Tu-154B-2 Flight Manual

(Brief English Version)

This document is a short version of the real Tu-154B-2 Flight Manual that was compiled for Project Tupolevs (www.protu-154.com) Tu-154B-2 pilots and students of the PT Flight School. All sections in this Flight Manual describe normal flight operations and do not include operations in emergency situations, aircraft systems description and other sections of the real Tu-154B-2 Flight Manual which will not be considered during primary training program. This Flight Manual is also not applicable for PT Tu-154M.

Index

Chapter 1. Limitations

1.1 Weight restrictions

Maximum taxi weight	98 500 kg (100 500 kg)
Maximum take-off weight	98 000 kg (100 000 kg)
Maximum landing weight	78 000 kg
Maximum zero fuel weight	72 000 kg
Maximum pax/cargo load	18 000 kg
Maximum fuel load	39 750 kg

Operation of the aircraft is allowed for up to 100 000 kg MTOW.
In case of an urgent necessity, landing is allowed even with weight exceeding maximum landing weight 78 000 kg at captains discretion.

Landing is also allowed for a landing weight of 80 000 kg in case the initial estimation was 78 000 kg but due to lower fuel consumption it equals to 80 000 kg on actual landing, and G-force in that case should be ≤1,8g.

1.2 Take-off and landing restrictions

Airport (runaway) elevation	-300 - +3000 m
Friction coefficient	≥0,3
Runway covered with:	
- ice	Not Allowed
- water	≤10 mm
- slush	≤12 mm
- dry snow	≤50 mm
Tailwind component	≤10 m/Sec
Crosswind component	
- dry runway	≤17 m/Sec
- precipitation layer on the runway ≤ 3 mm	See table below
- precipitation layer on the runway ≥ 3 mm	5 m/Sec
- in case of hydraulic system nr. 2 failure (dry runway)	10 m/Sec
Max runway gradient	±2%

Relation between the allowed crosswind component and runway friction coefficient can be found in the following table:

Friction coefficient	0,3	0,35	0,4	0,45	0,5	0,55	>0,6
Crosswind component (m/Sec)	5	7,2	9,3	11,3	13,6	15,8	17

1.3 Center of gravity (CG) restrictions

Forward limit for CG:

Take-off (landing gear extended)	21% MAC
Landing (landing gear extended), reserve fuel – 6 tons in tank nr. 1 and 3	20,5% MAC
Landing (landing gear extended), reserve fuel – tank nr. 1 – 3,3 tons, tank nr. 4 – 0 tons	18% MAC
Landing (landing gear extended), reserve fuel – in case of fuel in tank nr. 4	20,5% MAC

Remark: To compensate for possible errors in charts concerning CG and aircraft load, estimate the CG position using forward limit for landing 21% MAC, with reserve fuel of 6 tons in tanks nr. 1 and 3.

Rear CG limit in any flight phase (landing gear retracted) – 32% MAC.
If due to aircraft load CG of 32% MAC cannot be attained, then flight is allowed only under the following conditions:

- CG position ≤ 40% MAC
- TOW ≤ 80 000 kg
- ABSU in “yoke control” mode.

Empty aircraft on the ground will fall on its tail with CG position equals 52,5% MAC.

1.4 Power Plant

Maximum allowed:

- high pressure fan speed (N1)	98,5%
- low pressure fan speed (N2)	101%

Maximum allowed EGT:

- during start-up	600° C
- on take-off thrust	680° C
- on full-reverse thrust	575° C

Oil temperature and pressure:

- Maximum oil temperature	100° C
- Minimum oil pressure at thrust idle	≥2,5 kg/Cm2
- Minimum oil pressure for all other thrust settings	4-0,5 kg/Cm2
- Minimum oil pressure at higher altitudes (more than 10 000 m) may get as low as	3,3 kg/Cm2

Maximum altitude for engine start-up in mid-air	10 000 m

Engines are allowed to work at take-off thrust setting for the purposes of flight safety, however, for no longer than 15 minutes.

In case of flight level change at altitudes H≥8000 m, thrust should be advanced to nominal first - for engines nr. 1 and 3; and after 6 seconds of climb also for engine nr. 2, provided the situation allows nominal or take-off thrust for all three engines. Under such conditions, RPM and EGT should be monitored closely.

1.5 Airspeeds and M-speeds

Operational Vmax and M-speed with CG position ≤32% MAC:

- H <7 000 m	600 Km/h
- H ≥7 000 m	575 Km/h or M=0,88
- with CG position >32% MAC on all altitudes	525 Km/h
- in case of ABSU failure	525 Km/h or M=0,85

Vmax with flaps extended:

- angle 15°	420 Km/h
- angle 28°	360 Km/h
- angle 45°	300 Km/h
- during retraction from 15° to 0° the speed may increase to	430 Km/h

Vmax during landing gear extension/retraction:

- normal conditions	400 Km/h
- during emergency descent	See item “Operational Vmax and M-speed with CG position ≤32% MAC” above

Vmax with spoilers extended:

- central spoilers	No limit
- outer spoilers (on ground only)	300 Km/h

Vmax if stabilizer:

- in other than cruise position	450 Km/h
- moving	425 Km/h
- just moved to cruise position	450 Km/h

Vmax if slats:

- are fully extended	425 Km/h
- just moved to retracted position	450 Km/h

Vmax if lights:

- extended	340 Km/h

Vmax on taxi:

- with turn radius >40m	30 Km/h
- with turn radius <40 m or gear steering tiller at its maximum angle	10 Km/h

1.6 Minimal allowed airspeed

Weight (t) / **Flaps**	**60**	**62**	**64**	**66**	**68**	**70**	**72**	**74**	**76**	**78**	**80**
δ_3 =0°	230	235	238	242	245	250	253	258	260	262	265
δ_3=15°	205	208	210	213	218	220	223	227	230	232	235
δ_3=28°	190	192	197	200	202	205	208	210	213	218	220
δ_3=45°	178	180	182	185	190	193	195	198	200	203	205
Weight (t) / **Flaps**	**80**	**82**	**84**	**86**	**88**	**90**	**92**	**94**	**96**	**98**	**100**
δ_3=0°	265	270	272	275	278	280	285	288	290	295	300
δ_3=15°	235	238	240	243	247	250	252	255	258	260	265
δ_3=28°	220	222	225	228	230	232	235	238	240	242	245
δ_3=45°	205	208	210	213	216	220	222	225	228	230	232

1.7 Angle of attack (AoA) indicator setting

Flap angle δ_3=45°, slats extended, V alarm = 1,13*V stall;
Flap angle δ_3=28°, slats extended, V alarm = 1,13* V stall;
Flap angle δ_3=15°, slats extended, V alarm = 1,16* V stall;
Flap angle δ_3=0°, slats extended, V alarm = 1,17* V stall.

1.8 Landing gear restriction

Minimum aircraft turn radius on ground - 7 m. Front landing gear turn radius - 23 m.

Turning the aircraft on the ground by locking or applying full braking action one of the main landing gear bogies is **FORBIDDEN!**

Maximum speed braking speeds

- air temperature ≤25°C	240 Km/h
- air temperature ≤32°C	225 Km/h
- air temperature >32°C	215 Km/h

Maximum ground speed:

- for retracting the nose gear	315 Km/h
- of main landing gear separation	325 Km/h
- of main landing gear touchdown	280 Km/h
- of front landing gear touchdown	270 Km/h
- of touchdown (if landing gear strengthened)	310 Km/h

1.9 Allowed G-force and bank angles

G-force (Ny) min/max:

- Flaps/Slats retracted	-1 - 2,5
- Flaps/Slats extended	0 - 2,0

Bank angle (γ) max :

- for H≤250 m or V<340 Km/h on take-off / V<280 on landing	15°
- in all other cases	30°
- while executing SID with an initial turn at H≥50 m	25°

Bank angle alarm will sound:

- on take-off and landing when exceeding	15±2°
- in cruise when exceeding	33±4°

Bank angle alarm modes will change automatically when:

- “LANDING PREPARATION” switch - “ПОДГОТ. ПОСАДКА” is on and the altitude reaches	250 m
- “LANDING PREPARATION” switch - “ПОДГОТ. ПОСАДКА” is off and the speed :	
i) on take-off reaches	340 Km/h
ii) on approach decreases to	280 Km/h

1.10 APU (ВСУ) restrictions

Limitations:

- maximum altitude for start-up	3 000 m
- Vmax during start-up and/or flying with APU running	≤525 Km/h
- max running time (not interrupted)	≤5 hours

EGT at start-up:

- normal conditions	≤680°C
- emergency conditions	until automatic stop occurs, but ≤720°C

Flying with the APU not running and the APU ram door open, other than the time required for preparing the APU for start-up, is **FORBIDDEN!**

If the electrical system is fed by batteries, repeated APU start-up in cruise is **FORBIDDEN!**

1.11 Various restrictions

Avoidance of cumulonimbus clouds shall be done by maintaining at least 15 km distance from the nearest radar contour indication.

Avoidance of frontal cloud systems shall be done by flying between separated storm centres, where the distance between radar contour indication is at least 50 km. When flying above such weather, minimal vertical distance of 500 m above the upper cloud border must be maintained.

1.12 Maximum flight altitudes related to aircraft weight

Flight level, м	11 600	12 100
Maximum aircraft weight (tonnes)	94,5	86,5

Maximum flight altitude with CG position >32% MAC equals 10 100 m.

1.13 Control restrictions

Stabilizer and slats may be moved from one end position to the other and vice versa up to five times with 1 minute pause before each next movement (if so needed, one of the pauses may be shortened to 3 seconds).

Approach without touchdown may be repeated up to 10 times.

After the stated cycle has been completed, the slat and stabilizer equipment has to be cooled using at least 1 hour without any equipment activity.

In order to ensure stable engine performance, advance thrust setting during take-off from high-altitude airports (H>700 m) as follows:
- in 3-5 seconds all 3 engines to 0,4 of nominal thrust;
- in 10 seconds all engines to nominal thrust;
- in 2-3 seconds engine nr. 1 and 3 to take-off thrust;
- in 2-3 seconds engine nr. 2 to take-off thrust.

Rolling take-off at airports with high runaway elevation (H>700 m) is **FORBIDDEN!**

1.14 Temporary restrictions

Throttling up the engines to take-off thrust after line-up and take-off clearance, shall be done as follows:
- Allow 3-5 seconds to advance the thrust levers until engine air bleed valves close;
- Verify sucessful closure of the air bleed valves on the flight engineers panel (control light “BLEED VALVES” - “КЛАПАНЫ ПЕРЕПУСКА” goes off);
- Wait 2-3 seconds, and advance thrust levers to take-off thrust setting.

Operation of the aircraft on a glide slope with an angle higher than 4° is **FORBIDDEN!**

Chapter 2. Normal operations

2.1 Pre-flight preparations

Check and analyze the meteorogical conditions. In case of temperature inversion, calculations are made using the maximal temperature taken from the range 0 m – 150 m and adding 150 m to the barometric airport altitude.

Determine maximum take-off weight (MTOW) and maximum landing weight. Choose appropriate method for take-off.

Determine V_1, V_R, V_2, V_{REF} speeds.

Determine the aircraft's Centre of Gravity (CG) position. For a flight with less than a full load of passengers calculate the aircraft load using CG 27–28 % MAC.

2.2 Preparations for take-off

ATTENTION! The F/E is obliged to check the performance of the fuel system at all flight phases and report any discrepancies to CPT.

2.2.1 Preparation for taxi.

Upon receiving start-up clearance, the CPT commands the F/E to start-up the engines.

Before commencing taxi, all equipment must be checked and be in a correct position or show correct parameters. The navigator aligns the gyroscopic equipment (ТКС-П2), the F/O turns on the beacon lights, reads the "Before taxi Checklist" and requests taxi clearance from ATC.

2.2.2 Taxi

After pushback turn on the "GEAR STEERING" switch - "РАЗВОРОТ КОЛЕСА".

ATTENTION! It is forbidden to turn on "GEAR STEERING" - "РАЗВОРОТ КОЛЕСА" before the aircraft has started moving. During ground movement refrain from rough handling of the front gear tiller to ensure the absence of excessive centrifugal forces.

Beginning the taxi movement, check the main and emergency brake systems performance. After an emergency brake ensure the emergency hydraulic system accumulator is recharged.

Taxiing is **FORBIDDEN**:
- if the main or emergency brakes system is faulty;
- landing gear tires are damaged;
- if there is landing gear position alert;
- when Flaps/Slats are extended, with the exception of:
  i) taxiing from runway holding point to the runway;
  ii) taxiing to gate after landing;
- when using reverse thrust to fully stop the aircraft;
- when using reverse thrust on a runway covered with snow or dirt;
- in icy conditions.

At least a 50m wide runway is needed for 180° turn of the aircraft using no differential brakes, and at least 45 using differential brakes. Maximum taxi speed through the turn must not exceed 10 Km/h.

2.2.3 Preparation for take-off

“PITOT HEAT” - “Обогрев ППД” should be turned on 1 minute before commencing the take-off roll in temperatures above zero, and 3-5 minutes before commencing the take-off roll in temperatures at or below zero.

If take-off is expected in icy conditions (rain, snow, fog, drizzle, low clouds at temperatures equal to, or below +5°C), “PITOT HEAT” - “Обогрев ППД” should be turned on before taxi. In case of a delay (10 minutes or more) it has to be turned off to ensure the cooling down of pitot tubes. Heat should be turned on again 3-5 minutes prior to commencing the take-off roll.

2.2.4 Holding point procedures

Check control surfaces movement. During their movement, the hydraulic pressure in all systems need not fall below 180 kg/см^2;

Extend flaps for take-off and verify the take-off/landing mode control light - “ВЗЛЁТ. ПОС. РВ” turns on.

Read the checklist, make sure all altimeter settings are correct.

Request line-up clearance.

2.2.5 Procedures on the runway.

Taxi along the runway centreline for 5-10 meters, then switch the front gear mode to “10°” - after which, the control lights “FRONT GEAR 63°” - “РАЗВОРОТ 63°” and “NOT READY FOR TAKE-OFF” - “К ВЗЛЁТУ НЕ ГОТОВ” should turn off.

IT IS STRICTLY FORBIDDEN to take/off with the control light “NOT READY FOR TAKE-OFF” - “К ВЗЛЁТУ НЕ ГОТОВ” on.

In case the control light “NOT READY FOR TAKE-OFF” - “К ВЗЛЁТУ НЕ ГОТОВ” goes on during the take-off roll the CPT shall proceed as follows:

- if $V \leq V_1$ abort take-off;
- if $V > V_1$ continue with take-off. When reaching traffic pattern altitude, decide upon further action (land at departure airport/continue flight) based on the circumstances and the causes of the failure.

Control light “NOT READY FOR TAKE-OFF” - “К ВЗЛЁТУ НЕ ГОТОВ” lights up when:
- nose gear steering mode is at “63°” position;
- inner spoilers locking mechanism is open;
- main/cargo doors locking mechanism is open or passenger/service door latches are closed;
- emergency/back-up doors and emergency hatch latches are closed;
- “BOOSTER CONTROL” - “БУСТЕРНОЕ УПРАВЛЕНИЕ” switches lid is open;
- slats retracted and flaps unextended for take-off configuration.

When the nose gear steering mode is set to “10°”, the control light “NOT READY FOR TAKE-OFF” - “К ВЗЛЁТУ НЕ ГОТОВ” will only flash if the inner spoilers or main door and cargo locking mechanisms are open.

2.3 Take-off

2.3.1 Take-off in normal conditions.

CAUTION! In case the alarm sounds after setting thrust levers to take-off position, it is mandatory to abort take-off and check that slats and flaps are extended.

During take-off from wet, snow- or ice-covered runway take into account, that it is not possible to steer the plane using brakes at take-off thrust. Therefore it is not recommended to use brakes for this purpose after take-off thrust is set.

CAUTION! Take-off with airplane's CG position at the front limit and MTOW requires bigger deflection angle of the elevator at the moment of rotation. Therefore in case of more intense rotation the angle of the elevator may even reach its limit. Because of high pitch on such take-offs it is required to precisely observe all take-off speeds – such take-offs should be executed as pure instrument take-off starting at the moment of rotation until full retraction of the flaps.

After rotation, accelerate the airplane while climbing so that when reaching 10,7 m AGL, the IAS equals or exceeds V_2.

At 5-10 m AGL retract the landing gear and continue climbing while accelerating to V_2+40 Km/h. Maintain this speed until 120 m, and when IAS reaches 330 Km/h begin flaps retraction to 15°. When the IAS reaches 350 Km/h continue flaps retraction to 0°. IAS at clean configuration should be 380-400 Km/h.

Note: The moment the flaps retract from 28° to 15° neither slats nor the stabilizer move. This takes place only when "FLAPS" - "ЗАКРЫЛКИ" lever is set to zero.

Taking-off from airports having obstacles higher than 120 m at the take-off direction, the flaps should be retracted and acceleration executed using the "maximum climb gradient" recommendations (see table).

During take-off at turbulent conditions the AoA signalization alarm may sound.

Remark: If the standard departure chart requires a turn before flaps retraction, such a turn shall be executed at a height no lower than 50 m AGL at IAS= V_2+40 Km/h while climbing. In case of turns exceeding 15° bank if the bank limit alarm sounds, special attention should be paid to the artificial horizon working condition and 25° bank limit shall not be exceeded. Flaps retraction should be executed after turn completion on a straight portion of the flight.

Climbing shall be performed using one of following modes:
- Maximum climb gradient mode: for H≤9 750 m maintain V=575 Km/h; for H>9750 m maintain M=0,85;
- Maximum distance mode: for H≤9450 m maintain V=550 Km/h, for H>9450 m maintain M=0,8.

At 450 m, reduce thrust to nominal. For low TOW it is allowed to reduce thrust to nominal at lower heights to avoid exceeding IAS limits, however thrust reduction shall not be made lower than 260m.

In case the ground proximity (CCOC) alarm sounds before the moment of flap retraction, immediately stop the descent, if such occurs - and ensure that the aircraft starts to climb. In case the ground proximity (CCOC) alarm sounds after flaps retraction while flying over mountainous areas, swiftly manoeuvre the aircraft for a more steep trajectory (while watching that G-force and AoA limits are observed), set take-off thrust and maintain it until the alarm ceases to sound. At turbulent conditions it is possible that ground proximity (CCOC) alarm may sound up to 2 seconds without requiring the flight crew to change the flight trajectory.

At transition altitude set standard pressure (760 mm) for all altimeters, and check the indication accuracy on all of them.

2.3.2 Short stop take-off.

Take-off roll which starts before engines take-off thrust has been reached is allowed at airports with runaway elevation up to 700 m and runaway visual length not less than 400 m.

Read checklist "On holding point" during taxi to line-up.

Simultaneously release brakes and advance thrust levers for take-off position.

CAUTION! In case an alarm sounds after setting thrust levers for take-off position, it is mandatory to abort the take-off.

The moment take-off regime is reached (N1), the F/E reports “take-off thrust set” - “Режим взлётный” (Rezhim vzl’otni).

At IAS=150 Km/h navigator calls about accelerating to control speed - “Контрольная” (Kontrol’naya). If there is no call about crossing the control speed before take-off thrust has been reached, it is mandatory to abort the take-off.

CAUTION! If a headwind component is more than 15 m/Sec take-off thrust could be reached after passing IAS=150 Km/h.

Further actions after the calls “Control speed” and “Take-off thrust set”, as well as in case the ground proximity (CCOC) alarm sounds are similar to standard take-off procedure.

2.3.3 Non-stop take-off (Rolling takeoff).

Read the checklist during taxi along the runaway centerline without short stops and on idle thrust. CPT commands to commence the take-off right after the checklist is complete.

Such take-off is allowed at airports with runaway elevation up to 700 m and runaway visual length no less than 400 m. Required take-off distance is increased by 120 m when performing non-stop take-off.

2.3.4 Take-off with flaps 15°.

Such take-off is performed with the same stabilizer position as with flaps 28º. Determine take-off speeds for flaps 15°. Take-off roll, rotation, landing gear retraction are similar to take-off in normal conditions. The takeoff itself (ground detachment) takes place at a higher AoA ($\Delta\lambda \approx 1°\text{-}2°$).

After the landing gear retraction accelerate to V_2+40 Km/h and continue climbing until 120 m. At H≥120 m accelerate to 360-380 Km/h, retract flaps reaching 380-400 Km/h at the moment of full retraction.

Further actions are similar to take-off in normal conditions.

2.3.5 Take-off in crosswind and tailwind conditions.

Maximum crosswind and tailwind components should not exceed figures mentioned in the table on page 3. During take-off roll aircraft turns against the wind. Push the yoke away, maintain the take-off direction by using rudder pedals deflection. At rotation speed set the rudder pedals at neutral position and simultaneously pull the yoke. During and after rotation the plane may bank a little. Keep the take-off direction after rotation by maintaining the original course (compensate for drift).

The take-off procedure with tailwind component is similar to take-off in normal conditions.

2.3.6 Take-off with noise abatement procedure.

Take-off roll and rotation are similar to take-off in normal conditions.

After rotation and landing gear retraction accelerate to V_2+20 Km/h and maintain that speed climbing using take-off thrust.

At thrust reduction altitude, of but no lower than 260 m - reduce engines thrust.

If a noise control point and noise level are not clearly regulated reduce thrust level at 450 m and keep vertical speed 3-4 m/Sec.

At 900 m set thrust to nominal regime accelerating to 330-340 Km/h, start flaps retraction with intention to accelerate up to 380-400 Km/h until full retraction and than continue speed acceleration to expected climb mode.

Note: For additional noise abatement it is allowed to execute a turn out of an urban area at H≥100 m with bank ≤15°.

2.3.7 Take-off at nominal regime.

Take-off at nominal regime is allowed if take-off weight does not exceed 92 000 kg.

Advance thrust levers to nominal position (106±1°) assuring that high pressure fan speed (N1) corresponds to speed referred on the page 39.

Available take-off weight on nominal regime should be determined during flight preparation depending on actual take-off conditions.

At any stage of take-off on nominal regime it is allowed to increase thrust up to take-off regime.

2.3.8 Take-off in wind sheer conditions.

Take-off procedure with information about wind sheer:
- determine strength of wind sheer and make a decision for take-off. If there is a strong or sharp wind sheer take-off is **FORBIDDEN!**
- take-off should be performed at take-off thrust using the longest runaway with the lowest possible flap angle;
- in case of a rapid decrease in acceleration, it is mandatory to abort take-off if V_1 was not reached;
- rotation speed should be 10-15 Km/h higher than the speed determined during flight preparation;
- after rotation keep the speed no lower than V_2.

ATTENTION! Decreasing the pitch angle for acceleration purposes does not allow to achieve a maximum climb gradient therefore it could be used at heights that guarantee a safe trajectory to avoid obstacles.
- retract flaps/slats after leaving the wind sheer area.

Take-off procedure with no information about wind sheer :
- in case of a quick decrease of acceleration it is mandatory to abort take-off if V_1 was not reached;
- if wind sheer occurs, rotation speed should be 10-15 Km/h higher than that calculated during flight preparation;
- if take-off is originally performed at nominal regime, advance thrust levers for take-off position;
- when wind sheer occurs after rotation, follow the same guidelines as above.

CAUTIONS!
- For an airport having obstacles higher than 120 m at the take-off direction, retract flaps and slats and accelerate using the maximum climb gradient recommendations.
- In case the ground proximity (CCOC) alarm sounds during acceleration, immediately stop the descent, ensure that the aircraft starts to climb and(or) execute a turn keeping a speed no lower than the allowed minimum.
- If the standard departure chart requires a turn before flaps retraction, such a turn shall be done at height no lower than 50 m AGL at IAS= V_2+40 Km/h while climbing. In case of turns exceeding 15° bank if the bank limit alarm sounds, special attention should be paid to artificial horizon working condition and 25° bank limit shall not be exceeded. 25° bank decreases the vertical speed approximately by 1 m/Sec. Flaps retraction should be executed after turn completion on straight portion of flight.

2.4 Climb

Climb is commenced in yoke control mode or automatic IAS stabilization mode, and at nominal engine regime.

Climb shall be performed using one of following modes:
- Maximum climb gradient mode: for H≤9 750 m maintain V=575 Km/h; for H>9750 m maintain M=0,85;
- Maximum distance mode: for H≤9450 m maintain V=550 Km/h; for H>9450 m maintain M=0,8.

Notes:

- For safety reasons, upon CPT decision, it is allowed to use an engine regime that is higher than nominal (including take-off regime) for continuous operation that should not exceed 15 minutes.
- If EGT exceeds 680°C or high pressure fan speed (N1) exceeds 98,5%, or low pressure fan speed (N2) exceeds 101% - reduce thrust.
- To follow SID procedure or ATC commands, it is allowed to keep IAS≥450 Km/h.
- To reach a flight level requested by ATC it is allowed to reduce IAS to 500 Km/h and maintain speeds of 0,78-0,8 M.
- If take-off has been performed with APU running (IAS≤525 Km/h), close the APU ram door after switching the APU off. Flying with APU ram door open is **FORBIDDEN!**
- If during climb at nominal regime the vertical speed drops below 2 m/Sec, stop the climb and descend to cruise at the nearest permissible flight level. Set the appropriate engine regime for cruise at that level.

2.5 Cruise

Cruising at nominal regime is not limited but should not exceed 20% TBO (Time Between Overhauls - the predicted "life span" for the engine). Cruise speed is set by either M-speed or engine RPM: can be performed at any thrust up to – and including nominal.

- Maximum cruise mode: for H≤7 000 m maintain IAS≤600 Km/h; for H=7 000 - 10 100 m maintain IAS≤575 Km/h; for H>10 100 m maintain M-speed=0,87.
- Maximum distance mode:

Weight, t / Altitude	95-92	92-89	89-86	86-83	83-80	80-77	77-74	74-71
12100	0,835	0,830	0,830	0,830	0,825	0,820	0,820	0,820
11600	0,830	0,830	0,825	0,825	0,820	0,820	0,815	0,815
11100	0,830	0,825	0,820	0,820	0,820	0,815	0,810	0,810
10600	0,825	0,820	0,815	0,815	0,810	0,810	0,805	0,800
10100	0,820	0,810	0,810	0,810	0,805	0,800	0,800	0,790
9600	0,810	0,805	0,805	0,800	0,795	0,790	0,790	0,785
9100	0,800	0,800	0,795	0,790	0,790	0,785	0,780	0,775
8600	0,790	0,790	0,785	0,780	0,780	0,775	0,770	0,765
8100	0,765	0,765	0,765	0,765	0,765	0,765	0,760	0,755
7800	0,750	0,750	0,750	0,750	0,750	0,750	0,750	0,750
7200	0,720	0,720	0,720	0,720	0,720	0,720	0,720	0,720
6000	0,700	0,700	0,700	0,700	0,700	0,700	0,700	0,700
4200	0,625	0,625	0,625	0,625	0,625	0,625	0,625	0,625

CAUTION! If for maximal cruise thrust (up to and including nominal) the following conditions: IAS=500-550 Km/h at H≤4950 m or M=0,78-0,8 at H>9 450 m were not met, it is necessary to descend to the nearest lower flight level under the coordination of ATC.

2.6 Descent

Descent is performed at idle thrust, using either of the two following modes:

- Maximum descent gradient mode: for H>9750m maintain M=0,85; for H<9750 maintain IAS= 575 Km/h/. At H=7 000 m extend spoilers to 45° position, at H=3 000 m fully retract them. Spoilers can be extended to 30° at H=9 000 – 7 000 m, if necessary.
- Maximum distance mode: for H>10 750 m maintain M=0,8; for H<10 750m maintain IAS=500 Km/h. Spoilers should remain fully retracted when descent is performed using the “Maximum distance” mode.

In icing conditions with air bleed on, descend using “Maximum distance” mode! Spoilers should be fully extended at all applicable heights and the thrust set to no less than 0,4 nominal regime. Retract spoilers after the landing gear is extended.

CAUTION! Upon leaving the icing area, thrust setting lower than 60% N1 is allowed. After air bleed is turned off, setting idle thrust is permitted.

The distance required for speed to decrease by 100 Km/h in a horizontal section of the flight after setting idle thrust at H<3 000 m is 6 km for an initial airspeed of 600 Km/h, and 5 km for an initial speed of 500 Km/h.

At transition level, in a horizontal portion of the flight set the altimeters to QFE. The CPT should set it first, then the other crew members should set the altimeters under the CPTs control.

ATTENTION! In case of ground proximity system alarms during descent, including the landing area, immediately decrease vertical speed. When flying above mountainous terrain or when the crew is not familiar with the terrain avoidance procedure, start a climb not exceeding the permissible G-force and AoA. Set take-off thrust and keep it so until the alarm stops. Notify ATC about such maneuver.

2.7 Approach

2.7.1 Approach procedure in normal conditions.

Execute the approach maneuvers with bank up to 25°, bank on final turn in automatic or FD modes is up to 20°.

At traffic altitude before landing gear extension and IAS 400 Km/h determine the required setting for the "Stabilizer Position Lever" - "ЗАДАТЧИК СТАБИЛИЗАТОРА".

Abeam the outer marker (or at a distance of 20-25 km from the threshold for straight-in approach) extend the landing gear. 20-25 second after the last green light of landing gear position indicator ППС-2МК turned on and after pressure recovery in hydraulic system nr. 1 (up to 200-220 kg/cm^2) set landing gear lever to neutral position and fix it.

Base turn is performed with a bank of 15°-20° at IAS=360-370 Km/h.

On base (or at a distance of 18-20 km from the threshold for straight-in approach) extend flaps to 28° position reducing speed to no less than 280 Km/h. Assure that the adjusted stabilizer position was set according to the table below:

Flap angle	Slats position	CG, % MAC		
		<28°	28°≥35°	>35°
		Stabilizer changer position		
		"П" – "Forward" Green colour	"С" – "Central" Black colour	"З" – "Rear" Yellow colour
		Stabilizer position		
0º	Retracted	0º	0º	0º
15º, 28º	Extracted	3º	1,5º	0º
45º	Extracted	5,5º	3º	0º

Notes:
- If traffic pattern width is 12 km landing gear extension is allowed on base before flaps are extended to 28°;
- If traffic pattern width is 8 km and a bank of up to 25° is required for approach maneuvers, landing gear extension is allowed above of outer marker, provided the completion of all procedures prior to base turn.

On final at IAS≤300 Km/h before FAF (3-4 km before FAF in automatic mode) extend flaps to 45°, reducing the speed down to V_{REF} according to the table below:

Speeds	V_R	V_2	V_{SAFE}	V_{REF}			
Slats	Extended		0°	Extended			
Flaps	28°/15°	28°/15°	0°	45°	28°	15°	0°
60 000 kg	-	-	-	234	247	263	350
62 000 kg	-	-	-	237	251	267	÷
64 000 kg	-	-	-	241	255	272	÷
66 000 kg	-	-	-	245	259	276	÷
68 000 kg	-	-	-	248	264	280	÷
70 000 kg	222/236	237/252	314	252	268	284	÷
72 000 kg	225/240	240/255	317	256	272	288	÷
74 000 kg	229/242	243/258	322	259	276	293	÷
76 000 kg	232/245	246/262	326	263	279	297	÷
78 000 kg	236/248	249/265	330	266	283	301	÷
80 000 kg	240/252	252/268	334	269	287	305	÷
82 000 kg	244/255	255/271	337	273	290	-	÷
84 000 kg	247/258	258/275	341	276	294	-	÷
86 000 kg	251/261	261/278	345	279	297	-	÷
88 000 kg	254/264	264/280	348	283	301	-	÷
90 000 kg	258/267	268/284	352	286	305	-	÷
92 000 kg	261/270	270/287	355	289	308	-	÷
94 000 kg	264/274	274/290	358	293	312	-	÷
96 000 kg	268/276	277/294	362	295	315	-	÷
98 000 kg	270/280	280/296	365	298	317	-	÷
100 000 kg	274/282	283/300	368	300	318	-	÷

Control the stabilizer deflection and check its adjusted position (elevator indicator should be inside the green sector of the gauge; i.e. in the range of 3°-10°).

If the aircraft is stabilized and the elevator indicator shows a deflection outside the 3°-10° range, make corrections to the stabilizers position.

In case the elevator indicator is below the green sector push the electrical trimmer to “Nose Down” - “ПИКИР” position.

In case the indicator is above the green sector:
- if the stabilizer position angle is less than 5,5° set “Stabilizer Position Lever” - “ЗАДАТЧИК СТАБИЛИЗАТОРА” to forward CG position in combined mode or use the manual stabilizer setup lever - “СТАБИЛИЗАТОР” ;
- if the stabilizer was already set for 5,5° increase V_{REF} by 10 Km/h.

If the above measures did not lead to an elevator angle correction to the appropriate value, then it is necessary to execute a go-around procedure and change CG in horizontal flight.

If it is impossible to change CG, execute the approach and landing with flaps at 28º and stabilizer at a 5,5° angle.

When necessary the go-around procedure can be performed with 28° flaps position without any change of the stabilizers position.

The stabilizers position during go-around can be changed either through manual or combined mode - before flaps retraction.

In case the CG is between forward and central (28% MAC) or central and rear (35%) position and the stabilizer angle is 3°, it is allowed to continue approach with elevator angle indication up to 12°.

Notes:
- Approach with partially used enroute fuel reserve is done at V_{REF}+10 Km/h.
- If the elevator indicator is around 10° it is recommended to start flaring at H=8 m;
- Approaching airports at FAF altitude higher than 400 m, it is allowed to start flaps extension to 45° in steady descent and no lower than at H=400 m;
- Landing with flaps 28° position is allowed in case the runaway satisfies the Flight Manual requirements.

If before FAF the aircraft is not in landing configuration, it is mandatory to execute the go-around.

Thrust should be stable prior to overflying the outer marker.

Thrust corrections to adjust vertical speed should not exceed ±2-3% fan speed, and any vertical offsets should be corrected by yoke movement.

Notes:
- Thrust correction within ±5% leads to a difficulty in stabilizing the approach and is undesired for the final flight stages. Thrust reduction by 10% is unacceptable because it may lead to a vertical speed increase of 8-10 m/Sec in comparison with the determined Vy for descent on the glide slope. That's why thrust should be set precisely and be invariable, especially after overflying the middle marker.
- Avoid swinging the aircraft in yoke control (hand fly) mode when performing maneuvers for vertical profile adjustments, do not make thrust correction if the IAS had changed within ±10 Km/h.
- All vertical maneuvers must be finished before the middle marker, and this rule relates to any glide slope angle. Otherwise execute a go-around procedure.
- Above the middle marker, descent should be stabilized, vertical speed should be kept within ±1 m/Sec range. Offsets which do not exceed the boundaries of the aircraft silhouette on the PNP-I gauge (the little plane represented in the centre of the HSI) - should not be corrected, keep the descent on the extended glide slope.
- If the conditions above are not met it is mandatory to execute a go-around procedure.

In case of a ground proximity system alarms immediately decrease vertical speed and control vertical profile as well as landing gear position – if it is not extended, the go-around is mandatory. In case of a ground proximity system alarms before visual contact is established, the go-around is mandatory.

Note: Cruising at low altitudes or in turbulence conditions as well as approaching airports with hard relief on final, including high angle glide slopes, short term alarms of ground proximity system that has 2 seconds duration are possible. It does not require any actions for correction of descent trajectory.

2.7.2 The late landing gear and flaps extension approach procedure.

Execute the approach maneuvers with bank up to 25°, bank on final turn in automatic or FD modes should be up to 22°.

At traffic altitude before landing gear extension and IAS=400 Km/h determine the required setting for the "Stabilizer Position Lever" - "ЗАДАТЧИК СТАБИЛИЗАТОРА".

Base and final turns are performed at IAS≥370 Km/h.

On final at a distance of 6 km from the FAF extend the landing gear reducing airspeed to IAS≤360 Km/h. After the last green light on the landing gear position indicator ППС-2МК turns on, extend flaps to 28° reducing airspeed to IAS=280-300 Km/h. 20-25 seconds after pressure recovery in hydraulic system nr. 1 (up to 200-220 kg/cm^2) set the landing gear lever to neutral position and fix it.

Notes:
- If it is impossible perform the base turn so that there is a 6 km distance from the FAF after the final turn, or in case of hydraulic system nr. 1 failure - extend the landing gear on base leg;

- Descending on glide slope at IAS≤300 Km/h extend flaps to 45° position and assure that the adjusted stabilizer position was set accordingly. Flaps extension to 45° should be started at H≥350 m. Further piloting is similar to the standard approach procedure.

2.7.3 Features of steep glide slope approach (glide slope angle from 3°31′ to 5°)

Flaps and slats should be fully extended before FAF in case of a steep glide slope.

In automatic or FD mode as well as during NDB approach it is necessary to start descent on the glide slope earlier.

For all approach modes it is necessary to execute a go-around procedure in yoke control mode if vertical speed exceeds:
- for glide slopes from 3°31′ to 4°00′:
  i) 10 M/sec – to intercept the glide slope;
  ii) 7 M/sec – flying on glide slope before Decision Height.
- for glide slopes from 4°00′ to 5°00′:
  i) 12 M/sec - to intercept the glide slope;
  ii) 9 M/sec - flying on glide slope before Decision Height.

Autothrottle is allowed to be used in automatic mode before flare height. If the aircraft tends to accelerate on the glide slope with a constant thrust setting, switch off the autothrottle.

Maximum lateral offsets from runaways centerline at decision altitude:

Glide slope angle	**≤3°31′**	**3°31′≤4°00′**	**4°01′-5°00′**
Decision altitude, м	100	80	100
Offset, m	80	50	60

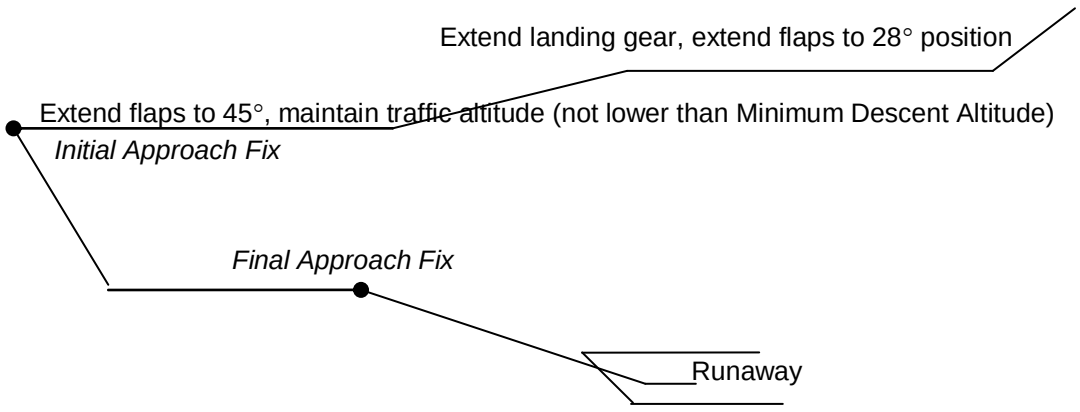
2.7.4 Visual approach features.

Visual approach is allowed if the runaway or its reference objects are visible.

Entering the airport area is performed according to STAR procedures, approach and descent [profile] towards the visual approach IAF are performed using all the available airport navigation aids.

Extend landing gear and flaps to 28° before the IAF.

Usually, a visual approach route is not defined. Visual approach is performed, generally, inside the visual contact area of the runaway according to traffic pattern at traffic altitude but no lower than MDA.



If visual contact with the runway or reference objects is not established at the assigned IAF altitude, roll out the aircraft to a horizontal flight until visual contact is established.

After visual contact was established, the CPT must inform ATC “Runaway In Sight” and coordinate the type of visual maneuver.

Note: If the runaway is not in sight or visual contact is lost, it is necessary to execute a turn towards the runaway climbing up to traffic altitude and a go-around procedure according to the defined scheme for the particular airport, followed by an IFR approach.

For a visual approach, a bank of up to 30° is allowed.

Before turning towards the runaway at H≥MDA it is necessary to:
- extend flaps to 45° position;
- set IAS to V_{REF} + 10 Km/h;
- read the “Before Glide Slope Capture” checklist.

Final turns are done descending at IAS=V_{REF}+10 Km/h. Vertical speed should not exceed -5 M/sec before final approach fix altitude. Recommended bank is 20° but not more than 30°. Height at final approach fix should not be lower than 150 m AGL.

ATTENTION! When executing the final turns, “MAXIMUM LEFT(RIGHT) BANK” - “КРЕН ЛЕВ (ПРАВ) ВЕЛИК” alarm indication is permitted.

On final the CPT should be aware of the aircrafts position relative to the runaway and determine the offsets. If the offsets are within the permissible limits, reduce the airspeed to $V_{REF.}$

The CPT flies the aircraft after VDP. The F/O monitors the flight parameters and notifies the CPT if a maximal 30° bank is reached.

2.8 Landing

2.8.1 Landing in normal conditions

Descent to flare height should be performed on the extended glideslope. At touchdown, lateral offset from the runaway centerline of the should not exceed ¼ runaways width. At that, aircraft should remain parallel or point towards the runaways centerline. If those conditions are not met, it is necessary to start executing a go-around procedure unless the aircraft is below flare height and thrust was set to idle.

At 6-4 m AGL start to flare and reduce thrust to idle. Continue with landing, not allowing hold-off and ballooning the aircraft that extend landing distance. At touchdown extend central spoilers and make a decision on reverse thrust usage.

Reverse thrust should be set:
- at the moment of touchdown provided the aircraft is on or parallel to the runways centerline;
- on landing roll after the aircraft is aligned, moving along the centerline, and the nose gear is down.

If done correctly, the aircraft will touch down in the landing area 300-600 m from the threshold at a speed that is 5-10 Km/h lower than V_{REF}, and with vertical speed -0,5 ÷ -1 m/Sec.
Approaching steep glideslope (>3°30′) with Vy>-4 m/Sec it’s necessary to perform a pre-flare. If Vy=-4,5÷-8 m/Sec the height of pre-flare equals to 15-25 m accordingly. The rate and amplitude of yoke movement “towards yourself” during pre-flare depends on flaps angle:
- at δ_3=45° - yoke movement should be done vigorously at 2/3 the amplitude of the control column, especially for forward CG;
- at δ_3=28° - rate and value decreasing;
- at δ_3=15° - continuous smooth movement of the control column.

Maintaining a flat trajectory at speed that is less than Vref could require thrust increase (not more than 5%).

Notes:
- During pre-flare thrust reduction is intolerable due to a possibility of hard landing;
- Yoke movement “away from” prior to or during pre-flare is intolerable because can lead to hard landing.

In case of ballooning, keep the yoke fixed and avoid nose dropping. Land again on the main gear, extend spoilers in case they had not been extended, pull down the front landing gear, move the yoke to full forward position. Make sure that touchdown occurred in the landing area, runaway condition and brakes permit effective braking and residual runaway length is sufficient for a safe stop, cut off reverse thrust at V≥115 Km/h (for aircraft w/o automatic flap/slat devices control system) or on V≥100 Km/h (for aircraft with automatic wing flap/slat control system).

ATTENTION!
- Engines operations time in reverse mode must not exceed 1 minute.
- In case of necessity use reverse thrust until the aircraft comes to a complete stop.
- If reverser doors don’t return to forward thrust position within 7-9 seconds (control light “REVERSE LOCK” - “ЗАМОК РЕВЕРСА” turned on), increase engines thrust up to 67% high pressure fan speed (N1), and the control light should turn off. If it has not turned off within another 5 seconds, cut off the engine.
- Braking should be carried out by smooth synchronous pressure on brake pedals at speeds in the range of limits.

If friction coefficient is less than 0,4 apply full braking starting from speed 150 Km/h. Maintain the direction on landing roll using rudder, on dry runaway light differential braking is allowed.

ATTENTION!
If the aircraft skids sideway off the centerline and is at risk of overrunning the runway :
- immediately reduce reverse thrust of both engines to idle regime, stop braking;
- using rudder pedals and ailerons as well as differential brakes on dry runaway, direct the aircraft towards the centerline;
- if the aircraft keeps skidding, switch off nose gear “GEAR STEERING”- “РАЗВОРОТ КОЛЕСА” to self-orientation mode (disable nose wheel steering) . After the aircraft skids no longer, set the rudder pedals at neutral, switch on “GEAR STEERING”- “РАЗВОРОТ КОЛЕСА” again and steer the aircraft parallel to the runaway centerline;
- after full control of the aircraft is regained, and its running along the centerline, apply brakes and, if necessary, advance reverse thrust until it comes to a complete stop;
- do not apply differential reverse thrust to correct the skid;
- do not allow S-shaped maneuver of the aircraft on landing roll.

Approaching a runaway with low friction coefficient, keep estimated V_{REF} and control threshold crossing height very strictly.

In case of one engine reverse failure and risk of overrunning the runaway, reduce reverse for both engines. After regaining control over the aircraft apply the reverse thrust on the fault-free engine again.

At the finish of landing run:
- switch nose gear mode switch to “63°”;
- retract flaps and ensure that the stabilizer has moved to adjusted position;
- retract spoilers;
- switch off “PITOT HEAT” - “ОБОГРЕВ ППД”.

CAUTION! In case of the reverse thrust usage until full stop as well as landing on a runaway covered with snow or dirt, do not retract flaps/slats until parking. On parking ensure the absence of ice and dirt on flaps, slats and spoilers, then retract control surfaces and lights.

It is allowed to retract flaps to 28° position before parking.

2.8.2 Landing in crosswind conditions.

V_{REF} until touchdown should be set to 10 Km/h higher than V_{REF} calculated for normal conditions. On final remove the drift angle aligning with the runway heading until touchdown.

Land, maintaining drift angle restrictions without bank and sideslip.

Extend central spoilers after touchdown, align using rudder, pull down the nose gear and, running on or along the centerline, advance reverse thrust. If touchdown occurred outside the centerline, keep rolling along it. In case of touchdown with some angle towards centerline, correct the aircrafts position reaching a parallel roll.

2.8.3 Landing in wind sheer conditions.

Approach is **FORBIDDEN** in case of wind longitudinal components on ground and at 100 m AGL differ by 15 m/Sec or more. Approaching in wind sheer conditions, increase IAS by 10-15 Km/h if it has not been increased for other reasons.

Keep speed on glide slope with small corrections of thrust level in the range of 5% N1 (high pressure fan speed). Thrust level should be also corrected if IAS changed by 15 Km/h after the aircraft had stabilized on the glideslope.

ATTENTION! Simultaneous elevator deflection and thrust level correction could result in a misbalance on final approach and aircraft swinging.

If the required thrust at 200 m height or below is higher than nominal regime (92,5%) or less than 70%, it is necessary to execute a go-around procedure.

2.8.4 Correction of lateral offsets from runaway centerline in automatic or FD approach modes.

Upon reaching decision height CPT must verify a lateral offset from centerline and offset from glide slope. Maximum lateral offsets from centerline are listed in the table below:

Height, м	**100**	**80**	**60**	**45**	**30**
Distance before runaway threshold, m	1950	1500	1050	700	400
Maximum lateral offset from centerline, m	100	70	40	30	30 (but no more than 1/2 runaway width)

The lateral offsets are estimated are based on the aircraft position relative to runaway landing lights or other visible objects.

If maximum lateral offset are reached, CPT must:
- In automatic mode press the “GO-AROUND” button on the yoke;
- In FD mode: cancel flight by flight directors and start go-around procedure in automatic or FD mode.

If lateral offset is within the limits, the CPT must switch off ABSU and auto throttle and start maneuvers for correction of the lateral offset.

At 60 m AGL or above:
- Execute S-shaped maneuver composed of two coupled turns towards runaway centerline. First turn (towards centerline) should be executed with a bank of 10-12° and counter turn with a 6-8° bank. Maximum bank should not exceed 15° in the beginning of this maneuver and 2-3° over the runaway threshold.

From 60 m AGL to 30 m (including):
- Approach is accepted as correct if at decision height a ground speed vector is directed inside the limits of runaway width. If at decision height a lateral offset is in the red lights area of the stop way (±12-15 m), decision on landing can be made with no visibility of the runaway threshold, landing is executed without correction of lateral

offset. If the lateral offset does not exceed 30 m but not more than ½ runaway width decision on landing must be made with clear visibility of the runaway threshold. In that case landing is performed by applying a correction using a single turn towards the centerline at an angle of 1-3° with a bank that not exceeding 5°. Touchdown between centerline and runaway side lights from the side of the lateral offset with further correction to get running on or along centerline. Touchdown across the centerline increases the risk for overrunning.

Maximal offset on glide slope at decision height should not exceed the boundaries of the "aircraft silhouette" in the centre of the PNP-I (HSI) gauge, which may result in an approximate landing distance extension of up to 100 m.

2.8.5 Go-around procedure with all operating engines or one faulty engine.

A safe missed approach is possible:
- before starting pre-flare;
- during pre-flare;
- at 4-6 m, or at 10 m AGL with one faulty engine.

CAUTION!
- Altitude lost ("dive depth") while aborting a balanced approach for a go-around procedure equals to:
    i) 4 - 8 m at Vy=-3,5 ÷ -4,0 m/Sec;
    ii) 10 - 12 m at Vy=5,0 m/Sec;
    iii) 15 - 18 m at Vy=6,0 m/Sec;
    iv) 20 - 24 m at Vy=7,0 m/Sec;
    v) 28 - 32 m at Vy=8,0 m/Sec.
- When executing a go-around from an unstable approach (yoke movement, thrust correction, swinging) there is a possibility for doubled depth.
-When executing a go-around at 25 m height or less, the depth decreases due to an increase in ground effect.

Executing go-around procedure CPT:
- after the go-around decision is made, notifies the crew, starts pulling up the aircraft and commands to advance thrust levers to take-off position;
- commands to retract flaps to 28º in case they had been set for 45° or to 15° if flaps were at 28, maintain the current speed from the moment the go-around procedure is commenced;
- after reaching a positive vertical speed commands to retract landing gear;
- climb while accelerating 300-310 Km/h (δ3=28°) or 320-330 (δ3=15°) Km/h;
- when IAS reaches 300-310 Km/h (δ3=28°) or 320-330 Km/h (δ3=15°) commands to start flaps retraction to 0° decreasing angle of ascent while retracting the flaps to accelerate to 340-400 Km/h;
- control flaps retraction and stabilizer movement to the adjusted position;
- climb to traffic pattern altitude at 340-400 Km/h ;
- at traffic pattern altitude reduce thrust and execute another approach.

Note: If go-around procedure requires a turn before flaps retraction, such a turn shall be done after flaps retraction from 45° to 28° or from 28° to 15° at a height no lower than 50 m at IAS 300 Km/h or higher while climbing. In case of turns exceeding 15° bank if the bank limit alarm sounds, special attention should be paid to artificial horizon working condition and 25° bank limit shall not be exceeded. Flaps retraction should be performed after turn completion on a straight portion of the flight.

2.8.6 Taxi to gate.

After leaving the runaway, F/E should pump over the remaining fuel from tanks nr. 3 to tanks nr. 2 and, if necessary, start APU.

After completing the landing roll and engines cooling on idle mode for 1 minute it is recommended to cut off engine nr. 2 or nr. 2 and nr. 3. Before cutting off the engine nr. 2 switch on the electrical pump of hydraulic system nr. 2.

Prior to stop at gate assure normal braking and normal pressure in hydraulic systems (200-220 kg/sm^2).

2.9 Training flights

2.9.1 Take-offs.

For training flights purpose it is allowed to execute take-offs on take-off or nominal thrust.

During series of take-offs CPT must control spoilers retraction to zero position, null position of spoiler lever and control light “SPOILERS LOCK OPEN” - “ЗАМКИ ИНТЕРЦЕПТОРОВ ОТКРЫТЫ “ turned off.

2.9.2 Go-around procedure.

For training flights purpose it is allowed to execute go-around on take-off or nominal thrust.

Nominal thrust is allowed to be applied:
- in case all engines are running and weight does not exceed 75 000 kg;
- for training with an engine failure simulation and weight that does not exceed 70 000 kg;
- landing with 28° flaps position and weight that does not exceed 92 000 kg.

ATTENTION!
In case of one engine failure during take-off on nominal regime with weight no more than 70 000 kg it is necessary to advance thrust levers for take-off position.

Note: At any stage of go-around procedure at nominal regime it is allowed to increase thrust to take-off regime.

2.9.3 Touch and go procedure.

Conditions for touch and go procedure:
- Initial landing weight should not exceed 78 000kg, flaps at 45° in each approach and landing;
- All flights should be executed with the extracted landing gear, flight duration should not be less than 15 minutes, a time interval between flights not more than 10 minutes.

CAUTION! When performing flights with the extracted landing gear it is necessary recycle the “GEAR STEERING” - “РАЗВОРОТ КОЛЕСА” switch, so as to avoid landing with the turned nose gear.

On landing run usage of reverse thrust is mandatory.

IAS for start braking should not more be than 160 Km/h. Braking action should not be intensive, ½ of brake pedals travel that relates to a pressure of 50-60 kg/см2 in braking system.

The number of such flights should not exceed:
- 5 if ground temperature is +20°C or lower;
- 3 if ground temperature is in the range +20°C ÷ +30°C.

For training flights in the above conditions, the runaway length should not be less than 3 500 m.

2.10 Piloting at maximum airspeeds or M-speeds

Minor forces on control column during acceleration caused by elevator position should be fully relieved by the trimmer. Aircraft “behavior” should be normal. Turns execution on maximum airspeed or M-speed should not present difficulties. In case of unpremeditated acceleration to M=0,88 decrease M-speed by reducing thrust.

At H=11 000 and M=0,7-0,8 there is a direct aircraft reaction on rudder deflection, at M>0,895 there is a back reaction, i.e. deflecting left rudder pedal the aircraft rolls to the right, deflecting right rudder pedal it rolls to the left, but due to good cross controllability the back reaction does not complicate piloting.

CAUTION! In order to avoid airframe vibration when flying at high altitudes and airspeeds it is necessary to avoid violent maneuvers and overriding G-force more than 1,2g-1,3g.

2.11 Piloting at minimum airspeeds

At all stages of flight an airspeed decreasing lower than recommended value for respective configuration is not allowed. In case of an unpremeditated airspeed decrease down to minimum airspeed the AoA indicator shall sound an alarm. If the AoA indicator has alarmed take an action to increase airspeed.

During flights in any configuration at low airspeeds there should be no airframe vibration, aircraft behavior should be normal. Maneuvers at speeds that are close to minimum require increased attention, perform smooth deflection of the control column and yoke to prevent high G-force value. Bank should not exceed 20°.

2.12 Aircraft piloting in intensive turbulence conditions

Upon entering into a zone with intensive turbulence (G-force>1,5g):

- set IAS=500 Km/h; and at H>10 750 set M-speed=0,8;
- switch off automatic mode of ABSU;
- execute soft control of aircraft;
- do not aim at maintaining precise altitude and airspeed, execute piloting by smooth deflection of control axes using average values.
- do not allow high pitch and don't exceed 10°-15° bank.

Execute turns near frontal cloud systems at M≤0,8. When entering strong upward blast keep a constant pitch on the artificial horizon. If an intensive airframe vibration arise, deflect the control column forward, not changing thrust levers position and not allowing the maximum airspeed or M-speed to exceed.
Entering into a strong downward blast (quick altitude loss), continue descent keeping all control axes in balanced position, do not allow maximum airspeed or M-speed to exceed. If adhered to, a stall is almost impossible.

In case of stall, immediately push the control column to the full forward position. After AoA decreased and aircraft accelerated to minimum airspeed + 50-70 Km/h, pull up aircraft to horizontal flight reaching G-force not more than 1,2g-1,3g. Altitude loss should not be more than 650 m.

In case of engine surge reduce thrust to idle. If after thrust reduction, normal operation of the engine was not restored, cut off the engine. Start the engine over again on normal AoA if EGT during the surge has not exceeded 680°C.

2.13 Night flights

2.13.1 Preparation for night take-off.

During preparation for night take-off (additionally to standard operations):
- check pilot console lighting, set brightness;
- check position lights/strobes;
- extract and check "LANDING" - "ПОСАДОЧНЫЙ" and "TAXI" - "РУЛЁЖНЫЙ" lights;
- "DAY-NIGHT" - "ДЕНЬ-НОЧЬ" switch to "NIGHT" - "НОЧЬ" position;

Upon receiving clearance to taxi, extend and turn on "TAXI" - "РУЛЁЖНЫЙ" light. When necessary, it is allowed to use "LANDING" - "ПОСАДОЧНЫЙ" light for over viewing a taxiway but its usage should not be more than 5 minutes.

On holding point ensure sufficient lighting of all gauges.

2.13.2 Night take-off features.

Take-off is executed with landing lights turned on. Hold visually the take-off direction based on visibility of runaway centerline lights and displacement of side lighting. After rotation guide yourself by runaway lights, PNP, artificial horizon, IAS and vertical speed indicators with further transition to pure instrumental flight. At H=50 m switch off and retract the landing lights.

2.13.3 Night approach and landing procedures.

Approach procedure at night is similar to standard approach procedure.

Extend wing and fuselage lights prior to reaching FAF. Landing lights should be turned on at H=100-150 m after a visual contact with landmark was established.

CAUTION! Approaching in fog, haze or atmospheric precipitations the landing lights could be switched on upon CPT decision. In case of light reflection immediately turn off the light.

Landing is similar to standard landing procedure.

Upon finishing a landing run switch light to “TAXI” – “РУЛЕЖНЫЙ” .

2.14 Piloting features if CG 32-40% MAC

Such CG is allowed if it’s not possible to move CG forward. At that, take-off weight should not exceed 80 000 kg. Stability and controllability of aircraft at CG >32% MAC are almost the same in comparison to forward CG, But it is necessary to take into account the following terms:
- on taxi short differential braking is needed to turn the aircraft;
- significant force needs to be applied on the control column during pull up on take-off and landing;
- stabilizer should be set to “REAR” - “3” position at CG >35% MAC;
- maximum flight level is 10 100 m.

Chapter 3. Aircraft characteristics. Auxiliary tables.

3.1 Crosswind, headwind and tailwind components

Wind Angle / Wind speed	0°	± 10°	± 20°	±30°	± 40°	±50°	± 60°	± 70°	± 80°	± 90°
4 m/Sec	0 4	1 4	1,5 4	2 3,5	3 3	3 3	3,5 2	4 1,5	4 1	4 0
6 m/Sec	0 6	1 6	2 5,5	2,5 5	4 4	4 4	5 2,5	5,5 2	6 1	6 0
8 m/Sec	0 8	1,5 8	3 7,5	4 7	5 6	6 5	7 4	7,5 3	8 1,5	8 0
10 m/Sec	0 10	2 10	3,5 9,5	5 9	6,5 8	8 6,5	9 5	9,5 3,5	10 2	10 0
12 m/Sec	0 12	2 12	4 11	6 10	8 9	9 8	10 6	11 4	12 2	12 0
14 m/Sec	0 14	2,5 14	4 13	7 12	9 11	11 9	12 7	13 4	14 2,5	14 0
16 m/Sec	0 16	3 16	5,5 15	8 14	10 12	12 10	14 8	15 5,5	16 3	16 0
18 m/Sec	0 18	3 18	6 17	9 16	11,5 14	14 11,5	16 9	17 6	18 3	18 0
20 m/Sec	0 20	3,5 20	7 19	10 17	13 15	15 13	17 10	19 7	20 3,5	20 0
22 m/Sec	0 22	4 22	7,5 21	11 19	14 17	17 14	19 11	21 7,5	22 4	22 0

In the upper row the crosswind component is indicated, and in the lower row the headwind or tailwind components depending on wind direction are indicated.

3.2 Take-off weight (Flaps 28°)

T, ºC Elevation	-10	-5	0	+5	+10	+15	+20	+25	+28	+30	+32	+34	+36	+38	+40
0 m													99,4	98,1	96,6
100 m												99,8	98,3	97,0	95,6
200 m												98,7	97,2	95,9	94,5
300 m											99,1	97,6	96,1	94,8	93,4
400 m										99,5	98,0	96,5	95,0	93,7	92,3
500 m										98,4	96,7	95,4	93,2	92,6	91,2
600 m									99,0	97,3	95,8	94,3	92,8	91,5	90,1
700 m								99,3	96,8	96,1	93,6	92,1	91,6	90,4	89,0
800 m								99,3	96,8	96,1	93,6	92,1	90,6	89,3	87,9
900 m								98,2	95,7	94,0	92,5	91,0	89,5	88,2	86,8
1000 m								97,1	94,6	92,9	91,4	89,9	88,4	87,1	85,7
1100 m							99,8	96,0	93,5	91,8	90,3	88,8	87,3	86,0	84,6
1200 m							98,7	94,9	92,4	90,7	89,2	87,7	86,2	84,9	83,5
1300 m							97,6	93,8	91,3	89,6	88,1	86,6	85,1	83,8	82,4
1400 m							96,5	92,7	90,2	88,5	87,0	85,5	84,0	82,7	81,3
1500 m						99,2	95,4	91,6	89,1	87,4	86,2	84,4	82,9	81,6	80,2
1600 m						98,0	94,3	90,3	88,0	86,3	84,8	83,3	81,8	80,5	79,1
1700 m					99,9	96,8	93,2	89,4	86,9	85,2	83,7	82,2	80,7	79,4	78,0
1800 m					98,8	95,5	92,1	88,3	85,5	84,1	82,6	81,1	79,6	78,3	76,9
1900 m					97,6	94,2	91,0	87,2	84,7	83,0	81,5	80,0	78,5	77,2	75,8
2000 m				99,2	96,4	93,0	89,9	86,1	83,6	81,9	80,4	78,9	77,4	76,1	74,7
2200 m			99,0	96,6	93,9	90,8	87,6	83,9	81,4	79,7	78,2	76,7	75,2	73,9	72,5
2400 m		99,4	96,3	94,0	91,4	88,3	85,2	81,7	79,2	77,5	76,0	74,5	73,0	71,7	70,3
2600 m	99,5	96,8	94,0	91,4	88,9	86,0	82,8	79,5	77,0	75,3	73,8	72,3	70,8		
2800 m	97,0	94,0	91,8	89,0	86,4	83,4	80,4	77,2	74,8	73,1	71,6	70,1			
3000 m	94,0	91,6	89,0	86,6	84,0	81,0	78,0	75,0	72,6	70,9					

3.3 Take-off weight (Flaps 15°)

T, ºC / Elevation	+12	+14	+16	+18	+20	+22	+24	+26	+28	+30	+32	+34	+36	+38	+40
700 m															99,0
800 m															98,0
900 m														98,8	97,0
1000 m													99,2	97,6	96,0
1100 m													98,4	97,1	95,8
1200 m												98,9	97,1	95,3	93,5
1300 m											99,2	97,5	95,9	94,1	92,4
1400 m											98,2	96,5	94,7	93,0	91,3
1500 m										99,0	97,2	95,5	93,6	92,0	90,3
1600 m									99,0	97,5	95,8	94,2	92,5	90,9	89,3
1700 m								99,3	97,9	96,5	94,8	93,1	91,5	89,8	88,2
1800 m							99,8	98,3	96,8	95,3	93,6	92,0	90,4	88,8	87,2
1900 m							98,9	97,3	95,7	94,1	92,1	90,9	89,3	87,7	86,1
2000 m						98,6	97,2	95,8	94,4	93,0	91,4	89,8	88,2	86,6	85,0
2100 m					99,0	97,6	96,2	94,8	93,4	92,0	90,3	88,8	87,0	85,4	83,8
2200 m				98,9	97,5	96,1	94,8	93,8	92,1	90,8	89,1	87,5	85,8	84,2	82,6
2300 m			99,1	97,7	96,3	94,9	93,6	92,3	91,0	89,7	87,9	86,3	84,7	83,0	81,4
2400 m		98,6	97,4	96,2	95,0	93,8	92,5	91,2	89,9	88,6	86,9	85,3	83,6	81,9	80,2
2500 m		97,6	96,4	95,2	94,0	92,6	91,2	89,8	88,4	87,0	85,5	83,9	82,3	80,7	79,1
2600 m	97,2	96,0	94,8	93,6	92,4	91,1	89,9	88,6	87,3	86,0	84,4	82,8	81,2	79,6	78,0
2700 m	96,5	96,7	94,9	93,1	91,3	89,9	88,5	87,2	85,9	84,6	82,9	81,3	79,7	78,1	76,5
2800 m	96,6	95,4	93,6	91,8	90,0	88,6	87,2	85,8	84,4	83,0	81,4	79,8	78,2	76,6	75,0
2900 m	95,0	93,5	92,0	90,5	89,0	87,6	86,2	84,8	83,4	82,0	80,2	78,5	76,9	75,3	73,7
3000 m	92,7	91,4	90,2	89,0	87,8	86,3	84,8	83,3	81,8	80,3	78,7	77,1	75,6	74,0	72,5

3.4 Take-off distance (Flaps 28°)

T, °C	Elevation, m	Take-off Weight, kg						
		70 000 kg	75 000 kg	80 000 kg	85 000 kg	90 000 kg	95 000 kg	100 000 kg
0	200	1020	1140	1320	1500	1780	1925	2150
	500	1040	1160	1340	1530	1800	1950	2200
	1000	1080	1240	1420	1600	1820	2030	2250
	1500	1160	1340	1550	1770	2000	2240	2480
+10	200	1050	1180	1360	1560	1730	1960	2180
	500	1100	1290	1410	1620	1820	2050	2310
	1000	1130	1400	1520	1700	1920	2140	2400
	1500	1300	1500	1720	1960	2200	2410	2700
+20	200	1120	1270	1460	1670	1900	2120	2370
	500	1160	1320	1540	1760	2000	2220	2480
	1000	1300	1460	1700	1920	2160	2400	2680
	1500	1440	1680	1920	2160	2420	2700	3000
+30	200	1210	1390	1600	1730	1960	2310	2450
	500	1300	1500	1720	1820	2050	2420	2650
	1000	1460	1700	1920	2180	2430	2700	2960
	1500	1640	1920	2200	2480	2760	3020	3880

3.5 Wind and runaway slope correction for required T/O distance, m (Flaps 28°)

Direction	Required T/O roll, m					
	1000	1500	2000	2500	3000	3500
	Per 1 m/Sec wind speed					
Headwind (-)	15	20	25	30	35	38
Tailwind (+)	44	56	70	82	100	112
	Per 1% slope					
Down (-)	20	30	60	80	120	140
Up (+)	20	40	80	120	150	180

3.6 Take-off distance (Flaps 15°)

T, °C	Elevation, m	Take-off Weight, kg						
		70 000 kg	75 000 kg	80 000 kg	85 000 kg	90 000 kg	95 000 kg	100 000 kg
0	200	870	1030	1210	1380	1560	1760	1950
	500	900	1060	1250	1420	1610	1810	2020
	1000	970	1130	1330	1500	1700	1900	2140
	1500	1080	1260	1470	1700	1900	2130	2420
	2000	1200	1400	1620	1900	2100	2370	2700
+10	200	930	1100	1260	1450	1620	1840	2030
	500	970	1150	1320	1520	1700	1910	2190
	1000	1040	1240	1420	1640	1850	2100	2460
	1500	1200	1420	1620	1860	2080	2360	2680
	2000	1370	1600	1820	280	2320	2630	2900
+20	200	1100	1170	1360	1560	1760	2020	2240
	500	1080	1240	1450	1650	1890	2150	2400
	1000	1200	1370	1600	1800	2100	2370	2660
	1500	1370	1580	1840	2060	2400	2660	3030
	2000	1550	1800	2080	2320	2700	2960	3400
+30	200	1090	1290	1510	1720	1890	2190	2460
	500	1180	1390	1610	1840	1980	2360	2620
	1000	1330	1560	1800	2050	2130	2640	2930
	1500	1560	1830	2100	2410	2650	3100	3460
	2000	1800	2100	2400	2780	3180	3570	4000
+40	200	1260	1490	1700	2000	2270	2500	2810
	500	1370	1630	1850	2160	2430	2720	3030
	1000	1570	1860	2100	2400	2700	3080	3400
	1500	1820	2100	2450	2810	3150	3590	3970
	2000	2080	2450	288	3230	3600	4100	4550

3.7 Wind and runaway slope correction for required T/O distance, m (Flaps 15°)

Direction	Required T/O roll, m					
	1000	1500	2000	2500	3000	3500
	Per 1 m/Sec wind speed					
Headwind (-)	15	20	25	30	35	40
Tailwind (+)	40	50	66	80	96	110
	Per 1% slope					
Down (-)	15	35	50	75	100	150
Up (+)	15	40	60	90	120	180

3.8 Range of operating temperatures

Altitude, km	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000
Range	-55	-43	-35	-35	-38	-45	-48	-52	-56	-62	-67	-70	-70	-70	-70
T, °C	+45	+38	+30	+25	+18	+13	+7	0	- 7	-13	-18	-26	-33	-40	-40

3.9 Recommended flight level

Flight distance, km	Flight Level, m	
	West direction (180º-360º)	East direction (0-180º)
less than 300	6 000	5 700
300 - 400	8 600	8 100
400 - 500	9 600	9 100
500 - 600	10 600	10 100
600 and more	11 600	11 100 – 12 100

3.10 Radius for executing turn at H=50 m or above at V_2+15 Km/h before retracting Flaps/Slats

Weight, kg	Radius, m			
	$\gamma = 10°$	$\gamma = 15°$	$\gamma = 20°$	$\gamma = 15°$
98 000	3886	2557	1882	1469
94 000	3755	2471	1819	1420
90 000	3500	2303	1696	1323
85 000	3377	2222	1635	1277
80 000	3135	2063	1519	1186

3.11 Maximum operating altitudes in case of one engine failure

Weight, tones ISA	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100
- 20°	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5	10.4
-10°	11.3	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.8
ISA	10.8	10.7	10.5	10.4	10.3	10.1	10.0	9.9	9.8	9.6	9.5	9.4	9.3	9.1	9.0	8.8
+10°	10.0	9.8	9.6	9.5	9.3	9.2	9.0	8.9	8.8	8.6	8.5	8.4	8.3	8.1	0.0	7.8
+20°	9.4	9.1	8.7	8.4	8.1	7.8	7.5	7.2	6.9	6.6	6.3	6.0	5.7	5.4	5.1	4.8

3.12 Maximum operating altitudes in case of two engines failure (V=360 Km/h)

Weight, tones / ISA	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100
-10°	2700	2100	1500	900	-	-	-	-	-	-	-	-	-	-	-	-
ISA	4800	4500	3900	3600	3000	2400	1800	900	-	-	-	-	-	-	-	-
+10°	6300	6000	5700	5400	5100	4500	4200	3600	3000	2700	2100	1500	800	-	-	-
+20°	8100	7800	7500	7200	6900	6600	6300	6000	5700	5100	4800	4200	3900	3300	2400	1500

3.13 Landing weight (Flaps 45°)

T, ºC Elevation	-15	-10	-5	0	+5	+10	+15	+20	+25	+30	+32	+34	+36	+38	+40
0 m	85,6	84,8	84,4	83,8	83,2	82,6	82,1	81,6	80,8	79,2	78,3	77,0	75,7	74,4	73,2
100 m	85,5	84,7	84,3	83,7	83,0	82,5	82,0	81,3	80,4	78,7	7,5	76,3	75,0	73,7	72,4
200 m	85,4	84,6	84,2	83,6	82,9	82,4	81,8	80,5	79,2	77,0	75,7	74,4	74,3	72,5	71,6
300 m	85,3	84,5	84,1	83,4	82,7	82,2	81,6	80,8	79,8	76,8	76,1	74,8	73,5	72,2	70,8
400 m	85,2	84,4	84,0	83,2	82,6	82,0	81,4	80,6	79,4	76,5	75,3	74,0	72,7	71,3	70.0
500 m	85,1	84,3	83,9	83,1	82,4	81,9	81,2	80,3	79,2	75,7	74,7	73,1	71,8	70,5	69,2
600 m	85,0	84,2	83,8	83,0	82,3	81,6	81,0	80,2	78,4	74,5	73,2	72,2	70,9	69,6	68,4
700 m	84,9	84,1	83,7	82,9	82,1	81,4	80,8	80,0	77,4	73,9	72,6	71,3	70,0	68,7	67,5
800 m	84,8	84,0	83,6	82,8	81,9	81,3	80,6	79,4	76,4	73,0	71,7	70,4	69,0	67,8	66,6
900 m	84,7	83,9	83,5	82,6	81,7	81,2	80,4	78,4	75,6	72,1	70,8	69,5	68,2	66,9	65,8
1000 m	84,6	83,8	83,4	82,5	81,6	80,9	80,2	77,4	74,6	71,2	70,1	68,9	67,6	66,3	65,0
1100 m	84,5	83,7	83,4	82,3	81,4	80,7	79,6	76,5	73,6	70,3	69,2	68,0	66,7	65,4	64,2
1200 m	84,4	83,6	83,2	82,2	81,3	80,4	78,6	75,6	72,8	69,4	68,2	67,0	65,8	64,6	63,4
1300 m	84,3	83,5	83,1	82,1	81,2	79,6	77,6	74,6	71,8	68,5	67,3	66,1	64,9	63,8	62,7
1400 m	84,2	83,5	83,0	82,0	80,6	78,8	76,6	73,6	70,8	67,6	66,5	65,4	64,3	63,2	62,0
1500 m	84,1	83,4	82,6	81,0	80,0	77,9	75,6	72,8	70,0	66,8	65,6	64,4	63,2	62,0	61,1
1600 m	84,0	83,3	82,2	80,0	78,8	77,0	74,8	72,0	69,0	66,0	65,0	63,8	62,6	61,4	60,2
1700 m	83,7	83,2	81,3	79,4	77,9	76,1	73,8	71,0	68,0	65,0	63,8	62,6	61,4		
1800 m	83,4	82,0	80,4	78,8	77,0	75,4	73,2	70,0	67,2	64,0	62,8	61,6			
1900 m	82,5	81,0	79,5	77,9	76,2	74,4	72,2	69,1	66,2	63,2	62,1	61,0			
2000 m	81,6	80,0	78,6	77,0	75,4	73,6	71,2	68,2	65,2	62,2	61,0	60,0			
2200 m	80,0	78,4	76,8	75,4	73,6	71,6	69,6	66,4	63,4	60,2					
2400 m	78,0	76,4	75,0	73,6	71,8	70,0	67,7	64,6	61,6						
2600 m	76,4	74,8	73,2	71,8	70,0	68,2	66,0	62,8							
2800 m	74,8	73,0	71,6	70,0	68,2	66,4	64.4	61,0							
3000 m	73,0	71,4	70,0	68,0	66,6	64,8	62,6	60,0							

3.14 Required landing distance (Flaps 45°)

T,°C	Elevation, m	65 000 kg		70 000 kg		75 000 kg		80 000 kg		85 000 kg	
		Runaway distance factor									
		1,5	1,67	1,5	1,67	1,5	1,67	1,5	1,67	1,5	1,67
0	200	1680	1870	1785	1987	1875	2087	1980	2204	2085	2381
	500	1740	1937	1860	2070	1950	2170	2055	2290	2145	2390
	1000	1860	2070	2010	2240	2040	2270	2190	2440	2280	2540
	1500	1920	2140	2055	2290	2160	2405	2265	2520	2370	2640
	2000	1980	2205	2100	2340	2220	2470	2340	2605	2475	2755
+10	200	1755	1954	1875	2087	1980	2204	2085	2321	2190	2438
	500	1800	2004	1920	2137	2025	2254	2145	2388	2265	2522
	1000	1890	2104	2025	2254	2130	2374	2250	2505	2385	2655
	1500	1965	2188	2100	2338	2205	2455	2325	2588	2460	2739
	2000	2040	2271	2160	2405	2280	2538	2400	2672	2550	2839
+20	200	1785	1987	1890	2104	2010	2238	2145	2388	2235	2488
	500	1845	2054	1950	2171	2070	2304	2205	2455	2295	2555
	1000	1920	2137	2040	2272	2173	2421	2325	2588	2400	2672
	1500	2025	2254	2145	2388	2295	2555	2445	2722	2550	2839
	2000	2130	2371	2250	2505	2400	2672	2550	2839	2700	3006
+30	200	1860	2070	1965	2188	2100	2338	2220	2471	2340	2605
	500	1890	2104	1995	2221	2130	2371	2250	2505	2355	2621
	1000	1950	2171	2070	2304	2190	2438	2310	2572	2460	2739
	1500	2070	2304	2190	2438	2340	2605	2490	2772	2625	2922
	2000	2205	2355	2340	2605	2505	2789	2670	2972	2805	3123
+40	200	1950	2171	2085	2321	2205	2455	2340	2605	2445	2722
	500	2010	2238	2145	2388	2265	2522	2385	2655	2505	2789
	1000	2100	2338	2250	2505	2400	2672	2550	2839	2655	2956
	1500	2205	2455	2370	2838	2520	2805	2670	2972	2805	3123
	2000	2325	2588	2490	2772	2640	2939	2790	3106	2910	3240

3.15 Engines parameters on the ground (H=0, V=0, ISA)

Regime	Thrust Lever Angle (TLA), deg	High pressure fan speed, % (N1)	Low pressure fan speed, % (N2)		EGT, ºC	Oil pressure, kg/cm^2	Operating period, min
			Nozzle	Reverse			
Take-off	114±2	$95{,}5\pm^{1{,}0}_{1{,}5}$	96,0±1,5	$97\pm^{1}_{2}$	630	4-0,5	No more than 15, and no more than 2,5% TBO
Nominal	106±1	92,5±1	91±1	91,5±1	590	4-0,5	No limit, but no more than 20% TBO
0,85 of nominal	96±2	89,5±1	86±1	86,5±1	550	4-0,5	No limit
0,7 of nominal	86±3	86,5±1	80,5±1	81,5±1	500	4-0,5	No limit
0,6 of nominal	80±3	84±1	76±1	77±1	475	4-0,5	No limit
0,4 of nominal	66±3	78,5±1	65,5±1	66±1	430	4-0,5	No limit
Idle	25 - 40	$55{,}5_{-3}$	29 - 33	29 - 33	-	2,5 and more	No more than 60
Reverse	$3\pm^{2}_{3}$	$88\pm^{2{,}0}_{1{,}5}$	-	86±1	575	4-0,5	No more than 1