

tkfk

Yak40 for X-Plane9 installation and flight manual

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Preamble

From developers

Dear buyer, Felis Planes team wants to thank you for your support and hopes, that you will have a good time, making virtual flights on Yak40 airplane. This manual will help you learn this plane in X-Plane flight simulator

But before we start, I would like to introduce you all, who worked in this project and helps it a lot:

Andrey Felis — Project leader, 3D modeling, programmer

Pavel Skyteacher — Aerodynamics specialist

Sergey Microfone — 2D designer, textures, <http://yak40.xplanes.ru/> site

Asso — Author of SASL plugin - <http://1-sim.com/>

We want to give our special thanx to developers of free Yak40 for MSFS for they sounds tracks, Anatoliy Boev for exclusive photos of two real planes and Valeriy Pallmall for a lot of technical photos and informations.

Contacts

If you have interesting ideas or purposes for future projects – you can freely contact with developers::

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We made a lot of tests on different systems and modes before release, but unfortunately, it is impossible to find all of mistakes in such complex model.

In case of any problems with using the model or you find any bug – please, make your report clear and give all information about what you've done to have this problem. Also it would be good to attach log.txt file from main directory of simulator to your message, taken just after the problem appears. This will help to reduce amount of time to find the mistake and fix it.

Anyway we will provide support at least one year after release date. After it we still will answer any your questions but hope, you understand, that this will take the time, when we making new model for you.

Disclaimer

Please notice, that this manual and model, stated in it, are for home use only on your own computer and cannot be used for teaching pilots. Even though we worked to make this model as close to real plane and its response in real world as it possible – simulator and model contains a lot of limits, disclarifications and simplifications comparing to real world. So using it as a reference of real plane is not recommended by developers.

If you want to study the real plane – please consult with instructors, pilots and official docs.

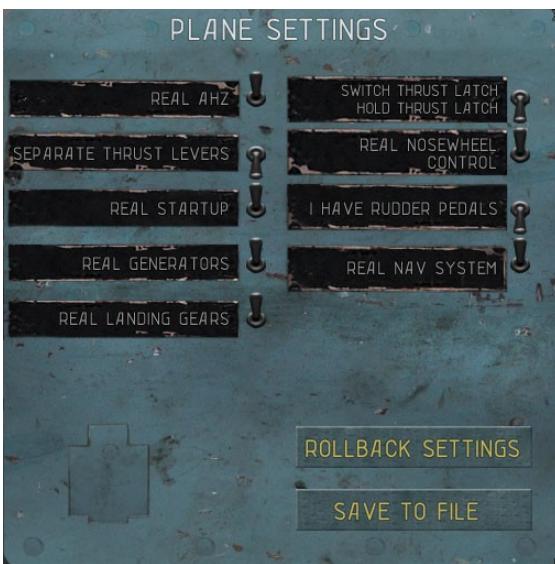
Installation and settings

Installing

To install this plane you only need to unzip the archive, which you've got by link from store in directory **X-Plane 9/Aircraft/Heavy Metal/**. This pack contains a plugin, which starts automatically when plane being open in simulator – it must not be copied to anywhere.

First of all the model comes with english signs on panels like an export variant of plane, but if you want to get the original, you will need to copy all files from **Language patch/RUS** directory into main directory of plane with saving all hierarchy and confirm file replacement.

Airplane settings



Before you start your first flight, you'll need to make initial settings of airplane. Start the simulator and in a menu **Aircraft → Load aircraft** select **yak-40.acf**. After plane loading you will see the small menu on left side of screen. Push the OPT button for open settings panel. Here you can set level of realism for some systems and make your preferences for plane manipulating. Let's look closer.

Real AHZ — when you start the plane, AHZs need some time for sync their gyros.

Separate thrust levers — turn this on if you have a three separate levers to manipulate engines. In this case you'll be able to set different thrust for them as you wish. If you have only one lever – this switch must be off. It is all about that Yak40 have only one engine with reverse thrust and when you engage it, two last engines will produce forward thrust according to lever position. This option will prevent manipulation of side engines and block them to minimum when you have one lever and engage reverse.

Real startup — this will turn on all needed procedures for engines start.

Real generators — turns on generators failures

Real landing gear — turns on gears failures: jam when overspeed and breaking when rough landing.

Switch/Hold thrust latch — For stopping engines on Yak40 you need to move levers to minimum position. To prevent the accidental engines cutoff, there used a thrust latches, which must be moved up to release and let levers go down. This option is for select method for manipulating those latches – hold button to hold them up or switch them up and down.

Real nose-wheel control — when taxi on Yak40, you have to push special button on its yoke. This turns on the hydraulics, that helps to turn the wheel up to 55 degrees. Without them you'll be able to turn it only to 5 degrees angle.

I have rudder pedals – turn off this option if you don't have pedals with three axes and using main brakes (B button). In this case pressure will be taken from main hydraulic system.

Real nav system – this option makes CourseMP system to work with VORs and ILS in separate modes. To use VOR, you must switch to Route mode and for ILS – to landing mode. Turn this option off, if you want to use both systems at once.

All changes works immediately, but every time when you load aircraft, they will be reseted to their defaults. If you want to save them – **push the save to file** button – this will save all settings into **settings.ini** file. Every time you load an aircraft – this file will be read and all settings will load from there. For reset – just delete this file.

Rollback settings will read the file again and set the values from it.

Setting the buttons

Yak40 model comes with fully functional virtual cockpit and all its manipulators placed according to their real analog. But for more comfort flight it is possible to set a lot of commands for your yoke/joystick buttons.



In most cases there used command, which are already exist in simulator, but their work were re-written. Also a lot of commands were added.

To set the buttons open menu **Settings → Joystick, Keys & Equipment** and select **Buttons: Adv** there. Push the button, which you want to assign and select command from the list for it.



To set non-standard command, click the square, marked by red on picture above and find needed command in directory **X-System — xap**. You can also copy and paste the command from this manual there.

Here is the list of commands, created and re-writed in Yak40

Clock AChS1

- sim/instruments/timer_start_stop — starts, stops and resets the stopwatch
- sim/instruments/timer_reset — starts, stops and resets the flight timer

Autopilot

- sim/autopilot/servos_on — Holds on the AP to give controls to the pilot. When holding the button – AP allows you to fly manually then remember the new position and holds it when button is released
- sim/autopilot/fdir_servos_down_one — disengage the autopilot
- sim/autopilot/fdir_servos_up_one — engage the autopilot by ENGAGE button
- sim/autopilot/override_left — turns roll knob left for 5 degrees
- sim/autopilot/override_right — turns roll knob right for 5 degrees
- sim/autopilot/override_up — increase pitch
- sim/autopilot/override_down — decrease pitch
- sim/autopilot/altitude_hold — engage the altitude hold mode
- sim/autopilot/fdir_on — switch on the power
- sim/autopilot/pitch_sync — switch on the pitch control

Thrust levers

- sim/flight_controls/tailhook_up — switches or holds the latches
- sim/flight_controls/tailhook_down — rises and lowers the red plank below the levers

Nose-wheel

- sim/flight_controls/nwheel_steer_toggle — when helded – allows to turn the wheel on wide angle. Look plane settings.

Cockpit

- sim/operation/slider_05 — opens a door on port-side
- sim/operation/slider_09 — switches the flight yokes visibility (shortcut by default is: **Shift+F9**)
- sim/operation/slider_13 — fixes throttles

2D panels

- xap/panels/panel_0 — main menu
- xap/panels/panel_1 — left circuit breakers
- xap/panels/panel_2 — right circuit breakers
- xap/panels/panel_3 — ground service
- xap/panels/panel_4 — camera control
- xap/panels/panel_5 — payload panel
- xap/panels/panel_6 — settings panel
- xap/panels/panel_7 — navigator's ruler NL-10m
- xap/panels/panel_8 — information panel
- xap/panels/panel_9 — autopilot panel

Introducing the aircraft

Short description

Yak40 – is a first soviet short range jet airliner and a first civil aircraft of Yakovlev design bureau. For its small size and black smoke from its engines it was called “cigarette butt”, and for its great fuel consumption - “fuel fighter”. But anyway this airplane shows itself as simple thing to fly and maintenance and reliable in flight. She could takeoff when one of her engines fails and continue to fly even after two of her three engines failed.

Yak40 finally replace Il12 and Il14, which was completely outdated it that time, on regional lines, and make a great confront for turboprop An24. Passengers loved Yak40 for its comfort, comparing to older planes, and pilots and engineers – for its simple manipulating and maintenance. Yak40 and An24 are still in use on many regional lines in countries of ext USSR and neighbor.



The plane is equipped with:

- full complex of navigating devices, including automatic directional finder ARK9, nav complex CourseMP, directional system GMK1 and MK8, meteolocator Kontur and TCAS
- fire extinguisher system
- pressurization and air conditioning systems
- fuel system with fuel buster pumps, cross and flow valves
- hydraulic system, which feeds the flaps, stab landing gears and brakes

Yak40 – is the first airplane, designed to be controlled by two pilots and one engineer. But really it could be flown even by two.

Exterior devices

Before we start to study the plane, let's take a look on its design and devices.



1. fuselage
2. wing
3. keel
4. aileron
5. flaps
6. horizontal stabilizer
7. elevator
8. rudder
9. main landing gear
10. nose landing gear
11. engines
12. reverse flaps on middle engine
13. tail ladder
14. dynamic pressure sensor (Pitot tube)
15. static pressure port
16. ice sensor
17. ADF antennas
18. radio antennas

In this model of Yak40 all exterior devices works as on real plane. So before flight, you must check if all covers were off and doors and hatches are closed.

Technical specifications

BASIC

Plane length, m.....	20,36
Plane height, m.....	6,5
Gear width, m.....	4,52
Gear base, m.....	7,465±10MM
Gear size, mm:	
main wheel.....	1120x450
nose wheel.....	720x310
Angles of rotate for nose wheel:	
taxi.....	±55-5°
takeoff and landing.....	±5+2°

FUSELAGE

Length, m.....	18,2
Maximum diameter, m.....	2,4
Closed fuselage volume, m ²	50,0

WINGS

Wing span, m.....	25,0
Wing area, m ²	70,0
Wing dihedral angle.....	+3°
Wing V angle.....	+5°30'
Mean aerodynamic chord.....	2,97
Angles of flaps:	
takeoff.....	20°
maximum.....	35°

MAXIMUM CONTROL ANGLES

Ailerons:	
(up).....	19°
(down).....	15°
Aileron trimmers:	
(up).....	23°30'
(down).....	20°
Elevator.....	±25°
Stabilizer:	
(up).....	+3°
(down).....	-6°
Rudder.....	±30°
Rudder trimmer.....	±10°

Flight specifications

Takeoff weight	14850kg	16100kg	16800kg	17200kg
Takeoff distance, m	630	755	800	850
Takeoff speed IAS, km/h	185	195	200	202
Vertical speed for climb on nominal thrust				
— near ground	8,5	8	7,5	7
— on altitude 6000m	5,7	4,9	4,3	4
Time for climb H=6000 m, min	15,5	16,1	17,5	19
Cruise speed at 6000m, TAS, km/h	510	510	510	510
Maximum flight speed at 6000, TAS, km/h	568	558	548	546
Landing speed IAS with max weight, km/h	175	180	185	192
Landing speed IAS with normal weight, km/h	165	180	180	180
Roll distance after landing				
— using reverse	400	550	550	550
— without reverse	570	750	750	750
Landing distance from altitude 15m to final stop				
— using reverse	700	840	840	840
— without reverse	930	1000	1000	1000

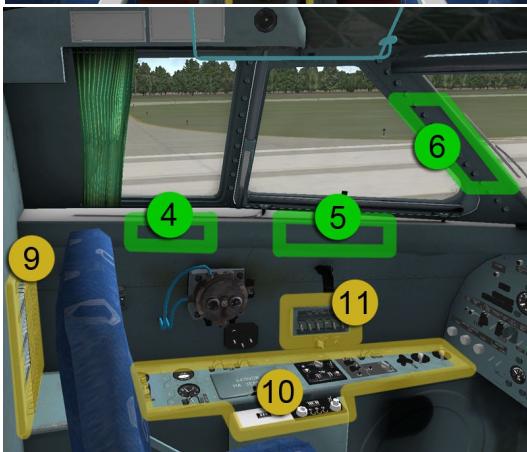
Cockpit panels

Basic location of panels and hidden elements



By yellow color marked panels:

1. Captain's front left panel
2. Captain's front panel
3. Central panel
4. Co-Pilot front panel
5. Co-Pilot front right panel
6. Overhead panel
7. Upper part of center console
8. Lower part of center console
9. Left circuit breakers panel (AZS)
10. Captain's left side panel
11. Cabin lighting panel
12. Control fixation panel
13. Power check panel
14. Po-Pilot's right side panel
15. Panel of pressurization controls
16. Right circuit breakers panel



By green color marked:

1. button for show/hide front left blind
2. button for show/hide center blind
3. button for show/hide front right blind
- 4 - 5. buttons for left blinds
6. button for open left window
7. button for open right window
- 8 - 9. buttons for right blinds

Captain's front left panel



1. Markers lamps
2. Lamps for anti-block system (ABS)
3. Exhaust gas temperature for AI-9
4. Indicators of AI-9 engine
5. Button for lamps test
6. Cockpit lighting controls
7. Fire sound alarm switcher. (yellow lamp lit – sound is off)
8. Landing gear and flaps sound alarm switcher
9. ABS switcher
10. Manual connect of PT-1000 inverter for 36v bus
11. Fire valve switcher for AI-9 engine
12. Pressure meter of startup system

Captain's front panel



1. Stall warning lamp
2. Indicators
3. Indicated and true airspeed gauge KUS730
4. Left artificial horizon - AGD1
5. vertical speed and turn indicator DA-30
6. Radioaltimeter RV-52
7. Altimeter UVID-30
8. Left Horizontal Situation Indicator (HSI) KPPM
9. ADF and VOR direction indicator
10. Fuel gauge
11. G-meter
12. Buttons for alarm reset
13. Auxiliary AGD1
14. Hydraulic system's gauges
15. External air temperature
16. Feet altimeter VD10FK

Center panel



1. Stabilizer position indicator
2. Landing gear position panel
3. Flaps position indicator
4. Fire alarm lamp
5. Lamps-indicators
6. Button for reset fire system
7. EGT gauges for AI-25 engines
8. Tachometers for AI-25 engines
9. Tripole-needed indicators for AI025 engines

Co-Pilot's front panel



1. Indicators
2. Distance indicator
3. Indicated and true airspeed gauge KUS730
4. Right artificial horizon - AGD1
5. vertical speed and turn indicator DA-30
6. Feet altimeter UVID15FK
7. Altimeter VD10
8. Right Horizontal Situation Indicator (HSI) KPPM
9. ADF and VOR direction indicator
10. Cabin altitude and pressure difference indicator
11. Air consumption gauge
12. Internal air temperature
13. Air system temperature
14. Electric system's gauges
15. Generators switcher
16. Cockpit variometer

Co-Pilot's front right panel



1. Markers indicators
2. Ladder down indicator
3. 115v inverter fail indicator (any)
4. Ground power connect indicator
5. Electric system controls
6. Lamps test button
7. Pressurization and air conditioning system's controls
8. Gyromagnetic compass control panel
9. Ladder controls
10. Switcher for "No smoking, fasten seatbelts" lamps in cabin

Overhead panel



1. Exterior lamps controls
2. Fire valves for AI-25 engines controls
3. Window heat controls
4. Left radio COM1
5. Right radio COM2
6. Magnetic compass KI-13
7. Left Automatic Directional Finder (ADF) panel ARK-9
8. Left ADF frequency selector
9. Right Automatic Directional Finder (ADF) panel ARK-9
10. Right ADF frequency selector
11. Fire system's panel
12. Aviation clock AChS1

Central console



1. Reverse control
2. Emergency AI-25 engines cutoff
3. Fuel system controls
4. Buttons for start engines in air
5. Hydraulic system controls
6. Pressure gauges switcher
7. Engine throttles
8. Throttles catch
9. Red plank for limit throttles from STOP position at minimum
10. Landing gears controls
11. Mechanic indicator of front gear position. When up – gear is extended.
12. Aileron trimmer control
13. Rudder trimmer control

Captain's left side panel



1. Cabin lighting panel
2. Startup panel for AI-9 and AI-25 engines
3. Angle of attack heat switcher
4. Radio altimeter switcher
5. Left ventilator switcher
6. Transponder SO-72
7. Sound selector panel
8. Left CourseMP system panel (NAV1)
9. Left course selector (OBS1)
10. Auxiliary AGD1 switcher

Co-Pilot's right side panel



1. Control fixation panel
2. Power check panel
3. Manual connect of Defrost Inverter (PO Steklo)
4. Sound selector panel
5. Fuel dump switcher
6. De-frost system's controls
7. Cockpit light controls
8. Cabin pressurization panel — Device 2077
9. Right ventilator switcher
10. Right CourseMP system panel (NAV2)
11. Right course selector (OBS2)
12. Distance measurement equipment panel (DME)

Left circuit breakers panel (left ASZ)



On circuit breakers panels are located switchers for most aircraft's gauges and systems. Therefore for the normal operation corresponding switches must be turned on. For normal flight, all switchers must be on, except "AI-9 IGN"

- 1 – Radio 1 switcher
- 2 – Both DA-30 gauges switcher
- 3 – Switcher for left AGD1
- 4 – Switcher for fuel gauge
- 5 – Switcher for test lamps system
- 6-8 – Switchers for engines gauges
- 9 – Switcher for aux AGD1
- 10 – Switcher for left ADF ARK-9
- 11 – Transponder switcher
- 12 – emergency connection of inverters for 36v bus switch
- 13 – Switch for Radio inverter 115v bus
- 14 – Switcher for Defrost inverter 115v bus
- 15 – Emergency connection of inverters for 115v bus switch
- 16-18 – Switcher for fire sensors in engines
- 19 – Switcher for stall alarm

- 20 – Cross feed of fuel system switcher
- 21 – Cross flow of fuel system switcher
- 22-24 – Switcher of fire valves for engines AI-25
- 25-27 – Fire extinguishers switchers
- 28 – Switcher for lamp indicators of startup system
- 29 – Switcher for lamp and sound alarm of flaps and gears
- 30 – Ignition of AI-9 engine switch
- 31-33 – Ignition of AI-25 engines switchers
- 34-36 – Switchers for fire tubes of fire system

Right circuit breakers panel (right AZS)



- 19 – Air turbo-cooler switch
- 20 – Hydraulic buster for nose-wheel switch
- 21 – Emergency hydraulic pump switch
- 22-24 – AI-25 engines heat switchers
- 25 – Braking system switch
- 26-27 – Air heating system switch
- 28-31 – Switchers for taxi and landing lights
- 32 – Aileron trim control switch
- 33 – Rudder trim control switch
- 34 – Main control of stab switch
- 35 – Main control of flaps switch
- 36 – Main control of landing gears switch

- 1 – Radio 2 switcher
- 2 – Switcher for G-meter ADP
- 3 – Right AGD1 switcher
- 4 – Switcher for gyromagnetic compass system
- 5 – Hydraulic system switch
- 6 – Autopilot switch
- 7 – Landing gear position panel switch
- 8 – Switcher for rockets (not implemented in current model)
- 9 – Switcher for navigation system CourseMP
- 10 – Switcher for right ADF ARK-9
- 11 – Switcher for manual connection of Radio inverter
- 12 – Switcher for emergency control of horizontal stabilizer
- 13 – Emergency flaps deploy system switch
- 14 – Emergency L.G. Deploy system switch
- 15 – De-Ice system switch
- 16 – Switcher for maximum roll and comparing unit (BSPK)
- 17 – Air conditioning system switch
- 18 – Ladder control switch

Gauges and systems of airplane

Flight gauges



Artificial horizon AGD1 Shows current position of airplane in the air. For its work it requires power from 36v bus.

1. Moving background for pitch indication. On picture pitch is 6 degrees nose up
2. rotating "plane" for roll indication. On picture shown 5 degrees roll left.
3. Slip indicator
4. Arrest button, resets gauge to zero pitch and roll
5. Pitch indicator correction knob
6. Pitch correction indicator
7. Failure flag – shows, when there is no power for gauge, it's off or failed



Combined IAS and TAS indicator KUS730-1100.

This gauge shows indicated (long needle) and true (short needle) airspeed in km/h. On picture it shows 355 km/h IAS and 440 km/h TAS



Barometric electric altimeter UVID30

Shows altitude in meters above given pressure in mm.Hg. For its work it requires power of 115v bus from Radio inverter.

The needle shows hundreds of meter for every kilometer.

Digits above – altitude in meters

Digits below – pressure, sat in mm.Hg. This pressure can be set by knob below gauge.

On picture altitude show ~4120m by pressure 745 mm.Hg.



Feet barometric electric altimeter UVID15FK

Shows altitude in feet above given pressure in hPa. For its work it requires power of 115v bus from Defrost inverter.

Its work is the same as UVID30

Red flag signs failure of gauge or no power for it.



Feet barometric altimeter.

It shows altitude in feet above pressure in hPa. This gauge requires no power.

1. Needle for hundreds of feet
2. Needle for thousand of feet
3. Needle for tens thousand of feet
4. given pressure
5. pressure set knob

On picture shows altitude 570 feet by pressure 1013 hPa.



Barometric altimeter VD10

It shows altitude in meters above given pressure in mm.Hg. This gauge requires no power.

Long needle shows hundreds of meters

Short needle shows thousands of meters

Digits – given pressure in mm.Hg, which can be set by knob below gauge

On picture shows altitude 4330 meter by pressure 760 mm.Hg



Radioaltimeter RV-52.

It shows current altitude in meters above ground surface. For normal work it requires 115v from Radio inverter.

1. Altitude needle
2. Marker for Decision Height (DH)
3. Lamp indicator. It will light when current altitude is below DH
4. DH set knob
5. Failure flag. It appears, when there is no power, or gauge fail
6. Hidden test button. If gauge works properly – needle will show altitude 15-17 meters.



Combined vertical speed and turn indicator gauge DA-30.

1. Vertical speed in m/s
2. Turn indicator. One mark equals roll bank of 15 degrees at speed 400 km/h. For work it requires 36v power.
3. Slip indicator



G-meter.

This gauge shows current vertical overload (white needle) and saves maximum and minimum overload (red needles) during flight. To reset red needles to current G – push the button at lower right corner.

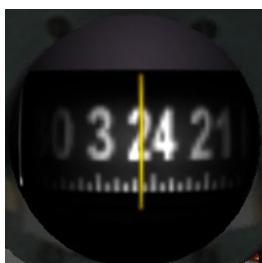
For normal work this gauge requires 115v from Radio inverter

Navigating gauges



Aviation clock AChS1

1. Main clock, shows UTC time. Needles: hours, minutes, seconds (in order of length increase)
2. Flight timer. Needles: hours, minutes
3. Indicator of flight timer's mode: white — reseted to zero, red — work, red/white — pause.
4. Flight timer button. It cyclic changes its modes: start, pause, reset to zero
5. Chronometer. needles: minutes, seconds
6. Chronometer button. It cyclic changes its modes: start, pause, reset to zero



Magnetic compass KI-13

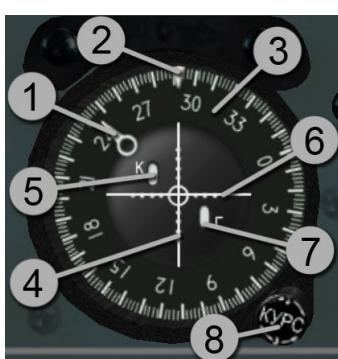
It shows current magnetic course in tens of degrees.

On picture you can see course ~250

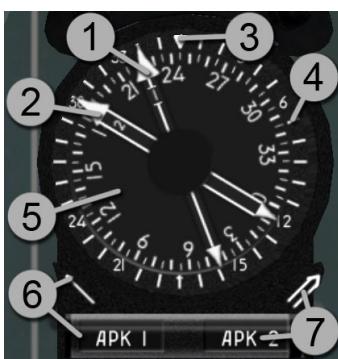
Horizontal Situation Indicator (HSI) KPPM

This gauge shows current flight course, using gyromagnetic system and aircraft position relative to VOR radial or ILS beams.

For normal work it requires 115v from Radio inverter for Captain's and Defrost inverter for Co-Pilot's side gauges



8. Course selector knob (it just rotate the scale for your own custom use)



ADF and VOR direction indicator

This gauge shows bearings to NDBs and/or VORs, which you can tune on respective systems

1. needle 1
2. needle 2
3. Stable marker of bearing 0
4. Stable scale of bearings
5. Rotating scale of courses. It uses GMK system
6. Selector and indicator of source for needle 1
7. Selector and indicator of source for needle 2

This gauge uses signals from ARK-9 and CourseMP. You can read about these systems below.



Weather and navigation radar “Kontur”

1. Power ON button
2. Weather button
3. Navigation button
4. TCAS button
5. Increase distance button
6. Decrease distance button
7. Distance indicator
8. Distance indicator for meddle scale
9. Weather marks
10. Needle for slip angle
11. Stable scale for slip angle
12. Marks of other aircrafts – TCAS information

13. Beacons and airports marks – navigation information

14. Modes indicators

For normal work this gauge requires 115v from Defrost inverter

Engines control gauges



Exhaust gas temperature gauge

This gauge shows EGT for main engines AI-25. you should never exceed temperature above 650 degrees.

This gauge requires no power.



Electric tachometer ITE-2

This gauge shows engine's RPM:

- needle 1 — high pressure turbine
- needle 2 — low pressure turbine

This gauge requires no power.



Electric-mechanic triple needle engine indicator EM13

1. Fuel pressure indicator
2. Oil pressure indicator
3. Oil temperature indicator

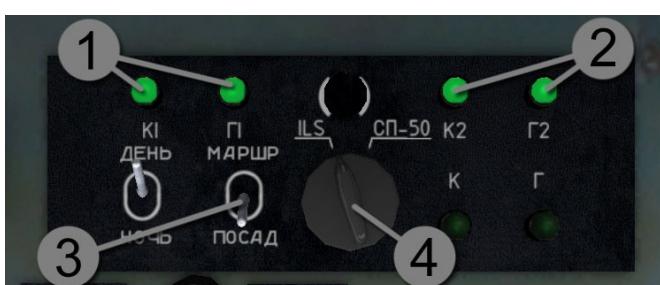
For normal work of pressure indicators this gauge requires 36v power.

Navigation complex CourseMP

CourseMP system allows you to control aircraft's position relative to navigation beacons VOR, VOR/DME and make approach by landing system ILS. In Yak40 this system appears as two panels for frequency set for VOR or ILS beacons and two panels for selecting radial of VOR or landing course. Also Yak40 equipped with Distance Measurement Equipment (DME), which frequency can be set on Co-Pilot's right side panel and indicator on Co-Pilot's front panel.

Yak40 has two CourseMP systems, which panels located on left and right side panels, and mode manipulation panel – on central console. Information about bearings and plane's location is shown on respective left and right HSI and radio-compasses. Take notice, that left system shows its information on left HSI, and right – on right HSI.

For its work, system requires power of 115v from Radio inverter.



System's mode panel

1. lamps for left course and glideslope
2. lamps for right course and glideslope
3. Switcher Route (up) / Landing (down). In route mode system works only with VOR and VOR/DME navaids and only course planks on HSIs corresponds; in landing mode – CourseMP works only with landing systems ILS or SP-50 (not implemented in X-Plane). In this case will work both course and glideslope planks on HSIs, but lamps TO VOR and FROM VOR will not work.
4. Switcher for landing system. If set to SP-50 – glideslope plank on HSI will not work properly.



Frequency set for VOR or ILS

1. Power switcher
2. Frequency indicator
3. Knob for set integer part of frequency in MHz
4. Knob for set fractional part of frequency
- 5.6.7. Buttons for test system. In Landing mode buttons on Captain's panel will test course and glideslope planks on left HSI, marker beacons receiver lamps and its sound. On Co-pilot's side – only right HSI tested.

In Route mode only course planks will correspond, marker lamps and sound from left panel, VOR1 and VOR2 needles on radiocompass indicator will show 0 or 180 bearing and lamps TO VOR or FROM VOR will lit.



Course selector

This panel is for set course for ILS or radial of VOR beacon



DME frequency set panel

1. Power switcher
2. Frequency
3. Knob for set integer part of frequency in MHz
4. Knob for set fractional part of frequency
5. Selector N Miles/Kilometers



DME indicator

Digits shows distance and below them there is value lit (NM or KM)

For normal work DME requires power 115v from Defrost inverter.

Automatic Direction Finder ARK-9

Yak40 airplane equipped with two ADFs, located on overhead panel, which gives signals to radio-compasses on front panels according to their settings. Each panel allows to set two frequencies, one of them will be active and second – standby. You can select which frequency to use by selectors above ADF panels.

ARK-9 can handle frequency in range from 150 to 1290 kHz (in current model you can set 100-1299).



1. Mode selector: OFF, COMP, ANT, RAM
2. Signal power indicator
3. Switcher for rotate antenna's contour
4. Hidden buttons for set hundreds of kHz of left frequency
5. Buttons for set tens of kHz of left frequency
6. Knob for fine tune of left frequency
7. Hidden buttons for set hundreds of kHz of right frequency
8. Buttons for set tens of kHz of right frequency
9. Knob for fine tune of right frequency

To read the frequency, you need to add digits from window, where hundreds and tens are set, to fine tune. On picture is shown 405 and 1143 kHz.

ARK-9 can work at three modes:

1. COMP — Automatic radio-compass. In this mode, compasses antenna automatically rotates to the most powerful signal direction. Needles on indicator will show beacon bearing.
2. ANT — Antenna mode. This one is not rotate antenna, but allows you to listen beacon's call-sign. To hear it you will need to select ADF on sound selector.
3. RAM – Manual compass. Antenna will not rotate automatically and you'll need to make it manually by switcher (3). In this case you have to look at signal power meter (2) and find maximum deflection of needle. This mode is less accurate and also you can make a mistake by 180 degrees.

For normal work those systems requires power 115v from Radio inverter for left, and Defrost inverter for right system.



Directional gyro system GMK-1 and magnetic corrector KM-8

Directional system of Yak40 gives signals of current heading to HSIs, ADF/VOR indicators and autopilot. It works from two separate gyros and magnetic corrector KM8



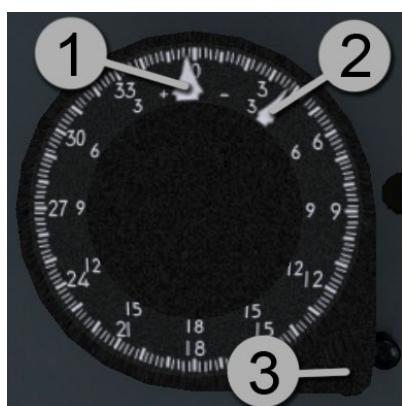
1. Swticher for select North or South hemisphere
2. Selector of active gyro
3. Fail lamp for auxiliary gyro
4. Fail lamp for main gyro
5. Mode selector (look below)
6. Manual correction of compass
7. Latitude select knob
8. Selected latitude indicator
9. Test switcher. When held left or right, compasses will show heading 0 or 300 (plus magnetic deviation, set on KM8) degrees, in case if system

works properly.

Gyro-Magnetic Compass GMK-1 can work at three modes, which can be selected by switch (5)::

1. Magnetic compass (MK) – in this mode gyros are synced with magnetic sensor MK-8 simultaneously. You can set magnetic deviation on magnetic corrector MK-8 – in this case compasses will show true heading.
2. Gyro-Half Compass (GPK) – in this mode compass will hold direction without any sync with magnetic field of Earth. This mode can be used for flights by Great Circle. To correct compass – use correct switch (6)
3. AK mode is similar to MK.

To enter the magnetic deviation, you have to use Magnetic Corrector MK-8, which gauge is located on backward panel near cockpit entrance



This gauge contains

1. Bold needle shows current magnetic heading
2. Thin needle shows selected magnetic deviation
3. Knob for set deviation

When you set magnetic deviation, all compasses will have a difference from real magnetic heading in value of that deviation. Also this will cause an error when test switch 0-CONTR-300 (6) is held on GMK panel.

For work, this system requires power 36v

Maximum roll and comparing unit (BSPK-1)

BSPK system made for comparing two artificial horizons (left and right) and generate signals of their failures or maximum bank. Here how it works:

1. System generates signal to lamps panel and sound alarm (bell) for 4 seconds in case when roll (by AHZs) exceeds 15 degrees on speeds below 240 km/h and more then 32 degrees at speeds higher then 240 km/h
2. System compare AHZs indication and generates failure signal, when their roll or pitch are different for more than 7 degrees. System cannot detect which AHZ fails exactly. In this case system generates signal for lamps panel and to turn OFF autopilot

For work this system requires power 36v

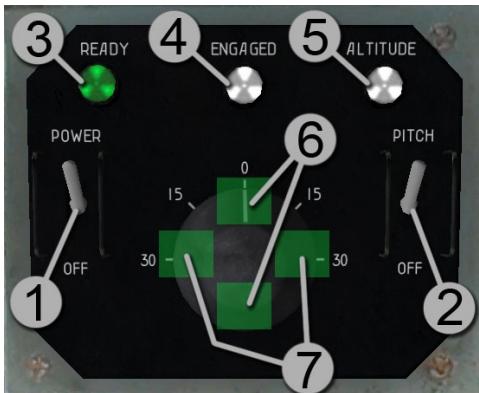
Transponder SO-72

Just because we can't make several panels to set transponder's code in X-Plane (we can, actually, but we can't make them to enter different codes), so in this model of Yak40 there is only standard transponder panel – SO-72. This panel is located on Captain's left side panel.



1. Power switch
2. Modes switch
3. Lamp-indicator of transponder's work:
blinking green – normal work
green – indent transmit
red – emergency code (7700)
4. transponder's code
5. Code set wheels
6. IDENT button
7. Emergency code button

Autopilot "Kremen40"



Autopilot's panel located on lower part of central console:

1. Power switcher
2. Pitch channel switcher
3. "READY" lamp, indicates that AP is ready for engage
4. Lamp/Button "ENGAGED" used for engage AP after its ready.
5. Lamp/Button "ALTITUDE" used for engage altitude hold mode.
6. Hidden buttons for set pitch
7. Hidden buttons for set roll

Autopilot is used for flight and can do:

- Hold pitch and roll angles
- Hold barometric altitude
- Hold magnetic and Great Circle headings
- Make coordinate turns
- Climb, descend, flights by spirals
- Automatic trimm the plane by its rotating horizontal stabilizer

Autopilot has limits:

- Roll 30 degrees
- Pitch 15 degrees
- Minimum altitude for engage – 300 meters

Autopilot controls the aircraft by all its three channels. For roll it uses ailerons, for pitch – elevator (stabilizer also moves to remove forces from yoke), for slip – rudder. When roll is set to 0 – AP will use ailerons (rolls) for hold heading.

Using autopilot

Before turn it on, you have to check if switcher POWER on its panel is OFF, PITCH switcher is ON and knob is on neutral position. Check if circuit breakers are ON:

- a) on right AZS panel: AGB right, GMK, Hydrosyst., AP, BSPK, Main stab.
- b) on left: AGB left.

Check if PT500 and PT1000 inverters are ON on Co-Pilot's right front panel. Incatch flight controls and check them by moving and rotating yokes and pedals. Set flight controls to neutral position. Also check if GMK is ON and synced – compass needles not moving, while plane in standing still or flight directly.

Turn ON the AP. It will make a few self tests and if it works properly, lamp READY will lit after 10-15 seconds. After you climb 300 meter and higher above ground – push the button ENGAGED. It will lit and AP will remember current position and will hold it. You can control the engaging of autopilot by slow self moves of yokes and pedals.

Autopilot controlled by central knob on its panel. By bending it you can set needed pitch to hold, and by rotating – roll. In this case AP always remembering the new position and heading, and will hold it, when you set knob in 0 position, by using 10 degrees banks.

In this model of Yak40, one click will rotate knob by 5 degrees; holding it up and down – decreases and increases pitch by 0,9 degrees per second.

For altitude holding (and pitch control) you'll need the pitch channel is ON. Make the airplane fly stable by changing its pitch and then push the lamp/button ALTITUDE – it will lit. AP will remember current altitude in moment of pressing that button and will hold it.

There is co-management for pilots and autopilot on Yak40. To get it, you'll need to set the custom button (look commands settings above), by pushing which AP will become in READY mode and remember new position when button is released. Altitude hold mode will disengage in that case.

You can also over-force the autopilot. But if you move controls more than $\frac{1}{4}$ of their whole range – AP FORCE lamp will lit and AP will disengage automatically, when forces applied for more than 2 seconds. This will cause an sound alarm for 4 seconds.

To disengage the autopilot, use special button on your yoke (look commands settings above) – AP will switch to READY mode. If you switch its power OFF – it will turns off completely.

Electric system

Electric system of Yak40 is separated on several buses: 27v direct current DC, 36v alternating current AC in three channels and 115v alternating current AC.

27v bus is main. It powered by batteries with voltage of 24v, three generators in every engine with output voltage 28v and ground power (available only on ramp). For select between inner and ground power, main switch is used. In flight it must be switched to inner power in position MAIN BATTERY.

27v bus powers all gauges and systems of airplane, some of which connected via inverters 36v and 115v. Those inverters power their respective buses.

36v bus is powered by two inverters (PT-500 and PT-1000), which takes power from main 27v bus. This bus powers all of gyros, pressure-meters and autopilot. If one of inverters fails – all its gauges and systems reconnects to remaining inverter, except the autopilot, which requires both inverters for work. If two of generators fails or disconnected – PT-500 will disconnect from bus and autopilot will disengage too.

115v bus is divided by two separate buses, which powered by inverters PO-1500 Radio and Defrost. Radio inverter powers left side of radio equipment and left window heat, Defrost inverter powers right side, right windows and most of defrost system. Those inverters can be connected only if there is power from one of generators for Radio inv and two generators for Defrost inv. But you can also connect them manually by emergency connect switchers.

Most controls for electric system are placed on Co-Pilot's front panels

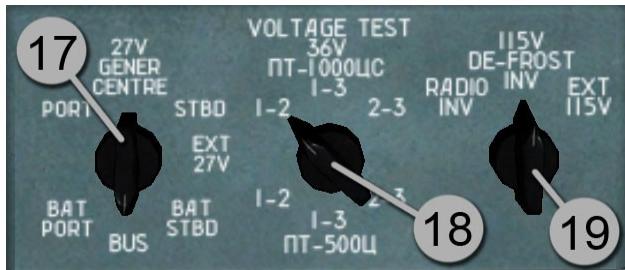
1. Ampermeter for selected source of 27v bus
2. Voltmeter for selected source of 27v bus
3. Voltmeter for selected source of 36v bus
4. Voltmeter for selected source of 115v



bus (Sources can be selected on power check panel).

5. Left generator's ampermeter
6. Middle generator's ampermeter
7. Right generator's ampermeter
8. Left generator's switcher
9. Middle generator's switcher
10. Right generator's switcher

11. Main switch: inner power – MAIN BATTERY/OFF/Ground power – EXT POW.
12. Switcher for PT1000 inverter (36v bus)
13. Switcher for PT500 inverter (36v bus)
14. Emergency connect of Radio inverter
15. Switcher for Defrost inverter (115v bus)



16. Switcher for Radio inverter (115v bus)
17. Source selector for 27v bus
18. Source selector for 36v bus
19. Source selector for 115v bus

Hydraulic system

Hydraulic system of Yak40 airplane is divided to main and emergency buses.

Main uses pumps in left and middle engines, which creates pressure for:

- autopilot's mechanics
- extending and retracting flaps
- extending and retracting landing gears
- stabilizer turn
- nosewheel steering
- main braking system

System contains the hydro-storage, which maintains pressure in main system and carry its devices for some time. Storage will accumulate pressure automatically from main pumps.

Normal system pressure – 120-160 kgs/sm²

Emergency system gives pressure for:

- emergency flaps extend (extend only)
- emergency landing gears extend (only)
- emergency and standing brakes
- nosewheel steering
- stabilizer turn
- lower and rise tail ladder

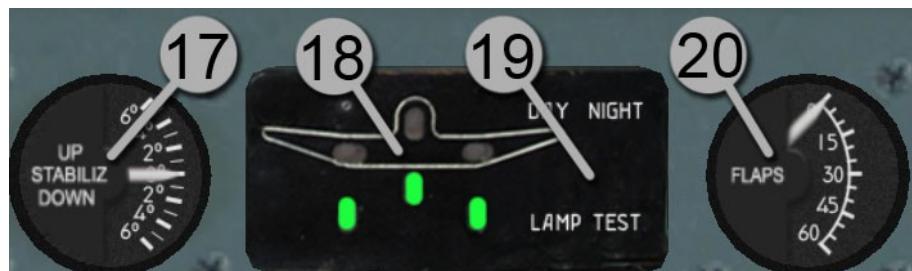
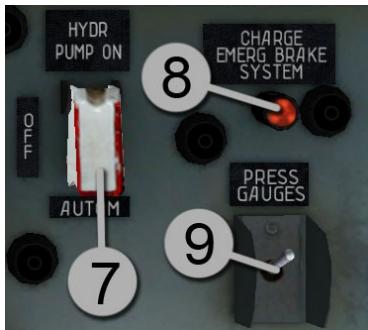


Emergency hydraulic system uses electric pump, which engages automatically when any of caps for emergency flaps or gears manipulation is open. Also you can turn it on by emergency pump switcher. Normal pressure in system is 100-140 kgs/sm²

System control gauges are located on Captain's front panel, and controls – on central console.

1. Pressure meters of main end emergency systems
2. Pressure meters of emergency and standing brakes
3. Pressure meter for main brakes
4. Lamp for indication of normal hydraulic quantity

5. Lamp for indication of low hydraulic quantity
 6. Outer air thermometer
 7. Emergency pump mode switcher
 8. Lamp-indicator of low pressure in emergency system
 9. Switcher for pressure meters
 10. Button for test the lamps
 11. Emergency gears extend
 12. Normal gear's manipulator
 13. Normal flaps manipulator
 14. Emergency flaps extend
 15. Standing brakes lever. To set brakes – push it down, for release – pull up.
 16. Nosewheel steering buster switcher
 17. Stabilizer position indicator
 18. Landing gears position panel
 19. Button for test lamps on L.G. panel.
 20. Flaps position indicator



Fuel system

Yak40 airplane equipped with two fuel tanks, located in wings, which has capacity 2000 kg for each. On each tank there is fuel buster pump, which creates pressure of fuel in system for simultaneous flow for main engines AI-25 and auxiliary power unit AI-9.

Fuel pumps powered by 27v bus. But take notice, that normally left pump will work from batteries and right – from generators. You can turn it on manually as by emergency switcher.

Fuel system divided to two parts – left and right. Each engine uses its respective bus: left engine – left tank and its pump, right engine – right bus and pump, middle engine can use both or any of available buses and pumps.

Also, there is flow and cross valves between tanks and pumps. The difference is that when you open flow valve – both tanks connects into one and each pump can suck fuel from any of them; and when you open cross valve - buses connects into one system and each pump can feed each engine – left to right and right to left.

To control fuel levels on both tanks automatic portion unit is used. It compares fuel levels in each tank and if there is difference more than 200 kg, it makes system to use that tank, where fuel level is higher. For normal work this system requires both busters work properly.



Fuel meter located on Captain's front panel. For work it requires power 27v from main bus.

1. Fuel level indicator. Outer scale is for both tanks, inner – for left and right separately
2. Test button. Moves needle to zero
3. Test button. Moves needle to maximum
4. Select tank switch. Left – both - right



Fuel system controls located on central console:

1. Lamps for normal fuel pressure
2. Lamps for open status of flow and cross valves
3. Fuel portion system switch
4. Left tank pump switch
5. Right tank pump switch
6. Switcher for pumps modes. When left (port) is selected – it will lower left pump power and fuel will be taken from right tank. When right (stbd) is selected – right pump will work at low power and fuel will be taken from left

tank.

7. Emergency power on the right pump
8. Flow valve switch to connect tanks
9. Cross valve switch to connect fuel buses
10. Fuel prop test button. If system is ready for work – green lamp will lit, if not – red
11. Lamps for fuel prop work indication

Fire valves (fuel cutoff) are located on overhead panel (for engines AI-25) and on Captain's front left panel (for AI-9)



Caution. For case of any pump failure it is recommended, that fuel flow and cross valves kept open during whole flight.

This model also equipped with emergency fuel dump system, which can be controlled from Co-Pilot's right side panel



Engines start-up system



Yak40 airplane equipped with air starters for start main engines. To gain pressure in it, auxiliary power unit AI-9 is used. Gauges and lamps for controlling AI-9 are located on Captain's front left panel. Here is also located pressure meter for start-up system.

On left you can see thermometer of exhaust gas for AI-9. This engine cannot cool itself and so it can work only for 14-15 minutes. If temperature rises to 800 degrees – it may cause an engine fire.

For start AI-9 engine, several conditions must be met: power is ON, Fire valve for AI-9 is open, one of fuel pump working and AI-9 IGN switch on AZS panel must be ON.

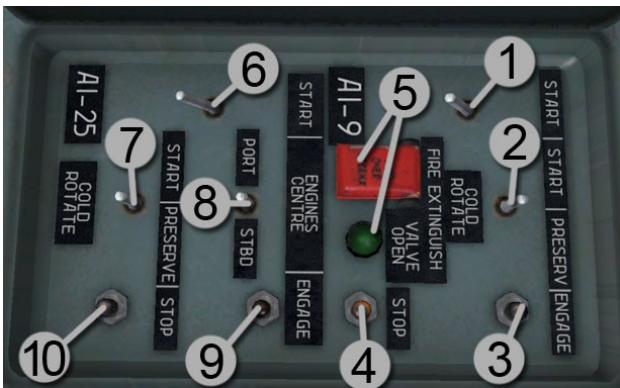


AI-9 itself can be started from start-up panel on Captain's left side. To do so, you must turn on the starter to START position, select starter mode to START and push the ENGAGE button. After that, STARTING lamp will lit and AI-9 will start by plane's automatic.

Just after starting and spin-up to normal RPMs, AI-9 starts to gain air to start-up system. This pressure you can control by pressure meter (showing left). Start-up system will be ready when pressure is more than 2 kg/cm²

To start engines AI-25, you must check if fuel busters are ON, fire valves are open on overhead panel and AI-25 IGNITION switchers on AZS panel are ON too. If so – open start panel on left side, turn on the starter, select its mode to START, select engine you want to start and push the ENGAGE button. Take notice, that minimum position of thrust levers equals to STOP (fuel cutoff), so they must be over the red plank in IDLE position.

Remember, that when all generators are OFF – only left fuel buster will work. So you have to start left engine and connect its generator first. Also remember, that AI-9 can work only for little amount of time, so after starting first engine, last two can be started from the first. To do so – set engine RPM to 80-90% to gain the pressure in starting system.



9. Engage button for AI-25
10. Stop start process of AI-25

Engines start panel located on Captain's left side panel.

1. Starter switcher for AI-9
2. Starter's mode switcher for AI-9
3. Engage button for AI-9
4. Stop button for AI-9
5. Button and indicator of fire extinguish valve – used when fire in AI-9 is detected
6. Starter switcher for AI-25
7. Starter mode switcher for AI-25
8. Engine selector for start

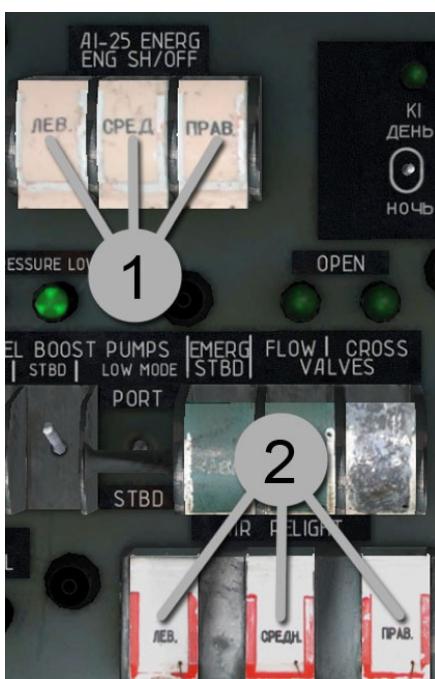
To stop AI-9 engine you can do any of this: close fire valve, turn off the starter, push the STOP button, turn off the ignition on AZS panel

For stop AI-25 engine you can do:

1. Close fire valve on overhead panel
2. Move throttle to STOP position
3. Push the emergency shutoff button on central console (look below)

In case, when you need to start engine in flight, you can use AIR RELIGHT buttons on central console. Engine will start of:

1. It's not damaged
2. Air flow is powerful enough to spin up it
3. Fire valves are open and fuel busters works too



To prevent rapid temperature of exhaust gas rising, throttle of engine that starts must be in IDLE position

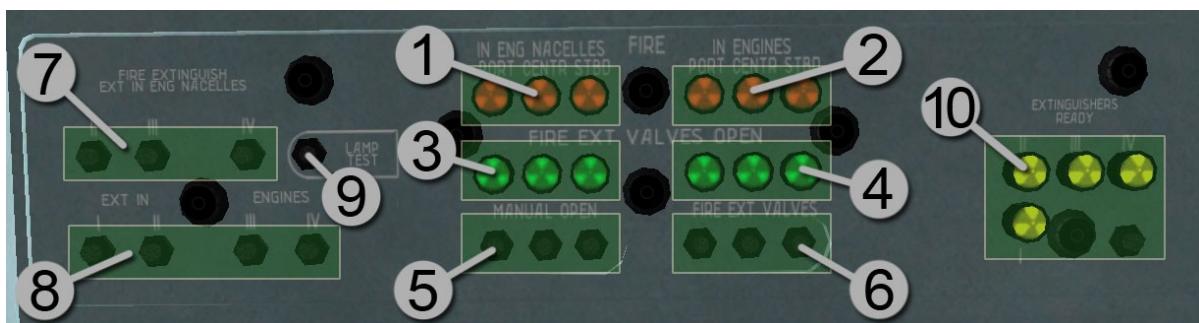
Start controls on central console

1. Emergency shutoff buttons
2. Air relight buttons

Fire system

Fire system on Yak40 airplane is made for automatic detect fires and extinguish it by itself or pilot's command. System consist of:

- seven sensors of fire, located in engines AI-25, engine AI-9 and engine's nacelles
- four fire extinguishers
- valves communications, that directs extinguishers to fired location



Almost all system's controls located on overhead panel:

1. lamps-indicators of fire in engines nacelles
2. lamp-indicator of fire in engines AI-25
3. lamp-indicators of fire extinguisher's valves open in engine's nacelles
4. lamp-indicators of fire extinguisher's valves open in AI-25 engines
5. buttons for manual open valves in nacelles
6. buttons for manual open valves in AI-25 engines (to open valve to AI-9 engine, use button on start panel on Captain's left side panel)
7. buttons for manual engage 2, 3 and 4-th extinguisher into engine nacelles. Make notice that when any valve to nacelle or AI-9 engine is open – first extinguisher will use automatically.
8. Buttons for manual engage extinguishers to AI-25 engines.
9. Test lamps button
10. lamps-indicators for extinguishers. When yellow lamp lit – extinguisher is ready for work, when it explodes – lamp will fade out.

System use

When fire detected in engines, engine's nacelles or in AI-9 engine – sound alarm engages, FIRE lamp is lit on central panel and respective red lamp on fire panel will lit, showing fire location. (If AI-9 is on fire – lamp on left panel will lit). Also fire extinguisher's valve to that direction will opens automatically. If any of engine's nacelles or AI-9 is on fire – first fire extinguisher will explode to that direction. In most cases fire will be extinguished and after some time red lamp will fade out. If not – use 2, 3 or 4 extinguisher manually.

If engine AI-25 is on fire, fire alarm engages too, red lamps lits, to show fire location. Also respective fire extinguisher's valve will open, but extinguisher itself will not explode automatically. It is made to prevent false engine shutoff. When it full of extinguish liquid – it will not start again! So pilots must be sure of fire in this engine and explode extinguisher manually.

After the fire will removed, you need to reset system by pressing the PUSH AFTER FIRE

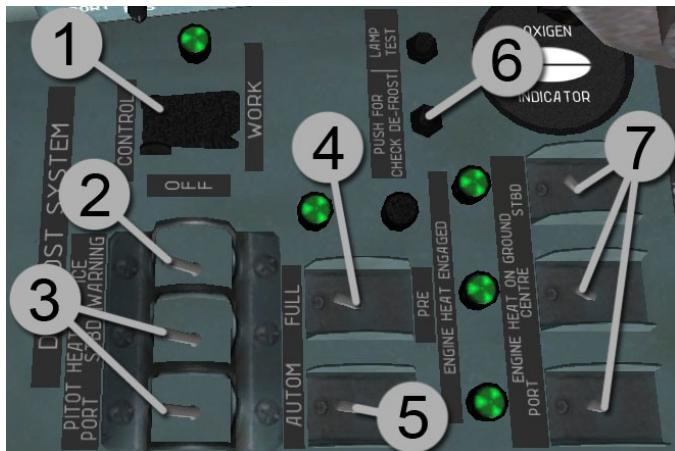


EXTIGUISH button on central panel. Make notice, that that button can work only after 15 seconds after fire located. Also fire alarm will not sounds, if it turned off on front left panel and yellow lamp is lit.

De-frost system

To prevent ice appearance on wings and sensors Yak40 equipped with de-frost system. It heats wings, tail and engine's inlets by hot air from engines and outer sensors: AOA, Pitot tubes, ice detector – by electric current.

System manipulates by panel on right side. Switcher for AOA sensor heat is located on left side panel.



1. Selector for ice detector modes
2. Ice detector switcher
3. Switchers for Pitot heat
4. Manual switch for set full or soft heat of wings and engines
5. Automatic heat switcher
6. Button for check system
7. Manual engage of engine's inlets heat.

System requires power of 27v bus for work, but also 115v from Radio inverter for ice detector and De-Frost inverter for heat AOA sensor. Also there at least two engines and generators must work for system function.

For automatic engage of heating wings and engines you must set switcher 1 to WORK position, turn ON switcher 2 and set automatic mode by switcher 5. If ice is detected, system will automatically set full or soft mode (depending on engines thrust) heat for wings and engines for one minute. It will engage again and again until ice is gone or you turn the automatic off.

Also there is manual engaging of system to soft or full heat by switcher 4. If you set it to "PRE" position, system will set soft heat, which is enough to maintain wings and engines clear from ice. Use full mode, if you are at great icing conditions. To turn heat off – set switcher 4 to neutral position.

Remember, that for full heating system takes hot air from engines, which reduces their power. If you set full mode (or automatics engage full mode) and engines thrust set more then nominal – system will be automatically switched to soft mode.

When taxi and there is ice conditions, it is recommended to engage manual heating for engines by switcher 7. They will also heats by system in soft or full mode by switcher 4 or automatic logic of system.

Check defrost button is used when engines are turned off. Turn on soft or full mode and push button 6 – respective lamps of modes and engines heat will lit.

For check ice detector – set switcher 1 to Control position – green lamp above will lit.

Pressurization and air conditioning system

This system is used for maintain proper for human live air pressure and temperature in cabin. On high altitudes air pressure is too low and temperature is lower than -60 degress by Celsius. When Air pressure drops to pressure equal to 4 km altitude – human gets low oxygen effect called Hypoxia.

Pressurization and air conditioning systems on Yak40 works this way. Part of air takes from engine's compressors for gain pressure in cabin. On its way air is heated by exhaust gases or cooled by turbo-cooler unit. All it works automatically refering to settings on Co-Pilots front left panel.

Pressurization system can carry cabin pressure equal to altitude from 1,5 to 4 kilometers with change rate equals to vertical speed from 1,4 to 2 meters per second. For stable work, system is dubbed, which can speed up air flow and lower cabin altitude to 0 level. But remember, that system can carry pressure difference between inner and outer air pressure up to 0,4 atmospheres.

In case of emergency, you can drop pressure to outer level by PRESS DUMP switcher, But remember, that you must immediately descend to safe altitude below 4 km to save passengers.



On panel are located:

1. System on lamp
2. Turbo cooler lamp
3. Emergency pressure dump switcher
4. Dubb system switcher
5. Emergency system switch
6. Sound alarm switcher
7. Normal system switch
8. Cabin temperature mode switcher. When in AUTO position, temperature will remains according to rheostats below (13)
9. System pipes temperature mode switcher. When in AUTO position, temperature will remains according to rheostats below (14)

10. System's flaps switcher. For normal work must be in OPEN or AUTO position
11. System mode switcher. 1 mode will rise air flow, 2 mode – lower.
12. Cabin air flow switcher
13. Cabin temperature rheostat
14. System temperature rheostat

For control air pressure and temperature, on Co-Pilot's front panel mounted few gauges:



Cabin altitude and overpress indicator.

Long needle shows current cabin altitude on outer scale

Short needle shows difference between pressures of inner and outer air.

This difference reads on inner scale of gauge.



Cockpit variometer

This gauge shows vertical speed of altitude change rate. When climb, it normally shows climb rate 2,5 m/s, when descend - -2,5 m/s. At horizontal flight – 0 m/s



Air flow indicator

This gauge shows current air utilization in system and becomes one of indicators of system's work.



Cockpit air temperature

Shows current temperature in cockpit and cabin



System temperature

This gauge shows current temperature in system, which it will try to

Pressurization system also equipped with sound alarm, which will work when:

1. Cabin altitude rise above 3,5 km – system will make series of short sound signals and RAPID DECOMPRESS lamp will lit
2. If pressure difference will be more than 0,38 – long sound alarm will engage and CABIN OVERPRESS lamp will lit

In this model of Yak40 you can get effects of decompression and Hypoxia when pressure in cabin falls rapidly. So we don't recommend you to open door and windows during the flight.

For controlling speed rate of pressurization and for set the airfield pressure (for pressure leveling in plane and outside for safe door open) panel on right side is used – **Device 2077**:



1. Maximum pressure difference
2. Maximum pressure in mm.Hg.
3. Pressure change rate in mm.Hg/sec
4. Knob for set maximum pressure difference
5. Knob for set maximum pressure or pressure on landing airfield
6. Knob for set pressure change rate

External lights

Yak40 is equipped with this kind of lamps:



1. landing/taxi lamps
2. left navigation light
3. Tail navigation light
4. Right navigation light
5. Tail beacon
6. Bottom beacon

All lights requires power 27v from main bus of airplane. The controlled from overhead panel:



Cockpit and cabin lights

In this model of Yak40 you can light the cabin and cockpit. Cockpit's lighting are built on three 3D lamps, which gives a natural light flood.

Cockpit lighting controls located on Captains front and Co-Pilot's left side panels, and cabin lighting controls – are on Captain's left side panel.



1. Left spot light control
2. Red flood light control
3. Right spotlight control
4. Gauges background light control
5. Switcher for main cabin flood
6. Switcher for standby or emergency cabin flood
7. Emergency exit lamps switch



All lighting in cockpit and cabin requires power 27v from main electric bus from any power source, except main cabin flood – this system uses up to 50A of current and can be connected only when one of generators works. But in this case you must be careful – more than 200A on one generator can cause its fail.

List of lamps-indicators in cockpit

On front panels of cockpit are located several lamps-indicators, which indicates failures, damages and gives pilots some information about systems status. So those lamps can be divided to three groups:

1. Emergency – those lamps are red with black text. They indicates failures and/or exceeding some limits in flight
2. Warnings – Yellow text on brown background. Those lamps indicates than engines has some troubles and may fail any time
3. Information – green text on black background. Those lamps indicates current status of AI-9 engine, starter or flight over marker beacons.

Let's take a look closer

Emergency lamps

- AP. FORCE FAIL — Autopilot mechanics cannot work properly or fails
- AP ROLL FAIL — Autopilot's roll and heading channel fails
- AP PITCH FAIL — Autopilot's pitch channel fails
- PORT HYDR FAIL — Left hydraulic pump off or fail
- CENTRE HYDR FAIL — Center hydraulic pump off or fail
- ROLL LEFT MAX — Signal from BSPK. Too much of left bank
- ROLL RIGHT MAX — Too much of right bank
- FLAPS FAIL — Flaps or hydraulic fail
- SWITCH OFF FIXATORS — control catch is ON
- FIRE AI-9 — Fire in AI-9 engine
- MAXIMUM RPM — Ai-9 is work on too high RPMs. It may cause its fire.
- CHECK AHZ — Artificial horizons in cockpit shows different rolls or pitch – they may be off, fail or un-synced.
- SLOW DOWN — Flight speed is too high.
- FUEL QTY PORT — Minimal amount of fuel in left tank
- FUEL QTY STBD — Minimal amount of fuel in left tank
- ICE DETECTED — Ice sensor is covered with ice or cap is not removed.
- CABIN OVERPRESS — Pressure difference is more than 0,38 atm.
- RAPID DECOMPRES — Cabin altitude is more than 3,5 km
- LOW OIL PRESSURE — One of engines have low oil pressure
- HIGH VIBR PORT. — Left engine has critical vibration
- HIGH VIBL CENTRE — Center engine has critical vibration
- HIGH VIBR STBD — Right engine has critical vibration
- ПІТ-500Ц FAIL — One of inverters of 36v electric bus is off or fail
- PORT GEN FAIL — Left generator is OFF or fail
- CENTRE GEN FAIL — Center generator is OFF or fail
- STBD GEN FAIL — Right generator is OFF or fail
- DOORS OPEN — Doors, hatches or windows are open
- FIRE — There is fire in one or several engines or nacelles
- REVERSE — Reverse flaps on middle engines are deployed

Warning lamps

- TO VOR — Course on CourseMP system is set in direction to VOR beacon
- FROM VOR — Course on CourseMP system is set in direction from VOR beacon
- EXTEND L.G. — Flaps are extended more than 25 degrees, but landing gears still not extended
- EXTEND FLAPS — Gears are on ground and engines at takeoff thrust, but flaps not extended to takeoff position to 20 degrees
- DA-30 POWER — Gauge DA-30 is off or fail
- LOW HYDR LEVEL — Hydraulic liquid level is too low for system to work properly
- OIL QTY PORT — minimum oil quantity in left engine
- OIL QTY CENTRE — minimum oil quantity in center engine
- OIL QTY STBD. — minimum oil quantity in right engine
- CHIP PORT — In left engine's oil are small parts of metal detected
- CHIP CENTRE — In center engine's oil are small parts of metal detected
- CHIP STBD — In right engine's oil are small parts of metal detected

Information lamps

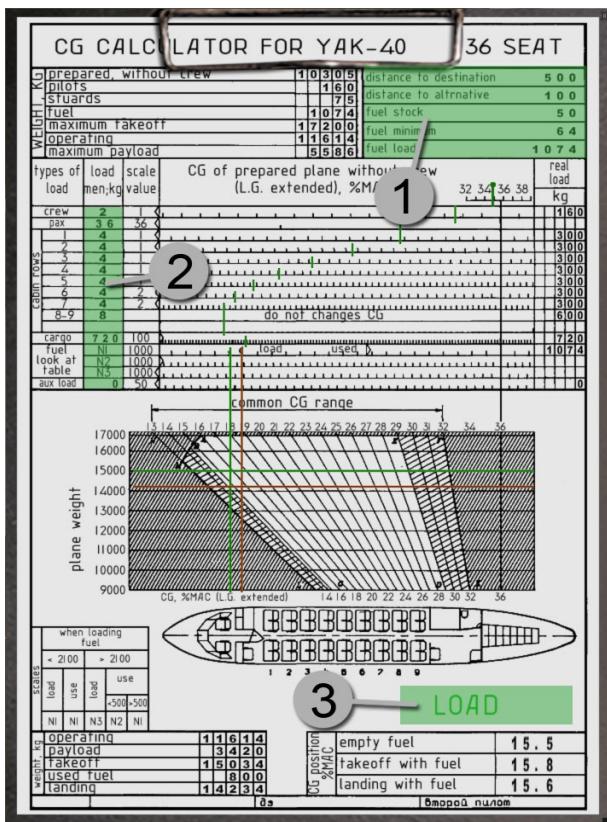
- OUTER MARKER — Plane is flying above outer marker beacon
- MIDDLE MARKER — Plane is flying above meddle marker beacon
- INNER MARKER. — Plane is flying above inner marker beacon
- STARTING — AI-9 starter engaged
- OIL PRESS NORMAL — Oil pressure in AI-9 engine is normal
- RPM NORMAL — AI-9 engine's RPM is normal
- FIRE VALVE OPEN — Fire valve for AI-9 engine is open
- AIR START OPEN — Air starter is open – starting process for main engines AI-25 is engaged

Normal procedures

Preparing the airplane

As any aircraft, Yak40 must be prepared for flight. And not only aircraft, but pilots themselves must collect maps, calculate the route and so on.

In this model some preparations is needed too. First of all we need to calculate payload, center of gravity position and needed fuel amount. To make it, open the payload panel from main menu by pressing LOAD button.



First of all, calculate fuel amount, required for flight. At fields (1) we mast enter distance to destination airport, distance to alternative airport from point of decision and amount in fuel stock. Calculator will automatically find summary amount of fuel and enter it to CG diagram (2)

Below on diagram we need to enter number of crew, passengers and cargo weight. Make notice, if passenger number is maximum, you can use only one row "passengers". If we fly an empty plane – to balance it we use special weight, placed on front rows. It enters in last row of diagram.

After fill the diagram, we check it and make sure if no number became red. If they are – we must to move some weights. It is prohibited to takeoff with overload or too forward or backward position of CG.

After the form is filled, push the LOAD button (3) – panel will close itself and plane will be loaded and balanced.



Now open the ground service panel (SERV button on menu) and take off all caps and covers from sensors and engines. If you need it – you can connect the ground power unit, but do not forget to disconnect it before taxi. Also remove the gear blocks.

Warning. Yellow lamp on ground power indicates that it is connected. When this lamp is green – it is disconnected and you free to go.

Engines start

No matter either ground power is connected or not, to start engines we will need air pressure from start-up system, which in this model gathers by auxiliary power unit AI-9. If you starts from battery, you must be quick, because batteries on Yak40 can power the airplane for a small amount of time. Also there is time limit after AI-9 start – it can work safely only for 15 minutes, after what it will overheat and may cause a fire.

Let's begin.

On front right panel turn on the power switch to BATTERY or EXT POWER position. Turn on the AZS for radios and transponder. Receive information from ATC and enter transponder's code. Turn on power on fixators panel and release it, make sure that all controls moves freely. Turn on inverters for 36v and 115v on left AZS panel, PT500 and PT1000 inverters on front right panel. Check the standing brakes. To make it turn on press gauges on central console and look at pressure meters on front panel. Read checklist.

Before start engines, turn on red beacon on overhead panel. On central panel turn on fuel pumps and fuel prop system. Left pump will work immediately and right will work after any generator is connected. On front left panel open fire valve for AI-9 engine and wait till FIRE VALVE AI-9 lits. Go to start panel, turn on the starter, select its mode to START and push ENGAGE button. If you do it right – STARTING lamp will lit and after few seconds AI-9 will start. This process can be controlled by EGT indicator and lamps on front left panel.

After AI-9 starts, STARTING lamp will fade and start-up system will gather air pressure for start main engines.

On left AZS panel turn on: AI-25 IGNITION, START WARN, ENGINE GAUGES, FIRE VALVES and all 9 switcher for fire system. On central console make sure, that all thrust levers are at IDLE position and red plank closed. Open fire valves on overhead panel and check their status by green lamps near. Check air pressure in start system and if it more than 2 kg/sm^2 – then we can start engines.

On start panel turn on the starter for AI-25 engines, select its mode START, select left engine and push ENGAGE button. On central panel AIR START OPEN lamp must lit and left engine begin to start. During this process you must control the EGT, RPM, fuel and oil pressure for this engine – all of it must rise.

After engine start, turn on generator on this engine on Co-Pilot's panel. Batteries charge must start – you can see it by negative current on batteries.

Next two engines you can start from AI-9 or working engine. In this case push throttle of working engine to rise its RPM to 80-90% to make it produce enough pressure for start other engines.

Start other engines just like you did it for first. To shutoff AI-9 you'll have to close its fire valve, turn off the starter and ignition.

Turn on all generators.

Engines are started.

Final preparations

After main engines started and their generators connected, check if AI-9 engine is off and power voltage remain still. Also check batteries current – it must be zero or negative – they will charge. If we used ground power, we can reconnect power to inner by quick move up of main power switch. After it we can disconnect ground power.

Turn on all devices and systems on both AZS panels, AOA heat, radio-altimeter and auxiliary AGD1 on left side panel, all inverters on front right panel and defrost system on right side panel. Artificial horizons will sync for some time and then show actual position of aircraft. You can speed up them by pressing ARREST button, but still they will need some time for full synchronization.

Check the hydraulic system and if needed – charge the emergency hydro-system. Check other systems and move on to navigation.

First of all – gyrocompass. To sync it – switch it to MK or AK mode – all compasses will slowly rotate to current magnetic heading. You can also set GPK mode and rotate them manually by ZK switcher. Check system by pressing 0-CONTR-300 switcher.

Going on to radio-compasses on overhead panel. Turn them on and set frequencies by your SID charts. To make sure of proper tune – listen to beacons call-signs. Also turn on CourseMP systems and DME on side panels. Tune them by your SID charts too.

Turn on the autopilot.

Turn on navigation and taxi lights, extending them before. Set flaps to 20 degrees and stabilizer to calculated angle.

Read checklist.

Taxi and takeoff

After we receive permission to taxi, rise engine's power to start move and lower it a little. Just when you start moving, check brakes by pushing pedals and controlling the pressure in braking system on its pressure meters. For steer nosewheel - push and hold special button on your yoke (look for commands assignments) and move pedals (left to steer left and right – to right). Remain speed not more than 30 km/h.

On direct parts of route check GMK system, flaps position and navigation systems. Read checklist on taxi and short.

On runway put a plane directly along it, check courses of runway and compasses and correct them, if necessary. Also turn on landing light. Slowly move throttles to maximum power and start run, holding a plane directly on runway's axis.

When speed rise to 16-180 km/h, slowly pull a yoke, rise airplane's nose and hold it. Plane will takeoff at speed 190-210 km/h. On altitude 15-20 meters retract landing gears and when speed rises to 250 km/h, retract flaps by several moves. In this time use yoke to prevent airplane to rise pitch and after flaps removing – from descending. Use stabilizer if needed.

After gears UP, set engines thrust to 90-95% and begin climb with vertical speed 6-8 m/s. If you want, engage autopilot at altitude more than 300 above ground level and use it to control aircraft. To do it – push ENGAGED lamp on its panel and check if AP takes control.

After we climb to flightlevel – stabilize altitude and set engines thrust for remain cruise speed. Turn on ALTITUDE mode on autopilot by pressing respective button.

Descending and approach

During the flight, you have to prepare for approach way before the descending: calculate descend from flightlevel, learn arrival charts and maps, set needed frequencies into CourseMP and ARK-9. Also set air pressure of destination airport into Device 2077 on right side panel. Altitude hold mode on autopilot will disengage automatically, when you push its handle to change pitch for descend. While descending, do not speed up more than 450 km/h IAS.

After descending to transition level you should hold it for a while and set pressure, given by ATC, into altimeters: QFE into metric and QNH into feet. Continue descend to pattern altitude, given by ATC on in your charts. Flaps and gears extends on upwind leg and before it you should slow down to 300 km/h. Extend flaps by several moves, controlling the pitch and do not let it rise up by yoke. Also do not the plane to slow down below 220 km/h. Landing gears can be extended on speed less then 300 kn/h. When you do it – plane can lower node a bit. Hold it by yoke.

When you slow down, force on your yoke will rise – you can lower it by rotating stabilizer up.

Read checklist before landing.

When on glideslope, you should set engines thrust to maintain calculated speed. Before leveling plane above runway, set engines to IDLE (if you need, you can also engage reverse) and slowly pull yoke to maintain vertical speed and soft landing. When main wheels touches ground, slowly lower nosewheel and engage full reverse thrust. Use brakes only below 100 km/h speed. Slow down to taxi speed, hold a taxi button and clear the runway. Disengage revers and turn on taxi light. Retract flaps.

After taxi to the ramp, set standing brakes, turn off all systems and gauges and shutoff engines. Set gear blocks, open a doors and lower passengers ladder.

Emergency cases

One or few engines fail

As we know, Yak40 can continue takeoff with two engines and continue a flight with only one engine running. So when one of engines fails, You can just shut it down, close its fire valve and disconnect its generator. In case of engine fail during the takeoff, it's up to Captain to make decision of continue or break the takeoff. If you decided to continue takeoff – reduce vertical speed and control the speed.

In case of two engines fail during takeoff – you have to cancel it and land back right in front of you. If two engines fail in flight – you have to search for nearest airfield for emergency landing. As two generators disconnects – Defrost and PT500 inverters and autopilot are disconnected too. If you need it – you can manually connect Defrost inverter, but make sure the current on last generator will not exceed 200A.

If all three engines fail – immediately start descend, do not drop the airspeed and look for any available field for emergency landing. As all generators disconnected - Radio, Defrost, PT500 inverters and all systems and gauges they feed, disconnects too. Now aircraft is powered only by batteries, which can give power only for 15-20 minutes, depending on their load. So it is recommended to turn off all unnecessary gauges and system, including cabin lights and landing lamps.

Flaps and landing gears should be extended from emergency hydraulic system, which maintains pressure by electric pump. But you can also extend landing gears using main hydraulic system – they will unlock and go down by their own weight and air press. Remember, that gears and flaps increases drag for flight and slows it down. So better extend them just before landing.

Checklists

Before takeoff

Before engines start

Doors, hatches, ladder	Closed, check
Covers, caps	Off, on board
Transponder	ON, checked, ready
Controls (rudder, ailerons)	Fixator off, moves free
Trimmers	Neutral
Standing break	ON
Device 2077	ON, set

Before taxi

AI-9	Off, fire valve closed
Hydrosystem	Pressure normal
Electric system	Checked, works normal
ARK	On, frequencies ...
Fuel system	... kg of fuel on board, ON
Artificial horizons	On, checked
Radio-altimeter	On, altitude set to ...
Takeoff data	Weight ... kg, CG position .. %MAC
	V1 km/h
	Vrkm/h
	V2km/h
Stabilizer	Set to. ..°

While taxi

Brakes	Checked, works
Defrost system	On (OFF), Ice detector ON
DA-30	On, checked
CourseMP	ON
GMK	Synced, course ... ° , mode ...
Flaps	Extended 20°

Before lineup

Altimeters, RV	Altitude 0, pressure ... mm. Hg. On feet: pressure QNH set, altitude ... RV ON, DH set to 100m
Artificial horizons	Checked
Controls	Checked, free
“zero” CourseMP	Checked
Windows	Closed
Standing brakes	OFF

Before takeoff

Ready for takeoff	Red lamps are off, AOA heat ON, Nosewheel buster ON Takeoff course ..., GPK mode, Pitot heat ON, Ice detector heat ON Transponder AC mode.
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Before landing

Before descend

Charts	Read
Landing data	Fuel ... kg, last for alternative ... hours Weight ... kg, CG position ... %MAC Landing run .. m Approach speed ... km/h
Radioaltimeter, DH	ON, DH set to ... m
CourseMP	ON, frequencies ...
Hydro-system	Pressure ... kg/cm ² , brakes checked
Device 2077	Pressure set to destination AP
Pitot heat	ON

After transition level

Altimeters	Pressure set ... mmHg, altitude, indication same on feet altimeters: MSL pressure set ... hPa altitude ... feet, indication same frequencies set, call-signs listened
ARK	

On upwind leg or 14-16 kilometer from airfield

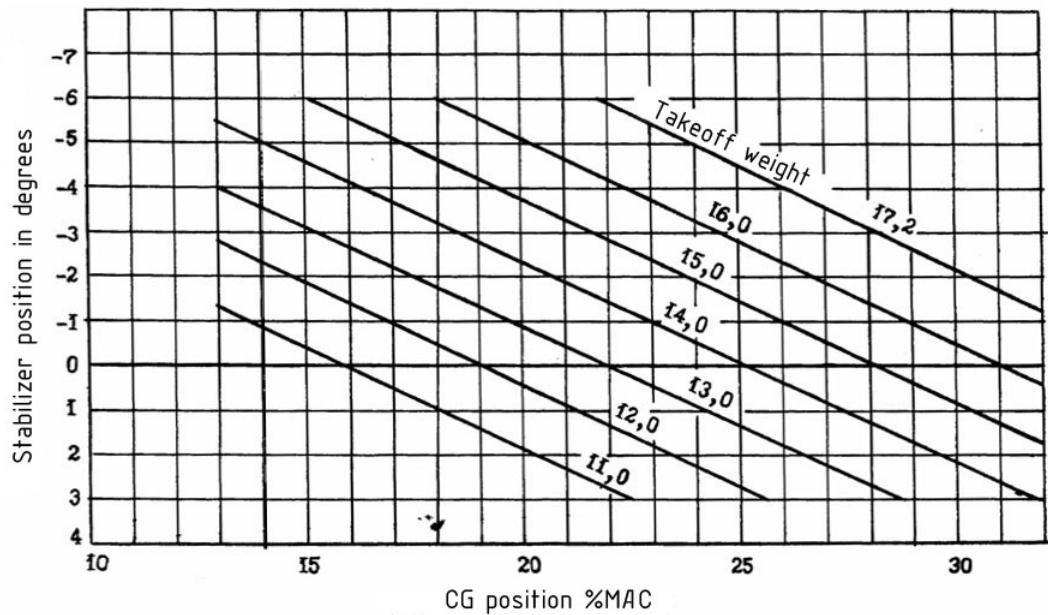
Nosewheel	Buster ON
“Zero” CourseMP	Checked
Radioaltimeter	DH set to ... meters

Before glideslope

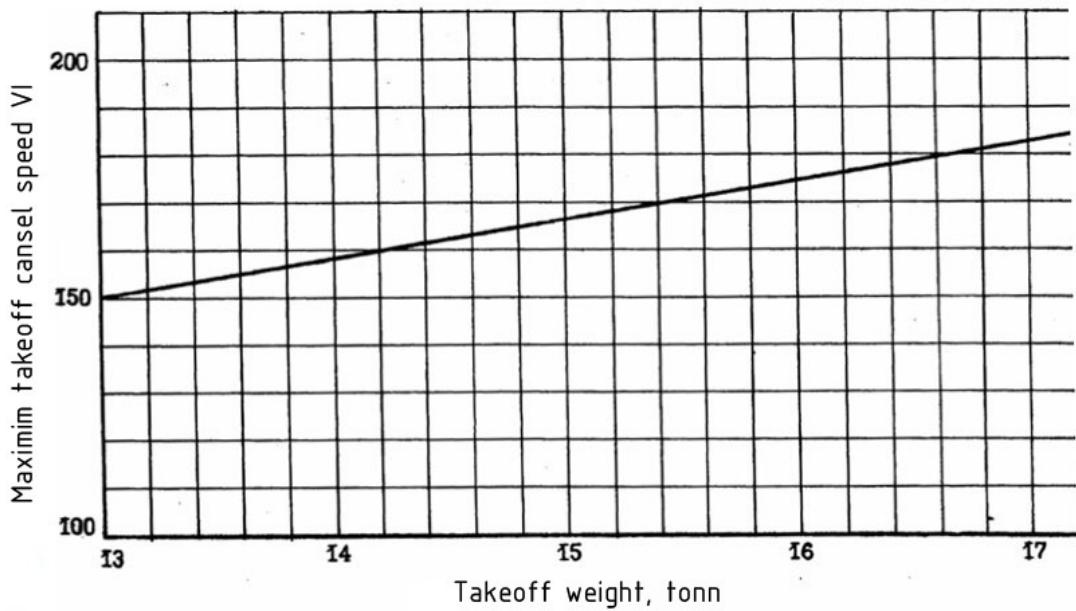
Landing gears	Down, green lights, pressure normal
Flaps	Extended to ...°
Cross valve	Open
Landing lights	Extended, ON
Ready for land	Ready

Extras

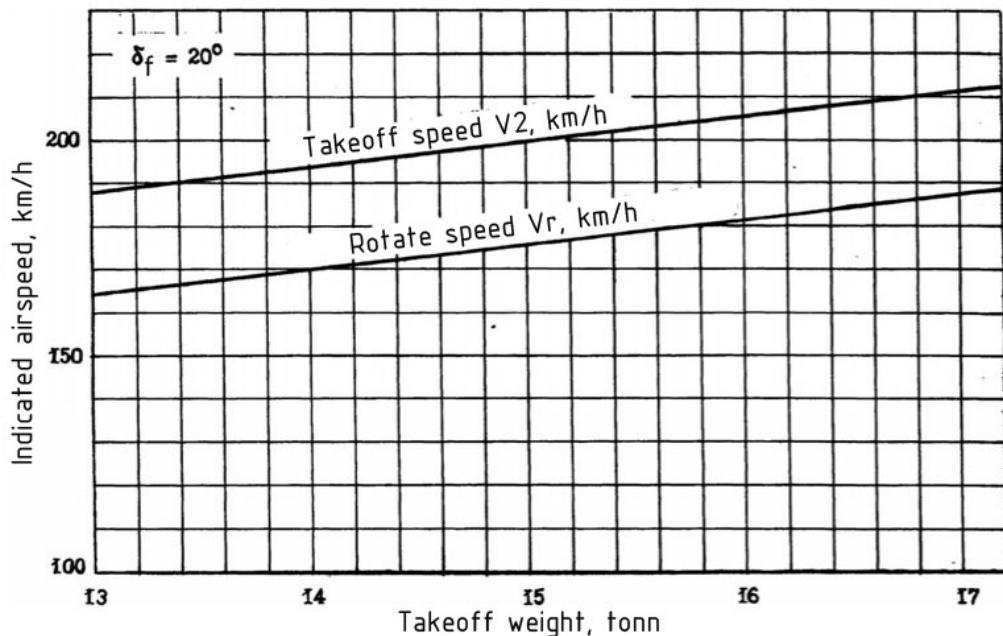
Takeoff stabilizer position calculator



V1 speed calculator



V rotate and V2 speeds calculator



Approach speed calculator

