly and the oil pressure is 4-6 kg/cm².

The engine with the diluted oil should be considered warmed up and ready for run-up when the cylinder head temperature is not lower than 120 °C and the oil temperature is not lower than +25 °C.

- if on the ground when the engine works on the IDLE power setting the oil pressure drops below 1.0 kg/cm², this should be considered to be due to excessive oil dilution, which has lost its viscosity. In this case, it is necessary to drain the diluted oil;
- the engine run up with the diluted oil should be performed as described in the section 3.2.4 of this manual;
- if the oil was not diluted during 100 or more flight hours, it is necessary to remove and clean the oil filters after the first landing on the diluted oil, because the diluted oil will wash up intensively all the dirt from cylinders and the crankcase;
- for summertime operations the oil dilution system must be disconnected from the oil system.

4.13. Aircraft Operation in High Ambient Temperatures (Above +29 Centigrade OAT)

4.13.1. Engine Start and Taxiing

There are no differences in starting the engine during hot weather conditions and it is to be performed according to the section 3.2.2 of this manual.

On the ramp and during taxiing, when operating in ambient temperatures above +30 °C, monitor the engine temperatures closely, as the cylinders warm up briskly in high ambient temperatures.

4.13.2. Take-Off and Climb

The take-off technique in hot weather conditions is the same as in standard weather conditions.

The ground roll for take-off in hot weather conditions is practically the same as in standard weather conditions.

For climb, use the following engine power setting and airspeeds:

- up to 3000 m – at the NOMINAL II (High-Cruise) power setting and indicated airspeed of 180 km/h;
- above 3000 m – at the NOMINAL I (Climb-Out) power setting and indicated airspeed of 160 km/h.

In this case, the engine temperatures will remain in the recommended ranges of values.

The 4000 m altitude time-to-climb will be a little higher than in standard conditions and takes up 40.5 minutes.

4.13.3. Level Flight

The level flight performance numbers during hot weather conditions are practically the same as in standard weather conditions.

The maximum level speed is 271 km/h at sea level.

The cruise range, 100 kg usable fuel and 1-hour reserve (35 kg) at altitude of 1000 m and cruise speed 175 km/h, is 354 km (T. O. weight 1650 kg).

The engine temperatures should remain within the recommended values.

4.13.4. Descent, Landing and Go-Around

The approach and landing technique in hot weather conditions is practically the same as in standard weather conditions.

During the descent, maintain airspeed of 160-170 km/h. The engine temperatures should remain within the recommended values.

Take into account that the rate of descent with the engine on IDLE power setting in hot weather conditions is greater than in standard weather conditions. Decrease the RPM to idle during the flare only.

The landing rollout distance in hot weather conditions is greater than in standard weather conditions, and consumes 490 m.

On final approach leg of the traffic pattern, if the temperature is +30 °C or more, the rate of descent should not be more than 5 m/sec, the lowest altitude for go-around is 20 m.

4.14. Aircraft Operation in Low Ambient Temperatures and on Airfields Covered with Packed Snow

4.14.1. General Flight Restrictions when Operating from Airfields Covered with Packed Snow

Maximum allowable crosswind component (direct crosswind)	6 m/sec
Minimum snow density	6 kg/cm ²
Maximum snow depth	10 cm
Minimum turning radius	6 m

4.14.2. Taxiing on the Packed Snow

The taxi speed should be 10-15 km/h and the engine RPM set to 60-65%. The control yoke should be deflected fully backwards to unload the nose wheel. When taxiing in a crosswind more than 5 m/s the assistance of the ground crew is required.

4.14.3. Take-Off and Climb

When taking off from a snow-covered grass- or dirt-paved runway, hold the yoke fully backwards until the nose wheel liftoff. It is permitted to use the differential braking to maintain the take-off direction.

As airspeed increases during the take-off roll, the efficiency of the controls increases either, so it is necessary to gradually reduce the amount of back pressure on the yoke to avoid nose wheel raising too much, which will cause the early liftoff at low speed and high angle of attack. After the nose wheel liftoff, maintain the take-off direction using the rudder only. The liftoff speed with the take-off weight of 1650 kg is 125 km/h.

The take-off roll on a concrete runway with the braking action 0.35 is 325 m, on a snow covered grass- or dirt-paved runway – 300 m.

After liftoff, accelerate to 160-170 km/h while climbing.

The time-to-climb to 4000 m is 28 minutes. To climb to the maximum altitude of 4700 m it takes 38 minutes.

4.14.4. Level flight

The level flight in low ambient temperatures is to be performed according to the section 4.6 of this manual.

The maximum level speed is 270 km/h at sea level.

The cruise range, 100 kg usable fuel and 1-hour reserve (35 kg) at altitude of 1000 m and cruise speed 175 km/h with CRUISE II power setting, is 325 km (T. O. weight 1650 kg).

4.14.5. Landing

The final approach and landing are to be performed according to the section 4.6 of this manual.

After the touchdown on the snow covered grass- or dirt-paved runway on two main wheels, hold the yoke in the touchdown position. During the rollout keep the yoke back to keep the nose wheel raised. As the airspeed decreases, the elevator efficiency decreases either, so deflect the yoke fully backwards. Use the brakes only to maintain the direction of movement after the nose wheel touchdown.

The landing rollout distance on concrete runway with braking action 0.35 is 600 m, on a snow covered grass- or dirt-paved runway it is 345 m.

4.15. Night Flights

4.15.1. Preparation for Taxiing and Taxiing

1. Check the operation of the following lightning, alerting and electrical equipment: cabin lights, placards, panels and gauges lightning, landing/taxi light, landing gear and flap position lights, danger airspeed signalization lights. Ensure there is an operating flashlight on board.
2. Before starting the engine on the ramp, turn on the navigation lights and signal the engine start by turning on the landing/taxi light for 1-2 seconds. After engine start, turn on the flashing beacon.
3. Prepare and check the necessary flight equipment.
4. Perform the "Before Taxiing" checklist.
5. Upon receiving the taxi clearance from the ATC, request the taxi clearance from the ground crew by shortly turning on the landing/taxi light.
6. On the taxiway, ensure the proper brakes operation from the right and left seat, and the proper operation of the turn-an-slip (EUP) indicator.
7. Perform the "Taxi" checklist.
8. When taxiing close to the obstacles and during turns shortly turn on the landing mode of the landing/taxi light. Avoid prolonged taxiing when engine RPM is lower than 42%, as this leads to battery discharge.

4.15.2. Take-Off

1. On holding position:
 - ensure the windows closed;
 - ensure the altimeters are set to "0" and the pressure setting corresponds to the current atmospheric pressure at the airport elevation;
 - turn on the Pitot heat 3 minutes before take-off;
 - perform the "Before Take-off Checklist";
 - request the permission to line up on the runway.
2. On runway line-up:
 - line up the aircraft with the runway centreline, taxi 5-10 m forward and set the brakes;
 - ensure free and correct controls movement;
 - check engine instruments and cowl flaps position;
 - perform the "Runway Line-Up" checklist.
3. Upon receiving the take-off clearance, switch the landing/taxi light to the landing mode.
4. On the aircrafts, equipped with the weather radar, switch it to the "Weather Observation" mode.
5. While holding the brakes, set the engine to 70% of power and check the instruments. Assured the normal operation, release the brakes and smoothly apply take-off power.
6. Maintain the take-off direction by the reference to the runway lights.
7. Avoid abrupt nose wheel lift-off and lift-off at low speed. Lift off at airspeed 5 km/h higher than during the daytime take-off. Gradually accelerate to 170-180 km/h while climbing gradually.
8. At altitude of 10 m apply the brakes and retract the landing gear.

4.15.3. Climb

1. During the climb, fly the aircraft using the instruments.
2. At 50 m turn off the landing light.
3. Crossing the transition altitude, set the altimeter to standard pressure (760 mm Hg, 29.92 in Hg).
4. The climb up to 3000 m is to be performed on the NOMINAL II (High-Cruise) power setting at airspeed of 180 km/h.
5. The climb from 3000 m and above is to be performed on the NOMINAL I (Climb-Out) power setting at airspeed of 170 km/h.

4.15.4. Level Flight

1. After climbing to cruise altitude (flight level), set straight and level flight and set the planned power setting.
2. Take into account the corrections to the altimeter while maintaining a planned altitude.
3. Trim the aircraft.

4. In any case during the night flight, do not allow the carburettor air inlet temperature to drop lower than +10 °C.
5. Monitor the correct fuel flow to be equal from the right and left tank.

4.15.5. Descent and Landing Approach

1. Investigate the approach chart of the destination airport before initiating the approach.
2. Before starting the descent, on the aircrafts equipped with the radio altimeter, set the altitude selector to the airport traffic pattern altitude.
3. Turn on and tune the Instrument Landing System to the supposed landing runway ILS frequency.
4. Tune the Automatic Direction Finder to the marker beacons frequency of the supposed landing runway.
5. Perform the “Before Descent” checklist.
6. If during the approach the course-tracking system is supposed to work in “MK” mode, the pilot needs to perform a system correction by switching the **МК-ГПК** mode switch (Magnetic – Gyro Correction) to the **ГПК** (Gyro) mode and then back to “MK” mode in 2-3 seconds.
7. Crossing the transition altitude, in level flight set the altimeter to the pressure at the airport elevation.
8. Set the course selector to the landing runway course.
9. Perform the “Before Descending from the Transition Altitude” checklist.
10. At the traffic pattern altitude, set the altitude selector on the radio altimeter to the decision height of the destination airport.
11. After the turn to the base leg, extend the landing gear and perform the checklist “After the Turn to the Base Leg (or Before Intercepting the Glideslope)”.
12. When on the glideslope, after passing the Outer Marker, switch the Automatic Direction Finder to the Inner (Middle) Marker
13. After the reliable visual contact with the ground and runway environment is set, on the altitude of 150-100 m turn on the landing light.

Note: If the landing light creates a light field which blinds the pilot, the operation of the landing light should be made at pilot’s discretion.

4.15.6. Flare and Touch-Down

1. Start the flare at height of 5-6 m.
2. During the flare and round-out the line of sight of the pilot should be directed towards the ground, along the beam of the landing light. The height estimation is accomplished using the lighted part of the runway during the landing with the landing light on, or using the runway edge lights when landing with the landing light off.
3. When the landing rollout is completed, turn off the Pitot heat and switch the landing/taxi light to the taxi mode.

SECTION 5 EMERGENCY SITUATIONS IN FLIGHT

5.1. Pilot Actions - Engine Failure

1. If an engine failure occurs during take-off roll just after lift-off pilot should immediately set throttle to idle, vigorously brake the aircraft, switch off the magnetos.

If it is still impossible to avoid obstacles, turn the aircraft to avoid head-on collision by applying differential braking. If it does not provide any opportunity to avoid an impact either, close the fire cock, switch off the battery, unlatch (using the emergency door unlatch lever) the cabin door and retract the landing gear.

2. If an engine failure occurs before turn to the crosswind leg is accomplished (after take-off on the upwind leg), set the aircraft for glide, switch off the magnetos, the alternator, the battery, close the fire cock and perform landing straight ahead. During the flare unlatch the cabin door. If landing straight ahead is impossible due to obvious life threat due to head-on collision with an obstacle, pilot should change the landing direction.

3. If the annunciator light **СТРУЖКА В ДВИГАТ.** (Engine Chip) illuminates (occurrence of metal chips in the engine oil system) it is necessary to verify oil temperature, oil pressure and engine RPM.

If the normal engine operation is assured, continue the flight, carefully monitoring engine parameters. If one of the parameters does not correspond normal operation, land at the nearest aerodrome.

5.2. Pilot Actions - Engine Oil Pressure Drop

1. If oil pressure drop is detected, pilot should check up oil temperature. If the temperature is increasing, and flight is conducted in the immediate vicinity of the aerodrome, land immediately and switch off the engine.
2. If the flight is conducted not in the immediate vicinity of the aerodrome land at the alternate aerodrome or choose a suitable field, inform the ATC about your location and land.

Note. *Performing a precautionary or forced landing pilot must follow the instructions in the section 5.7 of this manual.*

5.3. Pilot Actions - Fuel Pressure Drop and Unequal Fuel Flow from Tanks

1. Fuel pressure drop signs can be:
 - Engine roughness, RPM and manifold pressure drop, high engine vibration;
 - Dropping of indicated fuel pressure on the gauge.
2. If fuel pressure drops, pilot should:
 - Turn the primer pump handle **ЗАЛИВКА МОТОРА** to the left into **МАГИСТР** (feed) position and start pumping fuel into the induction system, monitoring its pressure using the fuel pressure indicator;
 - Report to ATC and land at the nearest aerodrome or alternate aerodrome;
 - If indication of fuel pressure on the gauge does not recover and the engine is still rough, it is necessary to switch the primer pump handle into **ЦИЛИНДР** (cylinder) position and manually create the necessary fuel pressure for the current power setting.
3. If the difference in indications of fuel levels in fuel tanks is occurred, create a 5-7° bank towards a tank with a smaller level of fuel and continue flight until equalization of fuel levels.

Warning! If the measures described above do not lead to positive result (corking of a drain tube or sticking of the petal valve should be suspected), it is necessary to define the remaining distance to the destination aerodrome and make a decision whether to continue the flight or land at the nearest alternate aerodrome, considering the rest of fuel only in the feeding tank.

5.4. Pilot Actions - High Engine Vibration

If and engine shaking (high engine vibration) is occurred, pilot should:

- In all cases (except during fuel pressure drop) immediately set the throttle lever to idle and set the aircraft for glide at the required speed;
- If the engine shaking stops, smoothly move throttle lever forward and establish necessary power settings necessary for normal flight;
- If the shaking does not stop, using the throttle increase rpm to 72% to clear the spark plugs;
- If roughness persists, operate throttle and propeller levers experimenting with the power setting in order to find a combination of manifold pressure and rpm that minimizes vibration and land as soon as possible, having preliminary reported to ATC.

5.5. Pilot Actions - Propeller Overspeed

1. The basic signs of propeller overspeed are:
 - Slight engine vibration;
 - RPM increase;
 - Sharp engine sound excursion.
2. If propeller overspeed has occurred during the take-off roll (what is found out, as a rule, immediately after lift-off), pilot should:

- With a small movement of the propeller control lever reduce the engine rpm;
- Continue take-off. Do not reducing manifold pressure;
- At a height of 5-10 meters retract the landing gear;
- Report to ATC;
- Fly a normal traffic pattern and return for landing.

3. If propeller overspeed is occurred during the dive, pilot should:

- Set the throttle to idle and propeller lever to high pitch (low rpm) position;
- Recover the aircraft from dive;
- Abort the flight, report to ATC and land at home aerodrome.

5.6. Pilot Actions - Fire in Flight

If the in-flight fire is occurred, pilot should:

- Close the fire cock; switch off the magnetos and ignition **ЗАЖИГ** circuit breaker.
- If it is possible report to ATC about the fire, specifying the current position;
- Set the aircraft for glide and, if it is necessary, slip to put out the flame;
- If aerodrome landing is impossible, choose a landing field for forced landing (see section 5.7);
- If the crew wears the parachutes and landing is impossible the crew must bail out.

In cases when the fire (smoke) is caused by malfunction of an onboard electric system or electric power devices, first of all it is necessary to switch off the malfunctioning equipment and the corresponding circuit breakers. If smoking has not stopped, and flight is conducted under VMC during daylight switch off the alternator and the battery.

If the smoke is still coming into the cabin despite of measures taken, operate, as described above in the beginning of this section.

5.7. Pilot Actions - Forced Landing

1. Upon deciding to conduct a forced landing notify the ATC.

2. Engine-out forced landing at an aerodrome is conducted with landing gear and landing flap retracted at indicated airspeed of 160-170 km/h. Landing gear and flaps should be extended only when the safe landing is assured.

3. Forced landing outside of an aerodrome at an unfamiliar (unprepared) place is performed only with landing gear retracted; landing flap is extended at pilot's discretion, depending on situation.

4. During a forced landing outside of an aerodrome at an unfamiliar place pilot should:

- Set the gliding speed of 160-170 km/h;
- Choose a landing field;
- Retract the landing gear (if extended);
- Close the fire cock;
- Switch off the magnetos, ignition **АЗС ЗАЖИГ** circuit breaker and the battery (during night flight or flight in IMC do not switch off the battery);
- Extend the landing flap when the landing is assured;
- At night or in poor visibility switch on the landing light;
- Plan to land long in order to correct the approach further with slipping;
- Before landing flare unlatch the cabin door.

5.8. Pilot Actions - Emergency Landing Gear Extension

1. Landing gear emergency extension procedure:

- Check air pressure in auxiliary air cylinder;
- Close the main air cock **ЗАРЯДКА СЕТИ** (to prevent air bleeding in case of the inward valve refusal);
- Set landing gear lever to (neutral) **НЕИТР.** position;
- Open emergency gear release valve **АВАР. ШАССИ** ;
- Check gear down as three green "Gear down" lights illuminate mechanical landing gear position indicators coming out;
- Set landing gear lever to **ВЫП.** (down) position.;

- Leave emergency gear release valve **АВАР. ШАССИ** in the open position until the end of the flight;
- Completing the landing and the landing roll, clear the runway and, ensured that brakes operate effectively, taxi to parking.

Warning! It is forbidden to retract the landing gear after emergency gear extension. Emergency gear extension for the training purposes is made using a backpressure from the main air system.

2. If the landing gear fails to extend either the basic or emergency way, landing with landing gear should be made only on unpaved runway.

Note. *If after emergency landing gear extension, a necessity to make an emergency landing outside an aerodrome has arisen (at which the gear should be retracted again):*

- Close the **АВАР. ШАССИ** valve;
- Check the main air supply **ЗАРЯДКА СЕТИ** closed;
- Set landing gear lever to neutral position;
- Release backpressure repeatedly applying a brake trigger (the manometer of the basic air system must show 0 kgs/cm²);
- Open the main air supply **ЗАРЯДКА СЕТИ** ;
- Set landing gear lever to **УБРАНО** (up) position;
- Check gear up using the electric and mechanical signal system.

5.9. Pilot Actions - Emergency Landing Flap Extension

To emergency extend the landing flap:

- Check air pressure in auxiliary air cylinder;
- Close the main air cock **ЗАРЯДКА СЕТИ** ;
- Open emergency gear release valve **АВАР. ШАССИ** ;
- Set landing flap lever to **ВЫП.** (down) position.;
- Check landing flap extended by the red light **ЩИТОК ВЫПУЩЕН** illumination.

5.10. Landing With Landing Flap Retracted

If landing flap does not extend in flight either the basic or the emergency way, land with the flap retracted.

Maintain 150-160 km/h after turn to the final. Landing with landing flap retracted has no essential differences from normal landing.

In this case keep in mind, that gliding range, skimming time and touchdown speed will be higher than during normal landing.

5.11. Pilot Actions - Wheel Brakes Failure

1. If brakes fail during taxi, stop taxiing, shut down the engine and find out the reason of failure.
2. If brakes fail during the landing roll:

At the end of the landing roll notify the ATC about the brakes failure and clear the runway if possible;

During taxi check up air pressure in the main air system and if it is normal, switch off the engine. If the air pressure in

the system is zero, close main air cock **ЗАРЯДКА СЕТИ** and open emergency gear release valve **АВАР. ШАССИ** , then, ensured that the brakes operate properly, continue taxi at minimum speed. During taxi, watch air pressure in

auxiliary system. If brakes do not function after emergency gear release valve **АВАР. ШАССИ** opening or air pressure is insufficient for braking, switch off the engine.

5.12. Pilot Actions - Communication Radio Failure

1. In all cases of sudden radio communication loss pilot should:
 - Check if headset plugs are secure;
 - Check if volume control is at maximum;
 - Check up radio communication on other communication channels;
 - Check if **СПУ** (intercom) and **УКВ** (VHF) circuit breakers are ON;

- Replace a fuse on the radio station block stand in an instrument compartment if possible.
- 2. When the radio failure is assured, pilot must abort the flight, increase attention and land at the home aerodrome (departure aerodrome) or operate according to NPP GA (FAA) recommendations.

5.13. Pilot Actions - Electrical Alternator Failure

1. Alternator failure is defined as the red light **ОТКАЗ ГЕНЕР** (alternator failure) on the annunciator panel is flashing and by the ammeter indication. The ammeter will show the battery discharge rate (the needle will deviate to the right from zero).
2. If the alternator has failed pilot should:
 - Switch off the alternator;
 - Switch off the maximal number of electric devices, except for **ЗАЖИГ** (ignition), **СИГН. ШАССИ** (gear position indicator), **ПРИБ. ДВИГ.** (engine instruments), **ЗУП** (turn and slip indicator) circuit breakers, flashing beacon in visual flight (VFR) conditions and **АНО** (navigation lights) at night;
 - Abort the flight and land at either home or alternate aerodrome.

3. The communication radio transmitter and Automatic Direction Finder should be operated only in the case of necessity for short periods of time and not simultaneously.

Note. The onboard **20НКБН-25** (20NKBN-25) battery is capable to feed the devices for 35-40 minutes at night, and 50 minutes in daytime conditions with alternator switched off.

5.14. Pilot Actions - DC-AC Converter PO-250A Failure

If PO-250A converter fails, ARK-9 (ADF), radio altimeter and marker beacon receiver MRP-56P disconnect simultaneously.

If the PO-250A failure is assured, pilot should:

- Switch off **ПО-250А**, **РВ**, **АРК**, **МРП** circuit breakers.

Fly to the destination aerodrome using GMK-1AE course system in a combination with approach radar control information or visual orientation.

5.15. Pilot Actions - DC-AC Converter PT-200TS Failure

1. If PT-200TS converter fails, artificial horizon AGD-1K, course system GMK-1AE and ADF (on the planes equipped with ARK-15M Automatic Direction Finder) disconnect simultaneously.

If the PT-200S failure is assured by the red **ОТКАЗ ПТ-200** annunciator lamp illumination, pilot should:

- Switch off the **ПТ-200Ц**, **АРК** (ADF, ARK-15M), **ГМК**, **АГД** circuit breakers on electrical control panel.

2. Fly visually and using the EUP-53 instrument. Fly aircraft to the destination aerodrome visually, using the KI-13K compass, ARK-9 Automatic Direction Finder and using the approach radar control information.

5.16. Pilot Actions - Airspeed Indicator Failure

If airspeed indicator has failed:

- Abort the flight and follow to the destination or alternate aerodrome;
- Check **ПВД** (Pitot heat) circuit breaker ON;
- Fly the aircraft by watching the position of the nose of the aircraft against the horizon, and vertical speed indicator, artificial horizon, altimeter and monitor the engine power setting.
- To avoid airspeed loss during final phases of flight pay special attention to the nose position relative to the horizon.

5.17. Pilot Actions - Emergency Bail-Out

During the initial pilot training flights, including simple and advanced maneuvers training in a training zone, the crew must wear on the parachutes which must be properly packed and adjusted on the ground prior to flight.

1. Emergency bail out is performed in the following cases:
 - fire in flight;
 - If the aircraft does not recover from a spin at altitude higher than 1000 meters AGL;
 - In case of controllability loss;
 - In all cases when the forced landing does not guarantee crew life.

Note. *Safe bailing-out in straight-and-level flight and during gliding is provided up to the 220 km/h indicated airspeed.*

The minimal safe bailing-out altitude in straight-and-level flight is 150 meters AGL.

2. The order of commands and their executions. Pilot-in-command commands: "Prepare to leave the aircraft" and an executive command: "Leave the aircraft".

Crew members leave the aircraft in the following sequence (priority):

- Trainee (the co-pilot);
- Instructor (pilot in command).

If the aircraft is uncontrollable only the executive command is given: "Bail out".

When departed the aircraft, the parachute is put into operation by the KAP-3P (PPK-3P) automatic device or manually by the ring on the suspension system.

The automatic device is set for 3 second and for altitude of 1000 m AGL.

3. Bailing-out crew actions (controllable aircraft).

Before abandoning a controllable aircraft establish level flight and reduce indicated airspeed to 220 km/h.

Bailing out from the left seat. By the command "Prepare to bail out":

- Disconnect the helmet plug or remove the headset;
- Move the seat to full back position;
- Release the shoulder harness and seat belts;

By the command "Bail out":

- Unlatch the left door;
- Remove feet from pedals;
- Turn yourself left;
- Grasp the forward side of the doorway by the right hand and the aft side of the doorway by the left hand;
- Put the left leg onto the wing, rise yourself a little from the seat, bend the head forward and with a jerk separate from the seat;
- Upon appearing on the wing, group yourself and slide off the wing.

Bailing out from the right seat:

- Disconnect the helmet plug or remove the headset;
- Move the seat to full back position;
- Release the shoulder harness and seat belts;
- Unlatch the right door;
- Remove feet from pedals;
- Turn yourself right;
- Grasp the forward side of the doorway by the left hand and the aft side of the doorway by right the hand;
- Put the right leg onto the wing, rise a little from the seat, bend the head forward and with a jerk separate from the seat;
- Upon appearing on the wing group yourself and slide off the wing.

4. Recommendations for emergency abandoning the aircraft in inverted flight, spin, dive and spiral dive:

- Unlatch the left door;
- Disconnect the helmet plug or remove the headset;
- Remove feet from pedals;
- Release the shoulder harness and seat belts;

Abandon the aircraft in a spin or spiral one crew member after another through one door inside the maneuver vigorously jerking by hands and legs from a door edge and along a wing.

Prepare to abandon the aircraft as specified in items 2 and 3.

SECTION 6 OPERATION OF AIRCRAFT EQUIPMENT AND SYSTEMS

6.1. Aircraft Intercom System SPU-9

The device is intended for:

- Internal radio communication between crew members;
 - External radio communication (between crew and another land and airborne radio stations) through radio station;
 - Audio monitoring by crew members of the ADF signals;
 - Reception by crew members **ОПАСНАЯ ВЫСОТА, СРЫВ** (danger alt, stall) and marker beacon signals.
 - Also two additional crew members are able to receive internal and external radio communication signals.
- Additional intercom control devices are located on the left and right sides of an instrument panel.

Two headset plugs are located on brackets near forward doorway edge and another two – on the back doorway edge.

The intercom is powered by 27V DC.

To switch on the intercom operate **СПУ** circuit breaker on the left electrical switch panel.

Intercom SPU-9 allows users to:

- Hold external and internal communications using **РАДИО** (radio) and **СПУ** (SPU) buttons respectively located on the control yoke; adjust volume level rotating **СПУ** and **РАДИО** handles on user's control units;
- Listen to ADF operation if the **РК-ВЫКЛ.** switch on user's control unit is in **РК** position;
- Listen to **ОПАСНАЯ ВЫСОТА, СРЫВ** (danger alt, stall) and marker beacon audio signals irrespective of controls position with 100 % volume level.

Warning! The **РЕЗ.** (RESERVE, ALTERNATE) switch on user's control unit should always be in the switched off (lower) position. If the first (initially connected) user device fails, operate **РЕЗ.** switch ON (upper position) to connect the headset to another unit.

6.2. Communication Radio Baklan-5 *("Baklan" is a Russian word for cormorant)*

1. On Yak-18T aircraft, "Baklan-5" radio station with a control unit located on an instrument panel is installed. This radio station is protected by **УКВ** (VHF) circuit breaker located on electrical switch panel and is powered by 27V DC.

The radio station provides long-time work with a following cycle: 1 minute - transmission, 4 minutes - reception.

Operation of the transmitting channel during transmission is checked by listening of own transmission.

Operation of the radio may be conducted from either left or right seat.

2. Before switching on the radio station, move **ПШ-ВЫКЛ.** (noise reduction) switch to **ВЫКЛ.** (OFF) position, and set volume to maximum.

3. To switch on the radio station set **СПУ** ("SPU", intercom) and **УКВ** ("VHF") circuit breakers to ON position (the radio station is ready to work in 1 minute after), the noise of the receiver should be heard in the headsets.

4. Before setting the frequency push the **РК-ВЫКЛ.** switch on SPU control unit to **ВЫКЛ.** (OFF) position, then set the required communication frequency operating the handles on the radio control unit.

5. To start a transmission press the **РАДИО** (RADIO) button on the control yoke and start the transmission.

6. To switch on the noise reduction set the ПШ-ВЫКЛ. switch to ПШ (noise reduction) position.

7. To switch off the radio set УКВ (VHF) circuit breaker to OFF position.

6.2a. Communication Radio Landysh-5 *("Landysh" is a Russian word for the lily of the valley)*

1. Some Yak-18T aircrafts are equipped with "Landysh-5" radio stations. This radio station has a panel-mounted control unit. It is protected by УКВ (VHF) circuit breaker located on the electrical switch panel. The radio station may be operated either from left or right seat.

2. Before switching on the radio station, move the ПШ-ВЫКЛ.(noise reduction) switch to ВЫКЛ.(OFF) position, and set volume to maximum.

3. To switch on the radio station set the СПУ (intercom) and УКВ (radio) circuit breakers to ON position (the radio station is ready to work in 2 minutes after), the noise of the receiver should be heard in the headsets.

4. Set the required communication frequency.

5. To start a transmission press the РАДИО (RADIO) button on a control yoke and start the transmission.

6. To switch on the noise reduction set its switch to ПШ (noise reduction) position.

7. To switch off the radio set the УКВ (VHF) circuit breaker to OFF position.

6.3. Automatic Direction Finder ARK-9

ARK-9 Automatic Direction Finder (ADF) is used for automatic determination of radio station relative bearings, air navigation using Non-Directional Beacons (NDB) and broadcasting radio stations, for NDB approaches and instrument landings using NDB landing facilities.

Working frequency range of ARK-9 Automatic Direction Finder is from 150 up to 1300 kHz. Range at altitude of 1000 m is about 160 km.

ADF control unit is mounted on the right instrument panel. UGR-4UK gauge is used as relative bearings indicator. It is possible to tune two working frequencies on ADF. For fine adjustment of the receiver there are two frequency adjustment handles on the ADF control unit, the handle FINE TUNING (ПОДСТРОЙКА) and the signal level indicator.

To select one of these two working frequencies in flight and on the ground a Б-Д (Near - Distant) switch is mounted on the instrument panel.

To listen to NDB Morse signals set the РК-ВЫКЛ. switch on active SPU-9 (intercom) control unit to РК position.

ARK-9 is powered through PO-250 converter (115 V, 400 Hz). The supply circuit is protected by ПО-250А and АРК circuit breakers mounted on the switchboard.

To switch on, to tune and to check the ADF:

- Switch on ПО-250А and АРК circuit breakers on the switchboard;

- Set РК-ВЫКЛ. switch on SPU control unit to РК position;

- Set the mode switch on the ADF control panel to АНТ (antenna) position and ТЛГ-ТЛФ (Morse - Phone) switch to the position depending on a radio station operation mode;

- Set the Б-Д switch on the instrument panel to «Б» ("Near") position, by the left frequency adjustment handle (on ADF control unit) set the inner (middle) marker frequency (or other desired frequency), listen the audio signal (Morse code if beacon is tuned) from the radio station and fine tune the ADF by the ПОДСТРОЙКА (FINE TUNING) handle, observing deflection of the signal level indicator's needle to the right as far as possible.

For more exact tuning it is recommended to set the signal level two points lower than maximum by the gain control (volume selector) from the control panel and after tuning the frequency set volume to maximum position;

- Do similar actions by the right tune handle having set the Б-Д switch to «Д» position (outer marker frequency is usually set here during landing approaches);

- Set the mode switch on the ADF control panel to **КОМП.** (COMPASS) position, the ADF needle of the UGR-4UK gauge should show the selected radio station relative bearing (outer marker if set);
- Set **ПК-ВЫКЛ.** switch on active SPU control unit to **ВЫКЛ.** (OFF) position.

To switch off the Automatic Direction Finder:

- Set the mode switch on the control panel to **ВЫКЛ.** position;
- Switch off the **АРК** and the **ПО-250А** circuit breakers.

6.4. Automatic Direction Finder ARK-15M

ARK-15M Automatic Direction Finder (ADF) is used for automatic determination of radio station relative bearings, air navigation using Non-Directional Beacons (NDB) and broadcasting radio stations, for NDB approaches and instrument landings using NDB landing facilities.

Radio frequency range of ARK-15M Automatic Direction Finder is from 150 up to 1799,5 kHz. Accuracy of frequency tune is +/-100 Hz. Range at altitude of 1000 m is at least 180 kilometres. ADF control unit is mounted on the right instrument panel. UGR-4UK gauge is used as relative bearings indicator.

To listen NDB Morse code set the **ПК-ВЫКЛ.** switch on SPU control unit to **ПК** position. It is possible to tune ADF on any two working frequencies; there are two handles and **КАНАЛ-1-2** (CHANNEL-1-2) switch on a control panel for this purpose. Also a **Б-Д** (Near - Distant) switch is mounted on the instrument panel to provide quick selection of the radio stations pre-tuned on the ADF control panel.

ARK-15M is powered from the onboard 27V DC power circuit through **АРК** circuit breaker, located on the instrument panel, and from the 36V 400 Hz power circuit from PT-200TS converter through the safety fuse **СП-1** located on the alternating currency fuse board.

The basic features of Automatic Direction Finder ARK-15M: motionless loop antenna, fixed frequencies adjustment through 0,5 kilohertz and modular and hardware construction built completely on transistors.

To switch on, tune and test the ADF:

- Switch on **ПТ-200Ц**, **АРК** and **СПУ** circuit breakers on the switchboard;
- Set **ПК-ВЫКЛ.** switch on SPU control unit to **ПК** position;
- Set the mode switch on the ADF control panel to **АНТ** (antenna) position and **ТЛГ-ТЛФ** (Morse - Phone) switch to the position depending on a ground radio station operation mode;
- Set the **Б-Д** switch on the instrument panel to **«Б»** position;
- Set the **КАНАЛ-1-2** switch on the ADF control panel to position "1", set the frequency of the desired radio station (inner or middle marker usually) using the left adjustment knob and listen to its signal (Morse code);
- Set the **Б-Д** switch on the instrument panel to **«Д»** position, set the **КАНАЛ-1-2** switch on the ADF control panel to position "2", set the frequency of the desired radio station (outer marker NDB usually) using the right adjustment knob and listen to its signal (Morse code);
- Set the mode switch to **КОМП.** (COMPASS) position, the ADF needle of the UGR-4UK gauge should show the selected radio station's relative bearing (outer marker if set);
- Press **РАМКА** (loop antenna) button on a control panel and observe deflection of the ADF needle on the UGR-4UK gauge for 90-100° from the selected radio station's relative bearing indication, release the button, the arrow should move with a speed not lower than 30 degree/sec and settle back on the relative bearing indication;
- Check operational capability of the **ТЛГ-ТЛФ** (Morse - Phone) switch for sound presence in phones in Morse mode and its loss in Phone mode;
- Check volume regulator operation by changing the level of a signal in phones rotating the **ГРОМК.** (VOLUME) handle on a control panel;

Set the **Б-Д** switch on the instrument panel to **«Б»** position, set the **КАНАЛ-1-2** switch on a control panel to position "1" and make similar Automatic Direction Finder check on channel pre-tuned here (inner or middle marker usually).

To switch off the Automatic Direction Finder:

- Set the mode switch on the control panel to **ВЫКЛ.** position;
- Switch off the **АРК** and **ПТ-200Ц** circuit breakers.

6.5. Course Tracking System GMK-1AE

6.5.1. Purpose

Course system GMK-1AE is used for heading, turn angles, magnetic and true bearings definition and indication. GMK-1AE has following elements:

- ID-3 induction sensor;
- KM-8 correction mechanism;
- PU-26E control unit;
- GA-6 directional gyro;
- UGR-4UK indicator;
- AS-1 slave mechanism.

Depending on flight tasks and conditions, the system can work in "magnetic correction" (MK) or "gyro" (**ГПК**) modes.

GMK- 1AE course system is powered from 36V AC circuit through PT-200TS converter.

6.5.2. Pre-Flight Preparation. Switching On

To switch on the course system before the flight:

- Set **СЕВ. - ЮЖН.** (Northern/Southern) switch on a control unit to **СЕВ.** (Northern) position to fly in the Northern hemisphere and to **ЮЖН.** (Southern) position to fly in the Southern hemisphere;
- Set the current aircraft latitude by **ШИРОТА** (Latitude) knob;
- Set magnetic variation to 0° on KM-8 correction mechanism;
- Switch on power of the course system.

The course system will come to normal operation mode in 3 minutes for MK mode and in 5 minutes for **ГПК** mode.

Make a pre-flight check of the course system in 3 minutes after switching on the power.

6.5.3. Pre-Flight Check

To check the course system before the flight:

- Set the **КОНТРОЛЬ** (Test) switch to "0" and then to "300" positions, check the compass card on UGR-4UK turns in order within the limits of 350-10 degrees and 290-310 degrees;
 - Set **ГПК** mode and, deflect the **ЗК** (HEADING SELECTOR) switch to the left or right side, observe the respective compass rotation;
- Set "MK" mode and by means of short-term switching to **ГПК** mode slave the system.

6.5.4. System Operation in Flight

6.5.4.1. Flight in MK mode

To fly in MK mode it is necessary to:

- Set zero on KM-8 correction mechanism;
- Set MK mode;
- After take-off and climb bring the aircraft to the initial point of a route (**ИПМ**);
- Pass above initial point of a route with a first route segment heading (loxodromic);
- Approaching an intermediate en-route turning point (**ППМ**), at a turn starting point (according to calculated turn parameters for **ЛУР** (turn anticipation) turn the aircraft to the next route segment heading.

Fly this way via all following route segments.

6.5.4.2. Flight in GPK (GYRO) mode

To flight in ГПК mode it is necessary to:

- Set KM-8 to zero;
- Set by ШИРОТА (Latitude) knob the latitude of departure aerodrome;
- Set mode switch to ГПК position;
- Set runway magnetic heading by ЗК (HEADING SELECTOR) switch on runway line-up if it is necessary.

From this moment the heading indicator will show orthodromic (great-circle) gyro magnetic heading (ОМК) relative to the aerodrome of departure meridian;

bring the plane to the first segment of a route with $ОМК = ОЗМПУ - УС$ (ORTHODROMIC MAGNETIC HEADING = ORTHODROMIC PLANNED MAGNETIC COURSE – SLIP ANGLE).

As a result of minor hardware errors, aircraft handling and slip determination mistakes the desired orthodromic direction can be slowly lost. That will lead to lateral deviation from the planned course.

To reduce the lateral deviation when getting on course:

- watch the heading indication;
- watch a slip angle change;
- control course using other navigational aids.

To stay on planned course:

- specify the average route segments latitude and enter it if necessary;
- watch slip angle changes, correct the heading in order to stay on the orthodromic planned magnetic course (ОЗМПУ);
- approaching the next route segment define a turn angle (УР) according to the formula

$$УР = ОЗМПУ 2 - ОЗМПУ 1,$$

Where $ОЗМПУ 1$ - orthodromic planned magnetic course of a current route segment;
 $ОЗМПУ 2$ - orthodromic planned magnetic course of the next route segment.

If УР has a plus sign turn to the right, if a minus sign turn to the left;

- Approaching the destination aerodrome (before descent) switch the course system to MK mode and make the correction (slave it) by МК - ГПК switch;
- After correction, switch the system to ГПК mode again.

Note. To perform in-flight control over the course system readings in ГПК mode use KI-13 magnetic compass and KM-8 correction mechanism.

6.5.5. Failures and Malfunctions of GMK-1AE Course Tracking System

Failure or Malfunction	Identification	Crew actions
Gyro failure	The warning light ЗАВАЛ ГА (Gyro tumble) illuminates on PU-26E control unit	Use KM-8 and KI-13 for heading calculations
ID-3 and KM-8 failure	Unstable and wrong magnetic heading indication on the KM-8 card and unstable and wrong gyro magnetic heading indications in straight-and-level flight	Switch the system to ГПК mode and use heading indications on UGR-4UK gauge. Also use KI-13 indications

6.6. Magnetic compass KI-13

KI-13 magnetic compass is used as a auxiliary device for a magnetic heading determination.

Keep in mind, that residual deviation of KI-13 can reach 10° on some headings.

Turns with the reference to the magnetic compass may be performed only if bank angle does not exceed $5-7^\circ$. During the roll out on the new heading take into account the northern headings turning mistake which is equal approximately to the bank angle. Read the KI-13 indication only when its card is stable.

6.7. Artificial Horizon AGD-1K

1. AGD-1K artificial horizon is used to inform pilot of aircraft bank and pitch attitude relative to natural horizon and of the slipping angle.

2. The artificial horizon must be switched on after engine start and PT-200TS converter switching on. To switch on the artificial horizon set the PT-200 and the AGD circuit breakers to ON position. AGD – 1K cages automatically after switching on.

Normal start of an artificial horizon is provided if an aircraft is on the ramp with $\pm 4^\circ$ pitch and/or bank angle.

3. On runway line-up, before take-off, the crew should check up the operation of an artificial horizon to ensure that:

- The small airplane on the attitude indicator is aligned with the horizon line of the indicator;
- The scale (indicators background) is movable by rotation of the pitch adjustment knob; set the scale to zero after AGD operation check;
- The red warning light (which warns about power missing on AGD) does not illuminate.

If at least one of the steps specified above has not been accomplished, take-off is **forbidden**.

Take-off not earlier than 3 minutes after artificial horizon switch on (it takes 3 minutes for AGD to come into normal operation after starting)!

Warning! It is forbidden to use the cage knob during AGD-1 start up, forbidden to use the cage knob on the ground or in-flight if the artificial horizon works normally.

4. The AGD bank and pitch angles working range is 360° , except $85-95^\circ$ pitch angles in a dive or a zoom.

Maximum allowable indication errors:

- After take-off - not higher than $\pm 3^\circ$;
- After 360° turns - not higher than $\pm 3^\circ$ (sometimes deviations up to $5-6^\circ$ are possible);
- After aerobatic maneuvers - not higher than $\pm 5^\circ$.

5. If AGD-1K shows wrong indications in flight, set straight-and-level flight and press

АРРЕТИР. ТОЛЬКО ГОРИЗ. ПОЛЕТА (cage only in straight-and-level flight) button, located on the front side of the attitude indicator. The cage light on the attitude indicator should illuminate, and upon caging the cage light will extinguish. Ensure that artificial horizon works normally. Continue the flight with increased attention, comparing AGD indications with EUP (turn-and-slip indicator) readings and with the aircraft's nose position against the natural horizon.

Note. Do not use the cage button at pitch angles more than $\pm 4^\circ$, because it can disconnect longitudinal axis correction of a gyroscope.

To switch off AGD – 1K set the AGD circuit breaker located on the switchboard to OFF position.

6. If the artificial horizon fails, define the aircraft actual attitude and bank using natural horizon, the EUP-53U indicator combined with vertical speed indicator and airspeed indications.

6.8. Turn-and-Slip Indicator EUP-53U

The electrically driven turn-and-slip EUP-53U indicator is used to provide indication of turn coordination with banks up to 45° .

It combines turn and slip indicators. The turn rate is indicated by the needle, and the amount of slip is indicated by the ball.

The instrument error under normal flight conditions in $15, 30, 45^\circ$ bank turns with angular speeds 1,1; 2,3 and 4 degrees/second respectively is $\pm 1,5^\circ$.

6.9. Radio Altimeter RV-5

6.9.1. General Information

RV-5 radio altimeter is used for absolute altitude measurement in a range of 0-750 m and for alerting about reaching the preset altitude.

Altitude indicator is UV-5 device mounted on the instrument panel. On a flange of the device there is

УСТАН. ВЫСОТ (altitude preset) knob with a yellow alarm light built in it and the **КОНТРОЛЬ** (control) button with the red alarm light built in it.

Rotation of the **УСТАН. ВЫСОТ** knob tunes preset altitude reaching alert system, the value of presetting altitude is counted by the yellow triangular index moving on a scale.

When the aircraft reaches the preset altitude the yellow light illuminates and 400 Hz sound signal is simultaneously heard in pilot's headphones during 3-9 seconds

If the **КОНТРОЛЬ** button is pressed on the operational radio altimeter, control height 15 +/-1,5 m is set up on the indicator. After releasing the button the device will show absolute flight altitude (or H=0 if on the ground).

RV-5 radio altimeter is switched on and its supply circuit is protected by the radio altimeter circuit breaker located on the switchboard.

6.9.2. Radio Altimeter Pre-Flight Check

Switch on RV-5 power supply by **РВ** circuit breaker. The red alarm light should illuminate, and the altimeter needle should move aside 750 m figure and overrun the scale black sector. After radio altimeter warms up the red light should extinguish, and the needle establish on 0 +/-0,8 m indication.

Set the yellow triangular index to 10 m indication by **УСТАН. ВЫСОТ** knob.

Press and hold the **КОНТРОЛЬ** button. This should establish the needle on the control altitude value of 15 +/-1,5 m.

Release the **КОНТРОЛЬ** button. The arrow will move to zero. When the needle passes through 10 m indication, the altitude alerting system will turn on - the yellow alarm light on altimeter's face will illuminate and the sound signal will be heard in pilot's phones.

6.9.3. Radio Altimeter Operation in Flight

Before take-off, it is necessary to:

- Switch on the **РВ** circuit breaker. RV-5 will be ready to use in 2 - 3 minutes;
- Rotate the **УСТАН. ВЫСОТ** knob to preset the value of decision height to be signalled.

Radio altimeter will work in flight the following way:

- When the aircraft reaches altitude of more than 750 m the needle on the UV-5 face will go to the black sector of the scale and will stay there all the time of flight until the aircraft will descend below 750 m; at the moment when the arrow passes the yellow preset decision height index, the yellow alarm light on RV-5 will illuminate and then extinguish, the sound will be heard in pilot's phones;
- When the aircraft reaches altitude of 1200 m and above, the red alarm light which is built into the **КОНТРОЛЬ** button will illuminate, the light will extinguish when the aircraft descends below 1200 m;
- At altitudes 750 m and lower the needle will show absolute flight altitude, and at the further descent radio altimeter will signal reaching of the decision height.

Attention! At bank and pitch angles more than 30°, RV-5 indications should not be trusted!

- After landing, switch off the radio altimeter;
- If the radio altimeter fails in flight at heights below 750 m AGL, the red alarm light - a signal of the altimeter malfunction - will illuminate. In this case it is necessary to switch off the radio altimeter.

6.10. Instrument Landing Approach System OS-1

6.10.1. General Information

OS-1 equipment is used for ILS and SP-50 landing approaches

OS-1 hardware sends deviation signals from on-ground beacon course and glideslope equisignal zones to PSP-48 gauge's course and glideslope needles (bars). It also signals passing outer and inner (middle) marker beacons.

OS-1 is managed by the control unit located on the left side of the instrument panel. On the control unit the following devices are placed:

- The Power switch;
- The frequency set knob and indicator;
- The SP-50 – ILS mode selector;
- Test buttons.

The active frequency is set by the frequency set knob on the KRP-69 course receiver in the range from 108,1 up to 111,9 MHz with 0,2 MHz interval. Glideslope frequency on the glideslope GRP-66 receiver tunes up automatically.

MRP-66 marker signal receiver works on fixed frequency of 75 MHz, it comes into operation simultaneously with all the OS-1 equipment and has no operating controls at all.

There is built-in self-test system in OS-1 hardware, which is operated from the control unit.

Power to the OS-1 system is supplied from an onboard 27V DC circuit. Protection is provided by the OS-1 circuit breaker located on the switchboard.

6.10.2. Switching On and Checks of OS-1 System before Flight

Switch on and test the equipment in the following order:

- Switch On the **ОСЬ-1** circuit breaker on the switchboard;
- Move the power switch on the OS-1 control unit to **ВКЛ** (ON) position;
- Move the **СП-50 - ILS** mode selector switch into **СП-50** position;
- Set the frequency 110,3 MHz on the indicator by the frequency set knob;
- Press the left **КОНТРОЛЬ** button. Glideslope and course failure flags should disappear, the course needle on the PSP-48 device should deviate to the left and take position between 3-rd and 5-th points, and the glideslope needle - upwards and take position between 3-rd and 5-th points. **МАРКЕР** (MARKER) window should illuminate on the annunciator panel;
- Press the middle **КОНТРОЛЬ** button. Glideslope and course failure flags should disappear, course and glideslope needles should come into centre position; **МАРКЕР** window should illuminate on the annunciator panel;
- Press the right **КОНТРОЛЬ** button. Glideslope and course failure flags should disappear, the course needle on the PSP-48 device should deviate to the right and take position between 3-rd and 5-th points, and the glideslope needle - downwards and take position between 3-rd and 5-th points. **МАРКЕР** window should illuminate on the annunciator panel.

6.10.3. Operation of System in Flight

To operate the equipment in flight:

- Set the **СП-50 - ILS** switch to the necessary position;
- Set the landing runway's ILS or SP-50 frequency by the frequency set knob;
- When the aircraft enters a course and glideslope operating range, glideslope and course failure flags would disappear on the PSP-48 device, and needles would show a deviation of the aircraft from course and glideslope beams;
- **МАРКЕР** window would blink on the annunciator panel in the form of long impulses (dash) above outer markers and short impulses (points) above inner markers;
- After landing switch off the equipment moving power switch on the control unit and **ОСЬ-1** circuit breaker located on the switchboard to OFF position.

Note. If one of SP-50/ILS frequencies in the aerodrome is 110.3 MHz do not use this frequency to conduct the systems self-test. Use the 110.1 MHz frequency instead.

6.11. Operating Windscreen Wiper

1. Maximum windscreen wiper operation speed is 220 km/h. The windscreen wiper is managed by **Стеклоочист.** (Wiper) switch, which is mounted on the left instrument panel.

The **Стеклоочист.** switch has four fixed positions: **Пуск** (start-up), **1 скорость** (speed 1), **2 скорость** (speed 2), neutral (the switched off position) and **Исход** (home position).

2. To switch on the windscreen wiper:

At outside air temperatures $+30 \div -20^{\circ}$ **Стеклоочист.** switch may be set to any of the following positions: **Пуск**, **1 скорость** or **2 скорость**. In **Пуск** position the wiper should work no longer than 5 minutes; in **1 скорость** or **2 скорость** positions working time is unlimited.

Notes:

1. At outside air temperatures above -20° , the **Стеклоочист.** switch may be set directly to "Speed 1" or "Speed 2" position.

2. The number of double turns of a windscreen wiper's brush during 1 minute at first or second speed positions:

1 скорость "speed 1" - 64-90;

2 скорость "speed 2" - 38-60.

3. At outside air temperatures below -20° move the **Стеклоочист.** switch into **Пуск** position for no longer than 3 minutes with its subsequent movement into **1 скорость** position.

Warnings.

1. Setting the **Стеклоочист. switch to **2 скорость** position when air temperatures are below -20° C is prohibited!**

2. If checking the windscreen wiper on dry glass, the maximum continuous operation time for the wiper is 10 seconds.

3. To switch off the screen wiper set the switch to neutral position from any speed.

4. Return the brush of a screen wiper to the home position when it stopped.

Keep the **Стеклоочист.** switch in **Исход** position for no longer than 2-3 seconds after the brush of the windscreen wiper takes place in the home position.

6.12. Cabin Heating and Ventilation System

To create normal temperature conditions inside the cabin of the aircraft the system of cabin heating and ventilation is installed on aircraft. For wintertime operations, a heater is installed in the forward fuselage compartment under the cowling. The control lever of warm airflow from the heater is mounted on the right side of the cabin. Warm air reaches the cabin through the air outlets located by pilot's legs and by the windscreen. It is possible to switch on the heating system after the engine start both in flight and on the ground.

For the summertime operations, the heater should be removed.

During summertime operations, ventilation from the relative wind is used on the aircraft. Individual ventilation nozzles are located on the left and on the right walls of the cabin and also on the ceiling.

6.13. Pitot-Static Instruments and Pitot-Static System

6.13.1. Purpose and General Description of the Pitot-Static Instruments

To measure flight altitudes, horizontal and vertical speeds the following Pitot-static instruments are installed on the aircraft:

- VD-10K altimeter;
- US-450K airspeed indicator;
- VR-10MK vertical speed indicator.

The air pressures PVD-6M sensor tube is connected to the instruments by the ram air pressure (painted in black colour) and the static pressure (white colour) pipelines. US-450K, VD-10K and VR-10MK devices are connected to the static system and only US-450K - to the dynamic (ram and static) pressure system.

The PVD-6M Pitot tube is mounted on the left part of the wing on a special 500 mm length bar on the frontal edge of the wing in a zone of undisturbed air stream.

The PVD-6M sensor has a heating element which is switched on by the **ОБОГРЕВ ЧАСЫ, ПВД** (clock and Pitot tube heating) circuit breaker which is mounted on the right part of the switchboard. The heating element is supplied by 27V DC power.

6.13.2. Operation of Instruments in Flight

Before the flight. Set the aerodrome's barometric pressure on the altimeter pressure scale according to current control tower information before take-off.

Before take-off. Check that indication on the altimeter pressure scale corresponds to atmospheric pressure on the aerodrome elevation. On holding position, switch on the PVD-6M heat.

In flight. 1. Control the vertical speed in climb and descent by the VR-10MK vertical speed indicator and the airspeed by the US-450K airspeed indicator.

2. If the aircraft enters rain, snow or icing condition switch on the PVD-6M tube heat using the **ОБОГРЕВ ЧАСЫ, ПВД** circuit breaker.

After landing. Switch off Pitot heat after landing during taxi.

6.13.3. Operational Restrictions

1. The allowable difference between pressure indication on the VD-10K altimeter barometric pressure scale and atmospheric pressure at the aerodrome elevation is ± 1.5 mm HG. Do not coordinate altimeter scales directly on the aircraft.

2. Maximum time of continuous operation of the PVD-6M heating element on the ground is no more than 5 minutes.

6.13.4. Power Supply systems of Pitot-Static Instruments. Pilot Actions in Case of Failure.

1. Plugging or icing of the static pressure sensor (static pressure holes of PVD-6M Pitot tube).

If the instruments static line is pressurized, this malfunction is determined by the following indications:

- The VR-10MK vertical speed indicator needle settles in zero position and does not change its position during altitude changes;
- VD-10K altimeter does not change its indications when altitude changes;
- US-450K airspeed indicator will undervalue its indications during climbs and overvalue during descends.

Pilot actions.

If altimeter, airspeed indicator or vertical speed indicator fails, pilot has to check **ОБОГРЕВ ЧАСЫ, ПВД** circuit breaker switched ON, continue the flight using artificial horizon and radio altimeter indications. Airspeed is controlled by the power setting with use of tachometer and manifold pressure indications.

2. Plugging or icing of the ram air pressure hole.

The main reason of the PVD-6M Pitot tube plugging is its icing. It occurs if the electric heating element was not switched on in time or has failed. Sometimes ram pressure hole of the Pitot tube freezes and plugs, but water drain holes remain open. In this case, in the ram pressure chamber of the sensor atmospheric pressure establishes and the ram pressure sensor acts like the static pressure system. In this case, the airspeed indication will drop to zero.

Plugging of the both ram air pressure hole and water drain holes of the PVD-6M Pitot tube has the following indications:

- The airspeed indicator keeps the last indication and does not react to airspeed changes;
- US-450K airspeed indicator will overvalue its indications during climbs and undervalue during descends.

Pilot actions.

Ensure the heating element of the PVD-6M Pitot tube switched on (the **ОБОГРЕВ ЧАСЫ, ПВД** circuit breaker should be in ON position). If airspeed indication does not restore in 2-3 minutes after the PVD-6M Pitot tube heat switching on, pilot has to monitor the flight speed by vertical speed indications, using also tachometer and manifold pressure indicators.

6.14. Aircraft Lighting Equipment

6.14.1. External Lights

1. External lighting equipment consists of navigation lights, flashing beacon and landing/taxi light.
2. Wingtip and tail navigation lights are installed on the aircraft.
3. A rotating beacon MSL-3 with two mirror-lights is installed on top of the vertical fin.
4. The SMF-5 landing/taxi light with two 200 and 130 W capacities is used on the aircraft. The lamp is mounted in

the left wing's leading edge.

5. 10 W lighting units are mounted on each landing gear to provide external landing gear down signalization.

6.14.2. Cockpit Lighting Equipment

1. The interior lighting equipment of the aircraft consists of instrument panel lightning, cabin dome light and individual lights.

2. For instruments, switchboards, control units and placards lightning the system of individual floodlights of red colour **CT** (ST), **CB** (SV) and **АПМ** (APM) is used.

3. ST lamps are used for instruments, switchboards, control units and instrument panels lightning by red floodlights. Each light consists of two SM-28-0,05 lamps. Lights are divided into two groups: the basic lightning (6 units) and the auxiliary lightning (2 units).

4. Slot-hole vertical SV light serves for panels, control units, individual gauge and placards illumination.

5. The APM lighting system is used for placards lightning. It is realized by light conductor technique.

6. The cabin main lightning is provided by the milk-coloured dome light located on the cabin ceiling.

7. The individual lightning of the left pilot's workplace is executed by the white-coloured floodlight. This light allows writing records, work with maps and other flight documents.

6.14.3. Operation of Lighting Equipment during Night Flights

1. Before engine start switch on the main cabin dome light, instrument panel lightning and navigation lights.

2. After engine start and alternator switching on switch on the flashing beacon MSL-3.

3. Adjust the light intensity necessary for normal instruments and placards reading.

Note. *Instrument faces lightning should not blind pilots and create bright patches of light on gauge glasses, cockpit interior and cabin doors.*

4. Switch on the taxi light just before commencing the taxi.

5. Switch off the cabin dome light if it has not been switched off before the beginning of taxi. Once again, adjust the brightness of the instrument panel lightning.

6. Before the beginning of the take-off switch to landing light mode.

7. After reaching 50-150 meters of altitude switch off the landing light.

8. Adjust instrument panel lightning brightness depending on eyes adaptation to an external light background (the shined city, landing lights, light of the moon, etc.).

9. For map viewing or paper work use floodlight lamp.

10. While descending, adjust cabin lightning depending on landing conditions:

- Reduce brightness of gauges lightning;

- Switch off the dome light and the floodlight.

11. Upon completing the turn to final at altitude of 150-100m AGL switch on the landing light.

12. Upon completing the landing roll switch the landing light to the taxi mode.

13. On the ramp switch off the landing light, navigation lights and rotation beacon.

14. Upon completing all after-flight operations switch off the instrument panel lightning and the cabin dome light.