State Civil Aviation Inspection of
Lithuanian Republic

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FLIGHT MANUAL

FOR THE SAILPLANE

LAK - 12 "LIETUVA"

Content

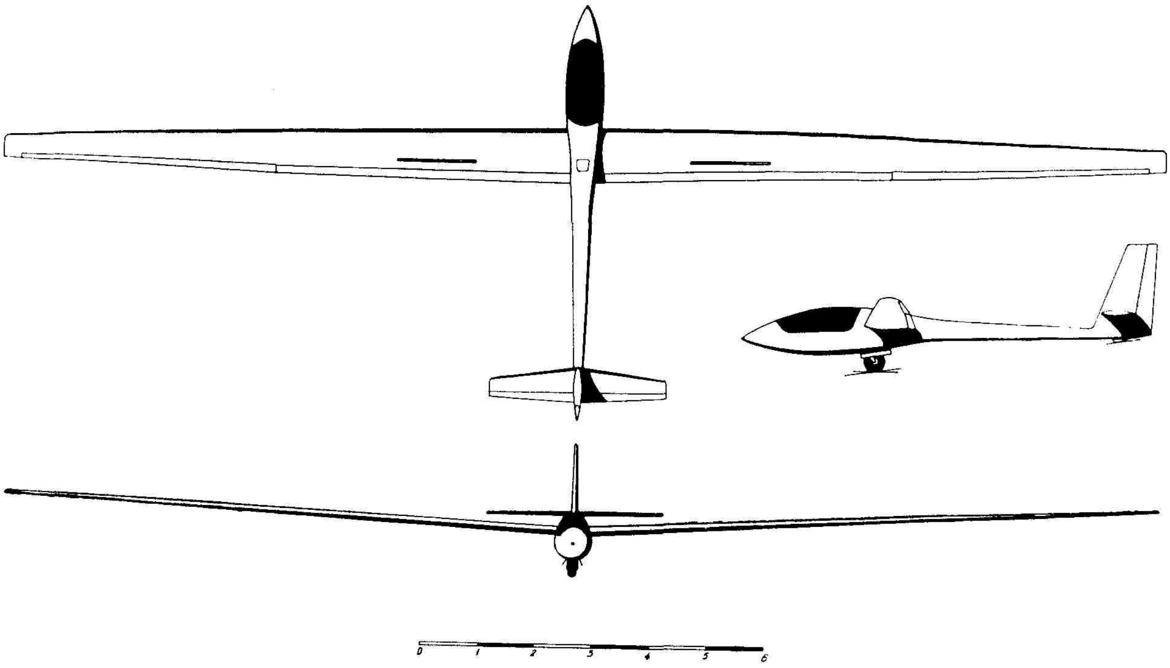

Fig. 1. Sailplane three point view

1. Basic data

1.1. Sailplane designation

Single seat open class sailplane "LIETUVA" is designated for training pilots-sportsmen with the first class also for participating in national and international soaring championships.

1.2. Technical data

WING	
Span	20.42 m
Area	14.63 m^2
Aspect ratio	28.5
Airfoil	FX67-K-170, FX67-K-150
Root chord	0.946 m
Tip chord	0.390 m
Mean aerodynamic chord	0.754 m
Dihedral angle	3°
Incidence angle	2°
Ailerons	non-slotted, drooping
Ailerons length	4.5 m
Ailerons deflection (flaps 0°)	
up	23°+-1°
down	12°+-1°
Flaps	non-slotted, deflected
Flap length	5.1 m
Flap deflection	
up (handle position "-2")	7°+-1°
down (handle position "T")	15°+-2°
Air brake type	extended
Area of air brakes	0.24 m^2
FUSELAGE	
Length	7.23 m
Height (cockpit)	0.81 m
Maximum height (fin)	1.92 m
Maximum width	0.64 m
VERTICAL TAIL	
Height	1.6 m
Area	1.24 m^2
Airfoil	FX71-L-150/30
Ruder deflection	
to the left	30°+-2°
to the right	30°+-2°

HORIZONTAL TAIL

Span	3.1 m
Area	1.395 m^2
Airfoil	FX71-L-150/25
Elevator deflection	
up	18° +-1°
down	18° +-1°

1.3. Weight data and c. g. position

Empty weight	360 kg +- 3.5%
Minimum flying weight	430 kg
Maximum flying weight (with water ballast)	650 kg
C. g. position of an empty sailplane	66 +- 3% m.a.c.

C. g. position in flight taking into account pilot's weight, water ballast capacity and position is presented in fig. 6.

1.4. Water ballast system

Water ballast tank capacity	190 l
Time for draining water off	5.5 min

1.5. Flying data

	without water ballast	with water ballast
Flying weight	430 kg	650 kg
Max. L/D	47	48
Best range cruise speed (flaps 0°)	95 km/h	115 km/h
Economy cruise speed (flaps 11°)	75 km/h	92 km/h
Minimum sink (flaps 11°)	0.48 m/s	0.58 m/s
Stalling speed (flaps 11°)	65 km/h	80 km/h
Distance to lift-off on grass cover		
towing plane " Wilga-35A"	80 m	100 m
towing plane " An -2"	40 m	65 m
Take-off speed	75 km/h	85 km/h
Take-off distance		
towing plane "Wilga-35A'	260 m	320 m
towing plane " An -2"	160 m	220 m
Touch-down speed	75 km/h	
Touch-down run on grass cover	95 m	
Landing distance on grass cover	255 m	

2. Operational limits

Maximum flight weight (with water ballast)		650 kg
Forward c.g. limit		21 % m.a.c.
Aft c.g. limit		38 % m.a.c.
Maximum load factor		
(without water ballast)	positive	negative
• at flap setting of 0, -4, -7	+6	-4
• at flap setting of 5, 11, 18	+4.6	-3.1
• with airbrakes extended and flaps at 5, 11, 18	+3.4	-2.3
• with airbrakes extended and flaps at 0 , -4 , -7	+4.4	-2.9
Maximum operational g-loading with water ballast		
• at flap setting of 0, -4, -7	+5	-3
• at flap setting of 5, 11, 18	+3.9	-2.3
• with air brakes extended and flaps at 0 , -4, -7	+3.7	-2.2
• with air brakes extended and flap setting of 5, 11, 18	+2.9	-1.7
Maximum indicated airspeed		
• at flap setting of 0, -4, -7		250 km/h
• at flap setting of 5, 11, 18		175 km/h
• with air brakes extended		250 km/h
• with air landing gear extended		250 km/h
• at the moment of extending and retraction of landing gear		140 km/h
• during flight in rough air and during manoeuvring		175 km/h
Maximum roll angle		60°

It is forbidden to:
-make flights into ice formatting zones;
-fly with water ballast when air temperature is lower than +5°
-perform complex aerobatics figures.

only simple aerobatics figures are allowed (spiral, side-slipping, steep climb and others).

3. Flight preparation

3.1. Pre - flight inspection

Pre-flight inspection is aimed at checking if sailplane is prepared for flight. Before inspection pilot must check recordings in flight log-book and make sure if all the insperfections revealed during previous flight were eliminated and must know what jobs were done in sailplane after the last flight day.

Pre-flight inspection should be performed clockwise beginning with the left side of cockpit.

During inspection should one must do the following:

- release tie-down, take-off protective covers, claps, protective covers from pilot-static tubes;
- check the landing gear shock-absorber (make sure that there is no leakage of working fluid and that there is no rod protective cover damage);
- check air pressure in landing gear wheel (2,6 kg/ cm^2);
- check the towing lock: connect the towing rope, pull it and check self-release. Self-release must occur at an angle of 135^0 and more (angle between rope and longitudinal axis of a sailplane);
- check the condition of fuselage nose shell;
- check the hinges of cockpit canopy;
- check the right wing shell and reliability of aileron, flap and air brakes mounting;
- check the reliability of aileron, flap and air brakes control rod connection (through a hatch on the upper surface of the fuselage);
- check the condition of fuselage shell, cleanness of orifices for static and total pressure;
- check the condition and reliability of tailplane rigging, make sure that the fixation pin is locked;
- check the condition and reliability of elevator mounting (backlash according to trailing edges must not exceed 2 mm)
- check the condition of fin shell and rudder shell and reliability of rudder mounting;
- check the condition of a tail bumper;
- check the condition of the left wing shell and reliability of aileron, flap and air braker mounting.

3.2. Preparation of cockpit and equipment

In cockpit do the following:

- take out the unnecessary thing;
- the canopy must not be damaged;
- the reliability of closing and opening of canopy;
- the position and operation of all controls;
- smoothness of moving controls; make sure that elevator, rudder and ailerons fully and easily deflect according to stick and pedal movements.

After cockpit inspection adjust seat and pedals according to pilot height, also adjust safety belts.

Check the instruments.

Set altimeter needle to zero and compare the pressure reading on altimeter with real pressure in airfield (the difference must not exceed 2mm Hg).

Set the needle of g-loading indicator to the reference position.

Check the correspondence of compass reading with sailplane's position on ground.

Check the turn indicator:

- turn on the switch on instrument panel and make sure that you hear noise of gyromotor rotation of the turn indicator;
- pressing on the left then on the right side of instrument panel make sure that the turn indicator needle deflects in the corresponding direction;
- turn off the switch.

Check the operation of radiostation:

- turn on the three position switch " O-ON-SOL/OF ", on radiostation panel to position " SOL/OFF " (noise suppresser is out) and you should hear some noise.

Check the operation of noise suppresser:

- when the switch is in the position " ON " (noise suppresser is on) noise must stop;
- set the two-way radio communication to the corresponding frequency.

NOTE: Existence of some crackling in radiostation means low capacity of battery.

Check the electronic variometer:

- press button " VAR ";
- press both buttons for introducing constant time "1+2 INERTIA".
- set the handle of input of expected climb to position "0";
- set the polar switch to position corresponding to water ballast presence or absence;
- set the knob of acoustic zero to position "0";
- switch on the vario. In 5-10 min. needles must return to zero position;
- press knob on indicator W20/OPT; indicator's reading must be " 2.5 ", not less; that means battery voltage is 24 V or more.

3.3. Water ballast filling

Keep sailplane in strictly horizontal position. Attach hose to pipe connection. Fill the tanks slowly up to 190 l.

3.4. Towing the sailplane to the start position

Before towing put the transporting wheel under tail unit, the control stick with harness connect towing rope (minimum length 10 meters), close the canopy.

Towing to the starting position performed is with all types of transport. Towing speed must correspond to the speed of a fast walking person.

4. Performing of flight

4.1. Preparations for take-off

Put the sailplane on the starting line strictly upwind.

Put on parachute, sit down into the cockpit, fasten harness.

Switch on radio station (if necessary switch on turn indicator and electric variometer).

Close the canopy. Check if air brakes are fixed in their retracted position and set the flap to position "-1".

Give command to connect the towing rope and check its degree of freedom.

4.2. Take - off

During take-off the seeing-off person must follow the sailplane as long as possible without re-tarding outer wing.

During take-off run keep the sailplane from banking with the help of ailerons and rudder keep wings from touching ground.

Tail bumper mustn't touch the ground during take-off, for this purpose at the beginning of run push the stick forward.

At speed of 75 km/h change flap setting to "+1" and get airborne. Eliminate waggling by energetic deflections of ailerons and rudder.

At towing speed of 100 km/h the airplane tends to climbing, which is easily compensated by pushing control stick forward. The sailplane must be maintained at such an altitude that the wing of the towing airplane projects on the horizon line.

Retrac landing gear at an altitude of 300 mm: pull the landing gear handle back and fix it at the position "RETRACTED".

CAUTION: If during the take-off run the sailplane wing touches the ground release immediately.

4.3. Towed flight

In towed flight it's recommended: to set flaps at "1" to climb at 120 km/h, to perform horizontal flight at 130-140 km/h.

In rough air climbing speed should be increased by 10 km/h but not exceed 130-140 km/h.

On reaching the prescribed altitude pull the release handle fully and make sure that the towing rope has released. Don't get into airplane wake.

4.4. Free flight

Free flight is performed with water ballast or without it depending upon the thermal nature and strength. Check sliding with the help of woollen attached on canopy in its plane-of-symmetry.

Deflected thread shows the presence of sliding.

Speed in banked spiral up to 30^0 is 80 km/h and up to 45^0 - 90 km/h, flap setting - "+1".

When performing banked spiralling with water ballast increase speed by 10 km/h.

4.5. Cross-country flight

Its recommended to fly with maximum water ballast. Having defined the thermal nature and strength drain off excessive water in order to achieve maximum wing loading. The amount of drained off water vs draining time is given in fig. 4.

Choose penetration speed and flap setting according to expected lift in the next thermal on the basis of data given in fig. 4. Enter thermal energetically, set flaps to soaring position while decreasing speed.

NOTE: Wing airfoil operates in laminar flow conditions. If these conditions are disturbed L/Dmax decreases. Due to presence of rain drops on wing surface L/dmax decreases almost two times.

4.6. Landing

Before landing approach drain off water ballast: open water ballast outlet cock and leave it open till landing. The approach is conducted at a speed of 120 km/h.

At an altitude of 300 m extend landing gear. Fix landing gear control handle in the position "LANDING GEAR EXTENDED".

After the fourth turn set flaps to "T" and descend at a speed of 90km/h.

CAUTION: at a wind velocity of 8 m/s increase approaching speed by BY 10 km/h, set flaps to position"2".

Correct approach by slipping and by changing flap setting from "T" or "+2" (at an altitude of 30 m) and by extending air brakes.

Start levelling at an altitude of 2-3 m by gently moving control stick back and complete levelling at an altitude of 0.3-0.5 m.

When sailplane touches the ground change flap setting from "T" or "+2" to "-2". Touch down speed is 75km/h and landing run without using wheel brake is 150 m.

Keep the direction during landing run with the help of rudder control.

To avoid touching ground with wing compensate rolling by energetic aileron and ruder deflections.

If necessary use wheel brake and keep in mind that in this case fuselage nose tends to lower down. Perform braking with by gently pressing the lever on control stick.

Perform landing in rain with flap setting " +2" and at speed of 100 km/h.

In extreme cases its permitted to land with water ballast. After such landing check all strong points of sailplane.

For out-of field landing chose a field of 100 m x 550 m that is oriented upwind and has open approaches.

To avoid impact or collision you may perform ground loop.

Landing on ploughed land is recommended parallel to furrows with retracted landing gear and at minimum speed.

4.7. Takeoff with the help of winch launching

Use the hook, nearest to the centre of gravity.

Prior to takeoff, it is necessary to set the trimmer handle in the forward position, if the pilot is light, or in the neutral position, if the pilot is heavy. The position of flaps should be "+1". At the min flying weight, best climb speed is 110-120 km/h, and at the max flying weight, best climb speed is 120-125 km/h.

Self-release may occur, when the control stick during a whole climb is held in the backward position or the pilot can perform the release by using the hook release cable (Prior to doing that you should push the control stick forwards).

When no wind, with the cable length of 1100 m, the power of winch launching of 220 HP and the flying weight of 460 kg, the altitude of 320-350 m can be obtained.

After release, pull the hook release handle several times, retract landing gear and proceed with flying.

If the towing cable has broken, push the control stick forward, release the cable hook and proceed with flying.

5. Emergencies

5.1. Radiocommunication failure

Indication:

- absence of two - way communication with ground radiostation;
- absence of self-hearing during radio operation;
- absence of noise in speaker while setting 3-position switch " O-ON-SOL/OFF to position "SOL/OFF ".

Pilot's action:

- make sure that the switch is set to position " SOL/OFF ";
- see if the frequency selection is correct;
- set the volume regulator to maximum volume.

In absence of two-way communication after the checking procedure pilot decides himself whether to land or to continue flight.

5.2. Altimeter failure

Indication:

- clear discrepancy between altimeter readings and real altitude;
- stable altimeter readings during changing altitudes.

Pilot's action:

- check the flight altitude visually and decide whether to land or to continue flight

5.3. Airspeed indicator failure

Indications:

- clear discrepancy between the flight speed and indicated airspeed; unstable speed readings.

Pilot's action:

- evaluate flight speed according to sailplane behaviour, to the sound of flow, to sailplane's position and landmarks;
- land in the airfield or in another suitable field.

5.4. Entering heavy rain

Heavy rain increases sailplane's sinking speed greatly (almost two times). Set the flying speed according optimise to 140-160 km/h and try to escape from heavy rain region.

The wing dries fully at a speed of 140-160 km/h in 4-6 minutes depending upon air temperature and humidity.

After evolution of sinking speed in heavy rain off excessive water ballast.

Approach landing in rain at a speed of 120 km/h. After the fourth turn maintain the speed of 100 km/h at flap setting "+2".

5.5. Landing gear extension failure

In case of landing gear extension failure land on fuselage with flap setting " T ". Land without water ballast and at minimum possible speed.

DO NOT EXTEND LANDING GEAR WITH THE HELP OF G-LOADING!

5.6. Stalling and Spinning

Stalling is possible due to excessive aft control stick position during manoeuvring and also due to speed loss aft c. g. position. When the stall, starts the sailplane stalls with the nose going down, speed increases, but the sailplane does not enter a spin.

With forward c. g. position it is impossible to recover from spin at a speed corresponding to that of the beginning of stalling because of insufficient elevator efficiency.

Minimum flight speeds corresponding to the onset of stalling with aft c. g. limit are presented in table 2. Load factors corresponding to flight speed are presented in figure 7-9.

Spin entry is possible due to excessive aft control stick in slipping at all c. g. positions. Having entered spin, apply opposite rudder, pause, ease the control stick forward until rotation ceases. Take the rudder into neutral position and recover from dive not exceeding speed and load factor limits.

5.7. Emergency Landing

Before such landing drain off water ballast, tighten safety belt. Landing on high grass or corn should be performed with extended landing, gear. The landing should be calculated on the top of the plants. While landing on forest keep the minimum speed and retract the landing gear.

When landing on water extend the landing gear, close the water ballast outlet cock and release parachute locks. Land parallel to shore as near as possible. After plunging into water the sailplane will soon emerge to the surface..

5.8. Emergency Exit

In case of emergency it necessary to do the following:

- lift the microphone attachment bracket,
- jettison the canopy,
- unlock safety belts,
- change your body sitting position,
- lift one leg over board, set the other leg against the board,
- lift yourself and exit,
- after leaving the sailplane open the parachute.

6. Short description of sailplane and its equipment

6.1. General data

The sailplane LAK-12 "Lietuva" is all-plastic cantilever monoplane with mid-wings of high aspect ratio, fully retractable one-wheel gear and single fin vertical tail made in one piece with fuselage.

Tailplane and elevator are mounted to fin.

The sailplane is equipped radio station LS-5, navigational instruments and water ballast system.

6.2. The fuselage

The fuselage is monocoque with oval, tapering upwards cross section. Behind the cockpit the fuselage tapers gradually and ends in fin.

The fuselage shell consist of three plies (glass cloth-foam fillerglass cloth). Carbon plastic strips are put in between glass cloth plies. The shell is glued from two halves and the gluing seam is located in vertical plane.

The fuselage-wing mounting location is reinforced with truss.

The vent orifice is located in fuselage nose, it is opened with help of a handle on the right side of instrument panel.

The towing lock is located at the bottom of fuselage nose, it consist of body, bracket and lever. The towing lock is controlled by handle situated on the left side of instrument panel. The towing lock is equipped with self release.

The cockpit is situated in the front part of the fuselage. The cockpit canopy is side ways hinged or opens forward.

The canopy fixation handle is either on the left or on the right hand sides of canopy frame.

The handle for canopy jettisoning is situated on the left side of instrument panel and canopy closing handle is on the right hand side of instrument panel.

Retractable one-wheel landing gear is situated in the middle of fuselage. Landing gear well is closed with slots during flight. Landing gear wheel is fitted with brakes, controlled with the help of the lever on control stick.

Extension and retraction of landing gear is controlled by the handle on the left side ofboard. The handle moves in longitudinal direction and has extreme fixation points. By forward handle motion the handle is extended, by backward motion it is retracted.

The tail bumper is mounted on the aft part of fuselage.

6.3. Wing

The wing is single spar monocoque and contains two airfoils: Wortmann FX67-K-170 at the root and FX67-K-150 at the tip.

The wing has flaps, drooping ailerons and air brakes (on the upper wing surface at 65% of chord). The wing shell construction is analogous to that of the fuselage.

The wing has I-section spar. Cantilever spar caps are made of carbon plastic on basis of epoxy resins of hot solidification.

The starboard and port wings spar cantilevers of 0.62 m for connecting both wings. The spar is fixed in the assembled position with the help of one pin.

The loading of wing torque moment is accepted by pins on the load carrying truss of the fuselage. The pins enter the seats (cut outs) in the root ribs of the wing.

During rigging the aileron and air brakes control rods are connected with bell cranks in the fuselage with the help of special end-piece locks and flap control rods connect automatically with the help of a special clutch.

6.4. Empennage

The empennage shell is analogous to that of the wing and fuselage.

Vertical plane consist of fin rudder. Fin is single spar, made in one piece with fuselage. At a height of 0.375 m from longitudinal datum line of the fuselage it has tailplane attachment point. Rudder is mounted to the fin spar on three hinges.

Horizontal tail consists of tailplane and elevator. Elevator is mounted to fin with the help of a tube entering the flanges fitted in fin. Loading of the torque moment of tailplane is carried by pins in the fin that enter into the tailplane seats (cut outs). The tailplane is fixed with help of a special spindle. The symmetrical elevator is attached to sailplane spar on tree hinges. The elevator connects with bell cranks in the fuselage automatically with the help of a special clutch.

6.5. Control system

Rudder control consists of pedals, cable run and bell cranks. Pedals are level type and can be adjusted according to pilots height. Adjustment is performed with a handle on the leftside of board. Pedals motion is limited by bell crank stop. Cable length is adjusted with the help of turn buckles placed in the cockpit or behind the truss.

Elevator and aileron control system consist of control stick and system of rods and bell cranks. Flap control handle is on the left side of board. There are six flap settings controlled by the position of flap control handle (table 1).

Air brakes are controlled with the help of a handle on he left side of board through the system of rods and bell cranks.

Table 1

Position of flap control handle	Flap deflection ^{0}	Application
-2	-7+-1	in transitional regimes
-1	-4+-1	
0	0	
1	5+-1	during take-off
2	11+-2	and in soaring
T	15+-2	during loading

6.6. Water ballast system

The water ballast system consists of tanks, hoses and outlet cock.

The sealed volume of wing root trapezium limited by spar and the front part of wing torsion box serves as water ballast tanks.

Water is drained off with the help of a handle on the right hand side of board.

6.7. Flight control and navigational equipment

The flight control and navigational equipment consist of:

- barometric altimeter ВД–10 (0-10000);
- airspeed indicator LUN-1106 (50-400 km/h);
- mechanical variometer ВР-10 (-5 - +5 m/s);
- electric variometer LAK-RE-303 (-5 m/s and -1 - +1 m/s);
- turn indicator LUN-1211;
- magnetic compass КИ-13;
- accelerometer AM-10 (vertical load from -5 to +10.

Electronic variometer operates in two regimes: regime VAR (variometer) and regime OPT (flight speed optimise).

Regime VAR measures the vertical speed of a sailplane with compensation of flight speed and altitude changes (indicator VAR/NETTO) and mean vertical speed during the last 20 sec (indicator W20/OPT).

Regime OPT indicates the deviation of actual flight speed (when flying from one thermal to another) from the best speed for expected lift in the next thermal (indicator W20/OPT) and measures vertical air speed (indicator VAR/NETTO).

Electric variometer produces acoustic signal when the vertical speed of a sailplane deviates from the selected speed (in the regime VAR) and when the actual flight speed deviates from the best-to-fly speed (in the regime OPT).

The electric variometer panel has the following controls:

- polar switch for absence or presence of water ballast;
- switch "5-1" for measuring vertical speed;
- button "1÷2 INERTIA" for input of the constant time for averaging the VAR/NETTO indications.
  The time constant is:
  1.0 sec for unpresseds buttons;
  1.5 sec for pressed button "1";
  3.0 sec for pressed button "2";
  5.0 sec for both pressed buttons.
- VAR and ORT for the selection of operation mode.
- handle "OTKL" for swiching vario feeding and adjusting the volume of acoustic signal;
- handle "+-0-1-2-3" for adjusting the threshold response of acoustic signal;
- handle "m/s" for the input of the expected thermal lift;
- spline "COMP" for variometer adjustment for individual characteristics of a sailplane;
- spline for setting the reference point of the optimizer.

Regime VAR is used during'the thermal climb. In this regime it is necessary to:

- set the volume just above the level of cocpit noise;
- select the constant time position according to contions so, that the VARIO/NET indicators were smooth and not too fast;
- for centering in a thermal use the readings of VARIO/NETTO indicator or the acoustic signal. For thermal strenght evalution use the readings of W20/OPT indxicator;
- when climbing in a weak thermal switch the instrument to measuring limit of 1 m/s;
- for vertical speed control according to acoustic signal set the thrashold of rasponce with the help of acoustic zero regulator. If the vertical speed is greater than the prescribed, the signal will be uninterrupted.

Regime OPT is used when flying from one thermal to another.
When the variometer operates in the regime OPT it is necessary:

- to set the polar switch to presence or absence of water ballast;
- to set the handle of input of expected lift to a position corresponding to the supposed vertical speed in the next thermal;
- press the button OPT.

CAUTION: **Before changing to the regime OPT, the measuring range switch must be at "5".**

In flight it is necessary to speed at which the needle of W20/OPT indicator is at the "zero" position

Now the acoustic signal will not be heard. Deflection of the indicator needle from the zero position or the response of the acoustic signal shows the deviation from the best-to-fly speed:

- inecessary correct the handle of input of the expected lift;
- control the needle position of VARIO/NETTO: deflection of needle upwards from its zero position means that sailplane has entered a thermal.

6.8. Radio equipment

The sailplane is equipped with radio station LS5. Its basic data is the following:

- the range of operating frequencies 118.0 - 136.0 MHz;
- frequency net-every 25 KHZ;
- operation at ten fixed frequencies is envisaged. At this moment operation at two fixed frequencies is possible: 125.0 MHz and 126.0 MHz;
- transmitter power is not less than 1 W;
- transmitter sensibility is not less than 5 mkV.

Transceiver unit is placed behind the instrument panel. On the front panel of the unit the following radio station controls and regulators are placed:

- a three position switch "O-ON-SOL/OFF" with:
  "O"-off;
  "ON"-on;
  "SOL/OFF"-noise suppresser is off;
- VOL-volume control handle;
- handle for setting the fixed operational frequency of radio station;
- button and indicator of technical condition of radio station.

The cockpit speaker has a low frequency amplifier. The distance of guaranteed two-way radio communication of LS-5 is 90-100 km at an altitude of 1000m.

6.9. Electric equipment

The energy source in a sailplane is Nickel-Cadmium 2 battery FG20651 with voltage of 12 V and capacitance of 6.5 Ah and electrical battery KBSL-0.5 with voltage of 4.5 V and capacitance of 0.5 Ah.

Batteries serve as power source for radio station and electrical variometer. Electrical battery serves as a source for turn indicator. Uninterrupted operation time is:

- 7.5 h for radio station and electric variometer;
- 4.4 h for electrical turn indicator.

7. Aerodynamic Features of the Sailplane, Stability and Controls

7.1. Aerodynamic Features

The sailplane flight data are characterised by sinking rate polar, the sinking rate polar (vertical sinking speed VS indicating airspeed) for different configurations and flying weights of the sailplane are shown in the fig. 2,3.

Characteristic flight modes can be defined i.e. optimum and economic.

Optimum flight mode (longest distance) corresponds to L/Dmax and is defined on the polar at the point of touching with the straight line, drawn from the origin of co-ordinates.

Economic flight mode (longest flight endurance) corresponds to the minimum sinking value and is defined on the polar at the point of touching with the straight line, parallel to the axis of indicated flight speeds.

It is clear from figures 2 and 3 that the optimum flight speed with water ballast is 115 km/h, without water ballast - 95 km/h. Economic flight speed with water ballast is 92 km/h, without water ballast - 75 km/h.

From fig. 4 it is clear that a definite flight speed range corresponds to each flap setting, at which L/D has its maximum value. That is why when flying at designated flight speed you must choose optimum flap setting. The optimum flap setting VS flight speed is given in fig. 4.

When flying from one thermal to another choose the flight speed with the help of electronic variometer.

The sailplane take-off characteristics depend on the type of towing plane. When towing with plane "Wilga" the starting run and take off distance up to an altitude of 10 m is 80 m and 260 m for a sailplane weighting 430 kg, and 100 m and 320 m for a sailplane weighting 650 kg.

With the towing plane "An-2" these values for a 430 kg sailplane are 40 m and 160 m, for a 650 kg sailplane - 65 and 220 m correspondingly.

Changing the length of towing rope does not significantly affect take-off characteristics.

Landing characteristics depend upon usage of air brakes and landing wheel brake, also upon the type of land surface.

When landing on dry grass with extended air brakes and full landing wheel brakes the touch-down distance and landing distance is correspondingly 95 m and 225 m for a 430 kg sailplane.

Without using spoilers when braking on the runway, the length of the runway and landing distance increases 1.5 - 2.0 times.

When landing on wet ground the corresponding values a 1.3 - 1.5 time greater.

7.2. Stability an Handling Features

The sailplane is stable for overloads and speed. When accelerating and braking, there are neither self rolling nor creeping tendencies.

Extension and retraction of. landing gear, air brakes, deflection of flaps does not significantly affect centre-of-gravity position of the sailplane.

The sailplane stability and control characteristics with water ballast an without it are practically the same.

Draining water ballast in flight does not cause overbalance.

The sailplane stability and control on towed flight are good. The longitudinal control system is effective.

Stick force for a G-loading unit is 1-2 kg in the operational range of centre-of-gravity position.

Elevator margin during landing with forward c.g. limit is not less than 30% at touch down.

The lateral-directional stability is good.

The lateral and directional control is also good.

The peculiarity of lateral control due to high aspect ratio is yawing during making turns with the help of ailerons, but is easily compensated by rudder deflection.

The efficiency of lateral an directional control makes it easy to land when wind side component is up to 5 m/s.

7.3. The Performance of the Sailplane at High Angles of Attack

Highs angles of attack are such angles at which wing stalls and then spontaneous motion in banking, pitching and direction may occur.

Lift is greater at higher angles of attack. Maximum angle of attack corresponds to CL max. Further increasing angle of attack leads to decrease in lift because of stalling flow from wing and the sailplane stalling.

Pilot must know the performance of the sailplane at high angles of attack.

The performance of the sailplane at high angles of attack is determined by the c.g. position and practically it does not depend on the sailplane configuration and weight.

When slowing down with forward and central c. g. position the sailplane does not reach the angles of attack, corresponding to pounding to full elevator deflection the sailplane start egging from wing to wing, then it passes on to the pancaking regime, lowers its nose and increases speed 7-10 km/h; by pulling the control stick back the sailplane slows down again, passes on to the pancaking regime, etc..

At aft c.g. position (21 : 38 m.a.c.) when control stick is pulled back speed decreases and the sailplane enters the stalling regime. Stalling mainly starts on wing with nose lowering down. If slipping is not present the sailplane does not enter a spin.

Spinning is possible at high angles of attack and when shipping takes place. When the sailplane enters a spin deflect pedals fully against spin direction, then push control stick forward. When rotation stops, set the rudder into neutral position and recover sailplane from a dive not exceeding speed and G-loading limit.

Minimum flight speed corresponding to full elevator deflection at forward c.g. limit and onset on stalling at aft c.g. limit are presented in Table 2.

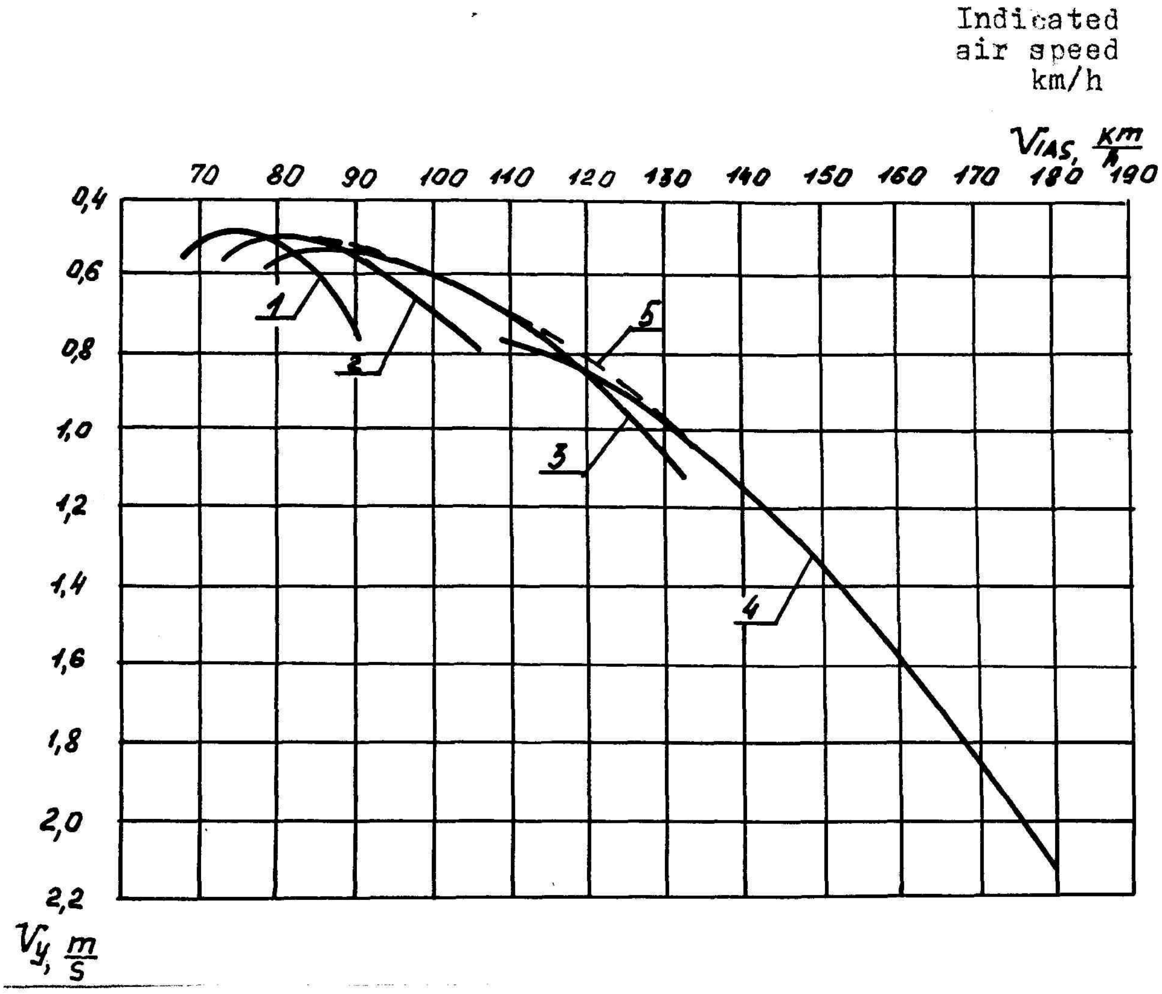

Fig. 2. Drag polar of the sailplane descent rate at the different flap positions (m = 430 kg)

1 - $\sigma_{fl} = 11^0$
2 - $\sigma_{fl} = 4^0$
3 - $\sigma_{fl} = 0^0$
4 - $\sigma_{fl} = -7^0$
5 - envelope drag polar

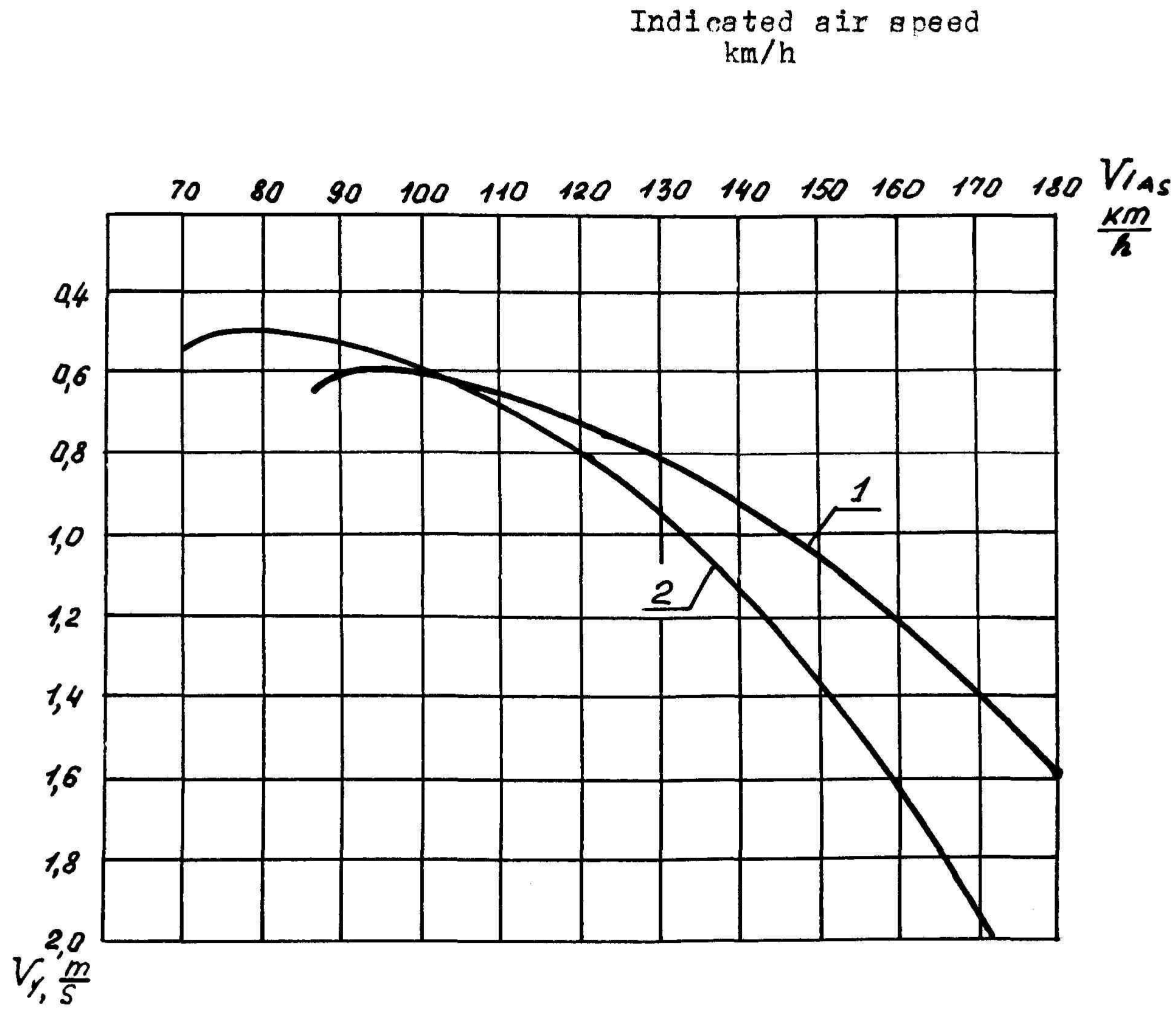

Fig. 3. Envelopes of the sailplane drag polars.
Landing gear and air brakes are retracted.

1 - with water ballast (m = 650 kg)
2 - without water ballast (m =430 kg 0

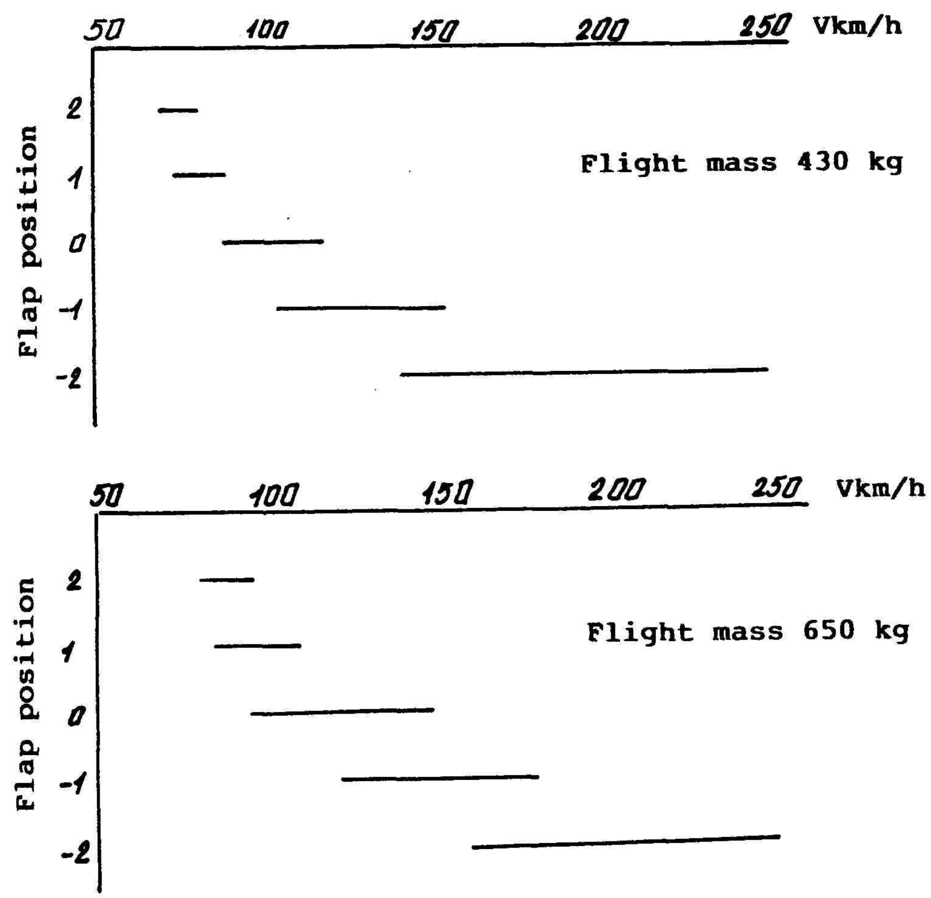

Fig. 4. Dependence of the optimum flap position on the flight speed.

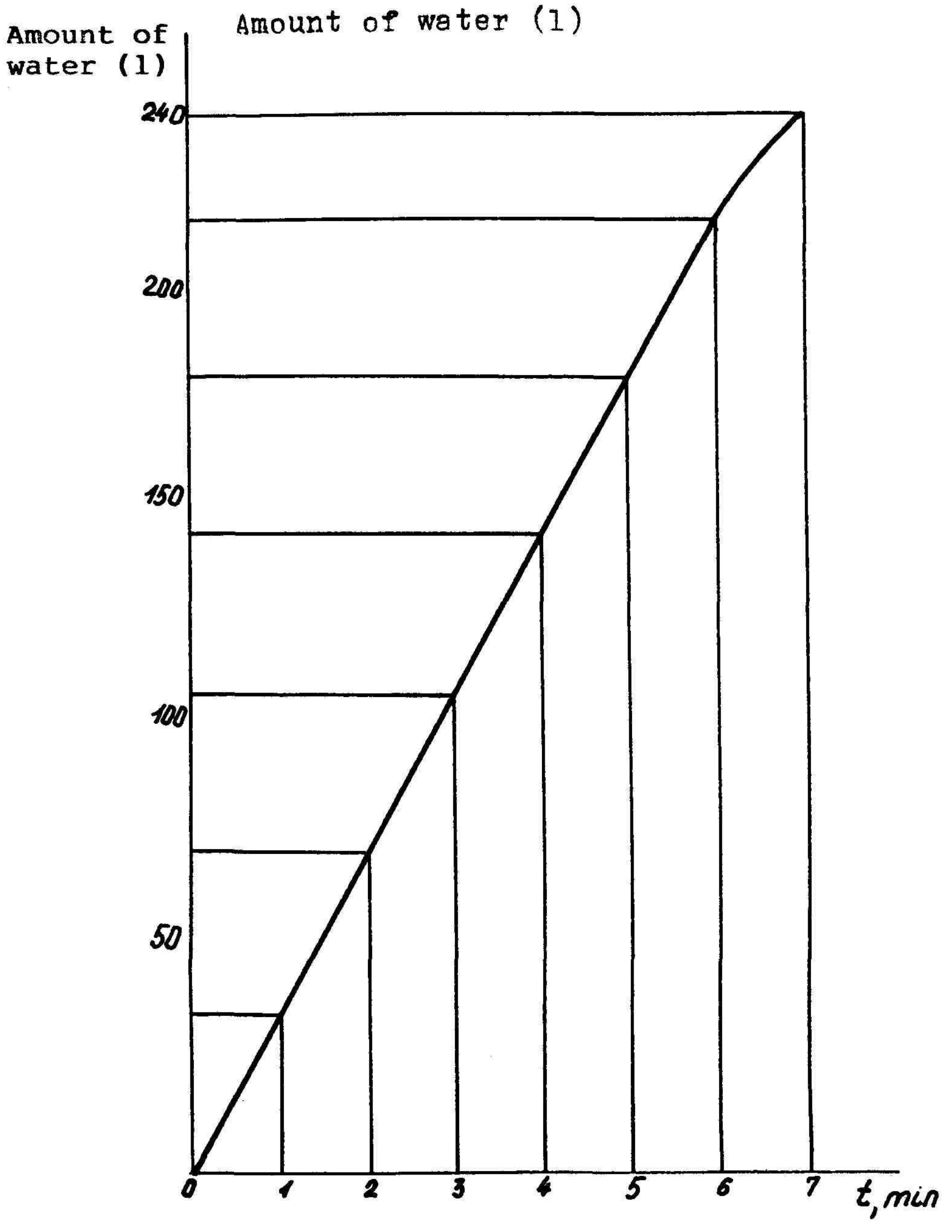

Fig. 5. Dependence of the drained water ballast amount on the drain time.

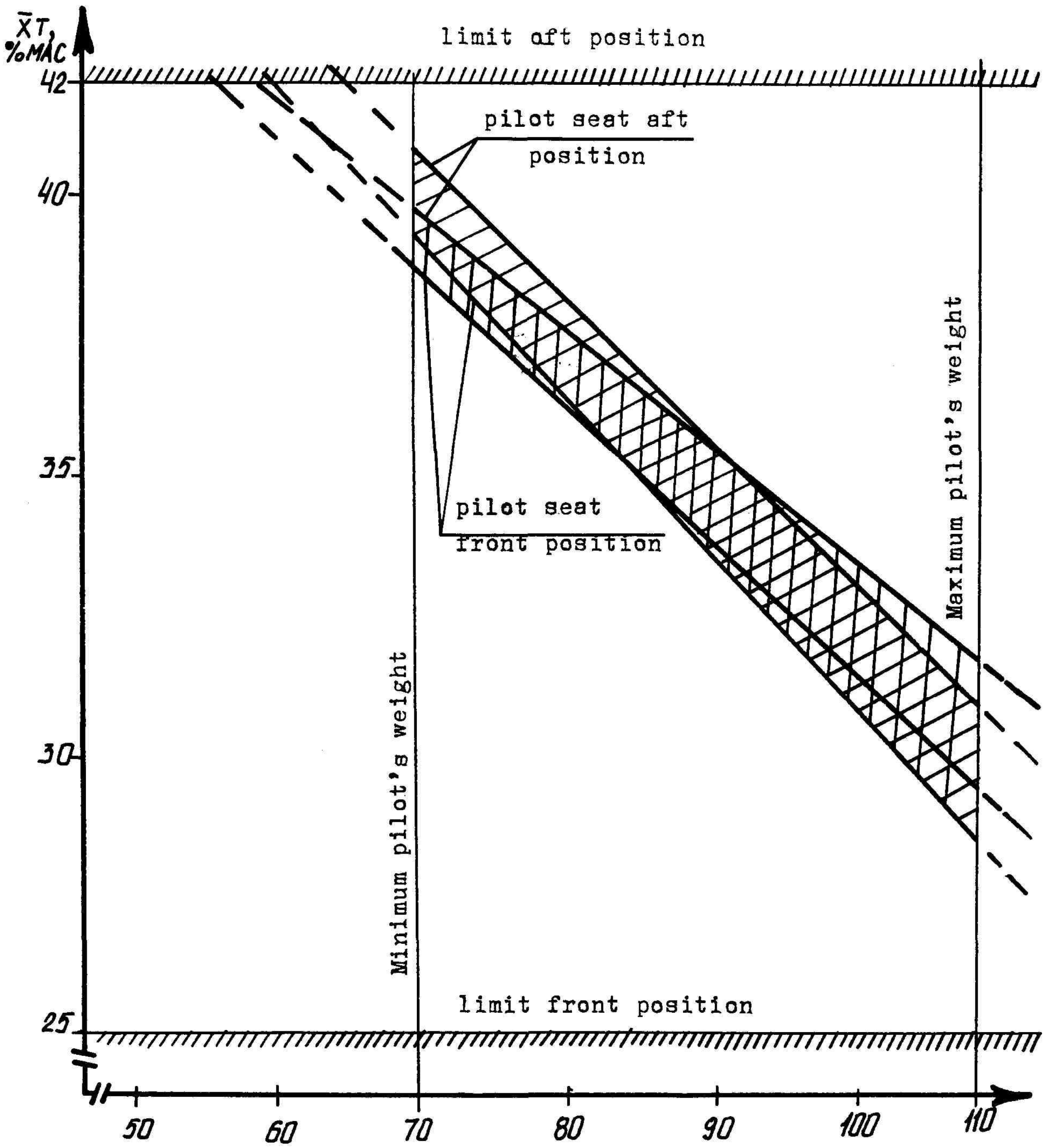

Fig. 6. Pilot with parachute weight, KG

- without water-ballast

- with water ballast

List of equipment, which is included
when calculating the empty weight

No.	Equipment name	Note	Amount	Weight	Distance from wing leading edge
1.	Electric variometer	LAK-RE-303	2	1,95	1,33
2.	Mechanical variometer	ВР-10	1	0,55	1,33
3.	Airspeed indicator	LUN-1106	1	0,4	1,33
4.	Altimeter	ВД-10	1	0,8	1,33
5.	Turn indicator	LUN-1211	1	0,365	1,33
6.	Accelerometer	АМ-10	1	0,270	1,33
7.	Magnetic compass	КИ-13	1	0,09	1,33
8.	Broadcasting station	LS 5	1	3,25	1,27
9.	Microphone	ДЭМШ-1А	1	0,105	0,3
10.	Forward accumulator	FG 20651	1	3,42	1,95
11.	AFT accumulator	FG 20651	1	3,42	0,04

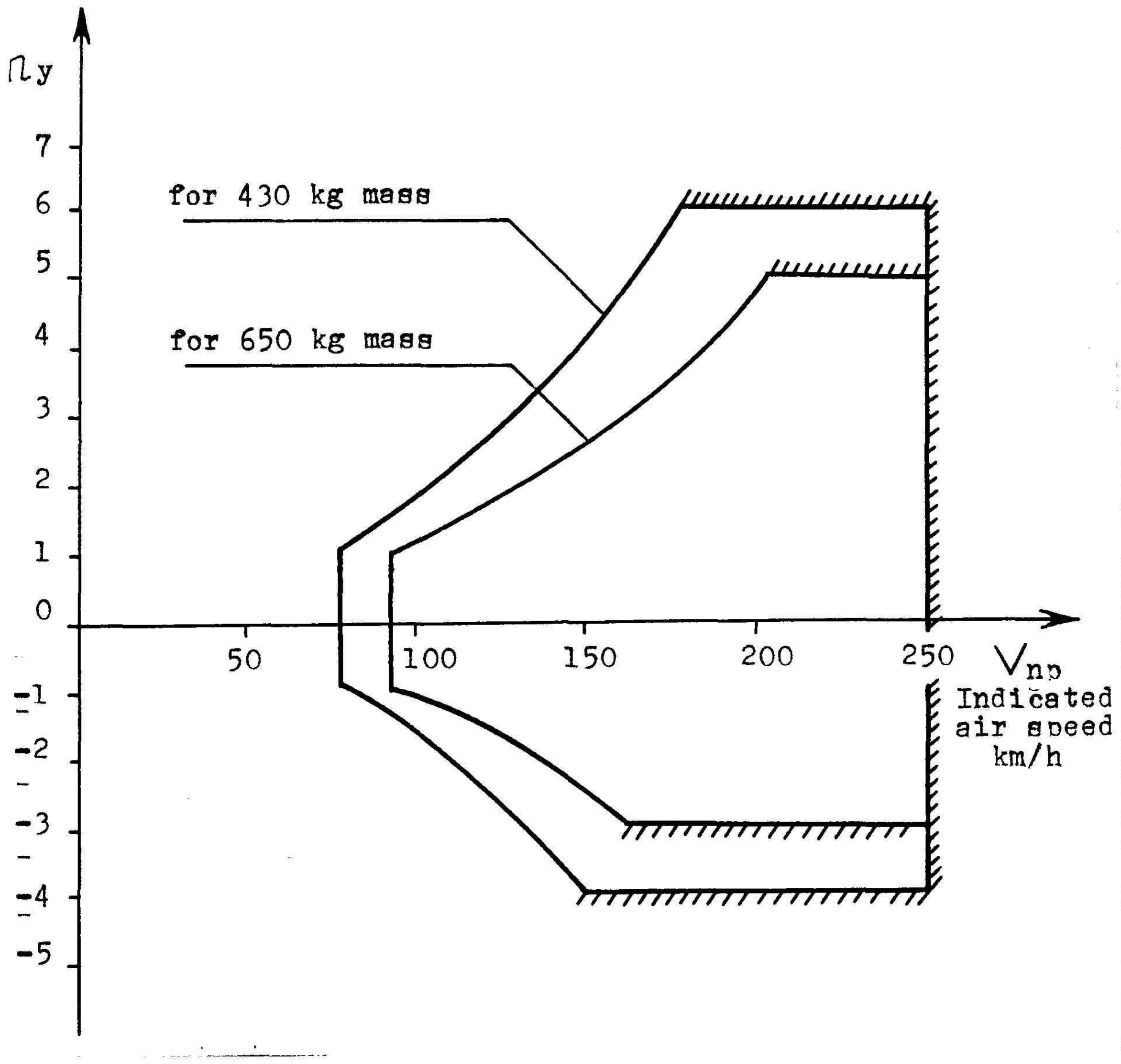

Fig. 7. Dependence of available load factor on the flight speed.
Flaps up ($\sigma_{fl} = 0^0$), landing gear and air brakes retracted.

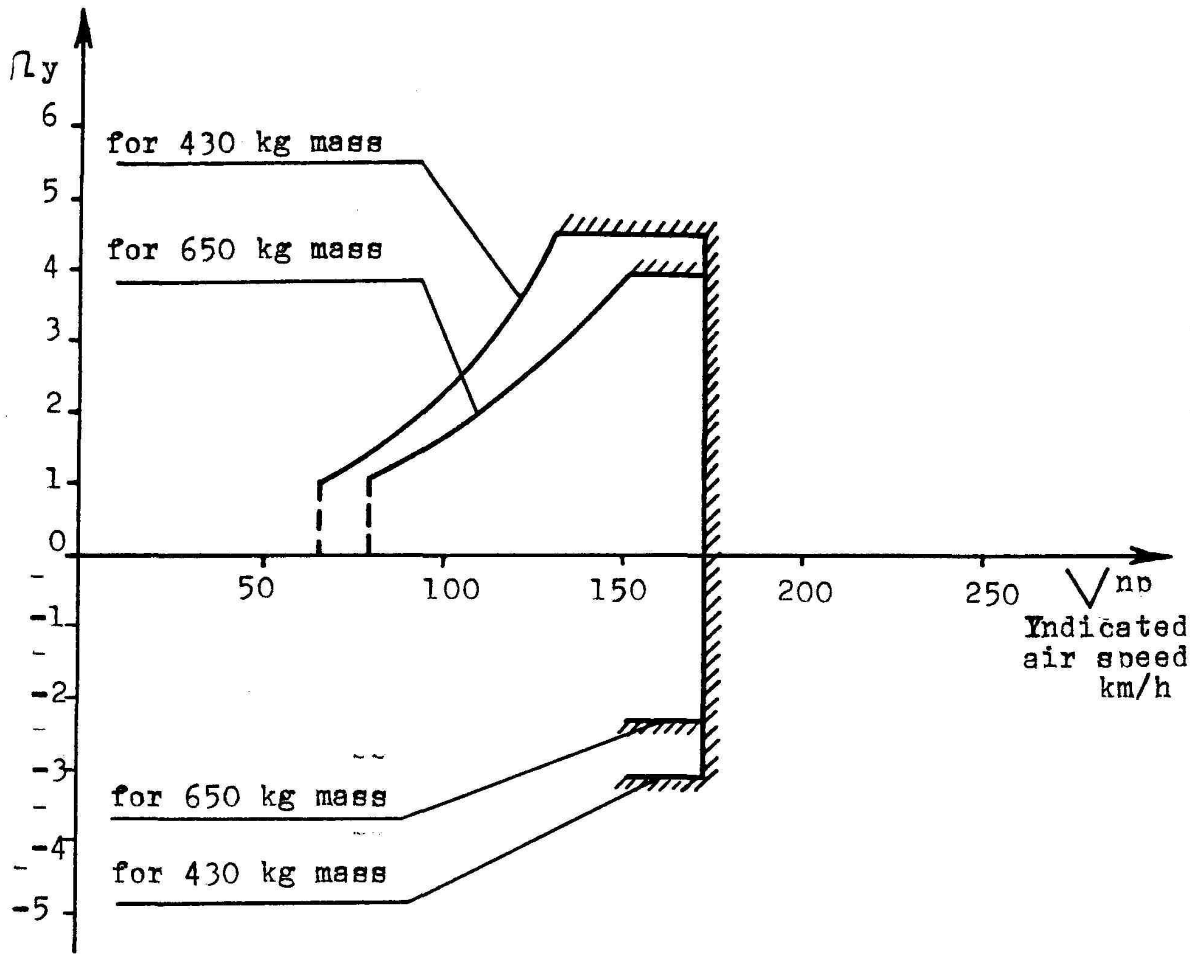

Fig. 8. Dependence of available load factor on the flight speed.
Flaps down ($\sigma_{fl}=18^0$), air brakes and landing gear retracted.

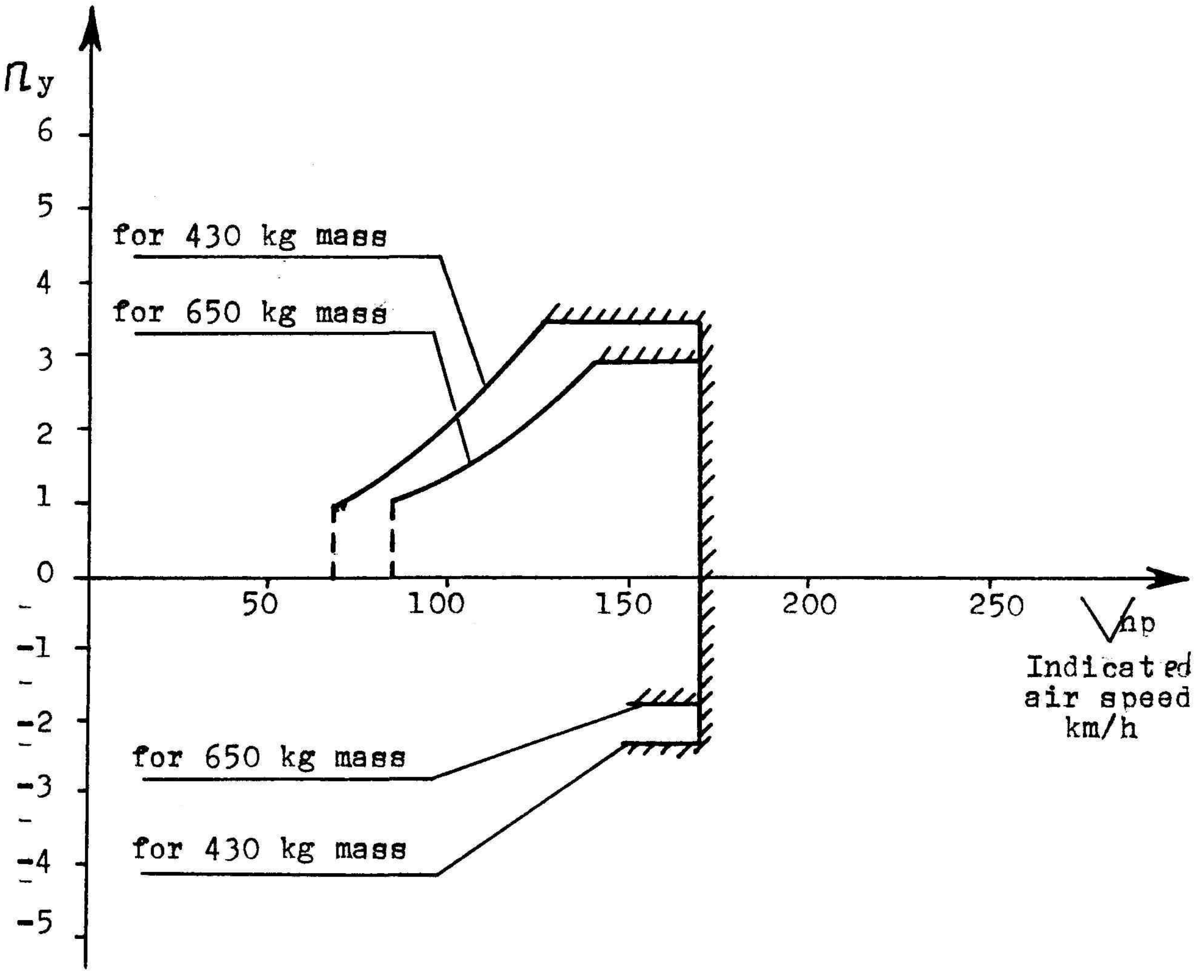

Fig. 9. Dependence of available load factor on the flight speed.
Flaps down ($\sigma_{fl} = 18^0$), air brakes and landing gear extended