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Installation and settings

The aircraft installation is very simple. You have to extract the archive to any location within the X-Plane folder. Suggested location is **/Aircraft/General aviation/**.

If you use X-Plane9, then you'll need to install smaller textures from /v9_texture_pack/ folder. Select your language and copy files into /objects/ folder of an aircraft.

When first starting An24, its plug-in will require activation. You'll need Internet connection for it. Input the serial number, which you've got when you bought An24 and plug-in will activate itself automatically. If you don't have an Internet connection, you'll have to find some Internet cafe. In this case choose “manual activation”. Plug-in will generate an unique code. You'll need to send this code to developers to felisleopard@gmail.com and we will return you an activation code.

Settings

This model has a setup panel for extensive control of the realism and other aircraft settings. You can open it with the “OPT” main menu button. Settings can be stored in the configuration file and are load automatically every time the aircraft is opened. The settings file name is “an24_settings.ini”. You can edit this file with text editor.

Let’s see what the settings do:

1. Real fuel meter – with this setting enabled the fuel gauge will show understated indication according to the actual table of deviation.

2. Realistic art. horizon – real world attitude indicator requires alignment and locks when power is off or even falls down. It also requires about 2 minutes for spin up when turned on.

3. Real fires – results in inflammation of the engine nacelles and wings if the engine fire was not extinguished on time.

4. Real startup – you’ll have to follow the realistic start up sequence if this option is enabled. If it’s disabled, the engines can be started in any circumstances.

5. Real generators – the real generators can sustain load up to 600 amperes. We have increased this limit to 650 amperes in the model. Generator will fail if overloaded. And because the generator is also used as a starter on this aircraft, you’ll lose a starter as well.

6. Real landing gear – landing gear can collapse on hard landing. Also if extended at speed over 400km/h, the gear will fail to retract.

7. Real brakes – the brakes can overheat and fail on the continuous heavy application. When released they cool down again but once overheated and failed they will not gain operability back.

8. Real tyres – can burst during the long skid on the dry paved surface.

9. Active camera – turns on the camera shake during the runway roll, on the critical AOA and on overspeed conditions.

10. Show GPS or Garmin – enables the hidden device located on the glareshield over the captains instrument panel. Only one of them can be used simultaneously.

11. Switch or hold mode of the throttle stops – if the toggle mode is enabled, the locks will toggle their state on every click. If the hold mode is enabled, they will stay raised only as long as the button is depressed.

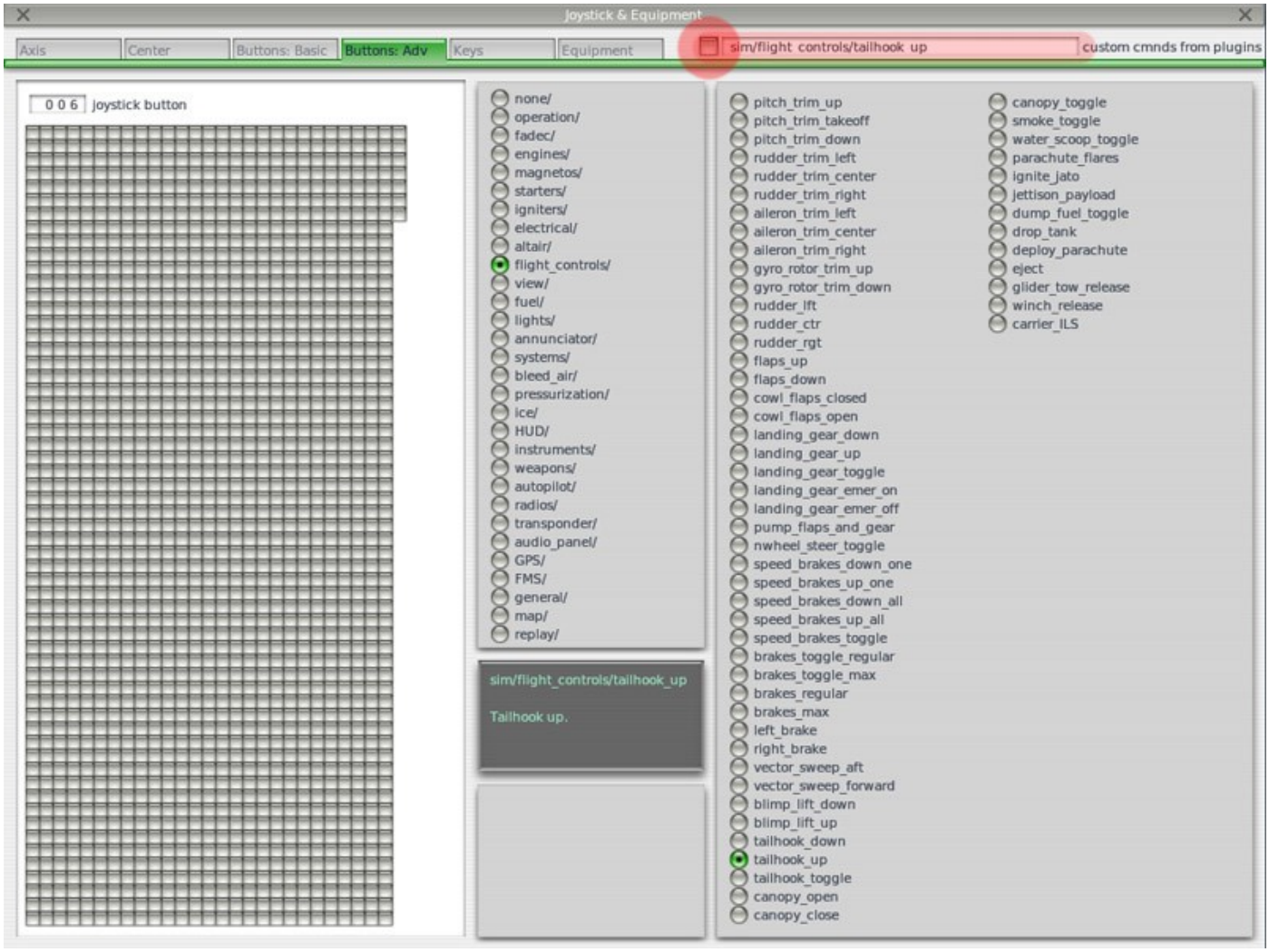
12. North and South GDI (gyro direction indicator) modification – select the North or South hemisphere for GDI system

13. Real fuel system or FSE compatible – use FSE compatible, if you play FS Economy. It will turn off some features of fuel system

14. USSR или CIS RSBN dataset – choose the proper nav base for RSBN system

15. Black Box – turns ON recording of some flight parameters into file

Commands



Open "**Settings / Joystick, Keys & Equipment**" menu and select the "Buttons: Adv" tab. Here you can set the variety of the An-24 specific commands to the buttons on your flight yoke or joystick. **To set custom commands – click on red square on top of settings menu.** The specific functions are:

1. sim/instruments/timer_start_stop – start/pause/reset of timer on chronometer. click
2. sim/instruments/timer_reset – start/pause/reset of flight timer on chronometer. click
3. sim/autopilot/fdir_servos_down_one – disconnect autopilot. click
4. sim/autopilot/fdir_servos_up_one – engage autopilot. click
5. sim/autopilot/servos_on – AP hold for manual flight. hold
6. sim/autopilot/override_left – AP roll left. click
7. sim/autopilot/override_right – AP roll right. click

8. sim/autopilot/override_up – AP pitch UP. click
9. sim/autopilot/override_down – AP pitch DOWN, click
10. sim/autopilot/altitude_hold – AP altitude hold mode. click
11. sim/autopilot/wing_leveler – AP horison mode. click
12. sim/autopilot/fdir_on – AP power switcher. click
13. sim/autopilot/servos_toggle – AP trimm switcher. click
14. sim/autopilot/pitch_sync – AP pitch switcher. click
15. sim/autopilot/airspeed_up – AP course selector UP. click
16. sim/autopilot/airspeed_down – AP course selector DOWN. click
17. sim/autopilot/hsi_select_nav_1 – Source selector for CFI switch left one. click
18. sim/autopilot/hsi_select_nav_2 – Source selector for CFI switch right one. click
19. sim/flight_controls/speed_brakes_up_one – posistion of throttle latch UP one step. click
20. sim/flight_controls/speed_brakes_down_one - posistion of throttle latch DOWN one step. click
21. sim/flight_controls/tailhook_up – main throttles latch UP/DOWN. click/hold
22. sim/flight_controls/tailhook_down – RU19 throttle latch UP. hold
23. sim/instruments/ah_ref_up – increase pressure on feet-meter. click/hold
24. sim/instruments/ah_ref_down – decrease pressure on feet-meter. click/hold
25. sim/flight_controls/flaps_up – retract flaps. hold
26. sim/flight_controls/flaps_down – extend flaps. hold
27. sim/flight_controls/landing_gear_up – gear valve UP for one step. click
28. sim/flight_controls/landing_gear_down – gear valve DOWN for one step. click
29. sim/autopilot/heading – fast sync compass button for GFC (gyroscopic fluxgate compass). hold
30. sim/autopilot/vertical_speed_up – switch GDI corrector left one step. click
31. sim/autopilot/vertical_speed_down - switch GDI corrector right one step. click
32. sim/autopilot/vertical_speed_sync - switch GDI corrector to center. click
33. sim/lights/landing_lights_toggle – switch to landing light. click
34. sim/lights/taxi_lights_toggle – switch to taxi light. click
35. sim/engines/thrust_reverse_toggle – set/release propellers latch. click
36. sim/autopilot/heading_down – turn ZK2 scale left. hold
37. sim/autopilot/heading_up - turn ZK2 scale right. hold
38. xap/panels/panel_1 … panel_16 – show/hide popup panels. click

    panel_1 = main menu

    panel_2 = nav panel1

    panel_3 = nav panel2

    panel_4 = electric panel

    panel_5 = fuel panel

    panel_6 = left panel

    panel_7 = right panel

    panel_8 = autopilot panel

panel_9 = radio panel

panel_10 = service panel

panel_11 = payload

panel_12 = nl10m panel

panel_13 = map panel

panel_14 = options

panel_15 = info panel

panel_16 = camera panel

39. sim/annunciator/gear_warning_mute – temporary disable the buzzer

We recommend do not use an axis to set flaps angle – it will cause conflict between your commanded flap position and plugin's commands. Also it counts for landing gears. Better use commands – it more realistic for An24.

Installation of KLN90

KLN 90 is a freeware add-on by Dennis Pruefer. You can download it from here:

http://www.benedikt-stratmann.de/index.php?kln90b

Because An24 is now copy protected – all of its files are encrypted and it is impossible to include unencrypted modules. To enable KLN90, you'll have to download special encrypted version here:

https://dl.dropboxusercontent.com/u/3443224/KLN90_encrypted.zip

Next, follow this instructions:

1. unzip the KLN90 package
2. copy all files from «X-Plane main folder» to X-Plane's root folder
3. find the folder named «your aircraft folder\Custom Avionics» and copy all of its files into «Custom Avionics» folder of An24. Replace some files, when asked.
4. Reopen An24 in simulator

The plug-in will automatically detect KLN90 and include it.

Aircraft specifications

General characteristics

1. Crew: 2-5 (2 pilots, 1 navigator, 1 flight engineer, 1 radio operator)
2. Capacity: 48 passengers
3. Payload: 5000kg
4. Empty weight: 14289kg
5. Maximum takeoff weight: 21800kg
6. Typical takeoff weight: 18000kg
7. Range: 1000km
8. Ferry range: 2800km
9. Maximum speed: 540km/h
10. Cruise speed: 420km/h
11. Ceiling: 6000m

Operating speeds

1. Rotation speed (VR): 190-210km/h
2. Takeoff speed (V2): 200-230km/h
3. Landing speed (VRef) with flaps 38: 180-200km/h
4. Final approach speed: 200-220km/h
5. **Max indicated air speed** with flaps fully retracted (VNO): 460km/h
6. Flaps 5-15 (VFE): 300km/h
7. Flaps 38: 250km/h
8. Maximum landing gear operating speed (VLO): 320km/h
9. Maximum landing gear extended speed (VLE): 450km/h
10. Emergency descend speed (VD): 540km/h

Other operating limitations

1. Maximum allowed roll with symmetric thrust: 30°
2. Maximum allowed roll with one engine out: 15°
3. Positive G load: 2.4
4. Negative G load: 0
5. Maximum side wind for the dry paved runway operation: 12m/s
6. For the 0.3-0.6 friction coefficient conditions: 5-12m/s
7. Minimum runway length: 1300m. Takeoff with flaps set at 5 is allowed from the 1600m or longer runways.
8. Takeoffs from the unpaved runways only allowed with flaps set at 15 regardless of the runway length.
9. Max taxiing speed 30km/h

Instruments and controls layout

General cockpit layout

1. Overhead instrument panel
2. Left side instrument panel
3. Captain instrument panel
4. Middle instrument panel
5. First officer instrument panel
6. Right side instrument panel
7. Middle console
8. Navigators instrument panel (behind the captains seat)
9. Engine vibration control system (IV-41) panel. Two gauges show vibration of the engines. Switch turns the system off. Button is used to test the system – when clicked needles go to max and annunciator lights are activated on the captain panel.

Green numbers on the yellow background show click areas for the following actions:

1,2 – lower/raise sun visors.

3,4 – open/close cockpit windows.

Detailed panels description follows.

Overhead instrument panel

The overhead panel consists of several system panels. The upper and lower parts of this panel are described separately.

Upper overhead panel:

1. Transponder control panel
2. DME receiver panel
3. ADF1 tuning indicator
4. ADF1 control panel
5. 36V bus voltmeter sourse selector
6. 36V bus voltmeter
7. 27/36V inverter switch. Middle position: off.
8. 115V bus frequency meter
9. 115V bus voltmeter
10. 27/115V inverter source switch. Down: ground power supply. Middle: off. Up: 27V bus.
11. Left 115V generator amperemeter
12. Right 115V generator amperemeter
13. 115V bus voltmeter source selector
14. Left 115V generator switch
15. Right 115V generator switch

16. Left 27V generator amperemeter
17. Right 27V generator amperemeter
18. APU generator and ground power source amperemeter
19. Battery ampere-meter
20. 27V bus voltmeter
21. 27V bus voltmeter source selector
22. Left 27V generator switch
23. Right 27V generator switch
24. APU generator switch
25. Power source switch. Down: ground power source. Middle: off. Up: battery or generators.
26. Left 27V generator emergency shut off.
27. Right 27V generator emergency shut off.
28. Battery switch. Down: battery feeds standby bus only. Middle: battery feeds all systems. Up: battery feeds standby bus but is connected to the main bus automatically when generators are on (for charging).

Lower overhead panel:

1. Com1 radio control panel
2. Com2 radio control panel
3. Radar scan speed buttons
4. Radar power switch
5. Radar mode selector. Select “Ready” mode before turning on. Green light indicates availability

of other modes. “Meteo” mode shows the areas of turbulence and electrification. “Drift” mode shows the true direction of flight.

6. Autofeathering check panel.

7. Autofeather annunciators. Top green lights: propeller is transferring from the featheedr to the operating position. Middle green lights: autofeather armed. Bottom red lights: propeller is feathered or feathering test is in process.

8. Left propeller feather button. Glows red when the propeller is feathered or engine failure. To un-feather the propeller, push and release this button.

9. Right propeller feather button.

10. Left engine fire annunciator

11. Left wing fire annunciator button.

12. Left engine nacelle fire annunciator button.

13. Right engine nacelle fire annunciator button.

14. APU fire annunciator button.

15. Right wing fire annunciator button.

16. Right engine fire annunciator.

17. Left engine fire extinguishers ready lights.

18. Right engine fire extinguishers ready lights.

19. First set of fire extinguishers ready lights.

20. Second set of fire extinguishers ready lights.

21. Fire protection system switch. Down: system test. Middle: off. Up: armed.

22. Discharge left engine fire extinguishers.

23. Discharge right engine fire extinguishers.

24. Discharge second set fire extinguishers (first set is discharged automatically).

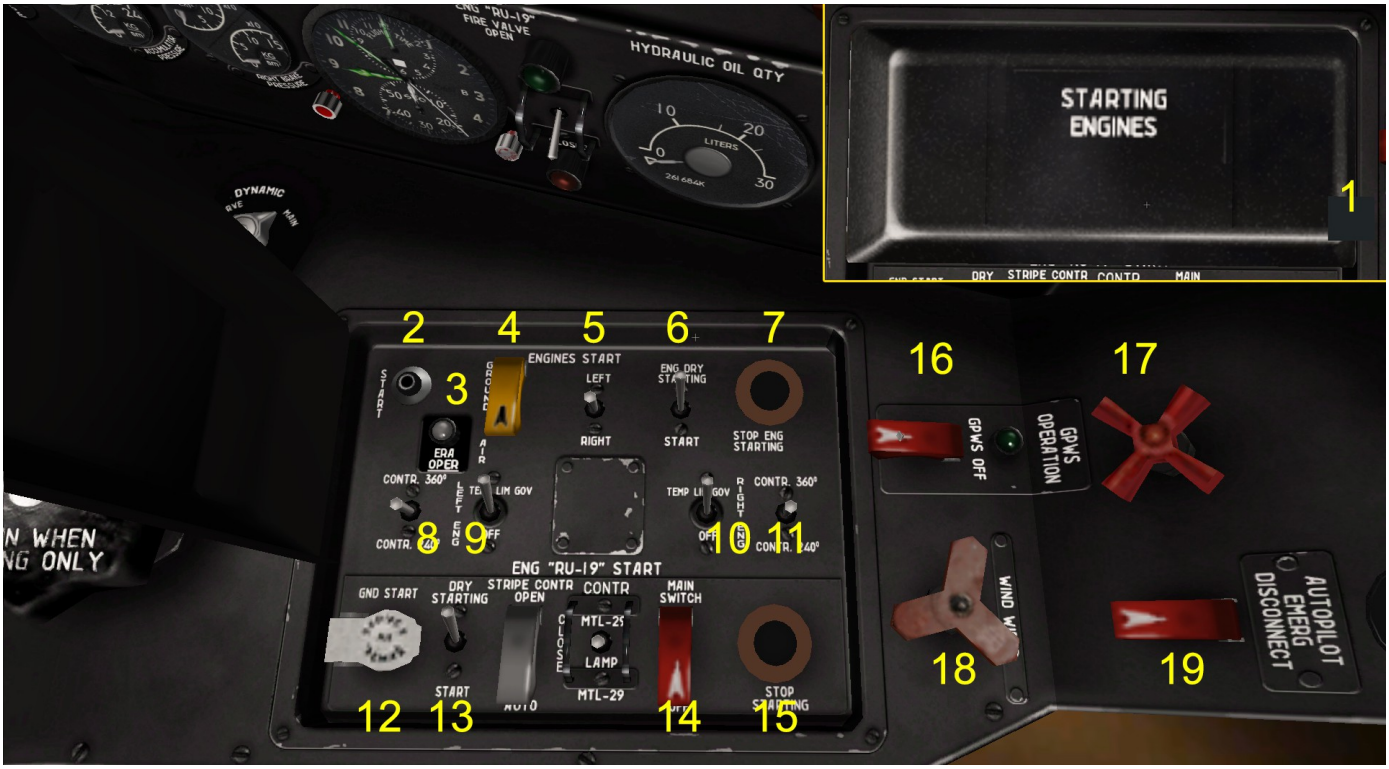
25. Magnetic compass KI-13

Left side instrument panel

Left side panel consists of the vertical and horizontal parts.

Vertical part:

1. Intercom panel. Selector sets the audio source. RC1 and RC2 options enable NAV1 and NAV2 audition.
2. Captain panel flood light rheostat
3. Middle panel flood light rheostat
4. FO panel flood light rheostat
5. Tilt control unit (TCU) test switch. Up and down: attitude indicators failure and synchronization lights on. Middle – activated.
6. GPWS test switch. Turns flashing “pull-up” lights and buzzer.
7. Engine start system amperemeter.
8. Engine start system voltmeter.
9. Emergency hydraulic system pressure gauge.
10. Main hydraulic system pressure gauge.
11. Hydraulic accumulator pressure gauge.
12. Left brake pressure gauge.
13. Right brake pressure gauge.
14. Chronometer AChS-1.
15. APU fire valve position switch. Down: red light on – fire valve closed. Up: green light on – fire valve open.
16. Hydraulic Oil quantity.
17. Oil quantity.



Horizontal part:

1. Engine startup panel's cover open/close button.
2. Engine start button.
3. Engine run-up automat (ERA).
4. Start mode selector – ground/air.
5. Start system engine selector.
6. Start mode selector – dry starting/start.
7. Stop engine starting button.
8. Left engine EGT control switch.
9. Left engine temperature limit governor switch.
10. Right engine temperature limit governor switch.
11. Right engine EGT control switch.
12. APU start button.
13. APU start mode selector: dry starting/start.
14. APU start system main switch.
15. Abort APU starting button.
16. GPWS power switch.
17. Main and emergency hydraulic systems cross tie valve. “+” position – open. “x” position – closed.
18. Wipers pressure valve (switch)
19. Autopilot servos emergency disengage.

Captain instrument panel

1. Barometric altimeter VD-10. Indicates altitude in hundreds of meters and kilometers. Atmospheric pressure is set in mmHg.
2. Combined speed indicator KUS-730/1100. Large needle – IAS in km/h, small needle – TAS in km/h.
3. Vertical speed indicator VAR-30. Shows vertical speed in m/s.
4. Radio altimeter RV-2.
5. Artificial horizon (AH-1).
6. Main menu button – 2D panels control.
7. Engine vibration annunciators.
8. Gyroscopic fluxgate compass quick alignment button.
9. Click area to hide/show flight yokes.
10. Standby Artificial horizon (AH).
11. Radio altimeter power switch
12. Feet altimeter switch (UVID-15FK located on top of the middle panel)
13. Nose gear steering mode indicators. Left to right: taxiing, off, takeoff/landing.
14. Nose gear steering mode selector. Up: taxiing. Middle: off. Down: takeoff/landing.
15. Window heat.
16. Tilt control unit (TCU) switch. Switch position down and guard closed – unit activated.
17. Standby artificial horizon (AH) switch.
18. Artificial horizon (AH-1) switch.
19. Instrument lighting switch.

Middle panel

Middle panel is divided into following areas: captain navigation instruments, engines, APU, fuel system and pressurization.

1. Feet altimeter UVID-15FK. Indicates altitude in hundreds of feet. Atmospheric pressure is set in hPa.

2. Radar display. Click to turn.

3. Radar display brightness knob.

4. Radar display contrast knob.

5. Radar indication brightness knob.

6. Marker beacon lights. Blue – outer marker. Amber – middle marker. White – inner marker.

7. Horn switch off button. Horn stays off till next warning.

8. Propeller unlutched annunciators.

9. Compound flying instrument (CFI). This instrument shows the magnetic heading based on the gyroscopic fluxgate compass and direction to the VOR or localizer. It also shows the glide slope. The knob on the bottom right rotates the bearing ring.

10. AOA/g-load gauge. Left needle indicates current angle of attack of the wing. Right needle shows vertical load in g units.

11. Heading indicator ZK-2. Needle is synchronized with gyro direction indicator. The knob on the bottom left rotates the bearing ring. It is used to set the autopilot heading in the “turn” mode.

12. ADF indicator. Needles show direction to the NDB transmitters.

13. AOA/g-load test button. When clicked, AOA and g-load needles go all the way up, stall annunciator and alarm buzzer are activated.

14. Three-needle indicator RU-19. Left needle shows oil pressure in kg/cm2, right needle – oil temperature in °C, upper needle – fuel pressure in kg/cm2.

15. APU N1 speed indicator. Shows low pressure stage speed in % of the max.

16. APU exhaust gas temperature (EGT).

17. Throttle levers position indicator TPI. Needle shows the throttles position 0 to 100 degrees. This corresponds to the current engine regime.

18. Left engine three-needle indicator EMI-3.

19. Right engine three-needle indicator EMI-3.

20. Left engine EGT.

21. Right engine EGT.

22. Left engine torque.

23. Right engine torque.

24. RPM indicator ITE-2. Left needle shows the speed of the left engine, right needle for the right engine.

25. Left engine fuel flow gauge. Shows fuel flow in hundreds of kg/hr. Knob at the bottom sets the initial amount of fuel in the left wing fuel tanks. The remaining amount is counted automatically.

26. Right engine fuel flow.

27. Low fuel annunciator. Indicates overall fuel level less than 1000kg. Yellow lights below indicate fuel filter blockage.

28. Fuel system control panel. Green lights indicate normal operation.

29. First officer combined speed indicator KUS-730/1100.

30. First officer vertical speed indicator VAR-3.

31. Fuel remainder gauge. Outer scale – fuel remainder in the wing tip tanks. Inner scale – fuel remainder in the wing root tanks

32. Altimeter UVID-30. Shows altitude in hundreds of meters. Atmospheric pressure is set in mmHg.

33. Fuel remainder indication mode switch.

34. DME indicator.

35. Emergency cabin pressure dump switch.

36. Cabin vertical speed indicator VAR-10. Shows the cabin pressure change rate.

37. Cabin altitude (upper needle) and cabin to outer pressure difference (lower needle).

38. Left engine air consumption gauge.

39. Right engine air consumption gauge.

40. Open doors annunciator (yellow) and low cabin pressure (blue).

41. Low oil quantity annunciators.

42. 27V generator failure annunciators.

43. Battery power annunciator.

44. 115V generator failure annunciators.

45. Emergency hydraulic pump switch. Feeds emergency hydraulic system.

46. Wheel anti blocking system switch. Avoids wheel blocking when brakes are applied.

47. Headlight switch. High beam, off, low beam. To the left – navigation lights switch (red and green on wing tips, white on the tail and red rotating beacon).

48. Headlights retraction switch.

49. Fuel level probe switch in the left and right wings.

50. Fuel flow meters switch.

51. Automatic fuel flow switch.

52. Landing gear position indicator. Red lights – gear is retracted. Green lights – gear is down and locked. The “gear down” light to the left is on if the gear is retracted and throttle set to less than 25 (on the throttle lever indicator TPI). The “flaps down” light to the right is on if the throttle is set to more than 76 but flaps are not set to 13-17 and the front landing gear strut is loaded. In both cases horn is activated.

First officer instrument panel

First officer of the An-24 is responsible for the navigation and de-ice system of the plane.

1. Marker beacon lights.
2. Artificial horizon AH-1.
3. CFI.
4. Gyroscopic fluxgate compass alignment button.
5. Turn coordinator EUP-53. Power switch to the bottom left.
6. Pitot heat failure annunciator.
7. NDB and VOR direction indicator.
8. Bearing ring knob. Rotates the bearing ring to set flight heading.
9. Direction indicator source switch. Down: ADF(NDB). Up: NAV(VOR).
10. Icing transmitter heating switch. Down: test heating. Middle: off. Up: activated. If the ice is detected, the de-ice system is activated which is indicated by the green lights above.
11. Outside air temperature.
12. Annunciator test button.
13. Gyroscopic fluxgate compass power switch. (GFC)

14. Artificial horizon (AH-1) power switch.

15. gyro direction indicator power switch (GDI)

16. Altimeter (UVID-30 on the right side of the middle panel) switch.

17. Window heat switch.

18. Engine inlet guide vane heat switch. Lights 2 and 5 above are on if activated.

19. Wing heat switch. Down: activated. Middle: off. Up: automatic activation by the ice detection system. It takes 30 seconds for activation. The bleed air is directed from engines to the wing surface to heat it and remove the ice. This reduces the power output of the engines. The throttle has to be pushed by 4 degrees (as indicated on the throttle position indicator UPRT) to compensate the power loss. The lights above are on when activated.

20. Propeller heat switch. Down: activated. Middle: off. Up: automatic activation by the ice detection system. Lights 3 and 4 above are flashing with 25 second period when activated.

Right side panel

Vertical part of the right side panel:

1. Intercom. All intercom selectors are synchronized.
2. Left engine bleed air for cabin pressurization switch.
3. Right engine bleed air for cabin pressurization switch.
4. Horn switch off button. Same as on the captain panel.
5. Chronometer AChS-1. Synchronized with the one on the left side panel.
6. Gyro direction indicator latitude correction unit. Left switch slowly turns directional gyro in the selected direction. Switch in the middle turns off temporary correction. Knob on the right sets the geographical latitude of the flight.

Horizontal part of the right side panel:

1. Right pitot heat switch. Up: on. Middle: off. Down: test.
2. Angle of attack probe heat switch.
3. Left pitot heat switch.
4. Wipers switch. Synchronized with the one on the left side panel.
5. Gyro direction indicator.

6. ADF2 panel.
7. ADF2 tuning indicator.

Middle console

1. Flaps position indicator
2. Oil radiators cowl flaps position indicator
3. Elevator trimmer position indicator. On the top and bottom of the indicator there are click areas that can be used to set the elevator trimmer.
4. Engine fuel cut off valves. Used to shut down engines. Must be down and guard closed before engine starting.
5. Aileron trimmer switch.
6. Rudder trimmer switch. Lights to the right indicate neutral trimmer position. Lights above indicate that trimmer is activated and controlled by the autopilot.
7. Throttle lock lever. When raised throttles are locked in the current position.
8. Throttle latch handle.
9. Throttle levers.
10. pitch stop switch. Flight position “pitch stop”.
11. Emergency flap extension switch. Uses emergency hydraulic system pressure.
12. Gear retraction on ground blocker switch.
13. Flap switch. Hold in the desired direction to extend or retract.
14. Landing gear switch. Switch to the appropriate position for extending or retracting. Switch to the neutral position when finished to remove pressure from the landing gear hydraulic system.
15. Autopilot roll selector.
16. Autopilot pitch selectors.
17. Auto trimming switch.
18. Autopilot master switch.
19. Autopilot activation and altitude hold reset button.
20. Autopilot heading hold source selector. Up: gyroscopic fluxgate compass. Middle: gyro direction indicator. Down: heading set on heading indicator (ZK-2).
21. Autopilot pitch channel switch.
22. Aicraft leveler.
23. Altitude hold button (holds current altitude when pressed).
24. Hidden click area to remove third seat in the cockpit. Emergency brake is not implemented.

Navigator instrument panel

Navigator panel contains VOR receiver (KursMP) controls and some other navigation instruments.

1. VOR receiver (Course-MP) control panel. ILS switch.
2. Marker beacon mode selector. In “approach” mode it works on altitudes up to 1.5km.
3. No signal or VOR receiver failure annunciators. NAV1.
4. No signal or VOR receiver failure annunciators. NAV2.
5. Captain and first officer CFI course and glide slope source selector. Left: both use NAV1. Middle: captain HIS uses NAV1, FO – NAV2. Right: both use NAV2.
6. NAV1 frequency selector. Click areas 3 and 4 to set the integer frequency part. 1 and 2 set the fractional part.
7. NAV2 frequency selector.
8. NAV1 power switch.
9. NAV2 power switch.
10. NAV1 course selector. The digital indicator shows currently set course. Switch 5 toggles TO/FROM mode. Use click areas 6 and 7 to adjust the course.
11. NAV2 course selector.
12. Click area to open navigators ruler NL-10m.
13. NDB/VOR direction indicator.
14. Direction knob.
15. Fan switch
16. Source switch: ADF/NAV.
17. Navigator direction indicator. Synchronized with gyroscopic fluxgate compass.
18. Declination set knob.
19. DME indicator.

Short description of the aircraft systems

Electric system

Physically and logically electric system of the An-24 aircraft consists of 4 buses that can be fed by several power sources. These buses power all the electric equipment on board.

27V DC bus.

This bus is powered by the battery, main (STG-16) and APU (GO-24) generators. If the external ground power source is available, the bus takes power from it unloading internal sources. This bus powers most of the aircraft equipment. It can also feed the 115V AC bus via the PO-750 inverter and 36V AC bus via PT-1000 inverters.

Standby 27V DC bus

Powered by the battery it feeds the essential flight instruments. It can be cross-tied with the main 27V DC bus in which case it will power all the electric equipment. It is automatically cross-tied and fed by the main 27V bus when generators produce power.

115V single-phase AC bus

Powered by GO-16 generators or PO-750 inverter. This bus can be powered by one source at a time. The priority of source selection is as follows: external ground power source, left GO-16 generator, right GO-16 generator, PO-750 inverter. The sources are switched automatically. If the source does not produce power, next one is used.

36V three-phase AC bus

This bus is fed from the main 27V DC bus through the one of the PT-1000 inverters. This bus powers attitude indicators and autopilot.

In normal flight all power sources on all buses should be turned on. Standby bus switch in the “main” or “auto” position.

Engine start should be performed either from the ground power source or APU GS-24 generator. Engine start is not allowed if the only power source is another engine STG-16 generator. This can result in generator overload and subsequent failure. With no external power source available, it is recommended to keep most of the equipment off until APU is started to increase battery life.

Ground power source can only be connected if the plane stands firmly on the ground.

Fuel system

Fuel system of the An-24 aircraft consists of 6 fuel tanks, three in each wing, two of which are combined in one. Thus there are 4 tanks implemented in this model: wing tips and soft tanks in the wing roots. Wing tips capacity is 1840 liters (1345kg) each. Soft tanks can fit 710 liters (520kg) each. Overall fuel capacity is 5100 liters (4770kg).

Every tank is equipped with a centrifugal fuel pump. Unusable fuel remainder with pumps operative is 50kg. With pumps off or failed it is 580kg (290kg in each tank group). Pumps can work in manual or automatic mode. In automatic mode pumps are turned off when fuel minimums are reached.

The wing root caisson tanks are used first. Then all others evenly. Left wing fuel tanks feed left engine. Right wing fuel tanks feed right engine. To feed engine on the opposite side of the aircraft open the fuel cross-feed valve.

Remaining fuel quantity control is provided by the fuel level sensors and fuel flow counters. Fuel level sensors use electro-inductive method to determine the fuel level in the tank. This method does not allow precise measurement. So the fuel gauge always shows understated value. The more precise technique is to use fuel flow counters to track the fuel remainder in the tanks. Before the flight, set the amount of fuel loaded on the fuel flow counters for each wing. As the fuel is consumed, the counters will show the precise fuel remainder. Only main engines are equipped with fuel flow counters. So the fuel consumed by APU is

not counted.

Hydraulic system

Hydraulic system powers flaps, landing gear, nose wheel steering and wipers. There are two hydraulic buses: main bus and emergency bus. Engine pumps feed hydraulic accumulator and sustain constant 120-106kg/cm2 pressure in the bus. Emergency bus is fed from the emergency electric pump which provides 120kg/cm2 hydraulic pressure. Both buses can be cross-tied with red cross-tie valve on the left side instrument panel.

Main bus operates all the hydraulic equipment on board. Emergency bus can be used only to extend flaps and landing gear and to steer nose wheel. Emergency bus does not provide flap and gear retraction.

The state of the hydraulic system is controlled with the pressure and fluid quantity gauges on the left side instrument panel.

Flaps and landing gear are controlled with valves on the middle console. To extend or retract flaps the flaps switch must be held in the appropriate direction. Emergency bus extends flaps about 4 times slower than normally.

Landing gear is similarly controlled by the landing gear valve. It has to be switched to the neutral position when the gear is fully retracted or extended to preserve system pressure. Landing gear can also be lowered by its own weight when the landing gear valve is opened regardless of the system pressure.

Fire protection system

Fire protection system of the An-24 is quite simple. There are several fire detectors and four fire extinguisher charges: one per engine and two for the rest of the aircraft.

The system is armed by turning switch up. Yellow lights indicate operative fire extinguishers. If the fire is detected in any of the five checkpoints, first set of fire extinguishers is automatically discharged at that location. To use second charge the annunciator button has to be clicked and a second charge activated.

Engine fire is extinguished by manually discharging fire extinguishers on the appropriate engine.

Keep in mind that engine with discharged fire extinguishers cannot be started again. Because of this, it is allowed to keep the burning engine running if necessary but no longer than for 1 minute. Otherwise the fire can spread on the engine nacelle and wing. This weakens the plane and reduces g-load limits.

Automatic direction finder (ADF) ARK-11

This is one of the most interesting instruments in An-24. It has memory for 9 frequency settings that can be freely stored and recalled.

Following features are implemented in the model:

1. Mode selector.
2. Memory buttons.
3. Band selector.
4. Rough tuning knob (step 4).
5. Precise tuning knob (step 1)
6. Manual antenna rotation switch.

ADF modes

ADF can operate in various modes as set by the mode selector.

Off – the instrument is off and does not consume power. Needles on the direction indicators are dead.

Comp I – device automatically tracks the direction to the NDB. This is not perfectly precise device so the direction needle may veer randomly a little bit.

Ant – listening mode. In this mode direction needles are dead and don't show actual direction to the NDB. But the Morse code of the NDB can be heard in the speakers. This is used to check if the tuning is made correctly for the required NDB.

Man – manual antenna rotation mode. As the frequency is tuned for the appropriate NDB, use switch 6 to rotate antenna to the left and right. Keep track of the tuning indicator beside the ADF panel. The higher level this indicator shows, the closer antenna position is to the direction to NDB. But keep in mind that antenna is symmetrical so you can't tell whether the NDB is on the selected direction or in reverse direction (i.e. plus 180°).

Comp II – this mode is similar to the Komp I. However this mode is significantly more precise. But the antenna turns with the closest side to the NDB in this mode so that you can get reverse direction indication (i.e. plus 180°).

Tuning, saving and restoring saved frequencies

There are 10 keys that can be used for tuning. 9 of them store the tuned frequency. The "P" key is used for the quick tuning when the frequency is not supposed to be stored. To tune for the NDB first you have to select the correct range. Use the range selector to choose the closest lower frequency to the required NDB frequency. Then use the rough and precise tuning knobs to set the exact frequency. In other words, frequency = band + tuning.

On the picture above the selected frequency is 420 (band) + 15 (tuning) = 435

To load frequency from memory, push the appropriate number key. All the knobs will be set automatically. To store the frequency you have to chose the correct cell (push the number key), tune for the correct the frequency, then click twice "range" and "rough tuning" labels. This will open the knob lock and save it position (every knob is stored separately and the storing is completed on the knob lock closing).

For example, to store 625 in the cell 3 do following:

1. Push key 3 and wait while the currently stored frequency is set.

2. Select the nearest lower band. In this case it is 580.
3. Click twice on the “band” label to open and close range knob lock. This will store it’s position.
4. Calculate required tuning. 625-580=45. Set 45 using rough and precise tuning knobs.
5. Click twice on the “rough tuning” label. This stores it’s position too.

The frequencies are stored in the “an24_ark1.ini” or “an24_ark2.ini” file - one for each ADF. These files can be edited with the text editor. If the file is missing, it will be created next time any frequency is stored. So the memory feature of the ARK-11 compensates for its cumbersome tuning procedure.

Autopilot AP-28

The autopilot used on An-24 is rather simple device to use despite the wealth of switches on its panel.

To engage autopilot first turn the "power" switch (6) on. Wait for the yellow "ready" light (2). Then push the "AP" button (7). The green "Engaged" light (3) indicates AP is engaged and controls aircraft in wing level and pitch hold mode. Current pitch is automatically held by the AP and can be adjusted with the switch (1). The roll can be adjusted with the "Turn" knob (4).

Switcher (5) engages the auto-trimm mode, which will release the force from yoke on its pitch channel. So when you disengage the autopilot – airplane will remain the pitch and will not requre immediate reaction from pilot.

AP is connected with gyroscopic fluxgate compass and gyro direction indicator. In the default wing level mode it holds current direction on the moment when AP was engaged or the heading source selector (8) was switched. In the first two modes AP will hold the heading using rudder only. In the "turning" mode it will roll aircraft for faster heading change. The heading for the "turning" mode is set on the heading indicator ZK-2.

To instantly level the aircraft you can push the "level" button (12). AP will perform this operation even in the "ready" mode. If leveling is performed while the AP is engaged then after leveling AP will switch to the altitude hold mode indicated with the light 13. In this mode switches 1 can't be used to change pitch. To reset the AP mode push "AP" button (7).

Altitude hold mode can be also enabled manually. First maintain level flight at the desired altitude. AP may be slow at doing so. Then press "ALT" button (14). AP will hold current barometric altitude. This mode can be disabled by using pitch selector switch (1) or resetting mode with the "AP" button.

"Turn" knob (4) has three click areas: left and right for turning and on top for returning to the neutral position.

Lights 10 and 11 indicate that pilot applies force to the yoke when AP is engaged.

Black Box

In a new version of An24 there is ability to record some flight parameters into file were added. Saving will engage automatically at the beginning of the flight and desingeges after it in that case, if “Black Box” option is enabled on settings panel.

All files are saved into “black_box” folder of An24. Names of files represent the date and time, when they are created.

Every file contains table of parameters, saved once per second and divided by tab symbol. They cintain:

1. UTC time – HH:MM:SS
2. Latitude of airplane's position – degrees
3. Longtitude of airplane's position – degrees
4. Altitude above sea level – meters
5. Altitude above ground - meters
6. Barometric altitude (by Captain's atimeter)
7. Barometric pressure, sat on Captain's altimeter
8. Vertical speed – meters per second
9. Indicated airspeed – km per hour
10. Vertical overload
11. Aileron's rotation angle – degrees
12. Elevator's rotation angle – degrees
13. Roll angle – degrees
14. Pitch angle – degrees
15. Magnetic course of airplane – degrees
16. Torque of left engine
17. Torque of right engine
18. Left throttle position
19. Right throttle position
20. Flaps position – degrees
21. some of commands and status:
    - icing — ice detected on the airplane
    - fire — fire on board
    - eng_L_neg — left propeller works as revers
    - eng_R_neg — right propeller works as revers
    - props_nostop — propellers are off the latch
    - AP_ON — autopilot is engaged
    - eng_stress — high vibration of engines
    - prop_feather — one or both propellers feathered
    - Out_mark — Outer marker fly by
    - Mid_mark — Middle marker fly by

- In_mark — Inner marker fly by
- LG_down — Landing gears extended
- roll_high — Too high roll
- TAWS — Warning about fast closing to ground

Aircraft operation

Preflight

As you open the aircraft there will be a small black panel to the left. This is the airplane menu used to control all the 2D instrument panels. If you open aircraft with engines running (see X-Plane settings) then all the instruments and systems will be turned on and working and aircraft will be partly fueled and loaded. But we strongly suggest to prepare aircraft for flight manually as it is very interesting procedure. To do so, open “Settings / Operations & Warnings”, disable “start each flight with engine running” option and enable “start each flight on ramp”. In this case you’ll have to do all the starting procedures, fueling and loading manually.

Preflight begins with the flight planning. You can make a flight plan using aeronautic charts or flight planning software. Save your charts as images in the PNG format to the aircraft folder with following filenames: map_1.png, map_2.png, map_3.png, map_4.png и map_5.png. These charts will be placed on the navigators table and 2D panel MAP. You can also save the NDB frequencies for the flight either using ADF control panels or directly editing an24_ark1.ini and an24_ark2.ini files.

Ground service panel is called with the SERV button. Remove all the caps and covers from the pitot, engines, icing probes. Do not remove heels yet – they are removed immediately before taxiing. If you are planning to fuel the plane, leave grounding too. This panel also controls all the doors and hatches. Use them as you wish but remember – all the doors and hatches has to be closed during the flight.

To load the plane, use LOAD panel. It resembles the actual aircraft CW chart with fuel calculation added. Set the flight crew and passengers number as well as the flight distance and fuel reserve here. Make sure none of the fields gets red. Red field indicates overload conditions. You are not allowed to take off overloaded.

Startup

As the plane is uncovered and loaded, it’s time to start it. To start engines you can either use the external ground power supply or APU which is started with the battery. You can enable ground power on the service panel.

1. If the ground power is available set the switch on the electric panel to the “ground” position or “on board” otherwise.

2. Turn PO-750 and PT-1000 inverters on. This will activate engine control instruments and hydraulic system. Check pressure gauges.

3. Switch the fire protection system on.

4. Switch navigation lights on.

5. If you are using ground power source and don’t need additional thrust on takeoff, skip to the step 11.

6. On the fuel panel activate right wing fuel pump and check the green light.

7. Move the APU throttle lever to the position beyond the lock and leave it. The lever will stay raised.

8. Open the APU fire valve on the left side panel. The red light should go off and 3 seconds later the red one should light.

9. On the starter panel open the red guard of the APU start system switch and turn it on. Switch the start mode selector to the “start” position. Open the start button cap and push it.

10. If everything is done correctly, the APU engine should be running in a few seconds. When the APU speed settles, engage the APU generator (GS-24).

11. Make sure all the redundant electric devices are turned off. Move rudders to idle (0 as indicated

on the throttle position indicator TPI). Close the engine shut off valves. Make sure that propellers are unlocked and not feathered.

12. Switch all the fuel pumps on. Open the engine fire valves.

13. Check the fuel gauges and set the loaded fuel amount on the fuel flow counters.

14. Switch the vibration control system (IV-41) on (top panel over the captains window).

15. Open engine start panel. Select the start mode. Open the start selector cap and switch it to the "ground" position.

16. Switch the temperature limit governor on. Select the engine with the "left-right" switch.

17. Push start button. The "ERA" light will indicate engine start in progress.

18. Check the bus voltage during engine start. It should not fall below 19V. Also check the engine speed and temperature. On ignition the temperature will raise but it should decrease as the engine speed increases. If the "engine start" light goes off and the engine speed keeps growing then the engine is running.

19. Switch on the STG and GO engine generators on the running engine. Do not disconnect ground power and APU yet. The sole STG generator on the running engine is not powerful enough to start second engine. In can fail if overloaded.

20. Apply the same procedure to start the second engine. Turn generators on when running. When both engines are running, you can disconnect ground power and shut down the APU (if required). Keep in mind that APU consumes more fuel than the main engines on idle. So it is not advisable to keep it running for the prolonged periods of time.

21. Check engines work up to the throttle 30 as indicated on the throttle position indicator. On this throttle setting run propeller feather test. This should drop the engines speed by 5-10%. Turn off the test and move throttles to idle.

22. Set the Idle gate.

23. Switch all the electrical instruments and check them working. Check the main and emergency hydraulic systems pressure. It should be 120 or higher. Use the emergency pump or cross tie hydraulic systems if necessary.

24. Switch attitude indicators and wait till they auto align. Standby artificial horizon in the captain panel (AH) has to be aligned manually.

25. Switch gyro compasses on and align them.

26. Switch the automatic brakes if necessary.

27. Switch the engine bleed air and de-ice systems on.

28. Start procedure is completed now.

Taxiing and takeoff

1. Check the control surfaces movement.

2. Set the transponder sqawk as provided by ATC and switch it to the "A" mode.

3. Remove the gear heels and disconnect grounding.

4. Select the "taxi" nose gear steering mode.

5. Remove the parking brake. Move throttles to 15-30 by the throttle position indicator (TPI). The aircraft should start moving. Taxi on throttle 10-15.

6. Check the brake pedals.

7. Do not taxi faster than 30km/h. Keep centerline. Use brakes if necessary. Check the gyrocompasses operation.

8. When holding short runway switch transponder to the “C” mode. Check attitude indicators.

9. When on the runway check the gyrocompasses indication. Adjust them if necessary.

10. Set flaps to 15. Set elevator trimmer according to the center of weight position. Switch steering to the “takeoff-landing” mode.

11. Switch idle gate on.

12. While holding brakes slowly move throttles to the 80-100 as indicated on the throttle position indicator. As soon as plane starts moving, release the brakes.

13. Keep the centerline by rudder pedals.

14. At 190km/h slowly pull the yoke. The plane should takeoff at about 200km/h.

15. At the 5-10 meters ground altitude retract landing gear with the gear switch. When gear is fully retracted, move switch to the neutral position. Move throttles to the 65 as indicated on the throttle position indicator.

16. Climb with 5m/s vertical speed. At 150m ground altitude and 250km/h speed slowly retract flaps. Make sure they are fully retracted before reaching 300km/h. Compensate pitching moment with the yoke.

17. Continue climb at 300-350km/h IAS. Vertical speed should be in the range of 3 to 7 m/s depending on the TOW and altitude.

18. When cruising flight level reached, transit to the level flight. Gain speed to 350-400km/h IAS. Move throttles to the cruise setting – 52 by throttle position indicator.

19. Cruise altitude can be held and changed with the autopilot if desired.

Descend, approach and landing

1. Descend to the approach altitude should be planned with the 5-6m/s vertical speed.

2. Set throttles to the flight idle – move throttle to the idle gate and push buzzer off button.

3. Adjust vertical speed to keep the IAS below 450km/h.

4. Level plane on the approach altitude and reduce speed to the 300km/h.

5. Lower landing gear. Extend flaps in several steps compensating the pitching moment with the yoke. Keep track of the speed. Don’t let it fall below 200km/h.

6. Approach speed should be 200-220km/h. 200km/h on final.

7. Vertical speed on final should be 2-3m/s.

8. Retard throttles to expedite descend if necessary. Increase throttles to reduce descend rate. Don’t move yoke violently. Stabilize plane with trimmers.

9. Before the flare slowly reduce throttles to the flight idle and level the aircraft pulling yoke steadily.

10. Touchdown should be on the main gear at the positive pitch and 180-190km/h IAS.

11. Reduce throttles to the full idle and remove propeller pitch limiters immediately after touchdown. Propellers will generate reverse thrust which will slow down aircraft rapidly.

12. As speed falls below 100km/h apply wheel brakes. Caution: do not use the full braking force! Brakes can overheat and fail. You must also avoid skidding as it may result in tire rupture.

13. Switch nose gear steering to the “taxi” position and taxi to the parking.

14. Switch engine generators off. Shut engines down with the engine shut off valves.

15. Switch all the electric devices off. Switch fuel pumps off. Close fire valves.

16. Switch electric power off.

17. Open doors and unload passengers ;-)