

FLIGHT MANUAL
for
SELF-LAUNCHING SAILPLANE
PIK-20 E II

ILMAILUHALLITUS

Lentoturvallisuusosasto

N:o 02738

PIK-20 E Flight manual

3.3 Symbols of the Controls
4.3 Flight Instrument Markings

FLIGHT MANUAL
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FLIGHT MANUAL

for

SELF-LAUNCHING SAILPLANE

PIK-20 E II

Model 20E II S/N:s 20266, 20294 and up

SERIAL NO:

REGISTRATION:

This sailplane must be operated in compliance with this Manual.

THIS MANUAL MUST BE KEPT IN THE SAILPLANE AT ALL TIMES.

Approved by National Board of Aviation, Finland



EIRI KY

Kisällinkatu 8
SF-15170 Lahti 17

page i

AUGUST 80
ENGLISH

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LOG OF REVISION

Any revision of the present Manual must be recorded in the following table. The new amended text in the revised page will be indicated by a black vertical line in the left hand margin and the Revision No. and date will be shown on the bottom of the page.

Rev. No.	Revised Pages	Description of Revision	Date	Signed
1	1	Wing area 10.0 m ² (107.6 sq ft)		
2	1	Aspect ratio 22.6		
3	1	Dihedral angle 3°		
4	1	Sweep-back angle 13.2°		
5	1	Quarter-chord line 1.39°		
6	1	Angle of incidence 1°		
7	1	Root chord 0.90 m (2.95 ft)		
8	1	Mean chord 0.65 m (2.13 ft)		
9	1	Tip chord 0.36 m (1.18 ft)		
10	1	Mean aerodynamic chord (MAC) 0.70 m (2.30 ft)		
11	1	Root profile FX 57-K-150		
12	1	Tip profile FX 57-K-150		
13	1	Flap area 2 x 0.80 m ²		
14	1	Flap movements		
15	1	+13° ± 1° down		
16	1	0° ± 1°		
17	1	-2° ± 1° up		
18	1	Flap root 40 ± 2.5 mm		
19	1	Flap on root 30 ± 1.8 mm		
20	1	Flap root 0 ± 2.5 mm		
21	1	Flap on root 0 ± 1.8 mm		
22	1	Flap root 35 ± 2.5 mm		
23	1	Flap on root 22.5 ± 1.8 mm		
24	1	Flap root 38.0 ± 0.8 mm		
25	1	Flap on root 24.5 ± 0.8 mm		
26	1	Flap root 36.0 ± 0.8 mm		
27	1	Flap on root 23.5 ± 0.8 mm		

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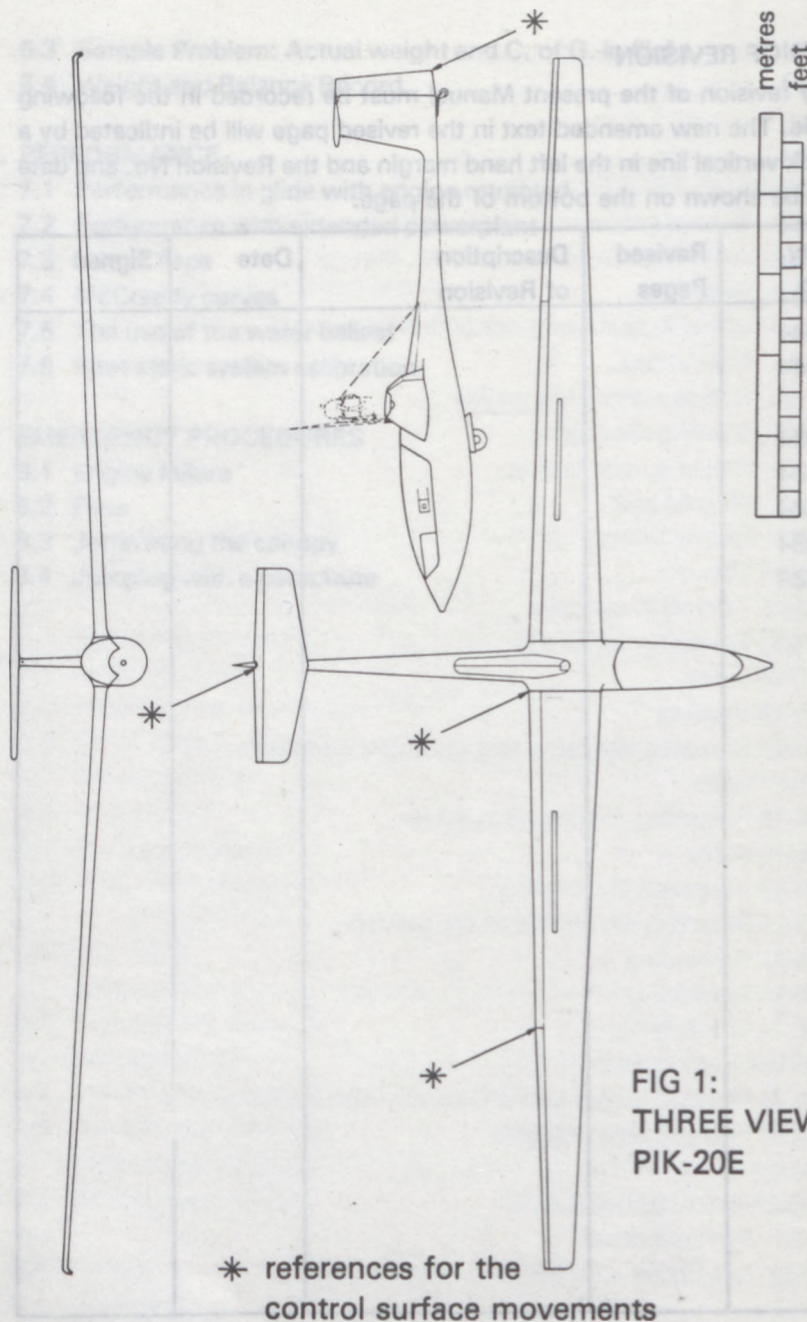


FIG 1:
THREE VIEW
PIK-20E

* references for the
control surface movements

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1. TECHNICAL DATA

1.1 Main technical data

— Span	15 m (49.2 ft)
— Length	6.53 m (21.4 ft)
— Height	1.47 m (4.8 ft)

1.2 Wing

— Wing area	10.0 m ² (107.6 sqft)
— Aspect ratio	22.5
— Dihedral angle	3°
— Sweep-back angle (quarterchord line)	1.36°
— Angle of incidence	1°
— Root chord	0.90 m (2.95 ft)
— Mean chord	0.65 m (2.13 ft)
— Tip chord	0.36 m (1.18 ft)
— Mean aerodynamic chord (MAC)	0.70 m (2.30 ft)
— Root profile	FX 67-K-170
— Tip profile	FX 67-K-150
— Flap area	2 × 0.80 m ²

— Flap movements

+ 16° ± 1° down	flap root	46 ± 2.5 mm
	aileron root	30 ± 1.8 mm
0° ± 1°	flap root	0 ± 2.5 mm
	aileron root	0 ± 1.8 mm
-12° ± 1° up	flap root	35 ± 2.5 mm
	aileron root	22.5 ± 1.8 mm

— Aileron movements

+ 16° flap	(13° ^{+2°} _{-1°}) up	flap root	38,0 ^{+5.0} _{-2.5} mm
		aileron root	24,5 ^{+3.6} _{-1.8} mm
(12.5° ^{+2°} _{-1°}) down		flap root	36,0 ^{+5.0} _{-2.5} mm
		aileron root	23,5 ^{+3.6} _{-1.8} mm

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0° flap	(12° ^{+2°} _{-1°}) up	flap root	35,0 ^{+5.0} _{-2.5} mm
		aileron root	22,5 ^{+3.6} _{-1.8} mm
	(11° ^{+2°} _{-1°}) down	flap root	31,0 ^{+5.0} _{-2.5} mm
		aileron root	21,0 ^{+3.6} _{-1.8} mm
— 12° flap	(11° ^{+2°} _{-1°}) up	flap root	32,0 ^{+5.0} _{-2.5} mm
		aileron root	21,0 ^{+3.6} _{-1.8} mm
	(9,5° ^{+2°} _{-1°}) down	flap root	27,0 ^{+5.0} _{-2.5} mm
		aileron root	18,0 ^{+3.6} _{-1.8} mm

1.3 Horizontal stabilizer and elevator

— Area	1.25 m ² (13.45 sqft)
— Span	2.4 m (7.87 ft)
— Aspect ratio	4.6
— Angle of incidence	-2°
— Profile	FX 71-L-150/20
— Elevator movements	Up and down 20° ± 1° (47 ± 2.5 mm)

1.4 Vertical stabilizer and rudder

— Area	1.02 m ² (10.98 sqft)
— Height	1.2 m (3.94 ft)
— Profile	FX 71-L-150/30
— Rudder movements	Right and left 33° ± 2° (179 ± 11 mm)

(Control surface movement references, see three view on page vi.)

1.5 Fuselage

— Height at the cockpit	0.86 m (2.62 ft)
— Width	0.60 m (1.97 ft)
— Main wheel	5.00 - 5
— Tail wheel	100 × 36 mm (4.0 × 1.5 in)

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1.6 Engine

- Engine Manufacturer: Rotax GmbH, Gunskirchen, Austria
- Engine Model: Rotax 505
- Engine Type: Retractable aircooled 2-stroke 500 ccm
2-cylinder engine with 1:2 toothed belt
transmission to the propeller
- Power Rating: 31.7 kW (43 hp) at 6200 rpm

1.7 Propeller

- Propeller Manufacturer: 1. Propellerwerk Hoffman GmbH,
Rosenheim, Federal Republik of
Germany
2. Lentokonekorjaamo E Pankkonen,
Järvenpää, Finland
- Propeller Model: 1. Ho 11* 127B 87
2. EP P127/87
- Propeller Diameter: 1270 mm (50 in)
- Propeller Type: 2 blade, wooden, fixed pitch

1.8 Weights and loads

- Empty weight approx. 320 kg (705 lbs)
- Gross weight 470 kg (1036 lbs)
- Maximum water ballast 80 kg (176 lbs)
- Wing loading 36. . . 47 kg/m²
(7.37. . . 9.63 lbs/sqft)

2. SAILPLANE DESCRIPTION

2.1 General description

The PIK-20 E is a single seat unlimited 15 m class Utility Category sailplane with self launching capability. It is designed in accordance with OSTIV- Airworthiness Requirements For Sailplanes 1976 and German LFSM issue 1975.

The whole sailplane is made of epoxy resin laminates. The shoulder configuration wing and the control surfaces are of rigid sandwich struc-

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ture, PVC-foam between epoxy laminates. The wing spar caps are made of carbon fibre.

The fuselage is made of epoxy laminates stiffened with seven ribs in the fuselage and two in the fin.

The cockpit area is reinforced with a double bottom and two carbon fibre beams.

The engine opening is stiffened with two large diameter beams. The retractable engine is situated behind the wing in the fuselage. The retractable main landing wheel is equipped with a drum brake. The steerable tail wheel is located under the vertical stabilizer. The whole trailing-edge flap (flaperon) is utilized as aileron and flap control. Aileron neutral position travels with flap setting up 12° to down 16° . Flaps may be used to improve performance while thermalling and gliding and during landing as landing flaps. The "T"-configuration tail unit has conventional elevator and rudder surfaces.

2.2 Flight control and flap system

The primary flight control surfaces (ailerons, elevator and rudder) are connected to a conventional control stick and rudder pedal arrangement.

The elevator trim is controlled by a green knob located on the left side console. It is connected to the elevator control system by a spring.

The trim is also connected to the flap deflection so that you have to trim the sailplane only once at your weight to fly with 0° flaps at 100 km/h. After that you trim the sailplane by moving the flap control arm, and you will then automatically have the optimum flap deflection for any speed (see 7.3.1). The positive range is optimized for circling and the negative range for cruising. For landing, the sailplane has to be trimmed once again.

The black trailing edge flaps control arm is located to the left of pilot's seat. The markings for flap deflection are on the side panel. Full negative position is forward.

2.3 Dive brake control

The blue dive brake control is situated together with the flap control on

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the left side panel of the pilot's seat. The overcenter locking system is in both wings.

The dive brakes are closed in the forward position.

2.4 Engine controls

Choke, decompression and throttle are situated on the left of the instrument panel. Below them are the fuses for alternator, fuel pump, radio and other instruments. Next to the throttle are switches for main power, ignition, starter and fuel pump.

2.5 Engine retracting system

The powerplant is retractable into the fuselage through a 1.4 m (4.6 ft) long opening which is closed with two doors. The engine retracting system is operated with a crank on the right cockpit wall. Retracting needs 15 turns and is balanced with a gas spring. Engine doors, propeller brake and engine locking are operated with the same lever behind retracting crank on the right wall.

The doors are closed and the locking is on in the forward position. The propeller brake is on, the locking off and the doors open in the rear position.

2.6 Landing gear control

The retractable main landing gear is operated by means of lever located on the right side of the cockpit. It is lightened by a spring. In the forward position the main wheel is down — in the rear position up.

The wheel brake handle is attached to the control stick.

2.7 Other controls

The yellow tow coupling release knob is located uppermost on the left side auxiliary panel. The tow coupling hook is located on the underside of the fuselage below the instrument panel or below the fuel tank. Winch tow can be made only with the rear tow hook. The water ballast draining knob is located just under the release knob. The forward position is closed — the rear position open. The ventilation knob is located under the water ballast knob. The forward position is closed — the rear position open.

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The canopy is hinged to the fuselage nose cone and can be opened by pushing the both white levers forward at both sides of the frame. Jettisoning occurs by pushing the canopy levers forward and by pulling the red knob right in the instrument panel and lifting the canopy.

The grey coloured pedal adjustment knob is located in front of the control stick on the right, below the instrument panel. The seat back adjustment knob is on the left side of the cockpit.

2.8 Fuel system

The 29 litres (7.7 gal U.S.) capacity fuel tank is situated behind the backrest. 1 litre (0,25 gal U.S.) of unusable fuel is included. Filling opening is on the left side of the fuselage between the rear canopy frame and wing. The fuel tank vent is in the cap on the left side of the fuselage. Accumulated water and sediment can be drained and checked by using the sampler cup when draining the fuel tank daily prior to first flight. The drain valve is situated on the left side of the fuselage. The in-line fuel filter is situated after the fuel cock in the baggage compartment. The electrical auxiliary pump is situated down in the engine compartment. The engine has an impulse driven primary fuel pump.

2.9 Electrical system

PIK-20E is equipped with 12V electrical system consisting of a battery and alternator. The battery is located in the middle fuselage on the right side. The engine has an electrical starter. The electrical power is controlled by a three position main switch. In the middle position (marked SOAR) only radio and flight instruments are operating. In the ON-position (up) the main relay is closed and the engine instruments are activated. Engine operations are allowed only with main-switch in ON-position.

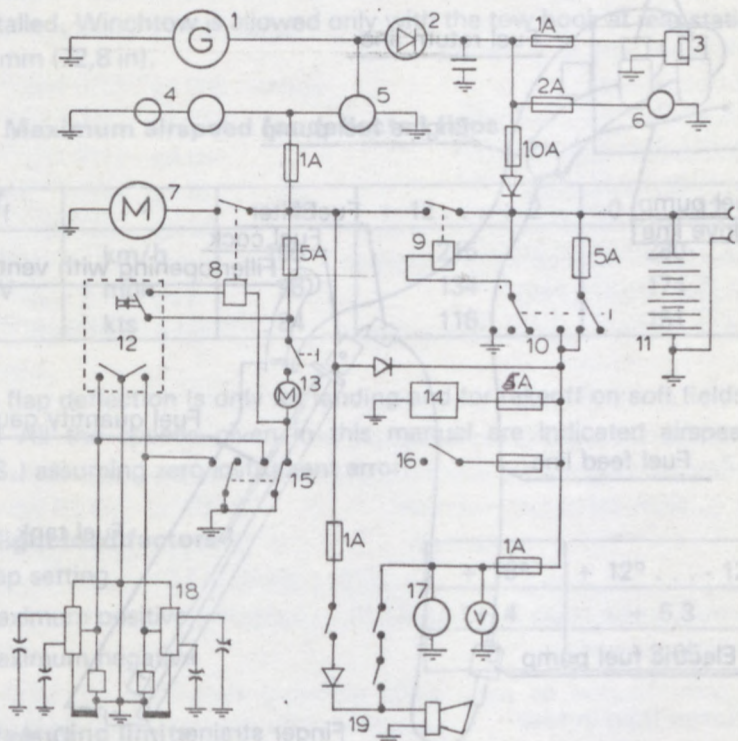
2.10 Water ballast system

The 40 litre nylon reinforced plastic bags are filled through the draining hole on the underside of the fuselage behind the geardoor.

Note 1: 1 m is the maximum filling height (distance from the funnel to the wing). Higher pressure than this, 0.1 Bar (kp/cm²), can cause serious damages to the wing.

No pressurized filling system is allowed.

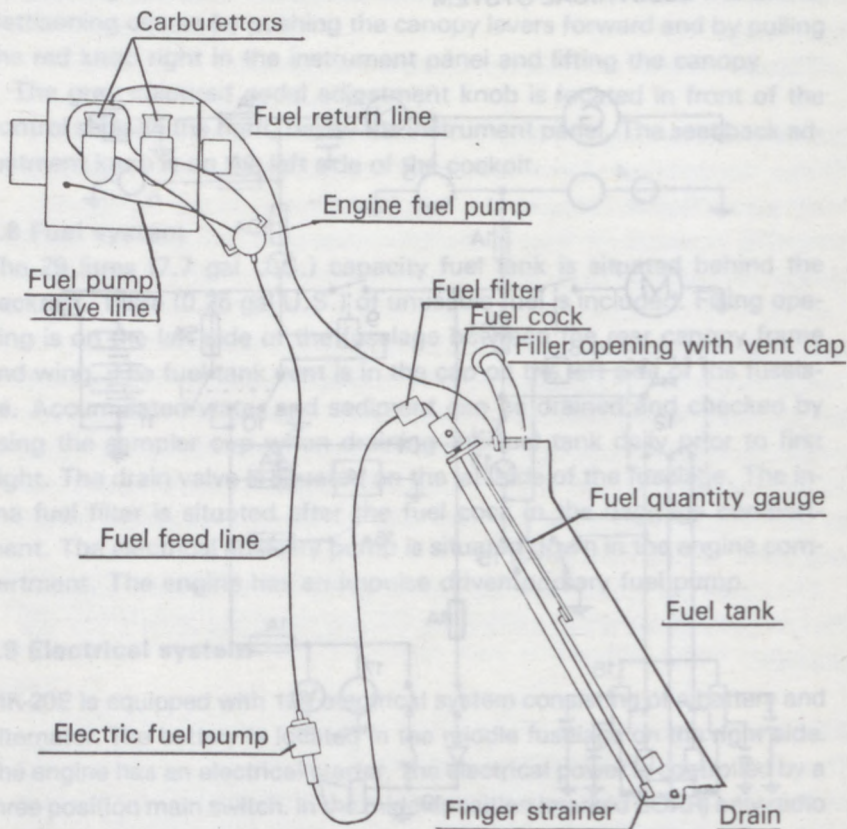
FIG 2.1: ELECTRICAL SYSTEM



- | | |
|-------------------------|---|
| 1. Alternator | 11. Battery |
| 2. Rectifier | 12. Ignition switch |
| 3. Barograph (optional) | 13. Fuel pump |
| 4. Fuel quantity gauge | 14. Radio |
| 5. Tachometer | 15. Safety switch |
| 6. Engine hourmeter | 16. Spare switch |
| 7. Starter | 17. Flight instruments |
| 8. Starter contactor | 18. Ignition system |
| 9. Main contactor | 19. Engine doors and landing gear warning |
| 10. Main switch | |

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FIG 2.2: FUEL SYSTEM



3. LIMITATIONS

3.1 Airspeed limits (I.A.S.)

Never exceed (V_{NE})	280 km/h (174 mph, 151 kts)
In rough air (V_B)x)	215 km/h (134 mph, 116 kts)
Maneuvering (V_A)	190 km/h (118 mph, 103 kts)
In aerotow (V_T) xx)	190 km/h (118 mph, 103 kts)
In winch tow (V_W) xx)	125 km/h (78 mph, 67 kts)
With engine extended	195 km/h (121 mph, 105 kts)
Extending and retracting the engine	135 km/h (84 mph, 73 kts)

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- x) Rough air means such movements of air as in eg. leewave rotors, thunder clouds, visible whirlwinds or when overflying mountain crests.
- xx) Aerotow and winchtow are allowed only if the original tow hook kit is installed. Winchtow is allowed only with the tow hook at rear station 1850 mm (72,8 in).

3.1.1 Maximum airspeed for deflected flaps

α_f	°	+ 16	+ 12 ... + 2	0 ... - 12
V	km/h	155	215	280
	mph	96	134	174
	kts	84	116	151

+ 16 flap deflection is only for landing and for takeoff on soft fields.

Note! All the speeds given in this manual are indicated airspeeds (I.A.S.) assuming zero instrument error.

3.2 Flight load factors

- Flap setting
- Maximum positive
- Maximum negative

+ 16°	+ 12° ... - 12°
+ 4	+ 5,3
0	- 2,65

3.3 Operating limits

- Minimum equipment list: airspeed indicator, altimeter, magnetic compass, ball type slip indicator, tachometer, fuel quantity indicator, cylinder head temperature indicator, safety belts, seat cushion, hour meter and mirror for checking the propeller position.
- Cloud flying, provided that the following instruments installed: minimum equipment and turn and slip indicator, variometer.
- Approved aerobatics:
 - Looping, stall turn, steep turn, lazy eight, chandelle and spin. Flap deflections from neutral to 12° up allowed.
- Flight into known or forecast icing conditions is prohibited.
- During aerobatics the engine must be retracted.

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- Takeoff in rain is prohibited.
- No snapped figures approved.
- Aerobatic manoeuvres with water ballast are prohibited.

3.4 Weight and C.G. limits

- | | | |
|--|----------------|--------------------|
| — Empty weight | approx. 300 kg | (660 lbs) |
| — Maximum gross weight | 470 kg | (1036 lbs) |
| — Maximum water ballast | 80 kg | (176 lbs) |
| — Pilot and parachute | 55 ... 110 kg | (120. ... 240 lbs) |
| — Maximum balance weight in nose | 10 kg | (22 lbs) |
| — Maximum balance weight fitted to the tail wheel spring | 3 kg | (6.6 lbs) |
| — Max. load in luggage compartment | 15 kg | (33 lbs) |
-
- | | | |
|--|---------|------------|
| — Maximum weight of nonlifting parts (take-off weight without wings) | 328 kg | (723 lbs) |
| — C.G. limits aft datum minimum | 2.267 m | (89.25 in) |
| maximum | 2.443 m | (96.18 in) |
- (19. ... 44 % MAC)

Datum: Vertical plane 2.113 m (83.19 in) forward of the first wing fitting tube forward surface.

3.5 Rated load in tow

6000 N (1320 lbs)

3.6 Powerplant limitations

3.6.1 Rotational speed

- max rpm 6800
- max continuous rpm 6000

3.6.2 Cylinder head temperatures

- max temperature 250°C (480°F)

3.7 Maximum crosswind is 10 kts.

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4. MARKINGS

4.1 Placards

4.1.1 In full view of the pilot

Maximum airspeed

In calm weather (V_{NE})

280 km/h 174 mph 151 kts

In rough air (V_B)

215 km/h 134 mph 116 kts

Maneuvering (V_A)

190 km/h 118 mph 103 kts

In aero tow (V_T)

190 km/h 118 mph 103 kts

In winch tow (V_W)

125 km/h 78 mph 67 kts

With engine extended

195 km/h 121 mph 105 kts

Extending/retracting the engine

135 km/h 84 mph 73 kts

Weights

Gross weight 470 kg (1036 lbs) including water ballast. If the pilot's weight with the parachute is below 70 kg (154 lbs) ballast weight must be installed in the nose (see Flight Manual and Weight and Balance Data Sheet).

Operational limitations

This sailplane must be operated in compliance with the operating limits as stated in the form of markings, placards and in the PIK-20E II Flight Manual.

All aerobatic maneuvers including spins must be accomplished in accordance with the PIK-20E II Flight Manual.

NO SMOKING.

4.1.2 In full view of the pilot

Maximum airspeed with deflected flaps				
δ_f	+ 16	+ 12 ... + 2	0 ... - 12	
V	km/h	155	215	280
	mph	96	134	174
	kts	84	116	151

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4.1.3 In full view of the pilot

Pre-flight check

Loading and ballast checked
Barograph (if installed) on
Parachute secured
Seat and rudder pedals adjusted
Safety harness fastened
Canopy locked
Main switch on
Engine and engine gauges tested and checked
Flight instruments checked
Flaps set
Trim set
Airbrakes closed and locked
Controls free
Choke off
Fuel cock (in tow: off) on
Electrical fuel pump (in tow: off) on
Tow rope (in tow) coupled

Before landing

Engine retracted
Water ballast drained
Landing gear down
Flaps 12°...16° down
Trim set for landing

4.1.4 Other placards

Adjacent to tow coupling **RATED LOAD 6000 N (1320 lbs)**
Above the main wheel **2.5 bar (35 psi)**
Adjacent to static pressure entry
on fuselage skin **STATIC PRESSURE KEEP CLEAR**
Adjacent to oxygen control valve
(if installed) **DURATION TABLE**
On fuselage nose (inside) **BALLAST**

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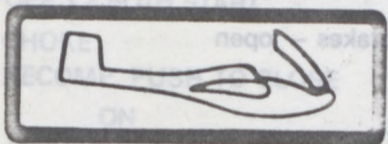
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Near the luggage compartment MAX RATED LOAD 15 kg (33 lbs)
Near the fuel filler opening 2-STROKE FUEL. OIL MIXTURE
RATIO 1:40 MIN. 96 OCT. (RON)
SUPER GASOLINE OR AVGAS
100 LL USABLE CAPACITY 28 L
Near the fuel valve ON . . . OFF
Near the fuel tank ventilation VENT, KEEP CLEAN

4.2 Symbols of the Controls



Tow release



Canopy Lock



Canopy jettisoning



Landing Gear up



Landing Gear down



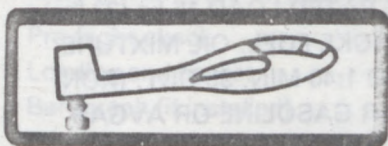
Trim control — Nose down

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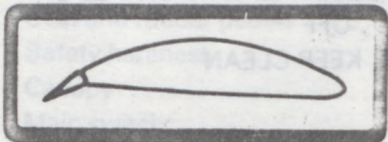
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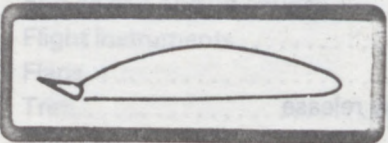
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Trim control Nose up



Flaps — down



Flaps — up



Airbrakes — open



Pedal adjustment



Cabin ventilation



Water ballast



Engine doors closed

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Engine doors open



Engine extending/retracting

OFF 1 2 BOTH START

CHOKE

DECOMP, PUSH TO CLOSE

ON

MAIN SOAR

OFF

PUMP ON

OFF

Ignition switch

Choke

Decompression

Main switch

Fuel pump switch

4.3.1 Air Speed Indicator

- Maximum;
Red radial 280 km/h (174 mph, 151 kts)
- Caution range;
Yellow arc 215...280 km/h (134...174 mph, 116...151 kts)
- Normal range;
Green arc 100...215 km/h (62...134 mph, 54...116 kts)
(100 km/h is the speed for the best climb)
- Operating range for landing flaps
White arc 84 . . 155 km/h (52 . . 96 mph, 45 . . 84 kts)
- Yellow triangle 100 km/h (62 mph, 54 kts)
Recommended landing speed without water ballast

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4.3.2 Accelerometer

- Maximum positiv; Red radial + 5.3
- Maximum negative; Red radial - 2.65

4.3.3 Engine instrument markings

- Tachometer; Red line at 6800 rpm
Yellow arc 6000—6800 rpm
Green arc 5000—6000 rpm
- Cylinder head temperature indicator;
Red line 250°C (480°F)
Yellow arc 230°C — 250°C (445—480°F)
Green arc 160°C — 230°C (320—445°F)

5. NORMAL PROCEDURES

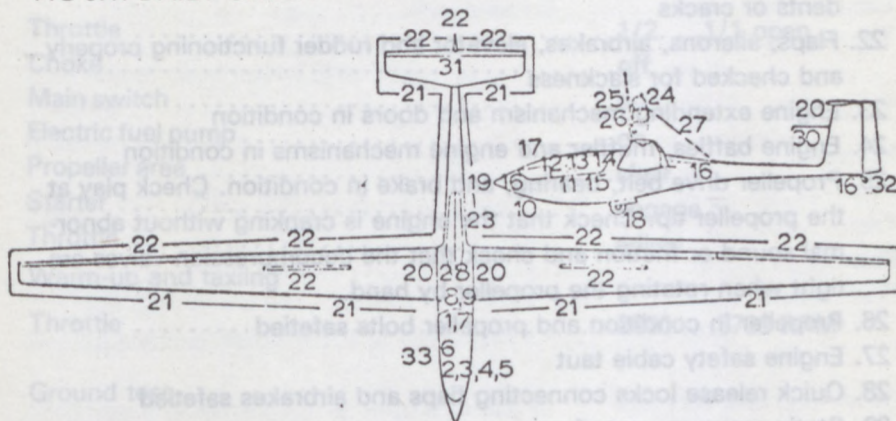
Normal procedure check lists are mainly to ease the operation with the engine.

5.1 Normal procedures check lists

Daily check

To be made after the sailplane has been rigged and before the first flight of the day.

FIG 5.1: DAILY CHECK



1. Fuel quantity
2. Fuel quantity gauge
3. Other instruments
4. Main switch off
5. Ignition off
6. Extend engine
7. Fuel-tank vent clean, drain and examine fuel
8. Main wing pin secured
9. Water ballast system in condition and functioning properly, hoses connected
10. Tow coupling clean and functioning properly or covered with tape if not needed

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11. Control stick, pedals, flaps, trim and airbrakes operating properly
12. Decompression, throttle and choke functioning properly
13. Wheel brake functioning properly
14. Safety belts in condition
15. No foreign or loose objects in the cockpit
16. Ballast properly fastened
17. Canopy clean and locking mechanism in condition
18. Tyre in condition and right pressure
19. Pitot tube free
20. Tapes at wing roots and horizontal stabilizer adherent (if fixed)
21. Wings, fuselage and empennage clean and checked for damages, dents or cracks
22. Flaps, ailerons, airbrakes, elevator and rudder functioning properly and checked for slackness
23. Engine extending mechanism and doors in condition
24. Engine baffles, muffler and engine mechanisms in condition
25. Propeller drive belt, bearing, and brake in condition. Check play at the propeller tip. Check that the engine is cranking without abnormal sound or friction and check that the decompression valves are tight when rotating the propeller by hand.
26. Propeller in condition and propeller bolts safetied
27. Engine safety cable taut
28. Quick release locks connecting flaps and airbrakes safetied
29. Static pressure vents free
30. Venturi tube correctly installed
31. Horizontal stabilizer mounted correctly and locking pin all the way in and safetied. Quick release for elevator control rod safetied.
32. Tail wheel working properly and locking pin removed
33. Required documents on board

Before starting the engine

Brakes	set
Fuel cock	on
Engine doors	closed
Decompressor	closed
Propeller area	free

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Starting the engine when cold

Throttle 1/4 open
Choke 3/4 on
Main switch on
Electric fuel pump on
Propeller area clear
Starter engage
Choke adjust

Starting the engine when hot

Throttle 1/2 . . . 1/1 open
Choke off
Main switch on
Electric fuel pump on
Propeller area clear
Starter engage
Throttle adjust

Warm-up and taxiing

Throttle 2000 . . . 5700 RPM

Ground test

The engine must run 5600 RPM smoothly also with the electrical fuel pump off.

Throttle 3000 rpm
Double ignition check

Engine is warm when the throttle can be opened without the engine faltering. Check the engine gauges.

Pre-flight check

Loading and ballast checked
Barograph (if installed) on
Parachute secured
Seat and rudder pedals adjusted

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Safety harness	fastened
Canopy	locked
Main switch	on
Engine and engine gauges	tested and checked
Flight instruments	checked
Flaps	set
Trim	set
Airbrakes	closed and locked
Controls	free
Choke	off
Fuel cock	(in tow: off) on
Electrical fuel pump	(in tow: off) on
Tow rope (in tow)	coupled

Takeoff

Normal

Flaps	+4. .0°
Trim	set
Throttle	fully open
Climb speed	90 km/h (370 kg) 105 km/h (470 kg)

Short field and soft field

Flaps	+16°
Throttle	fully open
Accelerate to	70 km/h (370 kg) 80 km/h (470 kg)
Climb speed	80 km/h (370 kg) 90 km/h (470 kg)
Gear	up
Flaps	retract on safe altitude to normal climb setting

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Takeoff in aerotow

Flaps	+ 4...0°
Trim	set
Airspeed	105 km/h (370 kg)
	120 km/h (470 kg)

Takeoff in winchtow

Flaps	+ 4°
Trim	1/2
Airspeed	110...125 km/h

Climb

Best rate of climb speed (gear up)	100 km/h
Throttle	6000 RPM
Electrical fuel pump	off at desired altitude
Flaps	+ 4...0°

Cruising

Normal cruising power (75 % at 135 km/h) 6000 RPM

Stopping and retracting the engine in the air

Speed	100 km/h
Idle (3000 RPM) until cylinder head temp is below 175°C	
Ignition	off
Doors (Propeller brake)	open until propeller has slowed down and close again
Propeller	check in mirror for right position
Doors (Propeller brake)	open when propeller is in right position
Engine	retract
Doors	close
Main switch	soar

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Restarting the engine

Speed	100 km/h
Doors	open
Engine	extend
Doors	close
Propeller	check in mirror that the propeller is rotating slowly
Main switch	on
Fuel cock	on
Electrical fuel pump	on
Choke	3/4 on if cold
Throttle	1/4 open
Starter	engage
Choke and throttle	adjust

Note! The engine begins rotating without using the starter when the speed is 165 km/h.

Before landing

Engine	retracted
Water ballast	drained
Landing gear	down
Flaps	12° . . . 16° down
Trim	set for landing

Approach and landing

Approaching speed	95 km/h (370 kg)
	105 km/h (470 kg)

Stopping the engine on the ground

Idle at	2000 RPM
Electric fuel pump	off
Radio	off
Ignition	off
Main switch	off

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5.2 Amplified normal procedures, general

The following explains the check lists more in detail and includes also outlandings, aerobatics, cloud flying and other normal operations.

5.3 Refueling

Fuel: Min 96 octane (RON) super gasoline or Aviation gasoline 100 LL.

Oil: Two-stroke, **super** quality, mixing ratio 1:40. (e.g. castrol super TT)

The mixture must be done in a separate can. The can must be shaken before refueling.

The use of a chamois funnel is recommended for proper filtering and for water separating. The earth wire can be connected to the engine body.

Use only well stored gasoline and clean containers to avoid water.

Note: When flying at temperatures below 0°C, automotive fuel anti-icing fluid (carburettor alcohol) must be used in the fuel. Mixture ratio is 1 to 100.

5.4 Water ballast filling instructions

1. Install the 2—4 m long filling tube with threaded filling connector into the outlet hole.
2. Keep the wings in level. Open the ballast valve and fill the system through a funnel.

Note 1: 1 m is the maximum filling height (distance from the funnel to the wing). Higher pressure than this, 0.1 BAR (0.1 kp/cm²), can cause serious damages to the wing.

No pressurized filling system is allowed.

3. When filled, check the equal amount (wings stay in level).
4. If the amounts are not equal, then keep the valve open and lift the heavier wing and wait for the water to flow. Check, if the wings are not yet in balance, then shake the wing, having the lightest tip down.
5. If the balance is not achieved, then you have to put the lightest tip down and let the water flow out through the filling hose.
6. When the amounts are equal, shut the valve and remove the filling hose.

Note 2: When maximum amount of water is needed, it is recommended before filling to suck all the air from the system through the filling hose (eg. with a vacuum cleaner).

5.5 Daily check

The daily check should be carried out every day and after the sailplane has been rigged. Fuel quantity, mass and C. of G. should be checked, taking into account the flying task. Fixed ballasts should correspond to the ballasts given in the last Weight and Balance Record.

The takeoff distance should also be checked for a safe operation. It is normal that the maximum allowed water ballast is used during the take-off and this affects the takeoff distance.

If the takeoff is intended to be made in tow, the tow hook should be checked for proper function. Specified checking procedures are given in the tow hook manual. It is recommended that the tow hook is covered with tape if not used.

Note: Winch launches are allowed only with the tow hook at rear station 1850 mm.

The wing surfaces should be clean and dry to ensure the right performance of the glider.

The inflation pressure in the main wheel tyre should be right to ensure the proper function of the landing gear. With too low pressure the tyre may bottom the rim flange in a rough landing and this may damage the rim and the landing gear. Too high pressure makes the landing gear too stiff and the energy will not be absorbed during the landing.

The engine should be checked carefully and cleaned from dust and oil. The engine compartment should also be kept clean.

The propeller should be checked and cleaned carefully. Specified checking procedures are given in the Propeller Manual. There should be no play when moving the propeller blade forwards and backwards.

The engine safety cable should be in proper tension when the engine is fully extended. Too loose wire may cause premature wear to the attachments.

Check that the tail wheel locking pin is removed.

5.6 Before starting the engine

Before starting the engine it should be checked that the engine compartment doors are closed. The propeller brake operation is connected to the engine doors. Starting with doors open and brake on will make the rotating difficult and it will wear the brake lining very soon.

The electric fuel pump helps the starting and it should be on. The decompressor must be closed. Turn radio and other electrical equipment off.

5.7 Starting the engine

When starting the engine 3/4 choke is required. The throttle should be opened about 1/4. When connecting the main switch and the electric fuel pump on, the sound from circling fuel can be heard when everything is in order. If the engine does not start within ten seconds, the starter should be allowed to cool down a little before the next attempt.

When the engine is running the choke must be adjusted. Otherwise the mixture is too rich.

When starting a hot engine no choke is required. The throttle should be more than half opened. If the engine has just been running, the electric fuel pump may be left off.

If the engine does not start, some choke and less throttle may be used.

If there is a reason to think that the engine is flooding, the choke should be fully off and throttle fully open. By pulling the decompression lever and at the same time cranking the engine with the starter, the extra fuel is effectively removed from the engine. When the decompression valves are closed, the starting can be continued normally.

5.8 Warm-up and taxiing

Let the engine run for about 2 min. with 2000 rpm. The warm-up can be made during taxiing. The choke can usually be closed soon after the engine has started. The throttle may be handled with rather fast movements to get a good engine rpm response.

More than 2000 rpm should be used during the warm-up and normal operation, in order to have the engine running smoothly.

The engine is warm when the throttle can be opened without the engine faltering. This corresponds to about 100°C cylinder head temperature.

During taxiing one wingtip wheel is down and the stick fully pulled. The flaps are recommended to be kept up (negative), in order to have more ground clearance at the ailerons.

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On a normal grass field it is easy to taxi alone with help of the steerable tailwheel. The ground clearance at the lower wing should be taken into account. The turning radius is smaller when turning around the lower wing.

The proper function of the wheel brake should be checked before taxiing.

On soft ground eg. sand with C. of G. in the foreward position and with water ballast tanks partly filled some experience is required to taxi without assistance, especially in strong crosswind. It is then easier to have an assistant walking at the wing tip.

When turning in windy conditions, it is normally easier to keep the wing turned to the wind, and then turn around the lower wing tip.

When taxiing longer distances in good conditions eg. on a runway, the wings may be levelled and taxiing made only on the main wheel.

WARNING

Be aware of the running propeller!

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5.9 Ground test

When the engine is warm, it can be tested for proper running. When the engine is functioning properly, it must run at least 5600 rpm smoothly.

The test can be done shortly or during taxiing, so the nose does not go down. The throttle can be pushed with a rather fast movement to get a good rpm response.

The functioning of the both ignition systems can be checked while the engine is running at 3000 rpm. Shortly test ignition circuit 2, a drop in rpm (about 200 rpm) should be observed. After checking circuit 2 run the engine with both circuits to clean the spark plugs. When testing circuit 1, the drop in rpm should be about the same as with circuit 2. If the rpm drop is more than 300 rpm on either circuit, the ignition system must be checked.

The function of the alternator can be checked from the battery voltage gauge. Proper alternator function should raise the gauge to the higher voltage area.

By turning the electric fuel pump off, the function of the engine's own fuel pump can be tested. The engine should run smoothly at all power settings with its own fuel pump.

5.10 Before takeoff

The pre-flight check must be done before the takeoff. The electric fuel pump must be on and the choke must be fully off and the decompressor closed.

5.11 Takeoff

During a normal takeoff flaps should be $+4^\circ$ down or neutral. The trim is about 1/4 from aft position with the C. of G. in central position.

continued . . .

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When the throttle has been fully opened, it takes about 30 m ground run, before the wings can be levelled. With partly filled water ballast tanks the distance to level the wings is longer.

Lift off speed:

80 km/h (50 mph, 43 kts) for 370 kg weight or

90 km/h (56 mph, 49 kts) for 470 kg weight.

After the lift off accelerate to the optimum speed for best rate of climb

90 km/h (56 mph, 49 kts) for 370 kg weight or

100 km/h (62 mph, 54 kts) for 470 kg weight.

At a safe altitude the power should be set to maximum continuous power 6000 rpm at 100 km/h. The electric fuel pump can be turned off at desired altitude.

On a soft field or a short field the shortest takeoff distance is achieved with the flaps +16° down. The trim should be in the middle position with normal C. of G. position.

Lift off speed:

70 km/h (44 mph, 33 kts) for 360 kg weight or

80 km/h (50 mph, 43 kts) for 470 kg weight.

The speed for the best angle of climb:

80 km/h (50 mph, 43 kts) for 360 kg weight or

90 km/h (56 mph, 49 kts) for 470 kg weight.

Retract the gear to get better rate of climb.

When reaching the safe altitude, accelerate to the optimum speed for climbing with flaps neutral and retract the flaps.

Especially on a soft field it is best to use the maximum possible lift of the wing during the ground run to minimize the drag from the wheel. This is achieved by keeping the tail wheel about 40 cm (1 ft) off the ground.

With a strong crosswind, when the C. of G. in the fore position, maintaining the right direction during the beginning of the ground run is difficult. An assistant at the wing tip is then recommended.

Maximum crosswind is 10 kts.

Negative flap positions shall not be used in any condition because of the increasing stalling speed.

Takeoff in the rain is prohibited

With wet or frosty wings the takeoff distance is remarkable longer and the wings must be kept clean and dry before takeoff.

Prolonged flying in the rain may cause wearing of the leading edge of the propeller and the drag is doubled referred to the given values in chapter 7: "Performance".

5.12 Takeoff in aerotow

The flaps are recommended to be neutral or $+4^\circ$ down. The trim is slightly back of central position. During tow $+8^\circ$ down can be used.

Recommended towing speeds are 105 km/h (65 mph, 57 kts) with 370 kg weight and 120 km/h (75 mph, 65 kts) with 470 kg weight.

-12° up deflected flaps are not allowed in aerotow because of high stall speed and poor controllability at low speeds. Maximum airspeed in aerotow is 190 km/h (118 mph, 103 kts). Maximum crosswind is 10 kts. Before coupling the towing rope the pilot must check that the right towing ring and weak link are used.

5.13 Takeoff in winchtow

The flaps are recommended to be in position $+4^\circ$ down. Negative and more than $+8^\circ$ down flap position are not allowed during takeoff because of difficult handling. To get as much height as possible, the takeoff can be made with $+4^\circ$ down deflected flaps and from 100 m (300 ft) height use $+12^\circ$ down deflected flaps.

With central C. of G. position and flaps $+4^\circ$ down the trim should be in the middle and with $+8^\circ$ flaps 1/3 from the forward position.

Recommended airspeeds are 110 km/h to 125 km/h (68. . . 78 mph, 59. . . 67 kts). Maximum airspeed in winchtow is 125 km/h (78 mph, 67 kts).

Maximum crosswind is 10 kts.

Before coupling the towing wire the pilot should check that the right towing ring and weak link is used. Winch tow is allowed only with the rear tow hook installation at station 1850 mm.

5.14 Climb

Optimum speed for best rate of climb is

90 km/h (56 mph, 49 kts) for 370 kg weight and

100 km/h (62 mph, 54 kts) for 470 kg weight.

Both speeds are with neutral flaps. The power setting for maximum continuous power is 6000 rpm at 100 km/h (62 mph, 54 kts). The best rate of climb is achieved with the gear retracted.

The electric fuel pump can be turned off at the desired altitude. The fuel consumption is about 1 l/h (0.26 gall U.S./h) greater when the electric fuel pump is on.

For noise abatement over noise-sensitive areas, the pilot can choose his climbing route so that the noise disturbance is minimized.

The route should, however, of course follow the Air Traffic Control clearances and instructions.

If possible when taking account of obstacles and other circumstances, the power can be decreased below the maximum continuous power to reduce noise.

The certificated noise level of PIK-20E II is 59.5 dB(A) in overflight at 300 m (1000 ft) with maximum continuous power 6000 rpm at 100 km/h.

5.15 Cruising

Cruising is normally performed with maximum continuous rotational speed 6000 rpm. The maximum level speed is then 135 km/h (84 mph, 73 kts) and this corresponds to 75 % power. To lower the fuel consumption the electric fuel pump should be off.

The maximum allowed speed with engine extended is 195 km/h (121 mph, 105 kts) and the engine rotational speed is then 6600 rpm when the throttle is in idling position. The maximum allowed rotational speed is 6800 rpm and this should not be exceeded.

Long throttle setting below 75 % power should be avoided in climb, cruise and glide for proper lubrication.

Longer glides with closed throttle must therefore be avoided.

Rpm settings which cause excessive vibrations should be avoided.

5.16 Stopping and retracting the engine in the air

A recommended air speed when stopping and retracting the engine is 100 km/h (62 mph, 54 kts). The propeller will then slow down fast and the retracting can be performed easily. The maximum allowed speed when retracting and extending the engine is 135 km/h (84 mph, 73 kts), but stopping the propeller requires then more experience, and more altitude is lost during the operation.

The stopping of the engine begins by reducing the power and letting the engine idle, ie. about 3000 rpm.

When the cylinder head temperature has dropped to 175°C (350°F), the ignition can be turned off. After some five seconds the propeller slows down a little, but is still rotating as if the engine would be idling. The propeller can then be braked by moving the control lever of the engine compartment doors (propeller brake) fully back (opening the doors). After this the doors must be closed to let the propeller slowly rotate by the air over the compression positions (propeller vertical and horizontal). The propeller position can be checked by looking in the mirror.

When the propeller is approaching the vertical position, the propeller can slowly be braked by moving the engine compartment doors control lever backwards. When the propeller is in right vertical position, the brake should be fully applied by opening the doors fully.

If the braking has been made too late and the propeller has passed the vertical position, the doors should be closed and the braking renewed when the propeller is approaching the vertical position again.

Before the first flight the braking of the propeller should be trained on the ground. The pilot can have another person turning the propeller slowly over the vertical compression position and the pilot brakes the propeller in the right position. The desired propeller position can be checked with the engine retracted and the doors open. **Check, that main and ignition switches are off before rotating the propeller by hand.**

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When the propeller is braked in the vertical position, the engine can be retracted with the cranking lever. The lever is first unlocked by pulling the handle out towards the pilot and cranking is made counter-clockwise.

After cranking fifteen turns the engine is retracted and slightly pressed towards the limiter in the rear fuselage. The doors can now be closed by moving the door lever forward. At the same time the engine is locked in down position. Because of the change in the C. of G. position, the trim can be moved some notches forward.

If some extra resistance is felt during the retraction, the right position of the propeller and the door lever should be checked.

To ensure proper braking of the propeller the tension in the brake cable and the proper functioning of the brake should be checked daily.

5.17 Glide

Main switch should be in SOAR-position to conserve energy.

In gliding flight with the engine retracted the sailplane is trimmed with neutral flaps to fly about 100 km/h (62 mph, 54 kts). The trim is connected to the flaps so that the optimum speed for a flap angle is automatically achieved when the sailplane once has been trimmed. The optimum flap angle with speed and other more detailed information and data are given in chapter 7 "Performance".

Note that full aileron deflection is permitted only at speeds below the manoeuvring speed (190 km/h, 118 mph, 103 kts). At higher speeds the controls should be moved gently and any sudden movement to the opposite direction should be avoided.

Note: A wet wing increases the stall speed and rate of sink.

5.18 Restarting the engine in the air

The recommended speed when extending the engine in the air is 100 km/h (62 mph, 54 kts). Then there is no tendency of the propeller to rotate during the extension if the brake is not in proper condition. The maximum allowed speed is 135 km/h (84 mph, 73 kts).

Open the engine compartment doors by moving the door lever backwards. The cranking lever cannot be moved when the doors are closed. Before restarting set the main switch to the ON-position.

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Unlock the cranking lever and extend the engine by turning fifteen turns clockwise. The lever has to be left in such position that the safety cable is taut.

When the door/brake lever is moved forward the propeller should rotate slowly in the air. This can be checked in the mirror.

When starting the engine the main switch should be on. Turn ignition and electric fuel pump on. Adjust the choke 3/4 open, if the engine is cold. The throttle should be opened about 1/4. The engine needs now only a kick with the starter and the propeller will then rotate by itself in the airstream. Adjust the choke and throttle when the engine is running.

If the battery is dead or if there is some other reason not to use the starter, the engine can be started by windmilling. The speed required to get the propeller rotating (windmilling) is about 165 km/h (103 mph, 89 kts). When the propeller once is rotating, it can be stopped only by reducing speed and using the brake.

The altitude required to extend and start the engine is normally 60 to 30 meter (200 to 100 feet) when using the starter. In an outlanding this operation can be made safely on the downwind leg. The height in the beginning of the downwind leg should be at least 300 m (1000 ft) to give time enough if something goes wrong. If the engine does not start it is possible to land with the engine extended.

The flight should be planned as a flight with a sailplane without an engine. There should always be the possibility to land and one should not go down over an area unacceptable for outlandings. There is always the possibility that the engine does not start, especially when one tries to start the engine in a rush above a forest or rocky area.

5.19 Stalls

In stall the nose drops without stall warning with retracted airbrakes. With airbrakes extended stall warning is noticed about 10 km/h (6 mph, 5 kts) before the stall. With the engine extended one wing may drop slightly. The altitude loss is about 12 to 6 m (40 to 20 ft). When stalled in a 45° banked turn with the engine and airbrakes extended, the loss of height may be 60 m (200 ft).

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Stall speeds for various flap angles and weights are given in chapter 7 "Performance".

Extending the airbrakes increases the stall speed about 8 km/h (5 mph, 4 kts), see 7.1.

5.20 Approach and landing

The landing is recommended to be made with the water ballast drained and the engine retracted. The flaps should be deflected down +12° to +16°. Negative flap angles should not be used because of high stall speed. The trim is a little forward from the central position.

Airbrakes can be used as desired. The approaching speed is 95 km/h (59 mph, 51 kts) with 370 kg weight and 105 km/h (65 mph, 57 kts) with 470 kg weight.

On ground the wheel brake can be used as desired.

In strong crosswind +8° down deflected flaps and a slightly higher approaching speed can be used.

When landing with the engine extended and idling, the airbrakes should not be used fully open near the ground because of the great rate of sink.

To avoid damages to the landing gear doors when landing on soft ground or in long grass, it is possible to keep the landing gear retracted. For inspection after a belly landing, see Service Manual.

If the ground run is going to be too long, it is possible to push the nose down at the same as using the wheel brake to stop the sailplane better.

Note: A wet wing increases the stall speed and rate of sink.

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5.21 Stopping the engine on the ground

Before stopping the engine, let the cylinder head temperature fall down to 150. . .175°C (300. . .350°F) when idling. Turn off the electric instruments and the electric fuel pump. The engine is stopped by switching off the ignition. The decompression valves must not be used when the ignition is on.

Note: The engine should be kept in retracted position.

5.22 Outlanding

Outlandings should be done as on a normal airfield. If the engine is going to be extended on the downwind leg, the landing circuit initial height should be more than 300 m (1000 ft).

5.23 Aerobatics

Even though PIK-20E is not especially designed for aerobatics, the following aerobatic maneuvers are approved with the recommended entry speeds listed below:

Steep turn	120 km/h (75 mph, 65 kts)
Looping	185 km/h (115 mph, 100 kts)
Stall turn	170 km/h (106 mph, 92 kts)
Lazy eight	170 km/h (106 mph, 92 kts)
Chandelle	185 km/h (115 mph, 100 kts)
Spin	Use slow deceleration
Stall (except whipstall)	Use slow deceleration

Note: Aerobatic maneuvers with engine extended are not allowed.

Note: Maximum maneuvering speed is 190 km/h (118 mph, 103 kts).

Flap deflections from neutral to -12° up are allowed.

During aerobatic maneuvers an accelerometer should be installed.

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The spin is possible at all C. of G. positions. However, with the forward C. of G. the sailplane will spin only two or three turns. Entry and control positions are normal (pulled stick, central aileron and rudder in spinning direction). Recovery is normal by neutralizing the controls.

Use airbrakes if the speed tends to increase too much during recovery.

The altitude loss is less than 90 m (300 ft).

Note: Drain the water ballast before aerobatic maneuvers.

5.24 Cloud flying

Minimum instrumentation required during the cloud flying is described in chapter 3: "Limitations":

Do not exceed the rough air speed limit. In severe turbulence less speed should be used. Extend the airbrakes if the speed tends to increase too much.

Observe icing.

5.25 Flying in the rain

Raindrops, ice or frost on the sailplane's surfaces will considerably reduce its performance. The stall speed increases 10 to 20 percent and the rate of sink is also greater than normal.

This must be taken into account particularly during the takeoff, approach and landing. Especially during the takeoff with engine the wing should be clean to assure the performance given in the performance paragraph. The rain will also wear the leading edge of the propeller. **Take-off in the rain is prohibited.**

The gliding performance of the sailplane in the rain is improved if there is no wax on the wing surfaces.

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5.26 Flying in icing and low temperature conditions

The sailplane and engine have no deicing devices. **Flying in icing conditions is prohibited.**

Note: The water ballast freezes rather quickly at low temperatures. Frozen ballast will cause serious damages to the wing. If the ambient temperature is below $+4^{\circ}\text{C}$ (40°F), the water ballast must be drained. A water temperature gauge is recommended. When flying at temperatures below 0°C antiicing fluid must be used in the fuel, see 5.3.

5.27 Flying at high altitudes

If the flight is made above 3500 m (11000 ft) altitude, oxygen equipment must be used.

When using automobile gasoline the use of the electric fuel pump is recommended at high altitudes because of the "vapor lock" possibility.

6. WEIGHT AND BALANCE

6.1 Pre-flight check

Before every flight check that the sailplane is loaded according to the given weight and C. of G. limitations. Weight and Balance Record sheet (6.4) gives the empty weight data after the latest change of equipment or fixed ballast.

Note 1: The sailplane has been weighed with the equipment marked with "x" in the Equipment List (Service Manual 7.). After changing the equipment or fixed nose or tail ballast the new actual empty weight and moment must be determined according to the Service Manual chapter 5.

Note 2: The loading criterias given in 6.1.1. and 6.1.2. have been determined so that

- when the C. of G. in flight is on the aft position there is minimum pilot, unusable fuel 0,7 kg, water ballast tanks empty and engine retracted,
- when the C. of G. in flight is on the fore position there is maximum pilot, usable fuel 23,2 kg (32 litres) and engine extended

When loading in accordance with these criterias, it is possible to keep the C. of G. in flight inside the allowable limits by any amount of fuel or water ballast, the maximum takeoff weight 470 kg shall, however, not be exceeded.

Allowed water ballast amount is:

$$m_w = 470 \text{ kg} - m_p - m_o - m_f$$

where

m_w = water ballast (litres)

m_p = pilot + parachute (kg)

m_o = actual empty weight, see Weight and Balance Record 6.4 (kg)

m_f = fuel weight (kg) (0,725 x fuel amount in litres)

Note 3: Because the minimum pilot weight is based on the aft C. of G. in flight, some 20 mm tolerance is recommended to add stability and convenience during flight, above all during first flights. This equals some 8 kg increase to the minimum pilot.

Note 4: When needed the actual C. of G. in flight can be calculated according to 6.2.

6.1.1. "Empty weight C. of G. range" -criteria

When loading the sailplane you can use the pilot weight range 70 kg to 110 kg (incl. parachute), if the empty weight C. of G. corresponding the actual empty weight is between the allowed limits given in fig. 6.1.

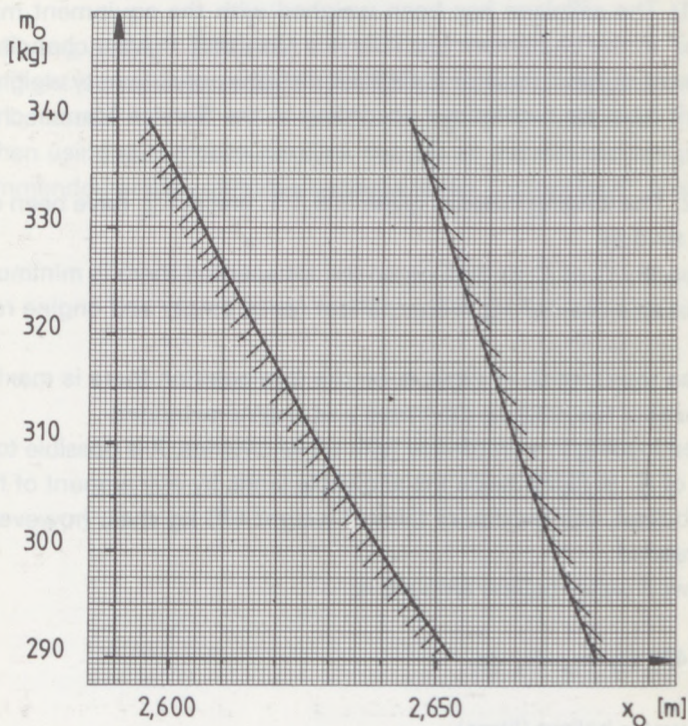


Fig. 6.1: C. of G. range x_0 (m), with different empty weights, m_0 . Minimum pilot 70 kg, max. pilot 110 kg (incl. parachute).

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6.1.2 "Actual pilot weight range" -criteria

To use the actual pilot weight range as criteria for loading, the range must be calculated according to Service Manual Chapter 5. After changing equipment or fixed ballast, it is not enough to determine the new actual empty weight and empty weight C. of G., but also the new actual pilot weight range should be calculated and marked on Weight and Balance Record, see 6.4.

6.2 Calculations for actual C. of G. location

The actual C. of G. location can be calculated according to Sample Problem as follows:

1. Take the last empty weight (including all equipment and fixed ballast) and corresponding moment (Record sheet 6.4) and write them down.
2. Put the weights of the fuel m_f (kg) = $0.725 \times$ fuel quantity (l), water ballast and pilot on the left column.
3. Calculate the corresponding moments by multiplying the arms given in the columns with the weights.

Note: The moment arm of the pilot depends on his length ie.

1.42 m for short pilot (length below 1,60 m)

1.50 m for tall pilot (length over 1,90 m)

Calculate all the weights and moments together and you get the total weight and moment. Divide the moment by weight to get the arm

$$\frac{\text{Moment (kgm)}}{\text{Weight (kg)}} = \text{arm (m)} = \text{location of C. of G. (m)}$$

The difference in the maximum L/D of the sailplane between the backmost and the foremost C. of G. location is 2 digits induced by the negative lift at the tail.

Therefore for maximum gliding performance it is better to have the C. of G. location rather near the backmost position.

The backmost C. of G. cannot be reached with a heavy pilot and heavy equipment in the instrument panel. In this case it can be helped by fitting max. 3.0 kg lead to the tail wheel spring.

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C. of G. position limits during flight are minimum 2,267 m and maximum 2,443 m.

6.3 Sample Problem: Actual weight and C. of G. in flight

	Sample sailplane			Your sailplane		
	Weight kg	Arm m	Moment kgm	Weight kg	Arm m	Moment kgm
1. Actual Empty Weight	296.3	2,677	793.2			
2. Fuel 20 l	14.5	1.90	27.6		1.90	
3. Water ballast	60.0	2.27	136.2		2.27	
4. Pilot + parachute	78.0	1.48	115.4			
	448.8	2.389	1072.4			

Thus we get C. of G. = $\frac{1072.4}{448.8} \text{ m} = 2.389 \text{ m}$

Without water ballast and fuel we get the backmost C. of G. =

$$\frac{793.2 + 115.4}{296.3 + 78} = \frac{908.6}{374.3} = 2.427 \text{ m}$$

$$296.3 + 78 = 374.3$$

being 16.0 mm forward of the allowed aft limit.

Note 1: The extending of the engine subtracts the moment by 16.5 kgm ie. the extending moves the C. of G. of the loaded sailplane (empty weight + pilot + water ballast + fuel) some 48. . .34 mm forward depending on the total weight of the sailplane.

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between the location of
(vertical plane 2.113 m
surface)

ment marked with "x" in Service

st or pilot. The engine is retracted.

[illegible]

Note: The minimum and maximum pilot weights are calculated based on the average C. of G. of the pilot. Thus a short pilot, length below 1.60 m, can subtract 3 kg from the minimum and maximum weights given on the list. A very tall pilot, length over 1.90 m can add 1.0 kg accordingly to the given weights. Maximum pilot weight limit is however 110 kg.

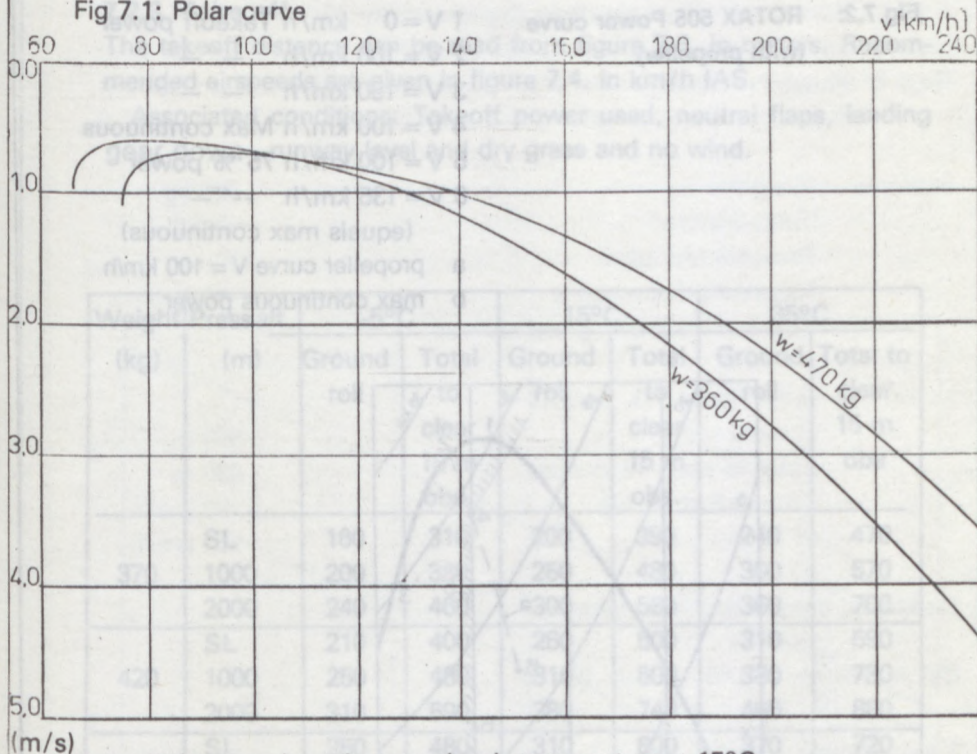
7. PERFORMANCE

7.1 Performance in glide with engine retracted

Weight 360 kg (794 lbs)		470 kg (1036 lbs)
— Stall speed (airbrakes retracted)		
Flaps: -12°	84 km/h (52 mph, 45 kts)	96 km/h (60 mph, 52 kts)
0°	74 km/h (46 mph, 40 kts)	85 km/h (53 mph, 46 kts)
+12°	68 km/h (42 mph, 37 kts)	78 km/h (48 mph, 42 kts)
+16°	67 km/h (42 mph, 36 kts)	76 km/h (47 mph, 41 kts)
— Stall speed with +16° flaps, landing gear down and airbrakes fully open (landing configuration)		
	74 km/h (46 mph, 40 kts)	84 km/h (52 mph, 45 kts)
— Minimum rate of descent		
	0.61 m/s (120 fpm)	0.70 m/s (138 fpm)
at speed	77 km/h (48 mph, 42 kts)	88 km/h (55 mph, 48 kts)
— Max L/D		
	39.5	41.0
at speed	103 km/h (64 mph, 56 kts)	117 km/h (73 mph, 63 kts)

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Fig 7.1: Polar curve



Note: Values are based on sea level, temperature +15°C.

7.2 Performance with extended powerplant

7.2.1 Power

Take-off power 31.7 kW (43 hp) at 6200 rpm at 100 km/h

Max continuous rpm 6000 at all speeds

Max continuous

power 29.4 kW (40 hp) at 6000 rpm at 100 km/h

22.1 kW (30 hp) at 6000 rpm at 135 km/h

75 % power 22.1 kW (30 hp) at 5500 rpm at 100 km/h

22.1 kW (30 hp) at 6000 rpm at 135 km/h

Max allowed rpm 6800

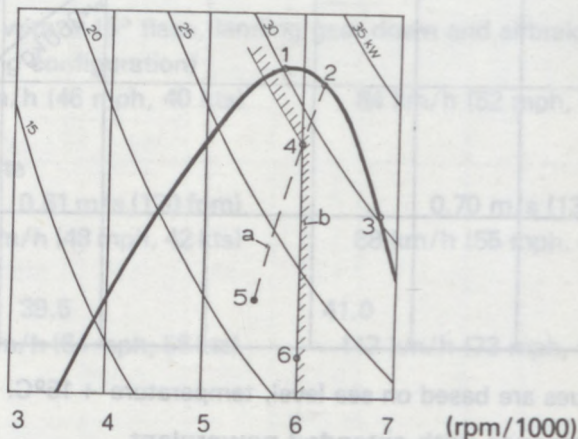
(The propeller rpm varies with flying speed with constant power. Thus some general valuepairs for rpm/airspeed are given. For additional information see Fig. 7.2.)

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**Fig 7.2: ROTAX 505 Power curve
(with propeller)**

- 1 V=0 km/h Takeoff power
- 2 V=100 km/h —"—
- 3 V=150 km/h —"—
- 4 V=100 km/h Max continuous
- 5 V=100 km/h 75 % power
- 6 V=135 km/h --"—
(equals max continuous)
- a propeller curve V=100 km/h
- b max continuous power



7.2.2 Fuel consumption

- 1 Take-off power 31.7 kW (43 hp) at 6200 rpm at 100 km/h
22,4 l/h (5.9 gall U.S./h)
- 2 Max continuous power (climb) 29.4 kW (40 hp) at 6000 rpm at 100 km/h
22,4 l/h (5.9 gall U.S./h)
- 3 75 % power (cruise) 22.1 kW (30 hp) at 6000 rpm at 135 km/h
17,2 l/h (4,5 gall U.S./h)

Note: Add 1.0 l/h, if the electric fuel pump is used in flight.

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7.2.3 Take off

The takeoff distance can be read from figure 7.3. in meters. Recommended airspeeds are given in figure 7.4. in km/h IAS.

Associated conditions: Takeoff power used, neutral flaps, landing gear down , runway level and dry grass and no wind.

Weight (kg)	Press.alt. (m)	-5°C		15°C		35°C	
		Ground roll	Total to clear 15 m obs.	Ground roll	Total to clear 15 m obs.	Ground roll	Total to clear 15 m obs
370	SL	160	310	200	390	240	470
	1000	200	380	250	480	300	570
	2000	240	460	300	580	360	700
420	SL	210	400	260	500	310	590
	1000	250	480	310	600	380	730
	2000	310	590	380	740	460	880
470	SL	250	480	310	600	370	720
	1000	300	590	380	730	450	880
	2000	370	710	460	890	550	1070

Figure 7.3. Takeoff distance in meters

α_f	0°		+8°		+16°	
W (kg)	Lift off	15 m	Lift off	15 m	Lift off	15 m
370	81	96	77	91	72	85
420	86	102	82	97	77	92
470	90	108	87	103	81	98

Figure 7.4. Takeoff airspeed km/h, IAS.

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Note 1: Use of +8° flaps shortens the takeoff by 15 %.

Note 2: Concrete runway shortens the takeoff by 10 %.

Note 3: 10 km/h headwind shortens the takeoff by 25 %.

10 km/h tailwind lengthens the takeoff by 30 %.

Example: Weight	420 kg
Temperature	25°C
Pressure altitude	1200 m
Headwind component	10 km/h
Flaps: neutral and grass runway	
From figure 7.3. and 7.4	
Ground roll	360 m
Total to clear 15 m obs.	690 m
Airspeed at lift-off	86 km/h
at 15 m	102 km/h

Headwind component correction.

$$690 - \frac{10}{10} \cdot 0,25 \cdot 690 = 520 \text{ m}$$

7.2.4 Climb

Rate of climb with takeoff power. Sea level, temperature +15°C (gear retracted flaps 0°. . . +8°)

W = 360 kg	4.0 m/s (790 fpm)
Optimum speed flaps 0°	90 km/h (56 mph, 49 kts)
flaps +8°	85 km/h (53 mph, 46 kts)

W = 470 kg	2.8 m/s (550 fpm)
Optimum speed flaps 0°	100 km/h (62 mph, 54 kts)
flaps +8°	95 km/h (59 mph, 51 kts)

Note 1: Use of max continuous power reduces the rate of climb by 0.35 m/s (70 fpm).

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Note 2: 20°C increase in temperature reduces the rate of climb by 0.20 m/s (40 fpm).

(Basic temperature at sea level + 15°C. Every 1000 m reduces it by 6.5°C.)

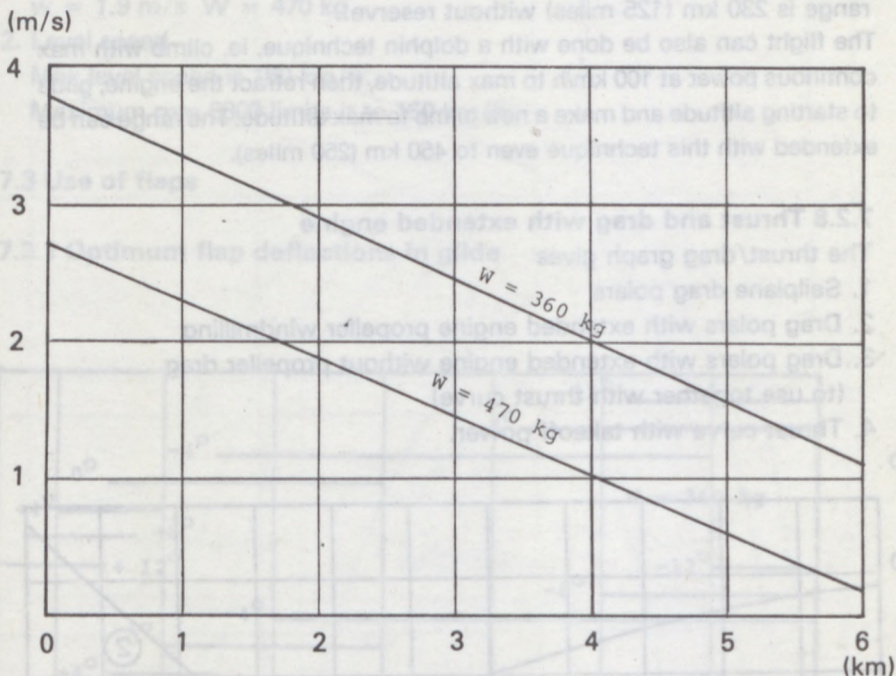


FIG 7.5: Rate of climb in standard atmosphere with max continuous power $\alpha_f = 0^\circ$ $V = 90$ km/h (W=360 kg) $V = 100$ km/h (W=470 kg)

7.2.5 Cruise

Cruising speed is 135 km/h (84 mph, 73 kts) with 75 % power 22.1 kW (30 hp) at 6000 rpm. This equals max continuous rpm.

Flap setting 0° .

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7.2.6 Ceiling

With 0.5 m/s rate of climb (see Fig 7.5)

W = 470 kg $h_{\max} = 5200$ m (17000 ft)

W = 360 kg $h_{\max} = 7200$ m (23500 ft)

7.2.7 Operating range

At cruising speed 135 km/h and 1000 m (3300 ft) altitude the operating range is 230 km (125 miles) without reserve.

The flight can also be done with a dolphin technique, ie. climb with max continous power at 100 km/h to max altitude, then retract the engine, glide to starting altitude and make a new climb to max altitude. The range can be extended with this technique even to 450 km (250 miles).

7.2.8 Thrust and drag with extended engine

The thrust/drag graph gives

1. Sailplane drag polars
2. Drag polars with extended engine propeller windmilling
3. Drag polars with extended engine without propeller drag (to use together with thrust curve)
4. Thrust curve with takeoff power.

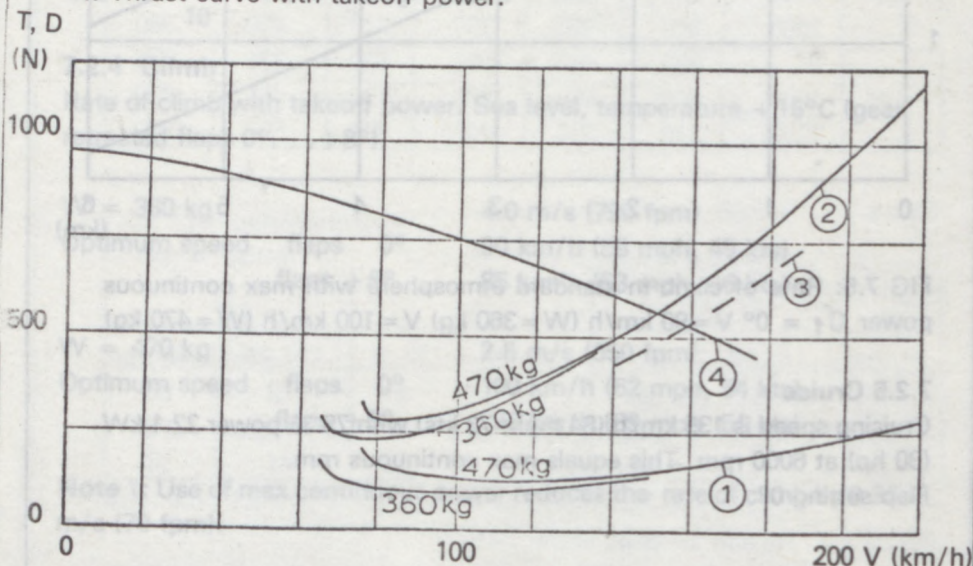


FIG 7.6: Drag and thrust curves

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Following observations can be deduced from the graph:

1. The sailplane drag is 3 to 4 times higher with extended engine

$L/D \text{ max} = 16.5$

$w_{\min} = 1.25 \text{ m/s}$ $W = 360 \text{ kg}$

$w_{\min} = 1.45 \text{ m/s}$ $W = 470 \text{ kg}$

and with $V = 100 \text{ km/h}$

$w = 2.0 \text{ m/s}$ $W = 360 \text{ kg}$

$w = 1.9 \text{ m/s}$ $W = 470 \text{ kg}$

2. Level speed

Max level speed is 160 km/h .

Maximum rpm 6800 limits it to 150 km/h .

7.3 Use of flaps

7.3.1 Optimum flap deflections in glide

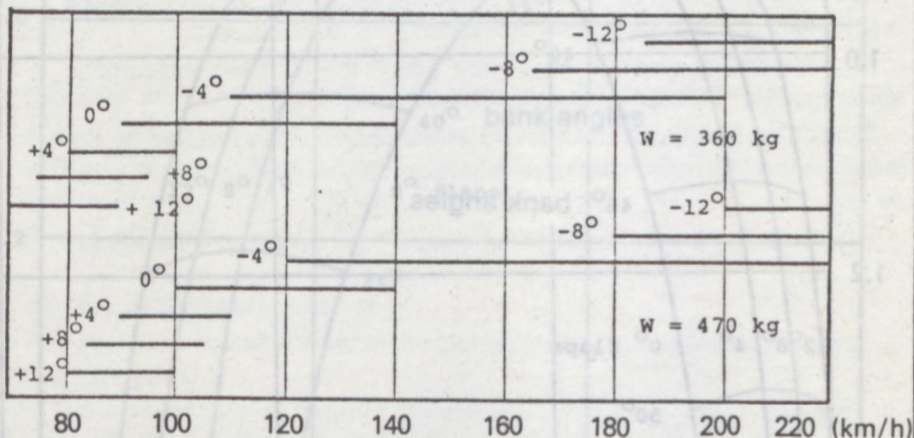


FIG 7.7: Optimum flap deflections in glide

7.3.2 Circling polars

radius (m)

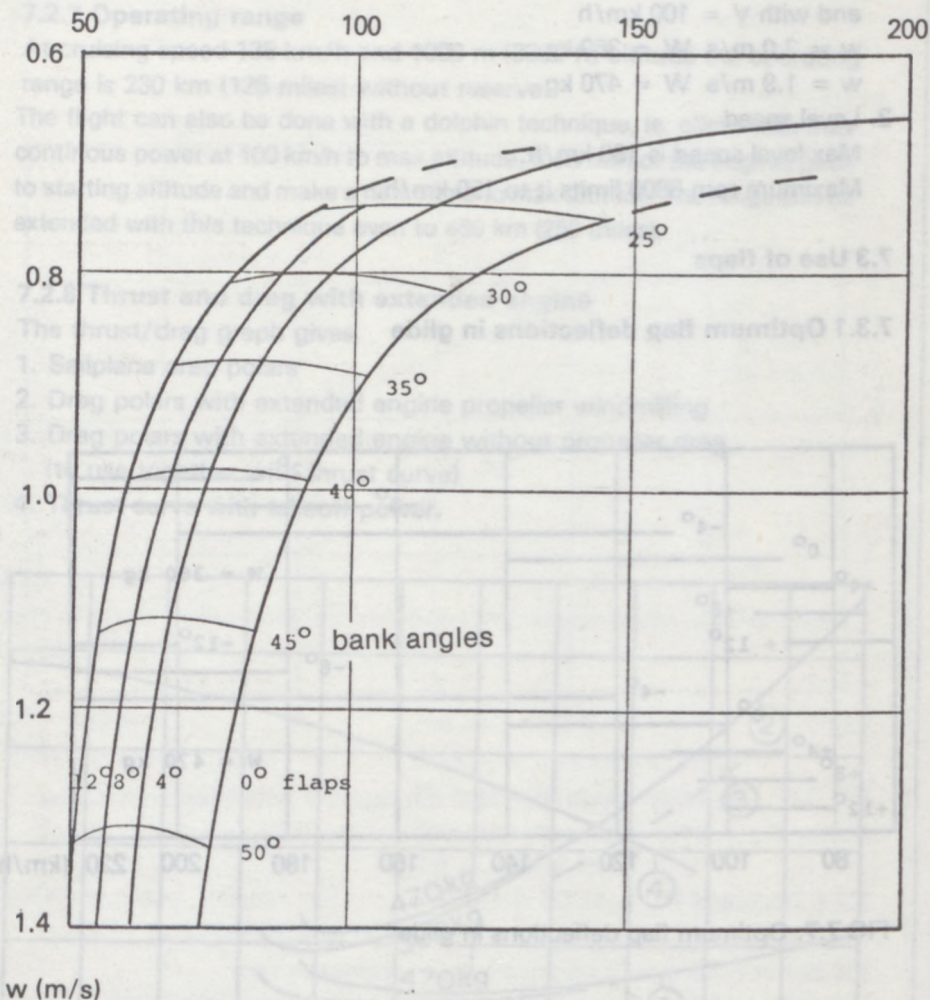


FIG 7.8: Circling polars $W = 350$ kg

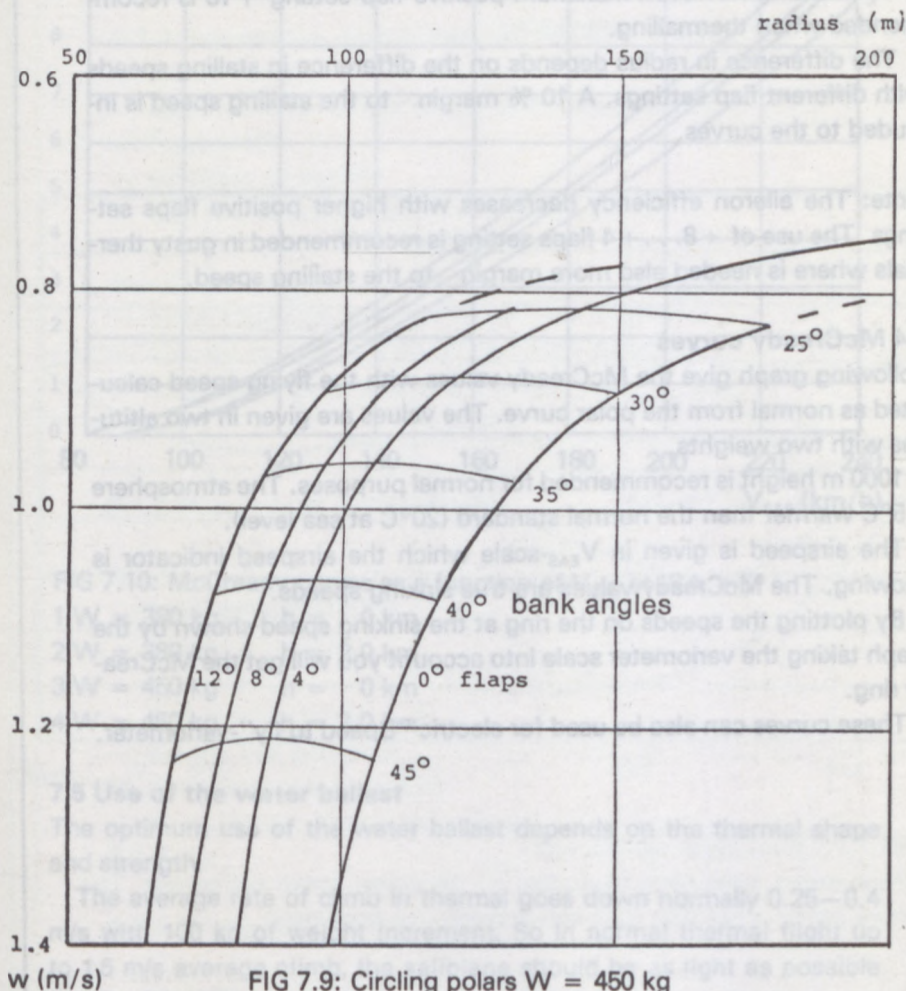


FIG 7.9: Circling polars $W = 450$ kg

From the curves can be seen that the use of $+12^\circ$ flaps decreases the curve radius by 30–50 m compared to 0° flaps. This means clear increase in the rate of climb in any normal thermal.

Thus the use of even maximum positive flap setting $+16$ is recommended when thermalling.

The difference in radius depends on the difference in stalling speeds with different flap settings. A 10 % margin to the stalling speed is included to the curves.

Note: The aileron efficiency decreases with higher positive flaps settings. The use of $+8$. . . $+4$ flaps setting is recommended in gusty thermals where is needed also more margin to the stalling speed.

7.4 McCready curves

Following graph give the McCready values with the flying speed calculated as normal from the polar curve. The values are given in two altitudes with two weights.

1000 m height is recommended for normal purposes. The atmosphere is 5°C warmer than the normal standard (20°C at sea level).

The airspeed is given in V_{EAS} -scale which the airspeed indicator is showing. The McCready values are true sinking speeds.

By plotting the speeds on the ring at the sinking speed shown by the graph taking the variometer scale into account you will get the McCready ring.

These curves can also be used for electric "Speed to fly"-variometer.

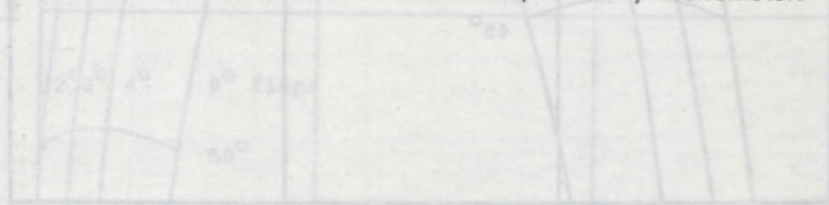


FIG 7.8: Climbing polars $W = 550\text{ kg}$

W_{mc} (m/s)

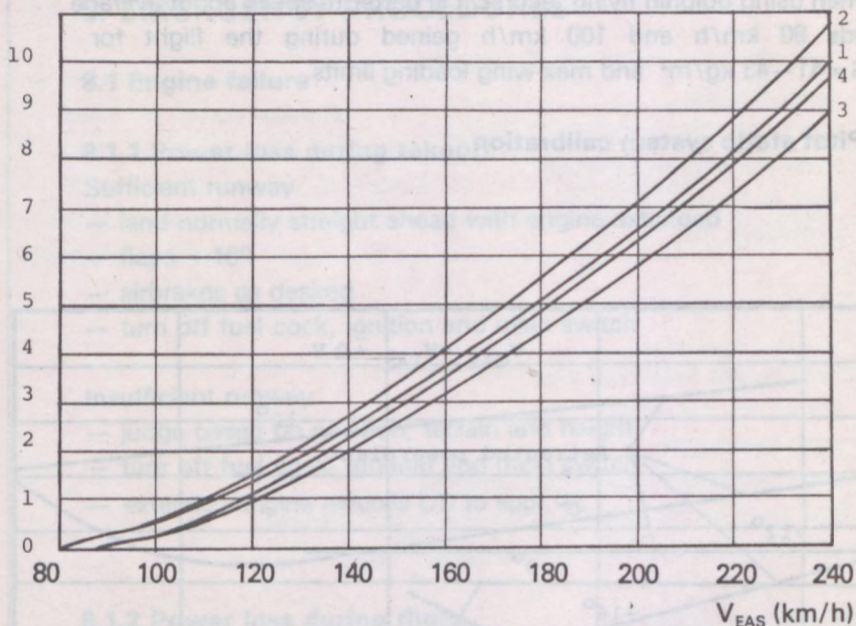


FIG 7.10: McCready curves as a function of V_{EAS} at ISA + 5°

1 $W = 380$ kg $h = 0$ km

2 $W = 380$ kg $h = 2.0$ km

3 $W = 450$ kg $h = 0$ km

4 $W = 450$ kg $h = 2.0$ km

7.5 Use of the water ballast

The optimum use of the water ballast depends on the thermal shape and strength.

The average rate of climb in thermal goes down normally 0.25–0.4 m/s with 100 kg of weight increment. So in normal thermal flight up to 1.5 m/s average climb, the sailplane should be as light as possible ($W/S = 36–38$ kg/m²). With an average climb of 1.5–2.5 m/s the recommended wing loading is ($W/S = 41–43$ kg/m²). Over 2.5 m/s the use of the maximum wing loading ($W/S = 47$ kg/m²) is recommended.

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When using dolphin flying technic it is better to speak about average speeds 80 km/h and 100 km/h gained during the flight for $W/S = 41 - 43 \text{ kg/m}^2$ and max wing loading limits.

7.6 Pitot static system calibration

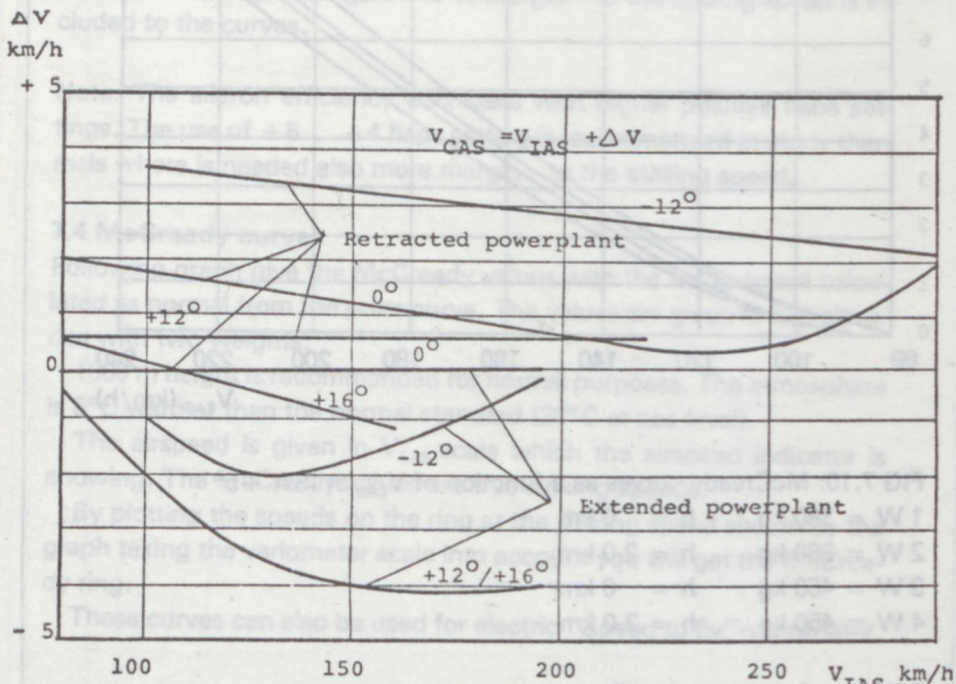


FIG 7.11: Pitot static system error

These errors have been included to the given speed limitations. The errors are so small that they can normally be neglected.

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8. EMERGENCY PROCEDURES

8.1 Engine failure

8.1.1 Power loss during takeoff

Sufficient runway

- land normally straight ahead with engine extended
- flaps + 16°
- airbrakes as desired
- turn off fuel cock, ignition and main switch

Insufficient runway

- judge based on position, terrain and height
- turn off fuel cock, ignition and main switch
- extended engine reduces L/D to appr. 16

8.1.2 Power loss during flight

Check

- fuel quantity
- fuel cock position
- choke off
- decompression off
- electric fuel pump on
- power with single ignition

If no change, retract the engine or land with extended engine.

8.2 Fires

8.2.1 In engine during starting

- turn off main switch and fuel cock
- keep engine extended
- do not open decompression valves
- use extinguisher, cloth or suitable external means

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8.2.2 In engine during starting in flight

- turn off main switch and fuel cock
- open throttle
- choke and decompression closed
- keep the engine extended
- land as soon as possible
- extinguish fire

8.2.3 In the fuselage

Front fuselage (electrical fire)

- search for the source
- main switch off
- close ventilation, open side window
- land as soon as possible if the fire is not damped
(circuits are effectively protected by fuses)

Rear fuselage (engine)

- main switch and fuel cock off
- if smoke prevents flying open ventilation
- when not sufficient, jettison canopy
- land as soon as possible
- extinguish fire

8.3 Jettisoning the canopy

- push both opening levers forward
- pull back the red jettisoning knob
- lift the canopy

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8.4 Jumping with a parachute

- jettison the canopy
- open the safety harness
- jump away from the sailplane
- open parachute after 3 seconds (if the height allows)

If the sailplane for some reason is impossible to fly and land, it is best to leave the sailplane.

8.2.2 In engine during starting in flight

8.2.4 Jumping with a parachute

- turn off main switch and fuel cock
- open canopy
- close and disarm parachute
- keep the engine running
- turn off fuel cock as soon as possible
- open parachute after 5 seconds in the height allowed
- if the engine for some reason is impossible to fly and it is necessary to leave the engine

8.2.3 In the fuselage

Front fuselage (ejection seat)

- search for the source
- main switch off
- close ventilation, open side window
- land as soon as possible if the fire is not damaged
- if the fire is not damaged, the engine is effectively protected by the engine

Rear fuselage (engine)

- main switch and fuel cock off
- if smoke prevents flying down ventilation
- when not sufficient, jettison canopy
- land as soon as possible
- extinguish fire

8.2.5 Jettisoning the canopy

- push both control levers forward
- pull back the red jettisoning knob
- off the canopy

